COOPER
ENERGY

East Coast Supply Project

Cooper Energy | Otway Basin | OPP

Role	Name	Signature	Document Control
Document Originator:	Joe Morris	Digitally signed by Joe Morris Date: 2024.12.06 21:29:57 +11'00'	**Doc No.** VOB-EN-EMP-0005
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Foreword

We are pleased to present the East Coast Supply Project- a strategic project that is critical to helping to meet domestic gas demand in Southeast Australia. Cooper Energy rebranded as Amplitude Energy at our November AGM. Our Otway Basin petroleum title ownership has not changed and remains held by subsidiary companies Cooper Energy (CH) Pty Ltd and Cooper Energy (MGP) Pty Ltd. To remain consistent with stakeholder consultation to date, this document refers to these companies collectively as Cooper Energy. As an Australian company, we recognise the crucial role of natural gas in our country's journey towards a net-zero emissions future. Our project aligns with the Commonwealth Government's Future Gas Strategy, which underscores the importance of gas in ensuring energy security, reliability and affordability and supports the broader economic transition. At Amplitude Energy we are committed to delivering gas to Australian consumers while minimising our environmental impact. The East Coast Supply Project uses our existing offshore and onshore infrastructure in the Otway Basin, a region where industry, the community and the environment have coexisted for decades.

Our project delivers domestic gas to local customers via existing pipeline connections, representing a smaller environmental and emissions footprint compared to greenfield developments or transporting gas by pipeline over long distances. It also offers a cost-effective alternative to liquefied natural gas (LNG) imports, which require more processing and transport, adding to their cost and emissions footprint.

Today in Southeastern Australia around 40% of gas is used by industrial customers to make the products which are the backbone of our economy, for example our construction and food processing and packing sectors. These industries use gas as a feedstock and for high temperature heat for which there is currently no electrification option. We are proud to support these Australian industries which produce dairy products, glass, bricks and paper for the local market.

The East Coast Supply Project represents a step towards fulfilling Australia's future energy needs and reflects our dedication to sustainable practices and community engagement. We believe that through careful planning, rigorous environmental assessments, and active stakeholder consultation, we can achieve a balance that benefits both the economy, the local community and the environment.

Thank you for reviewing our Offshore Project Proposal. We look forward to your feedback and to continuing to provide Australia with the energy security and reliability it needs for a sustainable future.

Sincerely,

Jane Norman

CEO

Amplitude Energy

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Acronyms and Abbreviations

Acronym	Definition
μPa	Micro Pascal
2D	Two-Dimensional
AAD	Australian Antarctic Division
ACAP	Agreement on the Conservation of Albatrosses and Petrels
ACCU	Australian Carbon Credit Units
ACMA	Australian Communications and Media Authority
AEMO	Australian Energy Market Operator
AFMA	Australian Fisheries Management Authority
AFS	Anti Fouling Systems
AGP	Athena Gas Plant
AHO	Australian Hydrographic Office
AHT	Anchor Handling Tug
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
ALARP	As Low as Reasonably Practicable
AMP	Australian Marine Parks
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment Conservation Council
ANZG	Australian and New Zealand Guidelines
API	American Petroleum Institute
APPEA	Australian Petroleum Production & Exploration Association
ARS	Area Restricted Search
AS	Australian Standard
ASBTIA	Australian Southern Bluefin Tuna industry association
ATSIHP	Aboriginal and Torres Strait Islander Heritage Protection
AUV	Autonomous Underwater Vehicles
BIA	Biologically Important Area
BMG	Basker Manta Gummy
BOP	Blowout Preventer
BP	British Petroleum
BW	Blackwatch
BWM	Blackwatch Manifold
BWMC	Ballast Water and Sediments Convention
BWS	Blue Whale Study
CA	Control Agency
CAMBA	China/Australia Migratory Birds Agreement
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CEMS	Cooper Energy Management System
CFA	Commonwealth Fisheries Association
CGR	Condensate to-gas Ratio

Acronym	Definition
CH_4	Methane
CHIRP	Compressed High-Intensity Radar Pulse
CHN	Casino-Henry-Netherby
CIA	Cumulative Impact Assessment
CM	Casino - Matador
CMP	Conservation Management Plan
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CoA	Commonwealth of Australia
COE	Cooper Energy
COLREGS	International Regulations for Preventing Collisions at Sea
CRA	Corrosion Resistant Alloy
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSV	Construction Support Vessels
CTD	Conductivity, Temperature and Depth
CTS	Commonwealth Trawl Sector
DAFF	Department of Agriculture, Fisheries and Forestry
DAWE	Department of Agriculture Water and the Environment. Note, at the time of writing DAWE had recently split into DCCEEW and DAFF
DAWR	Department of Agriculture Water and Resources, superseded by Department of Agriculture Water and the Environment (DAWE)
dB	Decibels
dB re 1 µPa	Decibel with a reference level of 1 micro-Pascal
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEC	Department of Environment and Conservation
DECC	Department of Environment and Climate Change
DEDJTR	Department of Economic Development Jobs Trade and Resources. Previously Department of Transport Planning and Local Infrastructure (DTPLI). Now Department of Jobs Skills Industry and Regions (DJSIR) and Department of Transport and Planning (DTP).
DEECA	Department of Energy, Environment and Climate Action (formerly DELWP)
DEH	Department of the Environment and Heritage
DELWP	Department of Environment, Land, Water and Planning. Now DEECA
DEWHA	Department of Environment Heritage Water and the Arts
DIIS	Department or Industry Innovation and Science now Department of Industry, Science, Energy and Resources (DISER)
DISER	Department of Industry, Science, Energy and Resources previously Department or Industry Innovation and Science (DIIS)
DISR	Department of Industry, Science and Resources
DITRDC	Department of Infrastructure, Transport, Regional Development and Communications
DJPR	Department of Jobs Precincts and Regions (formerly DEDJTR)
DJSIR	Department of Jobs, Skills, Industry and Regions (formerly DJPR)

Acronym	Definition
DMA	Dead Man Anchor
DNP	Director of National Parks
DoD	Department of Defence
DoE	Department of Environment
DoEE	Department of Environment and Energy (previously Department of Sustainability, Environment, Water, Population & Communities (SEWPC), Department of Environment Heritage Water and the Arts (DEWHA), DEH and Environment Australia)
DoH	Department of Health
DoHAC	Department of Health and Aged Care
DP	Dynamic Positioning
DPC	Department of Premier and Cabinet
DPI	Department of Primary Industry
DSE	Department of Sustainability and Environment
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DSV	Dive Support Vessel
DTP	Department of Transport and Planning (formerly Department of Transport)
DTPLI	Department of Transport Planning and Local Infrastructure
EAC	East Australian Current
ECSP	East Coast Supply Project
EEZ	Exclusive Economic Zone
EFL	Electrical Flying Lead
EHU	Electro-hydraulic umbilical
EIA	Environmental Impact Assessment
EIAPP	Engine International Air Pollution Prevention
EMAC	Eastern Maar Aboriginal Corporation
EMBA	Environment that may be affected
ENVID	Environmental Identification
EP	Environment Plan
EPA	Environment Protection Authority
EPBC	Environment Protection Biodiversity Conservation
EPO	Environmental Performance Outcome
ERP	Emergency Response Plan
ERR	Earth Resources Regulation
ESD	Ecologically Sustainable Development
ETBF	Eastern Tuna and Billfish
EU	Electrical Umbilical
FEED	Front End Engineering and Design
FPSO	Floating, Production, Storage and Offloading facility
GDA 2020	Geocentric Datum Of Australia 2020
GHG	Greenhouse gases
GMP	Garbage Management Plan

Acronym	Definition
GMTOAC	Gunditj Mirring Traditional Owners Aboriginal Corporation
GSACUS	Great Southern Australian Coastal Upwelling System
GSSO	Gas Statement of Opportunities
HB	Handbook
HDD	Horizontal Directional Drill
HF	high frequency
HFL	Hydraulic Flying Lead
HFO	Heavy Fuel Oil
Hg	Mercury
HLV	Heavy Lift Vessel
HP	High Pressure
HPU	Hydraulic Power Unit
HQ	Hazard Quotient
HSE	Health, Safety, Environment
HSEC	Health Safety Environment and Community
Hz	Hertz
IAPP	International Air Pollution Prevention
ICC	Incident Control Centre
IGP	Iona Gas Plant
ILI	Internal Line inspection
ILT	In-line Tee
ILUA	Indigenous Land Use Agreements
IMAS	Institute for Marine and Antarctic Studies
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IMO	International Maritime Organisation
IMOS	Integrated Marine Observing System
IMP	Integrity Management Plan
IMP	Incident Management Plan
IMR	Inspection Maintenance & Repair
IMS	Invasive Marine Species
IMT	Incident Management Team
IOGP	International Association of Oil and Gas Producers
IPA	Indigenous Protected Areas
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
IR	Infrared
ISO	International Standards Organisation
ISV	Installation Support Vessel
ITOPF	International Tanker Owners Pollution Federation
IUCN	International Union for the Conservation of Nature

Acronym	Definition
JAMBA	Japan/Australia Migratory Birds Agreement
JRCC	Joint Rescue Coordination Centre
KEF	Key Ecological Feature
Kg	Kilograms
kHz	Kilohertz
km	Kilometre
km^2	Square kilometres
kt	1000 tonnes
L	Litres
LGA	Local Government Area
LOC	Loss of Containment
LOWC	Loss of Well Control
LWD	Logging Whilst Drilling
m^2	Square Meters
m^3	Cubic Meters
MARPOL	International Convention for the Prevention of Pollution from Ships
MBES	Multi-beam echo sounder
MCS	Master Control System
MDO	Marine Diesel Oil
MEG	Mono-ethylene glycol
MEPC	Marine Environment Protection Committee
MF	medium frequency
MFO	Marine Fauna Observer
mg/l	milligrams per litre
MGA 54	Map Grid of Australia 54
MGO	Marine Gas Oil
MLV	Mainline valve
MMO	Marine Mammal Observer
MMscf	Million standard cubic feet
MNES	Matters of National Environmental Significance
MO	Marine Order
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
MS	Management System
MT	Metric Tonne
N_2	Nitrogen
N_2O	Nitrous Oxide
NA	Not Applicable
NDC	Nationally Determined Contributions

Acronym	Definition
NEPM	National Environment Protection Measure
NERA	National Energy Resources Australia
NGER	National Greenhouse and Energy Reporting
NIMPIS	National Introduced Marine Pest Information System
Nm	Nautical Mile
NMFS	National Marine Fisheries Service
NNTT	National Native Title Tribunal
NOAA	National Oceanic and Atmospheric Administration
NOO	National Oceans Office
NOPSEMA	National Offshore Petroleum Safety & Environmental Management Authority
NPI	National Pollutant Inventory
NORMS	Naturally Occurring Radioactive Material
NORSOK	Norsk Sokkels Konkurranseposisjon
NOx	Nitrogen Oxides
NPI	National Pollution Index
NRDA	National Resource Damage Assessment
NSW	New South Wales
NZ	New Zealand
ºC	Degrees Celsius
OCNS	Offshore Chemical Notification System
ODS	Ozone Depleting Substances
OHS	Occupational Health & Safety
OPEP	Oil Pollution Emergency Plan
OPGGS	Offshore Petroleum and Greenhouse Gas Storage
OPGGSA	Offshore Petroleum & Greenhouse Gas Storage Act
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (Com)
OPP	Offshore Project Proposal
OPRC	(Convention on) Oil Pollution Preparedness, Response and Cooperation
ORP	Oxidation-reduction Potential
OSMP	Operational & Scientific Monitoring Plan
OSPAR	Oslo-Paris Convention
OWF	Offshore Wind Farm
P&A	Plug and Abandonment
PAH	Poly-aromatic hydrocarbon
PBW	Pygmy Blue Whale
PIG (pig)	Pipeline Inspection Guage
PIMP	Pipeline Integrity Management Plan
PJ	Petajoule
PK	Peak
PLONOR	Pose Little or No Risk

Acronym	Definition
PM	Particle Matter
PMB	Property Management Branch
PMST	Protected Matters Search Tool
POB	Persons on Board
ppb	Parts per billion
ppm	Parts per million
PSV	Platform Supply Vessel
PSZ	Petroleum Safety Zone
PTS	Permanent threshold shift
PV	Parks Victoria
PWS	Parks and Wildlife Services
RAP	Registered Aboriginal Party
ROKAMBA	The Republic of Korea Migratory Birds Agreement
RO	Reverse Osmosis
ROV	Remotely Operated Vehicle
SBP	Sub-Bottom Profiler
SCERP	Source Control Emergency Response Plan
SCM	Subsea Control Module
SEEMP	Shipboard Energy Efficiency Management Plan
SEL	Sound Exposure Level
SEMR	South East Marine Region
SESSF	Southern and Eastern Scale-fish and Shark Fishery
SETFIA	South East Trawl Fishing Industry Association
SF_6	Sulphur Hexafluoride
SHS	Scalefish Hook Sector
SIMAP	Spill Impact Mapping Analysis Program
SIMOPS	Simultaneous Operations
SIV	Seafood Industry Victoria
SMPEP	Shipboard Marine Pollution Emergency Plan
SoE	State of Environment
SOLAS	Safety of Life at Sea
SOx	Sulphur Dioxides
SPL	Sound Pressure Level
SSF	Sustainable Shark Fishing Inc.
SSJF	Southern Squid Jig Fishery
SSS	Side Scan Sonar
SST	Subsea Tree
ST	Side Track
SUDU	Subsea Umbilical Distribution Unit
SUTU	Subsea Umbilical Termination Unit

Acronym	Definition
SVP	Sound Velocity Profiler
TA	Tuna Australia
TACC	Total Allowable Commercial Catch
TEC	Threatened Ecological Community
TJ	Terajoule
TPC	Third Party Contractors
TPH	Total Petroleum Hydrocarbons
TOC	Total organic carbon
TSIC	Tasmanian Seafood Industry Council
TSSC	Threatened Species Scientific Committee
TTS	Temporary Threshold Shift
UCH	Underwater Cultural Heritage
UK	United Kingdom
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Program
UNFCCC	United Nations Framework Convention on Climate Change
USBL	Ultra-Short Baseline
UTA	Umbilical Terminal Assembly
UXO	Unexploded Ordinance
VFA	Victorian Fisheries Authority
VIC	Victoria
VRFish	Victorian Recreational Fishing Association
VSP	Vertical Seismic Profiling
VTIC	Victorian Tourism Industry Council
WBDF	Water-Based Drilling Fluids
WCD	Worst Case Discharge
WMO-GAW	World Meteorological Organisation-Global Atmosphere Watch
WOMP	Well Operations Management Plan
WTOAC	Wadawurrung Traditional Owners Aboriginal Corporation

1 Introduction

1.1 Activity Overview

Cooper Energy is the operator of the Casino Henry Netherby (CHN) development, which is in the Otway Basin, off Victoria's southwest coast in the Bass Strait (Figure 1-1). The CHN fields have been developed incrementally since 2004, with gas transported from the offshore fields, via pipeline, for onshore processing. All gas is used to supply the domestic market in south-east Australia.

To meet continued demand as existing fields decline Cooper Energy proposes to continue the incremental development of adjacent fields and utilise existing CHN infrastructure to maintain supply. This is referred to as the East Coast Supply Project (East Coast Project).

The East Coast Project comprises up to 8 gas development opportunities (7 new prospective resource opportunities and one discovered field, as shown in Figure 1-2) with associated sub-sea wells, flowlines and manifolds - all located in Commonwealth waters. The project will be developed in stages, aligned with domestic demand and project approvals.

This Offshore Project Proposal (OPP) has been developed by Cooper Energy to seek primary approval for all phases of the project life of the East Coast Project, including:

- site surveys
- well construction activities
- installation and commissioning
- operations
- decommissioning
- support operations.

1.1.1 Activity Location

The East Coast Project is located in, and adjacent to, the existing CHN fields within Commonwealth waters of the Otway Basin in licence areas VIC/P76, VIC/L24, VIC/P44, VIC/L30 and VIC/L33.

Water depths range between ~50 to 90 m across the proposed development options. The closest proposed well to shore is ~9 km offshore (Figure 1-2). All gas wells will tie back to the existing CHN subsea facilities in offshore Commonwealth waters. The existing CHN pipeline will then be utilised to transport gas and condensate to the Athena Gas Plant for processing, which is situated ~5 km inland of Port Campbell, Victoria.

The nearest settlements to the East Coast Project are the towns of Peterborough and Port Campbell which are ~11 km and 16 km away, respectively. The closest significant ports are Portland, situated ~96 km west and Geelong >150 km east.

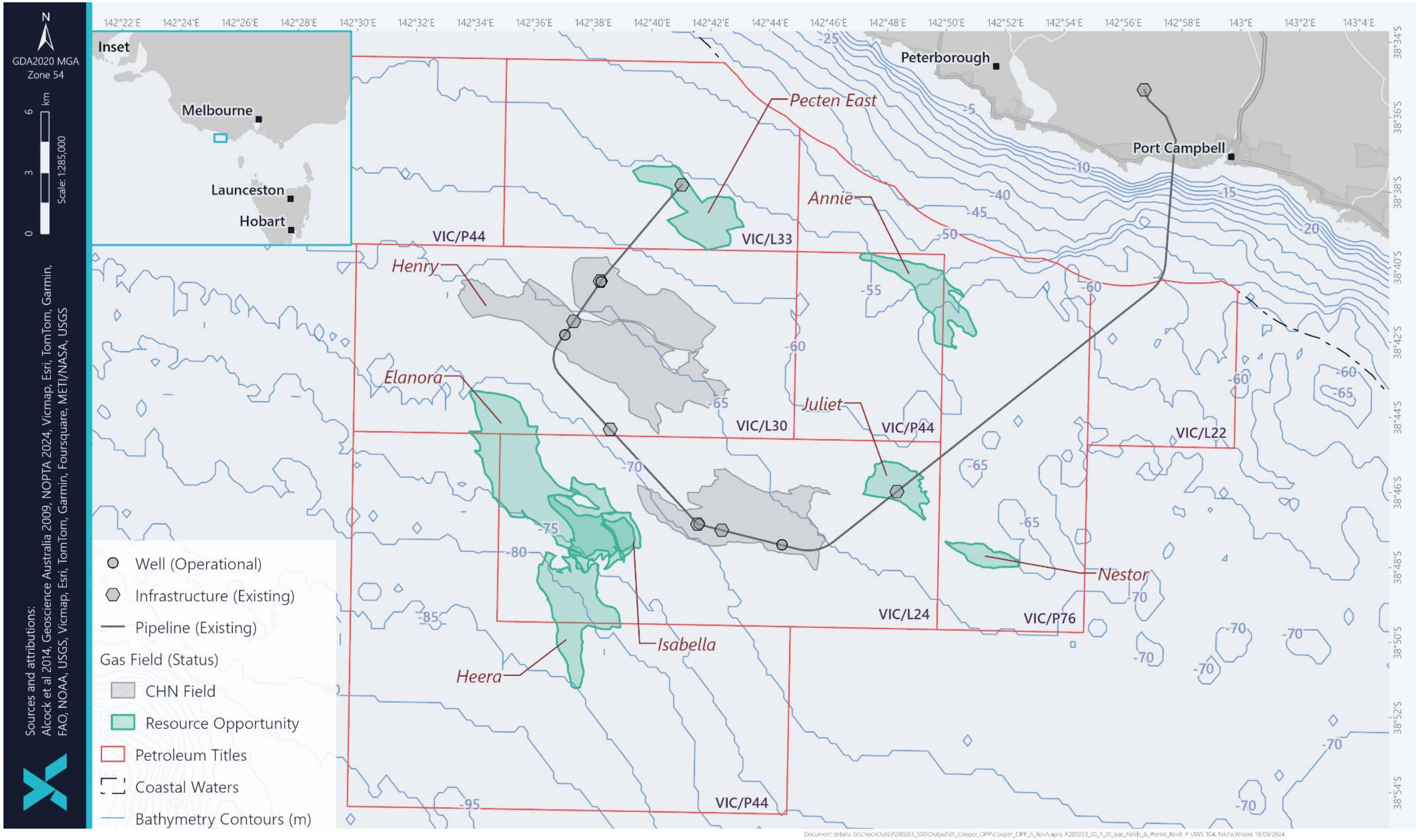


Figure 1-1: Existing CHN development

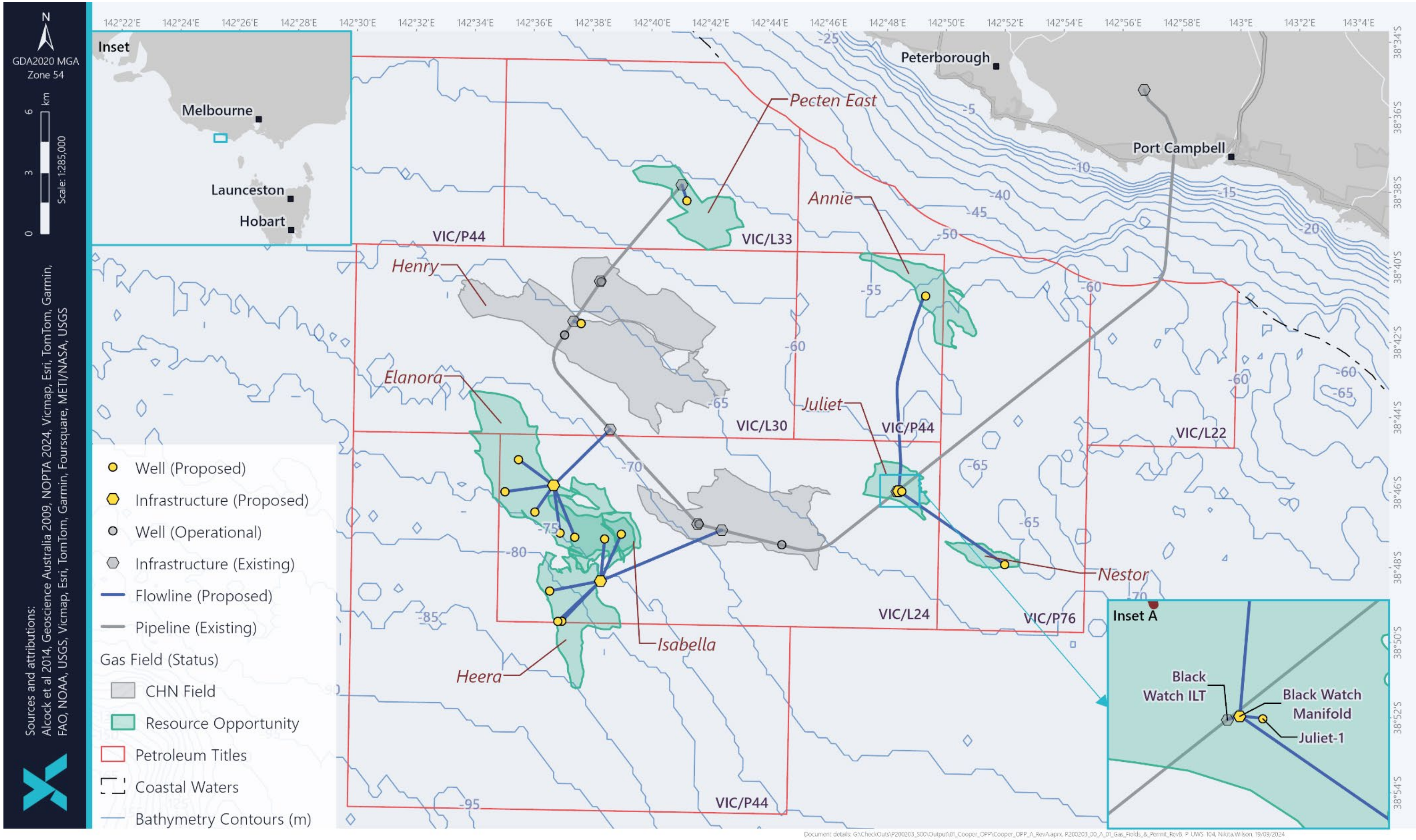


Figure 1-2: Location and Layout of East Coast Project and potential development scenario

1.2 Background

Exploration in the offshore Otway Basin has been undertaken for over 50 years, with hydrocarbons first discovered via drilling of the Pecten-1A well in 1969. Over the following decades, numerous other hydrocarbon discoveries were made. Gas and condensate have been produced from the Casino-Henry-Netherby (CHN) development assets since the early 2000's; the hydrocarbon resources proximal to the CHN facilities have been incrementally developed to meet south-east Australian gas demand and utilise existing infrastructure.

The existing Otway offshore facilities include the CHN development which produces from Production Licence Areas VIC/L24 (Casino) and VIC/L30 (Netherby and Henry). The CHN development has included the drilling of four wells which have been producing gas for over a decade. Products from these wells are transported through a subsea pipeline to the onshore Athena Gas Plant (AGP) on Victoria's southwest coast for processing. Processed gas is directed to third-party pipelines, where it is transported domestically for use within the southern and eastern states. Exploration undertaken proximal to the CHN development over the last couple of decades includes:

- Casino-1 exploration well was drilled in 2002, followed by two further exploration wells, which were both plugged and abandoned
- the Henry-1 exploration well was drilled in 2005 and was plugged and abandoned the same year
- the first exploration well in the Annie field (Annie-1) was drilled and plugged and abandoned in 2019.

The first production associated with the CHN development occurred in 2006 from two wells located within the Casino field (VIC/L24), later joined in 2010 by two single-well production wells in both the Henry and Netherby fields (VIC/L30).

Stage 1 of the CHN development comprised of the original Casino-2 well development, with gas processing through the nearby Iona Gas Plant (IGP), north of Port Campbell. In 2005, Casino-4 and Casino-5 wells (located in VIC/L24) were installed and have been in production since 2005.

Stage 2 of the development expanded the IGP for lower pressure operation and extended the pipeline to Pecten East. The Henry-2 and Netherby-1 development wells were drilled in 2008 and began producing in 2012. More recently, in late 2021, the Athena Gas Processing Project was completed, allowing CHN gas to be processed through the AGP.

The existing CHN facilities are shown in Figure 1-1 and comprise:

- Stage I, installed 2004:
  - Subsea production wells, including Casino-4 and Casino-5.
  - A 32.6 km subsea pipeline (Casino pipeline) connecting the Casino wells to the onshore gas plant.
  - A 31.2 km electro-hydraulic umbilical (EHU) cable connecting the Casino wells to the onshore gas plant.
- Stage II, installed 2008:
  - Subsea production wells, including Henry-2 and Netherby-1.
  - A 22 km subsea pipeline (Casino to Pecten East pipeline) tying into the Casino pipeline, carrying gas from the Henry-2 and Netherby-1 wells, with an additional section to the Pecten East where a future production well was anticipated.
  - A 22 km EHU cable (extension of the umbilical above to Pecten East) connecting the Henry and Netherby wells to the onshore plant. Sections of this EHU have been repaired in subsequent years via installation of electrical umbilicals that bypass electrical faults within the original EHU.

The CHN development, including the Otway offshore operations and associated activities described in the Otway Offshore Operations Environment Plan (EP) (Cooper Energy, 2023), has received

EPBC Act approval. Stage I, involving onshore, coastal and offshore construction and operations was approved as a controlled action in 2003 (EPBC 2003/1295). Stage II, involving the drilling and tie-back of gas/condensate resources to the Casino infrastructure was assessed as not-controlled action (EPBC Ref 2006/2635 and EPBC Ref 2007/3767).

The approvals and installed infrastructure provide for the integration of infill gas/condensate resources via existing tie-in points already installed in the CHN pipeline system. These tie-in points, as shown in Figure 1-2) are anticipated to be utilised for the East Coast Project.

1.3 Purpose

This Offshore Project Proposal (OPP) has been developed in accordance with the Commonwealth *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 [OPGGS(E)R].

Under the regulations, an OPP must be submitted for all offshore projects to the National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) for approval. An OPP is the initial assessment phase for an offshore project and must be accepted before the titleholder can submit Environment Plans (EPs) for the proposed phases of activity covered under the OPP. It is not until the regulator accepts an EP, that commencement of the activity covered by the EP can occur. This pre-requisite does not apply to exploration activities such as seismic surveys and exploratory drilling.

The proponent must ensure all environmental impacts and risks associated with the project will be managed to acceptable levels. This OPP will allow NOPSEMA to assess the potential environmental impacts and risks associated with the East Coast Project over the entire project life. Before acceptance, the OPP will be open for a public comment period. This opportunity for review and comment on the proposal by the public is an important part of the assessment process and assists in identifying environmental values and sensitivities and ensuring appropriate management of the impacts and risks across the whole project life of the East Coast Project.

1.3.1 Future Gas Strategy

The Commonwealth Government released the Future Gas Strategy in May 2024 (Department of Industry, Science and Resources (DISR), 2024). It maps the Australian Government's plan for how gas will support the Australian economy's transition to net zero. The strategy's objectives are to:

- support decarbonisation of the Australian economy
- safeguard energy security and affordability
- entrench Australia's reputation as an attractive trade and investment destination
- help Australia's trade partners on their own paths to net zero.

The strategy acknowledges that gas remains crucial to the Australian economy and region to support the transition to net zero (DISR 2024). Consistent with the Strategy, the East Coast Project can provide domestic gas supply in response to the AEMO forecast 2028 supply gap. Further, the phased development approach (Section 4.1.3) of the East Coast Project allows the development to respond to customer gas demand, aligning with the Future Gas Strategy principle of new sources of gas supply to meet demand during the economy-wide transition.

The East Coast Project development concept, being a backfill development for an existing gas plant in regional Australia, proximal (and already connected) to the east coast domestic gas market, can serve to reduce construction and transportation costs making the gas more affordable. The concept also avoids environmental impacts and emissions associated with the construction of new processing facilities and helps to reduce the need for (and associated emissions from) gas liquification, shipping and regassification into the eastern states from interstate or overseas.

1.3.2 Exploration Activities

Exploration activities are not provided for under this OPP. Cooper Energy is preparing an exploration drilling Environment Plan which covers drilling and well construction activities at Juliet-1, Nestor-1 and Elanora-1/ST1. In an exploration success case Cooper Energy may suspend these wells to allow their future use. In this scenario, Cooper Energy expects to integrate the exploration wells into the East Coast Project production infrastructure, subject to acceptance of this OPP and other relevant approvals.

This approach aligns with Cooper Energy's strategy of utilising existing infrastructure where safe and practicable to do so; this also has benefit in reducing the overall project footprint, and associated impacts and risks. If exploration wells are successfully integrated into the East Coast Project, some of the impacts associated with developing a field, such as emissions and disturbances from re-drilling or well workovers, can be reduced. The integration, production, operation and decommissioning of these wells is provided for in this OPP. Refer to Section 4 for further details.

1.3.3 Document Structure

The OPP has been prepared to align with NOPSEMA's guidelines for Offshore project proposal content requirements guidance note (NOPSEMA, 2020) and Offshore project proposal decision-making (NOPSEMA, 2021). The structure of this OPP is summarised in Table 1-1.

Table 1-1: OPP Structure

Section		Content
1	Introduction	Overview of the East Coast Project, location, background scope and proponent details.
2	Requirements	Legislation, other regulatory requirements, standards, policies, guidelines and international agreements relevant to the East Coast Project.
3	Stakeholder Consultation	A summary of Cooper Energy's stakeholder consultation methods which includes the process of stakeholder identification, consultation history and future requirements.
4	Project Description	A description of all proposed infrastructure and activities, including surveys, installation, commissioning, drilling, operation and decommissioning; and support operations.
5	Alternatives Analysis	An analysis of the feasible alternatives for the project concept, and design and activities of the selected concept.
6	Description of the Environment	A description of the values and sensitivities of the existing environment.
7	Impact and Risk Assessment	A description of the methodology used to identify and evaluate the environmental risks and impacts of the activities associated with the East Coast Project.
8	Environmental Impact Assessment	Environmental impact assessment for environmental impacts associated with planned aspects generated by the East Coast Project activities.
9	Environmental Risk Assessment	Environmental risk assessment for potential incident events associated with unplanned aspects generated by the East Coast Project activities.
10	First Nations Cultural Heritage Impact Assessment	Identifies and assess the potential impacts to First Nations cultural heritage generated by the East Coast Project activities.
11	Cumulative Impact Assessment	Identifies and assesses the potential cumulative impacts associated with the East Coast Project in the context of existing and future activities.
12	Implementation Strategy	An overview of Cooper Energy's management system and how environmental performance outcomes will be implemented.
13	References	

1.4 Scope

To address the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (OPGGS(E)R), Cooper Energy has assessed the potential environmental impacts and risks across all phases of the East Coast Project.

Phases and associated activities assessed within the scope of the OPP include:

- site surveys - geophysical and geotechnical
- well construction activities - drilling operations and well testing
- installation and commissioning - installation of subsea infrastructure and testing/start-up evaluations
- operations - maintenance, inspection and repair of infrastructure
- decommissioning - well decommissioning and removal of subsea infrastructure
- support operations - MODU, vessels, helicopters, ROVs.

Activities specifically excluded from the scope of this OPP are:

- exploration drilling[1]
- management and maintenance of existing CHN facilities[2]
- management of onshore activities including the Athena Gas Plant and MLV station.
- vessels transiting to or from the operational area. These vessels are deemed operating under the Commonwealth *Navigation Act 2012* and not performing a petroleum activity.

1.5 Proponent Details

Cooper Energy (CH) Pty Ltd and Cooper Energy (MGP) Pty Ltd are the proponent for the East Coast Project. In accordance with the Offshore Petroleum and Greenhouse Gas Storage Act (Environment) Regulations 2023 (OPGGS(E)R), details are provided below.

Contact details of the proponent are:

Cooper Energy (CH) Pty Ltd and Cooper Energy (MGP) Pty Ltd[3]

Level 8, 70 Franklin Street

Adelaide, South Australia, 5000

Phone: +61 8 8100 4900

Email: nathan.childs@amplitudeenergy.com.au

Website: https:/amplitudeenergy.com.au/

[1] Under the OPGGS(E)R, exploration activities such as seismic surveys and exploration drilling require an approved Environment Plan (EP) before an activity can occur but are not required to be assessed within an OPP (see Section 1.3.2).

[2] Interactions with existing CHN facilities within the scope of this OPP are those activities required to integrate the East Coast Supply Project (ECSP) facilities; these activities include hot tapping (described in Section 4.2.5), pig launching (described Section 4.2.3 and 4.2.5), and other inspection-maintenance and repair type works as described in Section 4.3.4.3 and 4.3.4.4.

[3] Amplitude Energy is the new parent company name for Cooper Energy (CH) Pty Ltd and Cooper Energy (MGP) Pty Ltd

2 Requirements

This section provides information on the requirements that apply to the activities. Requirements include relevant laws, codes, other approvals and conditions, standards, agreements, treaties, conventions or practices (in whole or part) that apply to jurisdiction that the activity takes place in.

The East Coast Project is located entirely within Commonwealth waters and therefore falls under Commonwealth jurisdiction. Projects located within Commonwealth jurisdiction must comply with two keys acts: *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGSS Act)* and *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).*

2.1 Commonwealth legislation

2.1.1 OPGGS Act Requirements

The OPGGS Act provides the regulatory framework for all offshore petroleum activities within Commonwealth waters. The Act ensures that activities are undertaken in a way that is:

- consistent with the principles of ecologically sustainable development as defined in section 3A of the EPBC Act
- reduces environmental impacts and risks of the activity to as low as reasonably practicable (ALARP)
- ensures that environmental impacts and risks of the activity are acceptable.

There are several regulations under the Act including:

- Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009
- Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011
- Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (OPGGS(E)R).

Section 6 of the OPGGS(E)R specifies that prior to beginning an offshore project, a person must submit an OPP to the regulator.

Section 572 of the OPGGS Act places duties on titleholders in relation to the maintenance and removal of structures, equipment and property brought onto the petroleum title. Decommissioning requirements are addressed in Section 4.3.5.

Facilities to meet the requirements of Section 270 and 572 of the OPGGS Act is addressed in Section 4.3.5.6.

The OPGGS(E)R require a titleholder to have an accepted Environment Plan (EP) in place for any petroleum activity or greenhouse gas activity.

EPs related to activities associated with the OPP development can be submitted for assessment after the OPP has been accepted by NOPSEMA. Activities can only commence once the relevant EP has been accepted by NOPSEMA.

An EP is supported by an Oil Pollution Emergency Plan (OPEP) and an Operational and Scientific Monitoring Plan (OSMP), which are required to be included within an EP's implementation strategy.

Table 2-1 specifies the requirements of the OPGGS(E)R in relation to the content of this OPP.

Table 2-1: Concordance Table for the OPP Requirements of the OPGGS(E)R

Regulation Section	Description	Document Section
7(2)(a)	The proposal must: (a) include the proponent's name and contact details;	Section 1.3

Regulation Section	Description	Document Section
7(2)(b)	(b) a summary of the project, including the following: I. a description of each activity that is part of the project; II. the location or locations of each activity; III. a proposed timetable for carrying out the project; IV. a description of the facilities that are proposed to be used to undertake each activity; V. a description of the actions proposed to be taken, following completion of the project, in relation to those facilities;	Section 4
7(2)(c)	(c) a description of the existing environment that may be affected by the project;	Section 6
7(2)(d)	(d) details of the relevant values and sensitivities (if any) of that environment;	Section 6
7(2)(e)	(e) the environmental performance outcomes for each activity that is part of the project;	Section 8 and 9
7(2)(f)	(f) a description of any feasible alternative to the project, or an activity that is part of the project, including: I. a comparison of the environmental impacts and risks arising from the project or activity and the alternative; and II. an explanation, in adequate detail, of why the alternative was not preferred.	Section 5
7(3)	Without limiting paragraph (2)(d), relevant values and sensitivities may include any of the following: (a) the world heritage values of a declared World Heritage property; (b) the National Heritage values of a National Heritage place; (c) the ecological character of a declared Ramsar wetland; (d) the presence of a listed threatened species or listed threatened ecological community; (e) the presence of a listed migratory species; (f) any values and sensitivities that exist in, or in relation to, part or all of: I. a Commonwealth marine area; or II. Commonwealth land.	Section 6
7(4)	The proposal must describe: (a) describe the requirements, including legislative requirements, that apply to the project and are relevant to the environmental management of the project; and (b) describe how those requirements will be met.	Section 2
7(5)	The proposal must include: (a) details of the environmental impacts and risks of the activities that are part of the project; and (b) an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk.	Section 8 and 9

2.1.2 EPBC Act Requirements

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides protection and enables the management of nationally and internationally important flora, fauna, ecological communities and heritage places.

The EPBC Act refers to the living things (including plants and animals), habitats and places that need protecting as 'matters of national environmental significance' (MNES).

MNES relevant to the OPP include:

- listed threatened species and ecological communities
- listed migratory species (protected under international agreements)
- Commonwealth marine areas
- World Heritage places
- Commonwealth Heritage places
- wetlands of international importance (listed under the Ramsar Convention).

NOPSEMA oversees the assessment process as the delegated authority for petroleum activities under the EPBC Act, after streamlining of regulatory processes under the OPGGS Act and EPBC Act in 2014.

An independent review was conducted on the EPBC Act in 2022 (the Samuel Review), and the Australian Government is in the process of reforming the EPBC Act. Public consultation on the details of the draft legislation will occur in the second half of 2023; however, no draft legislation was available at the time of writing.

2.1.2.1 Protected Areas

Under the EPBC Act, protected areas (marine and terrestrial) are established to meet objectives consistent with local and national goals (Environment Australia, 2002). Once protected areas are established, an International Union for Conservation of Nature (IUCN) category is assigned, to ensure objectives are met. Any activities occurring within a protected area must be consistent with the Australian IUCN Reserve Management Principles which embody the objectives and values of the area:

- Strict Nature Reserve (IA) – possesses outstanding or representative ecosystems, geological or physical features and/or species. Managed primarily for scientific research or environmental monitoring.
- National Park (II) – designated to protect and manage natural condition and provide a foundation for spiritual, scientific, educational or recreational opportunities.
- Habitat/Species Management Area (IV) – subject to active intervention to ensure the maintenance of habitats and/or meet the requirements of specific species.
- Managed Resource Protected Area (VI) – managed to ensure long-term protection and maintenance of biodiversity while providing a sustainable flow of natural products and service to meet community needs.

The Australian IUCN Reserve Management Principles for each category are within the EPBC Regulations and summarised in Table 2-2.

Table 2-2: Australian IUCN Reserve Management Principles

Category IA: Strict Nature Reserve	Category II: National Park	Category IV: Habitat/Species Management Area	Category VI: Managed Resource Protected Areas
1.01 The reserve or zone should be managed primarily for scientific research or environmental monitoring based on the following principles	3.01 The reserve or zone should be protected and managed to preserve its natural condition according to the following principles.	5.01 The reserve or zone should be managed primarily, including (if necessary) through active intervention, to ensure the maintenance of habitats or to meet the requirements of collections or specific species based on the following principles.	7.01 The reserve or zone should be managed mainly for the sustainable use of natural ecosystems based on the following principles.

Category IA: Strict Nature Reserve	Category II: National Park	Category IV: Habitat/Species Management Area	Category VI: Managed Resource Protected Areas
1.02 Habitats, ecosystems and native species should be preserved in as undisturbed state as possible	3.02 Natural and scenic areas of national and international significance should be protected for spiritual, scientific, educational, recreational or tourist purposes.	5.02 Habitat conditions necessary to protect significant species, groups or collections of species, biotic communities or physical features of the environment should be secured and maintained, if necessary, through specific human manipulation.	7.02 The biological diversity and other natural values of the reserve or zone should be protected and maintained in the long term.
1.03 Genetic resources should be maintained in a dynamic and evolutionary state	3.03 Representative examples of physiographic regions, biotic communities, genetic resources, and native species should be perpetuated in as natural a state as possible to provide ecological stability and diversity.	5.03 Scientific research and environmental monitoring that contribute to reserve management should be facilitated as primary activities associated with sustainable resource management.	7.03 Management practices should be applied to ensure ecologically sustainable use of the reserve or zone.
1.04 Established ecological processes should be maintained.	3.04 Visitor use should be managed for inspirational, educational, cultural and recreational purposes at a level that will maintain the reserve or zone in a natural or near natural state.	5.04 The reserve or zone may be developed for public education and appreciation of the characteristics of habitats, species or collections and of the work of wildlife management.	7.04 Management of the reserve or zone should contribute to regional and national development to the extent that this is consistent with these principles.
1.05 Structural landscape features or rock exposures should be safeguarded	3.05 Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.	5.05 Management should seek to ensure that exploitation or occupation inconsistent with these principles does not occur.	
1.06 Examples of the natural environment should be secured for scientific studies, environmental monitoring and education, including baseline areas from which all avoidable access is excluded	3.06 Respect should be maintained for the ecological, geomorphologic, sacred and aesthetic attributes for which the reserve or zone was assigned to this category.	5.06 People with rights or interests in the reserve or zone should be entitled to benefits derived from activities in the reserve or zone that are consistent with these principles.	
1.07 Disturbance should be minimised by careful planning and execution of research and other approved activities.	3.07 The needs of indigenous people should be taken into account, including subsistence resource	5.07 If the reserve or zone is declared for the purpose of a botanic garden, it should also be managed for the increase of	

Category IA: Strict Nature Reserve	Category II: National Park	Category IV: Habitat/Species Management Area	Category VI: Managed Resource Protected Areas
	use, to the extent that they do not conflict with these principles.	knowledge, appreciation and enjoyment of Australia's plant heritage by establishing, as an integrated resource, a collection of living and herbarium specimens of Australian and related plants for study, interpretation, conservation and display.	
1.08 Public access should be limited to the extent it is consistent with these principles.	3.08 The aspirations of traditional owners of land within the reserve or zone, their continuing land management practices, the protection and maintenance of cultural heritage and the benefit the traditional owners derive from enterprises, established in the reserve or zone, consistent with these principles should be recognised and taken into account.		

2.1.2.2 *Management / Recovery Plans and Conservation Advice for Listed Threatened Species and Ecological Communities*

Relevant requirements associated with the EPBC Act, related policies, guidelines, plans of management, recovery plans, threat abatement plans, and other relevant advice issued by the Department of Climate Change, Energy, the Environment and Water (DCCEEW) are detailed in the applicable sections within Section 6 as part of the description of the existing environment.

The requirements identified within management/recovery plans and conservation advice have been considered in the development of the OPP and used as guidance in developing the management of proposed activities.

Table 2-3 outlines the management plans, recovery plans and conservation advice of listed species identified in Section 6 and highlights any key threats or conservation actions relevant to the proposed activities. Guidance and advice have been considered when assessing the impacts and risks, acceptability and in developing environmental performance outcomes (EPOs).

Table 2-3: Management/Recovery Plans and Conservation Advice Relevant to the East Coast Project

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
Fish					
Australian Grayling	National Recovery Plan for the Australian Grayling (Backhouse et al., 2008)	• Vulnerable	The overall objective of recovery is to minimise the probability of extinction of the Australian Grayling in the wild, and to increase the probability of important populations becoming self-sustaining in the long term. Relevant specific objectives within the lifespan of the recovery plan are: Protect and restore habitat for Australian Grayling Investigate and manage threats to populations and habitats	Climate Change	No explicit relevant management actions; climate change identified as a threat.
				Poor Water Quality	Manage water quality where Australian Grayling occurs to maintain waters free of significant levels of nutrient, sediment, pesticide and other pollutants, consistent with the ANZECC guidelines for water quality.
	Conservation Advice *Prototroctes maraena* Australian Grayling (TSSC, 2021)		No explicit relevant objectives	Climate Change	No explicit relevant management actions; climate change identified as a threat.
Black Rockcod	Approved Conservation Advice for *Epinephelus daemelii* (Black Rock-cod) (DSEWPaC, 2012e)	• Vulnerable	No explicit relevant objectives	Climate Change	No explicit relevant management actions; climate change identified as a threat.
Eastern Dwarf Galaxias	National recovery plan for the Dwarf Galaxias (*Galaxiella pusilla*) (Saddlier et al., 2010)	• Endangered	No explicit relevant objectives	Climate Change	No explicit relevant management actions; climate change identified as a threat.
	Conservation Advice for *Galaxiella pusilla* (dwarf galaxias) (DCCEEW 2023a)				
Variegated Pygmy Perch	National recovery plan for the Variegated Pygmy Perch (*Nannoperca*	• Vulnerable	No explicit relevant objectives	Climate Change	No explicit relevant management actions; climate change identified as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
	variegate) (Saddlier and Hammer, 2010b)				
Yarra Pygmy Perch	National recovery plan for the Yarry Pygmy Perch (*Nannoperca obscura*) (Saddlier and Hammer, 2010a)	• Endangered	No explicit relevant objectives	Climate Change	No explicit relevant management actions; climate change identified as a threat.
	Approved Conservation advice for *Nannoperca obscura* (Yarra pygmy perch) (DCCEEW, 2023b)				
Handfish	Recovery Plan for Three Handfish Species: Spotted Handfish (*Brachionichthys hirsutus*), Red Handfish (*Thymichthys politus*), and Ziebell's Handfish (*Branchiopsilus ziebelli*) (CoA, 2015c)	Critically Endangered: • Red Handfish • Spotted Handfish Vulnerable: • Ziebell's Handfish	No explicit relevant objectives	Pollution and siltation of waterways	No explicit relevant management actions; pollution and siltation of waterways identified as a threat.
				Climate Change	No explicit relevant management actions; climate change identified as a threat.
	Approved Conservation Advice for *Thymichthys politus* (Red Handfish) (DSEWPaC, 2012f)	• Critically Endangered	No explicit relevant objectives	Habitat Degradation	Ensure there is no disturbance to areas where the red handfish occurs, excluding necessary actions to manage the conservation of the species. Manage any known, potential or emerging threats including introduced species
White Shark	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013)	• Vulnerable • Migratory	The overarching objective of this recovery plan is to assist the recovery of the white shark in the wild throughout its range in Australian waters with a view to: Improving the population status leading to future removal of the white shark from the threatened species list of the EPBC Act	Habitat modification	No explicit relevant management actions; habitat modification identified as a threat.
				Climate Change	No explicit relevant management actions; climate change identified as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
			Ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future. The specific objectives of the recovery plan (relevant to industry) are: Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas.		
Grey Nurse Shark (east coast population)	Recovery Plan for the Grey Nurse Shark (*Carcharias Taurus*) (DoE, 2014a)	• Critically Endangered	The long-term objective of this recovery plan is to assist the recovery of the grey nurse shark in the wild, throughout its range in Australian waters, with an aim to improve its population status and ensure that anthropological activities do not hinder the recovery of the grey nurse shark. The specific objectives of this recovery plan (relevant to industry) are: Objective 8: Continue to identify and protect critical habitat to the survival of the grey nurse shark and reduce the impact of threatening processes within these areas.	Pollution	Review and assess the potential threats of introduced species, pathogens and pollutants.
				Habitat Modification	Review the level and spatial extent of protection measures at key aggregation sites to ensure appropriate levels of protection, and a consistent approach to the designation and implementation of protective measures, are applied. Use Biologically Important Areas (BIA) to help inform the development of appropriate conservation measures, including through the application of advice in the marine bioregional plans on the types of actions which are likely to have a significant impact on the species and updating such conservation measures as new information becomes available.
				Climate Change	No explicit relevant management actions; climate change identified as a threat.
Whale Shark	Approved Conservation Advice for *Rhincodon typus* (Whale Shark) (TSSC, 2015k)	• Vulnerable • Migratory	No explicit relevant objectives	Vessel Strike	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Pollution	No explicit relevant management actions; pollution (marine debris) identified as a threat.
				Climate Change	No explicit relevant management actions; climate change identified as a threat.
Shorebirds and Seabirds					
Threatened Albatross and Petrel species	National Recovery Plan for Albatrosses and Petrels (2022) (DCCEEW, 2022e)	Endangered: • Chatham Albatross • Grey-headed Albatross • Northern Royal Albatross • Shy Albatross • Gould's Petrel • Southern Giant Petrel Vulnerable: • Antipodean Albatross • Black-browed Albatross • Buller's Albatross • Campbell albatross • Indian Yellow-nosed Albatross • Northern Giant Petrel • Salvin's Albatross	Overall objective: To ensure the long-term survival and recovery of albatross and giant petrel populations breeding and foraging in Australian jurisdiction by reducing or eliminating human related threats at sea and on land. Specific objectives: Land-based threats to the survival and breeding success of albatrosses and giant petrels breeding within areas under Australian jurisdiction are quantified and reduced. Marine-based threats to the survival and breeding success of albatrosses and giant petrels foraging in waters under Australian jurisdiction are quantified and reduced.	Marine pollution	Undertake, as feasible, monitoring of breeding colonies for marine debris, plastics and marine pollution impacts including, as a priority: • Incidence of oiled birds at nest • Effect of plastics and marine pollution • Develop baseline measures of levels of heavy metals and persistent organic pollutants. Risk-based response strategies are implemented where appropriate, for marine pollution incidents that have the potential to affect breeding populations.
				Marine infrastructure interactions	No explicit relevant management actions; marine infrastructure interactions identified as a threat.
				Climate Change	No explicit relevant management actions; climate change identified as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
		• Sooty Albatross • Southern Royal Albatross • White-capped Albatross			
All Migratory Shorebirds	Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015b)	N/A	Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated.	Habitat degradation / modification (oil pollution)	No explicit relevant management actions; identified as a threat.
				Anthropogenic disturbance	Investigate the significance of cumulative impacts on migratory shorebird habitat and populations in Australia. Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes (specifically for coastal developments).
				Climate Change	Investigate the impacts of climate change on migratory shorebird habitat and populations in Australia.
All Seabirds	Wildlife Conservation Plan for Seabirds (CoA, 2020)	N/A	Seabirds and their habitats are protected and managed in Australia.	Pollution (marine debris, light, water)	Enhance contingency plans to prevent and/or respond to environmental emergencies that have an impact on seabirds and their habitats.
				Habitat loss and degradation from pollution	No explicit relevant management actions; identified as a threat.
				Anthropogenic disturbance	Ensure all areas of important habitat for seabirds are considered in the development assessment process. Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Invasive species	Ensure seabirds are protected from the adverse effects of invasive species.
				Climate Change	No explicit relevant management actions; climate change identified as a threat.
Sooty Shearwater	Conservation Advice for *Ardenna grisea* (sooty shearwater). (DCCEEW, 2023m)	• Vulnerable • Migratory • Marine	The primary conservation objectives for the conservation advice are; • To increase the trend of Australian breeding population. • The At-sea losses within Australia remain minimal.	Climate Change	No explicit relevant management actions; climate change identified as a threat.
Australasian Bittern	Approved Conservation Advice for *Botaurus poiciloptilus* (Australasian bittern) (TSSC, 2019)	• Endangered	The objective of this conservation advice is to provide guidance for actions that will expand the range and the number of Australasian Bitterns in Australia.	Habitat loss and degradation	No explicit relevant management actions; habitat loss and degradation recognised as a threat.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
	National Recovery Plan for the Australasian Bittern (*Botaurus poiciloptilus*) (DCCEEW, 2022h).		The objective of this recovery plan is to demonstrate, by 2032, an increasing trend (compared to 2020 baseline counts) in the number of mature individuals being recorded in annual surveys at key locations, and to ensure that habitat critical to the survival of the Australasian Bittern is protected and managed to meet the ecological requirements of the species.	Climate Change	No explicit relevant management actions; climate change recognised as a threat.
				Reduced water quality	No explicit relevant management actions; reduced water quality recognised as a threat.
Red Knot	Approved Conservation Advice for *Calidris canutus* (Red Knot) (DCCEEW, 2024a)	• Vulnerable • Migratory • Marine	Minimise further loss of habitat critical to the survival of red knot throughout Australia (including habitat predicted to become habitat critical in the future because of climate change)	Acute Pollution	No explicit relevant management actions; oil pollution recognised as a threat.
				Habitat loss, disturbance and modifications	Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies, and site managers

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Great Knot	Conservation Advice for Calidris tenuirostris (great knot) (DCCEEW, 2024b)	• Vulnerable • Migratory • Marine	Minimise further loss of habitat critical to the survival of red knot throughout Australia (including habitat predicted to become habitat critical in the future because of climate change)	Acute Pollution	No explicit relevant management actions; oil pollution recognised as a threat.
				Habitat loss, disturbance and modifications	Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies, and site managers
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Curlew Sandpiper	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DCCEEW, 2023q)	• Critically Endangered • Migratory • Marine	Minimise further loss of habitat critical to the survival of curlew sandpiper throughout Australia (including habitat predicted to become habitat critical in the future because of climate change).	Acute and chronic pollution	No explicit relevant management actions; oil spill is recognised as a threat.
				Habitat loss, disturbance and modifications	Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies, and site managers
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Sharp-tailed Sandpiper	Approved Conservation Advice for *Calidris acuminata* (sharp-tailed sandpiper) (DCCEEW, 2024c)	• Vulnerable • Migratory • Marine	Australian Objective: Minimise further loss of habitat critical to the survival of the sharp-tailed sandpiper throughout Australia.	Habitat loss, degradation and fragmentation	Ensure that future development projects avoid any activities that disproportionately affect the upper-tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
Terek Sandpiper	Approved Conservation Advice for *Xenus cinereus* (Terek sandpiper) (DCCEEW, 2024d)	• Vulnerable • Migratory • Marine	Australian Objective: Minimise further loss of habitat critical to the survival of the terek sandpiper throughout Australia.	Habitat loss, degradation and fragmentation	Ensure that future development projects avoid any activities that disproportionately affect the upper-tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Greater Sand Plover	Approved Conservation Advice for *Charadrius leschenaultia* (Greater Sand Plover) (TSSC, 2016b)	• Vulnerable • Migratory • Marine	No explicit relevant objectives	Habitat loss and degradation	Identifies research priorities and the need for actions to prevent destruction of key breeding and migratory staging sites. Protect important habitat in Australia.
				Pollution and contamination	No explicit relevant management actions; pollution / contaminants recognised as a threat.
				Introduced Species	No explicit relevant management actions; introduced species recognised as a threat.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Lesser Sand Plover	Approved Conservation Advice for *Charadrius mongolus* (Lesser Sand Plover) (TSSC, 2016h)	• Endangered • Migratory • Marine	No explicit relevant objectives	Habitat loss and degradation	No explicit relevant management actions; Habitat loss and degradation is identified as a threat.
				Pollution/contamination impacts	No explicit relevant management actions; Climate Change is identified as a threat.
				Introduced species	No explicit relevant management actions; Pollution/Contamination identified as a threat.
				Direct mortality	No explicit relevant management actions; Disturbance identified as a threat.
				Climate Change	No explicit relevant management actions; Direct morality is identified as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
Grey Plover	Approved Conservation Advice for *Pluvialis squatarola* (grey plover) (DCCEEW, 2024e)	• Vulnerable • Migratory • Marine	Minimise further loss of habitat critical to the survival of grey plover throughout Australia (including habitat predicted to become habitat critical to survival in the future because of climate change).	Habitat Loss	Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.
				Climate Change	No explicit relevant management actions; Direct morality is identified as a threat.
Blue Petrel	Approved Conservation Advice for *Halobaena caerulea* (Blue Petrel) (TSSC 2015b)	• Vulnerable • Marine	No explicit relevant objectives	Habitat Loss, Disturbance and Modification	No explicit relevant management actions; habitat loss, disturbance and modification recognised as a threat.
Nunivak Bar-tailed Godwit	Conservation Advice for Limosa lapponica baueri (Alaskan bar-tailed godwit) (DCCEEW, 2024j)	• Endangered	Minimise further loss of habitat critical to the survival of grey plover throughout Australia (including habitat predicted to become habitat critical to survival in the future because of climate change).	Habitat loss, degradation and fragmentation	Ensure that future development projects avoid any activities that disproportionately affect the upper-tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.
				Acute Pollution	No explicit relevant management actions; oil pollution recognised as a threat.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Eastern Curlew	Approved Conservation Advice for *Numenius madagascariensis* (far eastern curlew) (DCCEEW, 2023r)	• Critically Endangered • Migratory • Marine	Minimise further loss of habitat critical to the survival of far eastern curlew throughout Australia (including habitat predicted to become habitat critical in the future because of climate change).	Acute and chronic pollution	No explicit relevant management actions; oil spill is recognised as a threat.
				Habitat loss, disturbance and modifications	Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies, and site managers
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
Fairy Prion (southern)	Approved Conservation Advice for *Pachyptila subantarctica* (Fairy Prion (southern)) (TSSC, 2015d)	• Vulnerable	No explicit relevant objectives	Habitat Loss, Disturbance and Modification	No explicit management actions; habitat loss, disturbance and modification recognised as a threat.
Australian Painted Snipe	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (DSEWPaC, 2013b)	• Endangered • Marine	No explicit relevant objectives	Habitat loss disturbance and modifications	Habitat recovery actions are a priority.
	National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (DCCEEW, 2022g)		By 2032, sustain a positive population trend (compared to 2020 baseline counts) in the number of mature individuals of the Australian Painted Snipe.	Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Australian Fairy Tern	Approved Conservation Advice for *Sternula nereis* (Australian Fairy Tern) (DSEWPaC, 2011)	• Vulnerable	No explicit relevant objectives	Oil spills, particularly in Victoria	Ensure appropriate oil spill contingency plans are in place for the subspecies' breeding sites that are vulnerable to oil spills.
	National Recovery Plan for *(Sternula nereis nereis)* (Australian Fairy Tern) (DAWE, 2020)		Long-term Vision: The Australian Fairy Tern population has increased in size to such an extent that the species no longer qualifies for listing as threatened under any of the Environment Protection and Biodiversity Conservation Act 1999 listing criteria.	Habitat degradation and loss of breeding habitat	No explicit management actions; habitat degradation and loss of breeding habitat recognised as a threat.
				Pollution	No explicit management actions; pollution recognised as a threat.
				Climate variability and change	No explicit management actions; climate change recognised as a threat.
Grey-headed Albatross	Approved Conservation Advice for *Thalassarche Chrysostoma*, Greyheaded Albatross) (DEWHA, 2009)	• Endangered • Migratory • Marine	No explicit relevant objectives	Pollution	No explicit management actions; pollution recognised as a threat.
				Entanglement in Marine Debris	No explicit management actions; marine debris recognised as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Climate Change	No explicit management actions; climate change recognised as a threat.
Shy Albatross	Conservation Advice *Thalassarche cauta* Shy Albatross (TSSC, 2020)	• Endangered • Migratory • Marine	Refer to objectives in the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2022	Marine Pollution	No explicit management actions; marine pollution recognised as a threat.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Hooded Plover (eastern)	Approved Conservation Advice for *Thinornis rubricollis* (Hooded Plover, Eastern) (TSSC, 2014)	• Vulnerable • Marine	Primary Conservation Objectives: Achieve stable numbers of adults in the population, and maintain a stable number of occupied and active breeding territories Maintain, enhance and restore habitat, and integrate the subspecies' needs into coastal planning	Oil spills	Prepare oil spill response plans to ensure effective rehabilitation of oiled birds.
				Entanglement and Ingestion of Marine Debris	Reduce in-shore marine debris
				Invasive Species	No explicit management actions; invasive species recognised as a threat.
				Climate Change	No explicit management actions; climate change recognised as a threat.
Gould's Petrel	Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC, 2006)	• Endangered	The overall objective of the Gould's Petrel recovery effort is for Gould's Petrel to be down listed from endangered to vulnerable by 2011. Specific recovery objectives are: To identify and manage the threats operating at sites where the subspecies occurs	None identified	NA
Herald Petrel	Conservation Advice *Pterodroma heraldica* (Herald petrel) (TSSC, 2015l)	• Critically Endangered	No explicit relevant objectives	None identified	NA
Soft-plumage Petrel	Approved Conservation Advice for *Pterodroma mollis* (Soft-plumaged Petrel) (TSSC, 2015g)	• Vulnerable • Marine	No explicit relevant objectives	None identified	NA

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
Kermadec Petrel (western)	Lord Howe Island Biodiversity Management Plan (Department of Environment and Climate Change (DECC), 2008)	• Vulnerable	No explicit relevant objectives	None identified	NA
	Norfolk Island Region Threatened Species Recovery Plan (DEWHA, 2010c)		No explicit relevant objectives	None identified	NA
White-bellied Storm Petrel (Tasman Sea)	Lord Howe Island Biodiversity Management Plan (Department of Environment and Climate Change (DECC), 2008)	• Vulnerable	No explicit relevant objectives	None identified	NA
Swift Parrot	National Recovery Plan for the *Lathamus discolour* (swift parrot) (DCCEEW, 2024m)	• Critically Endangered • Marine	By 2032, anthropogenic threats to Swift Parrot are demonstrably reduced.	Climate Change	No explicit relevant management actions; climate change recognised as a threat.
	Conservation Advice *Lathamus discolor* Swift Parrot (TSSC, 2016d)		No explicit relevant objectives	None identified	NA
Orange-bellied Parrot	National Recovery Plan for the Orange-bellied Parrot (*Neophema chrysogaster*) (DELWP, 2016)	• Critically Endangered • Marine	The three primary objectives of this Recovery Plan are based on the recovery strategy outlined above, while the fourth, supporting objective is essential in order to achieve the three primary objectives: Objective 1. To achieve a stable or increasing population in the wild within five years.	Habitat degradation and modification	• Retain habitat • Manage threats to habitat quality • Monitor the wild population and habitat
				Barriers to migration and movement	Assess and manage the risks from development proposals that may represent a barrier to migration or movement.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
			Objective 2. To increase the capacity of the captive population, both to support future releases of captive-bred birds to the wild and to provide a secure long term insurance population. Objective 3. To protect and enhance habitat to maintain, and support growth of, the wild population. Objective 4. To ensure effective adaptive implementation of the plan.	Climate Change	No explicit relevant management actions; climate change impacts recognised as a threat.
Grey Falcon	Conservation Advice *Falco hypoleucos* Grey Falcon (TSSC, 2020b)	• Vulnerable	No explicit relevant objectives	Climate Change	No explicit relevant management actions; climate change impacts recognised as a threat.
White-throated Needletail	Conservation Advice *Hirundapus caudacutus* White-throated Needletail (TSSC, 2019b)	• Vulnerable • Migratory • Marine	No explicit relevant objectives	NA	NA
Common Greenshank	Conservation Advice for *Tringa nebularia* (common greenshank) (DCCEEW, 2024f)	• Endangered • Migratory • Marine	Minimise further loss of habitat critical to the survival of common greenshank throughout Australia (including habitat predicted to become habitat critical to the survival of the species in the future because of climate change).	Habitat loss, degradation and fragmentation	Ensure that future development projects avoid any activities that disproportionately affect the upper-tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.
				Acute Pollution	No explicit relevant management actions; acute pollution recognised as a threat.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Black-tailed Godwit	Conservation Advice for *Limosa limosa* (black-tailed godwit). (DCCEEW, 2024g)	• Endangered • Migratory • Marine	Minimise further loss of habitat critical to the survival of common greenshank throughout Australia (including habitat predicted to become habitat critical to the survival of the species in the future because of climate change).	Habitat loss, degradation and fragmentation	Ensure that future development projects avoid any activities that disproportionately affect the upper-tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Acute Pollution	No explicit relevant management actions; acute recognised as a threat.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Latham's Snipe	Conservation Advice for *Gallinago hardwickii* (Latham's snipe) (DCCEEW, 2024h)	• Vulnerable • Migratory • Marine	Minimise further loss of habitat critical to the survival of common greenshank throughout Australia (including habitat predicted to become habitat critical to the survival of the species in the future because of climate change).	Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Ruddy Turnstone	Conservation Advice for *Arenaria interpres* (ruddy turnstone) (DCCEEW, 2024i)	• Vulnerable • Migratory • Marine	Minimise further loss of habitat critical to the survival of common greenshank throughout Australia (including habitat predicted to become habitat critical to the survival of the species in the future because of climate change).	Habitat loss, degradation and fragmentation	Ensure that future development projects avoid any activities that disproportionately affect the upper-tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.
				Acute Pollution	No explicit relevant management actions; acute recognised as a threat.
				Climate Change	No explicit relevant management actions; climate change recognised as a threat.
Blue-winged Parrot	Conservation Advice for *Neophema chrysostoma* (blue-winged parrot) (DCCEEW, 2023d)	• Vulnerable • Marine	No explicit relevant objectives	NA	NA
King Island Brown Thornbill	Conservation Advice for *Acanthiza pusilla magnirostris* (King Island brown thornbill) (DCCEEW, 2023e)	• Endangered	No explicit relevant objectives	NA	NA
	King Island Biodiversity Management Plan (DPIPWE, 2012)		No explicit relevant objectives	NA	NA
	Conservation Advice for *Acanthornis magna*		No explicit relevant objectives	NA	NA

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
King Island Scrubtit	*greeniana* (King Island scrubtit) (DCCEEW, 2023f)	• Critically Endangered			
	King Island Biodiversity Management Plan (DPIPWE, 2012)		No explicit relevant objectives	NA	NA
Regent Honeyeater	National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (DoE, 2016)	• Critically Endangered	No explicit relevant objectives	NA	NA
	Conservation Advice *Anthochaera phrygia* regent honeyeater (TSSC, 2015h)		No explicit relevant objectives	NA	NA
Southern Whiteface	Conservation Advice for *Aphelocephala leucopsis* (southern whiteface) (DCCEEW, 2023g)	• Vulnerable	No explicit relevant objectives	NA	NA
Tasmanian Wedge-tailed Eagle	Threatened Tasmanian Eagles Recovery Plan 2006-2010 (Threatened Species Section, 2006)	• Endangered	Minimising both the modification of foraging habitat and the occurrence of human-related mortality with the ultimate goal of an increase in the population size and stability	Pollution; specifically oiling	No explicit relevant management actions; oiling recognised as a threat.
Gang-gang Cockatoo	Conservation Advice for *Callocephalon fimbriatum* (Gang-gang Cockatoo) (DAWE, 2022)	• Endangered	No explicit relevant objectives	NA	NA
South-eastern Red-tailed Black-Cockatoo	National Recovery Plan for the South-Eastern Red-tailed Black-Cockatoo *Calyptorhynchus banksii graptogyne* (CoA, 2007)	• Endangered	No explicit relevant objectives	NA	NA

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
South-eastern Glossy Black-Cockatoo	Conservation Advice for *Calyptorhynchus lathami lathami* (South-eastern Glossy Black Cockatoo) (DCCEEW, 2022d)	• Vulnerable	No explicit relevant objectives	NA	NA
Tasmanian Azure Kingfisher	Conservation Advice for *Ceyx azureus diemenensis* (Tasmanian Azure Kingfisher) (DEWHA, 2010a)	• Endangered	No explicit relevant objectives	Habitat Loss, Disturbance and modification	Minimise disturbance to terrestrial and aquatic components of the Tasmanian Azure Kingfisher's habitat in areas where the subspecies occurs, including necessary actions to manage the conservation of the subspecies.
Brown Treecreeper (south-eastern)	Conservation Advice for *Climacteris picumnus victoriae* (brown treecreeper (south-eastern)) (DCCEEW, 2023o)	• Vulnerable	No explicit relevant objectives	NA	NA
Eastern Bristlebird	National Recovery Plan for Eastern Bristlebird *Dasyornis brachypterus* (CoA, 2022c)	• Endangered	No explicit relevant objectives	NA	NA
Painted Honeyeater	Conservation Advice *Grantiella picta* painted honeyeater (TSSC, 2015i)	• Vulnerable	No explicit relevant objectives	NA	NA
	National Recovery Plan for the Painted Honeyeater (*Grantiella picta*) (DAWE, 2021a)		No explicit relevant objectives	NA	NA
Malleefowl	National recovery plan for Malleefowl (*Leipoa ocellata*) (Benshmesh, 2007)	• Vulnerable	No explicit relevant objectives	NA	NA
South-eastern Hooded Robin	Conservation Advice for *Melanodryas cucullata*	• Endangered	No explicit relevant objectives	NA	NA

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
	cucullata (hooded robin (south-eastern)) (DCCEW, 2023i)				
Plains-wanderer	Conservation Advice *Pedionomus torguatus* (plains-wanderer) (TSSC, 2015j)	• Critically Endangered	No explicit relevant objectives	NA	NA
	National Recovery Plan for the Plains-wanderer (*Pedionomus torquatus*) (CoA, 2016)		No explicit relevant objectives	NA	NA
Night Parrot	Conservation Advice *Pezoporus occidentalis* night parrot (TSSC, 2016i)	• Endangered	No explicit relevant objectives	NA	NA
Green Rosella (King Island)	Conservation Advice *Platycercus caledonicus brownii* green rosella (King Island) (TSSC, 2015m)	• Vulnerable	No explicit relevant objectives	NA	NA
Pilotbird	Conservation Advice for *Pycnoptilus floccosus* (Pilotbird) (DAWE, 2022a)	• Vulnerable	No explicit relevant objectives	NA	NA
Diamond Firetail	Conservation Advice for *Stagonopleura guttata* (diamond firetail) (DCCEEW, 2023j)	• Vulnerable	No explicit relevant objectives	NA	NA
Black Currawong (King Island)	Conservation Advice *Strepera fuliginosa colei* black currawong (King Island) (TSSC, 2015n)	• Vulnerable	No explicit relevant objectives	NA	NA

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
Masked Owl (Tasmanian)	Conservation Advice for *Tyto novaehollandiae castanops* (Tasmanian Masked Owl) (DEWHA, 2010b)	• Vulnerable	No explicit relevant objectives	NA	NA
Marine Turtles					
All Marine Turtles	Recovery Plan for Marine Turtles in Australia, 2017 – 2027 (CoA, 2017)	Endangered: • Loggerhead turtle • Leatherback turtle • Vulnerable: • Green turtle • Flatback turtle • Hawksbill turtle	Long-term recovery objective: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: Anthropogenic threats are demonstrably minimised.	Chemical and Terrestrial Discharge	Minimise chemical and terrestrial discharge into marine turtle habitat.
				Marine debris	Reduce the impacts from marine debris: Support the implementation of the EPBC Act Threat Abatement Plan for the impacts of marine debris on vertebrate marine life.
				Noise interference	Assess and address anthropogenic noise: Understand the impacts of anthropogenic noise on marine turtle behaviour and biology.
				Light interference	Minimise light pollution: Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats. Develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches. Identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution.
				Vessel disturbance	Vessel interactions identified as a threat; no specific management actions in relation to vessels prescribed in the plan.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Habitat modification	Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical to the survival. Manage anthropogenic activities in Biologically Important Areas to ensure that biologically important behaviour can continue.
				Climate Change and variability	Adaptively manage turtle stocks to reduce risk and build resilience to climate change and variability: Continue to meet Australia's international commitments to address the causes of climate change. Identify, test and implement climate-based adaptation measures.
Leatherback Turtle	Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA, 2008)	• Endangered • Migratory • Marine	No explicit relevant objectives	Boat strike	No explicit relevant management actions; vessel strikes identified as a threat.
				Habitat degradation (changes to breeding sites and degradation to foraging areas)	Identify and protect migratory corridors between nesting beaches and common foraging areas to facilitate colonization.
				Marine debris	No explicit relevant management actions; marine debris identified as a threat.
Cetaceans					
Sei Whale	Approved Conservation Advice for *Balaenoptera borealis* (Sei Whale) (TSSC, 2015e)	• Vulnerable • Migratory	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program in Australian waters.	Vessel disturbance	Minimising vessel collisions: Develop a national vessel strike strategy that investigates the risk of vessel strikes on Sei Whales and also identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Vessel Strike Database.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Noise interference	Once the spatial and temporal distribution (including biologically important areas) of Sei Whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).
				Habitat degradation	No explicit relevant management actions; habitat degradation identified as a threat.
				Pollution (persistent toxic pollutants)	No explicit relevant management actions; pollution identified as a threat.
				Climate and Oceanographic Variability and Change	Understanding impacts of climate variability and change: Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica.
Fin Whale	Approved Conservation Advice for *Balaenoptera physalus* (Fin Whale) (TSSC, 2015f)	• Vulnerable • Migratory	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program in Australian waters.	Vessel disturbance	Develop a national vessel strike strategy that investigates the risk of vessel strikes on Fin Whales and identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Vessel Strike Database.
				Noise interference	Once the spatial and temporal distribution (including biologically important areas) of Fin Whales is further defined, assess the impacts of increasing anthropogenic noise (including seismic surveys, port expansion, and coastal development).
				Habitat degradation	No explicit relevant management actions; habitat degradation identified as a threat.
				Pollution (persistent toxic pollutants)	No explicit relevant management actions; pollution identified as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Climate and Oceanographic Variability and Change	Understanding impacts of climate variability and change: Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica
Blue Whale	Conservation Management Plan for the Blue Whale, 2015-2025 (DoE, 2015a)	• Endangered • Migratory	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the Blue Whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Noise interference	Assess and address anthropogenic noise: shipping, industrial and seismic noise.
				Vessel disturbance	Minimise vessel collisions: Develop a national vessel strike strategy that investigates the risk of vessel strike on blue whales and also identifies potential mitigation measures. Ensure all vessel strike incidents are reported in the National Ship Strike Database. Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.
				Habitat modification	No explicit relevant management actions; habitat modification identified as a threat.
				Climate Change	Understanding impacts of climate variability and change: Continue to meet Australia's international commitments to reduce greenhouse gas emissions and regulate the krill fishery in Antarctica.
				Marine Debris	No explicit relevant management actions; marine debris identified as a threat.
Southern Right Whale	National Recovery Plan for the Southern Right Whale	• Endangered • Migratory	Long term recovery objective: The population has increased in size to a level that the conservation status	Vessel interaction	Manage, minimise, and mitigate the threat of vessel strike:

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
	Eubalaena australis (DCCEEW, 2024l)		has improved, and the species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria. Interim Recovery Objective 2: Anthropogenic threats are managed consistent with ecologically sustainable development principles to facilitate recovery of southern right whales Target 2.1: Robust and adaptive management principles are implemented to reduce anthropogenic threats to southern right whales in Australian waters and minimise the risk of mortality, injury, auditory impairment, or disturbance to biologically important behaviours from anthropogenic activities. Target 2.2: Management decisions are supported by high quality information and scientific data, and high priority research areas identified in the Recovery Plan to deliver this information are supported through national and/or state funding programs and conservation planning.		1. Assess the risk of vessel strike to southern right whales in BIAs. 3. Ensure environmental impact assessments and associated plans consider and quantify the risk of vessel strike and associated potential cumulative risks in BIAs and habitat critical to the survival (HCTS) of the species. 5. Ensure all vessel strike incidents are reported in the National Ship Strike Database managed through the Australian Marine Mammal Centre, Australian Antarctic Division.
				Noise interference	Assess, manage, and mitigate impacts from anthropogenic noise: 2. Actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that it does not prevent any southern right whale from utilising the area or cause auditory impairment.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
					3. Actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that the risk of behavioural disturbance is minimised. 4. Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy (e.g., EPBC Act Policy Statement 2.1) and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to southern right whales to the lowest possible level 5. Quantify risks of anthropogenic underwater noise to southern right whales
				Habitat modification	Address habitat degradation impacts from coastal and offshore marine infrastructure developments: 1.Coastal and offshore development actions are assessed according to principles of ecological sustainable development to ensure the risk of injury, auditory impairment and/or disturbance to southern right whales is minimised. 2. Baseline surveys and monitoring undertaken during activity implementation are conducted in accordance with best practice standards and guidelines to ensure standardised datasets are obtained and suitable to inform environmental management decision making that can reduce the risk of threats to southern right whales. 3. Current information on species' occurrence, particularly in HCTS, BIAs, and historic high use areas, are used to

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
					inform planning, assessment, and decision-making on marine infrastructure development actions.
				Entanglement (marine debris)	No explicit relevant management actions; entanglement identified as a threat.
				Pollution	No explicit relevant management actions; pollution identified as a threat.
				Cumulative effects from threats	No explicit relevant management actions; cumulative effects identified as a threat.
				Climate Change	Understand impacts of climate variability and anthropogenic climate change on the species biology and population recovery: 1. Continue to meet Australia's international commitments to address causes of climate change, including greenhouse gas emissions.
Pinnipeds					
Australian Sea Lion	Conservation Advice for the *Neophoca cinerea* (Australian sea lion) (TSSC, 2020c)	• Endangered • Marine	Primary conservation actions: Mitigate the impacts of marine debris on Australian Sea Lions	Noise interference	Monitor and mitigate impacts (including cumulative impacts) of human interactions on Australian Sea Lion colonies. Control access to breeding colonies to minimise the impacts of disturbance on Australian Sea Lions.
				Marine debris	Assess the impacts of marine debris on Australian Sea Lion populations and identify the sources of marine debris which have an impact. Develop and implement measures to mitigate the impacts of marine debris on the species (including reducing the amount of these marine debris entering the oceans), noting linkages with the

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
					Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life.
				Disease and parasites	Improve human wastewater management to minimise dispersal of bacteria, parasites and pollutants into the marine environment.
				Habitat degradation and pollution (oil spills)	Require all vessels to have oil spill mitigation measures in place and implement jurisdictional oil spill response strategies as required.
				Climate Change	Review and adjust management measures to address the threats from disease/parasites and prey depletion, if it is demonstrated that increased temperatures compound these threats.
	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (CoA, 2013a)		The overarching objective of this recovery plan is to halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: Improving the population status leading to the future removal of the Australian sea lion from the threatened species list of the EPBC Act Ensuring that anthropogenic activities do not hinder recovery in the near future or impact on the conservation status of the species in the future.	Vessel strike	Collect data on direct killings and confirmed vessel strikes.
				Marine debris	Identify the sources of marine debris having an impact on Australian sea lion populations. Assess the impacts of marine debris on Australian sea lion populations. Develop and implement measures to mitigate the impacts of marine debris on Australian sea lion populations, noting the linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life.
				Pollution and oil spills	Implement jurisdictional oil spill response strategies as required.
				Habitat degradation	No explicit management actions; habitat degradation recognised as a threat.
				Disease	No explicit management actions; disease and pathogens recognised as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
				Climate Change	No explicit management actions; climate change recognised as a threat.
Southern Elephant Seal	Conservation Advice Mirounga leonina southern elephant seal (TSSC, 2016f)	• Vulnerable • Marine	Continue high levels of protection for the southern elephant seal in important breeding, foraging and haul-out sites. Assess the impacts of disturbance, pollution and associated risks of disease on the health status of southern elephant seals	Climate and oceanographic variability and change	Improve knowledge of climate and oceanographic variability, including El Niño events, that affect southern elephant seal foraging and reproductive success.
				Pollution (including marine debris)	Continue, and where necessary adapt, management actions to reduce disturbance and pollution/marine debris impacts on southern elephant seals and their important breeding, foraging and resting habitats
	Sub-Antarctic Fur-seal and Southern Elephant Seal Recovery Plan (Department of the Environment and Heritage (DEH), 2003)		To maintain existing levels of protection for the Sub-antarctic Fur and Southern Elephant seals to enable population growth so that these species may be removed from the threatened species list under the EPBC Act, and to ensure that any future anthropogenic impacts are not limiting.	None identified	NA
Threatened Ecological Communities					
Giant Kelp Marine Forests of Southeast Australia	Approved Conservation Advice for Giant Kelp Marine Forests of Southeast Australia (DSEWPaC, 2012b)	• Endangered	No explicit relevant objectives	Invasive species	No explicit management actions; invasive species recognised as a threat.
				Climate Change	No explicit management actions; climate change recognised as a threat.
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Approved Conservation Advice for the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community (DoE, 2015b)	• Critically Endangered	No explicit relevant objectives	None identified	NA

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
Subtropical and Temperate Coastal Saltmarsh	Conservation Advice for Subtropical and Temperate Coastal Saltmarsh (DSEWPaC, 2013c)	• Vulnerable	No explicit relevant objectives	Pollution (oil spills)	Identify Coastal Saltmarsh as important habitat in all oil spill contingency planning at national and State levels and monitor the application of protocols on the management of spills involving saltmarshes.
				Invasive Species	No explicit management actions; invasive species recognised as a threat.
				Climate Change	No explicit management actions; climate change recognised as a threat.
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria	Approved Conservation Advice (including Listing Advice) for the Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community (DoEE, 2018a)	• Endangered	The conservation objective is to mitigate the risk of extinction of the Salt-wedge Estuaries ecological community, assist recovery and maintain its biodiversity and function.	Land use and associated decline in water quality	Apply recommended buffers around the ecological community and avoid activities that could cause significant change to hydrology or water quality.
				Invasive species	No relevant management actions; invasive species recognised as a threat.
				Extractive and recreational activities	No explicit management actions; Extractive and recreational activities recognised as a threat.
				Climate Change	Enhance the resilience of the ecological community to the impacts of climate change by reducing other pressures.
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Conservation Advice for the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria (DAWE, 2020a)	• Critically Endangered	To mitigate the risk of extinction of the River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria.	Climate change	No explicit management actions; climate change recognised as a threat.
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and	Conservation advice (incorporating listing advice) for the Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and	• Endangered	To mitigate the risk of extinction of Coastal Swamp Oak Forest, and help recover its biodiversity and function	Climate Change	No explicit management actions; climate change recognised as a threat.

Species	Plan/ Advice	Protection under EPBC Act	Relevant objectives	Threats identified relevant to the activity	Relevant conservation actions
South East Queensland	South East Queensland ecological community (DoEE, 2018b)				
Other relevant species					
Vertebrate Species	The Threat Abatement Plan for the impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Ocean (CoA, 2018)	N/A	There are four main objectives: Contribute to the long-term prevention of the incidence of harmful marine debris Remove existing harmful marine debris from the marine environment Mitigate the impacts of harmful marine debris on marine species and ecological communities Monitor the quantities, origins and impacts of marine debris and assess the effectiveness of management arrangements over time for the strategic reduction of debris.	Marine debris	No explicit management actions for non-fisheries related industries (note that management actions in the plan relate largely to management of fishing waste (for example 'ghost' gear), and State and Commonwealth management through regulation.

Table 2-4: Guidance on 'Key Terms' within the Blue Whale Conservation Management Plan (CMP) and how it is applied in this OPP

Relevant Plan/Advice	Description
Recovery Plans	The CMP for the Blue Whale (DoE, 2015b) has been treated as a recovery plan (under the EPBC Act) throughout the EP.
Recovery Plan actions	Actions identified in the CMP for the Blue Whales (DoE, 2015b) have been considered in the assessment of impacts and determination of acceptability of potential impacts to blue whale within this OPP.
Biologically Important Areas (BIAs)	BIAs for blue whale, CMP for the Blue Whale (DoE, 2015b), are described in this OPP
Legal requirement - Action A.2.3. from the Blue Whale CMP: "*Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury, and is not displaced from a foraging area*".	Action A.2.3 and the DAWE key terms (September 2021) have informed the assessment of acceptability of underwater sound emissions, described in this OPP. In the assessment of underwater sound emissions, Cooper Energy has taken a conservative approach. This is presented through the application of conservative impact thresholds for potential disturbance and injury.

Relevant Plan/Advice	Description
Further, the DAWE key terms state: '*The recovery plan requirement, Action A.2.3, applies in relation to BIAs. A whale could be displaced from a Foraging Area if impact mitigation is not implemented. This means that underwater anthropogenic noise should not: stop or prevent any blue whale from foraging cause any blue whale to move on when foraging stop or prevent any blue whale from entering a Foraging Area. It is considered that a whale is displaced from a Foraging Area if foraging behaviour is disrupted, regardless of whether the whale can continue to forage elsewhere within that Foraging Area. Mitigation measures must be implemented to* ***reduce the risk*** *of displacement occurring during operations where modelling indicates that behavioural disturbance within a Foraging Area may occur*'.	Adaptive management approaches will be designed into the work programs, suitable to the nature and scale of each individual activity, such that the risk of injury and displacement are reduced so that the foraging behaviour of any blue whale should not be impacted. Cooper Energy understands the typical seasonal presence of species in the Otway and the duration of activities (which could cause behavioural disturbance) and has considered temporal restrictions to activities to eliminate the risk of behavioural disturbance; this would go beyond the requirement under the CMP Key terms to apply mitigation to ***reduce the risk***. Temporal restrictions are unlikely to be manageable; schedule flexibility is necessary to allow for external factors outside of Cooper Energy's control. If temporal restrictions were to be applied consistently for the purpose of eliminating the risk of disturbance due to vessel noise within blue whale foraging areas, it would prevent the use of vessels for a range of offshore activities for large periods of the year across the entire south-eastern bioregion, with significant impacts to shipping, fishing, existing and transitional offshore projects.
Definition of 'a foraging area'	The activity operational area is located within a foraging BIA. Blue whale foraging is considered throughout the assessment of potential impacts and risks to blue whales. Timeframes when blue whale foraging is more likely to occur has been defined based on contemporary literature.
Definition of 'displaced from a foraging area'	The definition of 'displacement from a foraging area' has been adopted throughout the assessment of underwater sound emissions in this OPP
Definition of 'injury to Blue Whale'	Injury has been defined as permanent threshold shift (PTS) and temporary threshold shift (TTS) throughout the assessment of underwater sound emissions in this OPP

2.1.3 Additional Relevant Commonwealth Legislation

In addition to the OPGGS and EPBC Acts there are other Commonwealth legislation (Table 2-5) as well as policies and guidelines (Table 2-6) which are relevant to the East Coast Project.

Table 2-5: Relevant Commonwealth Legislation

Legislation / Regulation	Scope	Application to Activity	Administering Authority
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (ATSIHP Act) is Commonwealth legislation that can be used by Aboriginal and Torres Strait Islander people to make applications to protect places and objects from injury or desecration. The places or objects in question must be of particular significance in accordance with Aboriginal tradition.	Areas or objects protected under this Act may be present within the operational area and EMBA.	DCCEEW
Air Navigation Act 1920	This Act is responsible for managing navigation within the avian environment.	Helicopter and other aircraft activities occurring throughout all phases of the project are required to abide to the requirements of this Act.	Department of Infrastructure, Transport, Regional Development and Communications (DITRDC)
Australian Heritage Council Act 2003	This Act was formed to establish the Australian Heritage Council and associated functions. The act also classifies areas that have heritage value, including those identified on the Commonwealth Heritage List, World Heritage List and National Heritage List.	The Act applies to any activities that may occur within an area that may have associated heritage values.	DCCEEW
Australian Maritime Safety Authority Act 1990	The main objects of this Act are: • to promote maritime safety; and • to protect the marine environment from: ○ pollution from ships; and ○ other environmental damage caused by shipping; and • to provide for a national search and rescue service; and to promote the efficient provision of services by the Authority. In Commonwealth waters AMSA is the Statutory Agency for vessels and must be notified of all incidents involving a vessel. In Commonwealth waters AMSA is the Control Agency for all ship-sourced marine pollution	The Act is applicable to all incidents that may occur within Commonwealth waters during the East Coast Project which require AMSA to lead or support the response to pollution in the marine environment.	AMSA

Legislation / Regulation	Scope	Application to Activity	Administering Authority
	incidents and will respond in accordance with the National Plan for Maritime Environmental Emergencies. Under the National Plan AMSA support oil spill response for non-ship sourced pollution incidents on the formal request of the respective incident controller.		
Australian Radiation Protection and Nuclear Safety Act 1998	This Act aims to protect the health and safety of people and the environment from radiation effects.	The use of radioactive material (e.g. during formation evaluation) must comply with the Act.	Department of Health and Aged Care (DoHAC)
Biosecurity Act 2015 (& Regulations 2016)	The objects of this Act are: (a) to provide for managing the following: (i) biosecurity risks; (ii) the risk of contagion of a listed human disease; (iii) the risk of listed human diseases entering Australian territory or a part of Australian territory, or emerging, establishing themselves or spreading in Australian territory or a part of Australian territory; (iv) risks related to ballast water; (v) biosecurity emergencies and human biosecurity emergencies; (b) to give effect to Australia's international rights and obligations, including under the International Health Regulations, the Sanitary and Phytosanitary Agreement and the Biodiversity Convention.	The Biosecurity Act and regulations apply to 'Australian territory' which is the airspace over and the coastal seas out to 12 nm from the coastline. Provides regulations for the vessels used during the East Coast Project regarding ballast water and biofouling.	Department of Agriculture, Fisheries and Forestry (DAFF)
Climate Change Act 2022 (Cwth)	This Act sets out Australia's greenhouse gas emissions reduction targets. As the Nationally Determined Contribution (NDC) are at the heart of the Paris Agreement, NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. Australia's emissions reduction targets include: • Reduce greenhouse gas emissions to 43% below 2005 levels by 2030. • Reach net zero by 2050	Activities within this OPP will be conducted in a manner consistent with Australia's GHG emission reduction targets.	Commonwealth Government
Climate Change Act 2017 (Vic)	Victoria was one of the first jurisdictions in the world to legislate a net zero emissions target with the implementation of	Provides Victoria with the legislative foundation to manage climate change risks, maximise opportunities that arise from decisive action, and drive the	Victoria Government

Legislation / Regulation	Scope	Application to Activity	Administering Authority
	the Climate Change Act 2017 (Vic).	transition to a climate-resilient community and economy with net-zero emissions by 2050.	
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) *(and Regulations 2000)*	The Act aims to: Protect matters of national environmental significance (MNES); Provides for Commonwealth environmental assessment and approval processes; and Provides an integrated system for biodiversity conservation and management of protected areas. MNES are: • World heritage properties; • RAMSAR wetlands; • Listed threatened species and communities; • Migratory species under international agreements; • Nuclear actions, • Commonwealth marine environment; • Great Barrier Reef Marine Park; and • Water trigger for coal seam gas and coal mining developments. For offshore petroleum activities, the assessment process is overseen by NOPSEMA as the delegated authority under the EPBC Act.	Petroleum activities are excluded from within the boundaries of a World Heritage Area (Sub regulation 10A(f). The activity is not within a World Heritage Area. The OPP must describe matters protected under Part 3 of the EPBC Act and assess any impacts and risks to these. Section 6 describes matters protected under Part 3 of the EPBC Act. The OPP must assess any actual or potential impacts or risks to MNES from the activity. Part 8 of the regulations establish caution zones and actions to avoid interfering with cetaceans.	DCCEEW
Environment Protection (Sea Dumping) Act 1981	Aims to prevent the deliberate disposal of wastes (loading, dumping, and incineration) at sea from vessels, aircraft, and platforms.	May be triggered in the event equipment remains on the seabed following decommissioning during the East Coast Project. This is not the base case for planning purposes.	DCCEEW
Hazardous Waste (Regulation of Exports and Imports) Act 1989	To ensure the management of Australia's hazardous waste is exported, imported and transited in and environmentally sound manner.	The Basel Convention is implemented in Australia by the Act.	DCCEEW
Industrial Chemicals (Notification and Assessment Act) 1989	This Act enforces restrictions on using particular chemicals that may have detrimental and harmful effects on health and the environment and creates a national register if chemicals used in the industry.	Where relevant, chemicals used during the project will be considered under the requirements of this Act prior to use.	DoHAC
National Greenhouse and Energy Reporting Act 2007 (NGER Act) *(and NGER Regulations 2008)*	A national framework for reporting and disseminating company information about greenhouse gas emissions, energy production and energy	Activities associated with the project will result in the generation of atmospheric emissions and greenhouse gases. Requirements of the Act must be adhered to including energy and greenhouse	The Clean Energy Regulator

Legislation / Regulation	Scope	Application to Activity	Administering Authority
	consumption. It is administered by the Clean Energy Regulator.	gas reporting. Cooper Energy will report information in accordance with the Regulations.	
National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cwth)	Key statutory instruments for regulating Australia's GHG emissions in line with Australia's NDCs under the Paris Agreement	The Safeguard Mechanism was developed to ensure that Australia's largest GHG emitters keep their net emissions below an emission baseline. The Safeguard Mechanism currently applies to facilities that emit more than 100,000 tCO_2-e per annum which may be the case of East Coast Project for some years.	Commonwealth Government
Navigation Act 2012	Regulates international ship and seafarer safety, shipping aspects of protecting the marine environment and the actions of seafarers in Australian waters including: • vessel survey and certification • construction standards • crewing • seafarers' qualifications and welfare • occupational health and safety • carriage and handling of cargoes • passengers • marine pollution prevention • monitoring and enforcement activities. It gives effect to the relevant international conventions (MARPOL 73/78, COLREGS 1972) relating to maritime issues to which Australia is a signatory. The Act also has subordinate legislation contained in Regulations and Marine Orders.	All ships involved in petroleum activities, such as the East Coast Project, in Australian waters are required to abide to the requirements under this Act. Several Marine Orders (MO) are enacted under this Act which relate to offshore petroleum activities, including: MO 21: Safety and emergency arrangements MO 27: Safety of navigation and radio equipment MO 28: Operations standards and procedures MO 30: Prevention of collisions MO 31: SOLAS and non-SOLAS certification MO 47: Offshore industry units MO 60: Offshore floating facilities MO 71: Masters and deck officers	AMSA
Offshore Petroleum and Greenhouse Gas Storage (OPGGS) Act 2006 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations (OPGGS(E)R 2023	The Act addresses all licensing, health, safety, environmental and royalty issues for offshore petroleum exploration and development operations extending beyond the three-nautical mile limit. Part 4 of the OPGGS(E)regulations specifies that an EP must be prepared for any petroleum activity and that activities are undertaken in an ecologically sustainable manner and in accordance with an accepted EP. Requirements and regulations are described in Section 2.1.1.	The OPGGS Act provides the regulatory framework for all offshore petroleum exploration and production activities in Commonwealth waters, to ensure that these activities are carried out: • Consistent with the principles of ecologically sustainable development as set out in section 3A of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). • So that environmental impacts and risks of the activity are reduced to ALARP.	NOPSEMA

Legislation / Regulation	Scope	Application to Activity	Administering Authority
		• So that environmental impacts and risks of the activity are of an acceptable level.	
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	This aims to control and reduce the manufacturing, import and export of substances that deplete the ozone layer and synthetic greenhouse gases.	This Act will apply to Cooper Energy as the company manufactures, imports or exports these kinds of substances.	DCCEEW
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	The Act aims to protect the marine environment from pollution by oil and other harmful substances discharged from ships in Australian waters. It also invokes certain requirements of the MARPOL Convention such as those relating to discharge of noxious liquid substances, sewage, garbage and air pollution. Requires ships greater than 400 gross tonnes to have pollution emergency plans in place and provides for emergency discharges from ships. The Act requires an approved Shipboard Oil Pollution Emergency Plan (SOPEP) and/or Shipboard Marine Pollution Emergency Plan (or equivalent, according to class) that describes emergency response activities.	All ships involved in the East Coast Project are required to abide to the requirements under this Act. Several MOs are enacted under this Act relating to offshore petroleum activities, including: MO Part 91: Marine Pollution Prevention – Oil MO Part 93: Marine Pollution Prevention – Noxious Liquid Substances MO Part 94: Marine Pollution Prevention – Packaged Harmful Substances in Packaged Forms MO Part 95: Marine Pollution Prevention – Garbage MO Part 96: Marine Pollution Prevention – Sewage MO Part 97: Marine Pollution Prevention – Air Pollution MO Part 98: Marine Pollution Prevention – Anti-fouling Systems.	AMSA
Protection of the Sea (Harmful Antifouling Systems) Act 2006	The Act aims to protect the marine environment from the effects of harmful anti-fouling systems. Under this Act, it is an offence to engage in negligent conduct that results in a harmful anti-fouling compound being applied to a ship. This Act also requires that Australian ships must hold 'anti-fouling certificates', provided they meet certain criteria.	All ships involved in offshore petroleum activities in Australian waters are required to abide to the requirements under this Act. The Marine Order MO 98: Marine Pollution Prevention – Anti-fouling Systems is enacted under this Act.	AMSA
Radiation Act 2005 (Vic)	The purpose of this Act is to protect the health and safety of persons and the environment from the harmful effects of radiation	Handling of radioactive material (i.e., NORMS) received onshore or encountered through intervention activities or decommissioning will be consistent with the Act.	Department of Health (DoH)
Underwater Cultural Heritage Act 2018	Protects remains of vessels and aircraft (including Aboriginal and Torres Strait Islander traditional watercraft) that have been wholly or partially submerged in Australian waters for 75 years or longer. Other types of	Cooper Energy is responsible for meeting protection requirements of the Act, including: • No adverse impact to UCH without a permit; • Notify the discovery of all suspected UCH exposed	DCCEEW

Legislation / Regulation	Scope	Application to Activity	Administering Authority
	underwater cultural heritage (UCH), including First Nations archaeological heritage associated with dry-land habitation on the submerged Pleistocene landscapes on the Australian continental shelf and remains of shipwrecks or aircraft younger than 75 years, can also be declared by the Minister upon discovery (NOPSEMA, 2024d).	through the proposed action within 21 days of discovery. • Adhere to requirements of Protected Zones and obtain a permit to enter a Protected Zone should entry into a Protected Zone be required. An adequate process of UCH assessment, impact mitigation and management is to be undertaken ahead of (and in certain cases concurrent with and/or following) proposed actions (DCCEEW, 2024n).	

2.1.4 Additional Relevant Commonwealth Policy

This OPP has been developed in accordance with the NOPSEMA Offshore project proposal content requirements Guidance Note (N-04790-GN1663, September 2020).

Table 2-6 summarises other relevant government guidelines that have been incorporated into the preparation of this OPP.

Table 2-6: Relevant Commonwealth Policies and Guidelines

Policy/Guideline	Scope	Application to Activity	Administering Authority
Offshore project proposal content requirements Guidance Note (NOPSEMA, 2020a)	Reflects NOPSEMA's interpretation of the content requirements of the OPGGS(E)R to support proponents in the preparation of OPPs.	This OPP has been developed to meet the requirements described.	NOPSEMA
Nature Positive Plan: better for the environment, better for business (DCCEEW, 2022)	Sets out the government's commitment to reform Australia's environmental laws to better protect, restore and manage our unique environment. Builds on the recommendations of the Independent Review of the EPBC Act and considers the findings from the 2021 State of the Environment Report.	The Australian Government will introduce legislation to give effect to this response in 2023, and which is anticipated to apply to future activities described within this OPP.	DCCEEW
Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG, 2018)	Aims to achieve the sustainable use of water resources by protecting and enhancing their quality while maintaining economic and social development.	Provides guideline values on ambient water quality and monitoring assessment which will be used during the East Coast Project.	DCCEEW
Future Gas Strategy May 2024 (DISR, 2024)	Considers the future role of natural gas in Australia's energy mix and the transition to net zero. Considers the decarbonisation of the production of natural gas. Establishes the Commonwealth Government	The development of the East Coast Project is consistent with the approach outlined in the Future Gas Strategy.	DISR

Policy/Guideline	Scope	Application to Activity	Administering Authority
	policy driver for continued investment in natural gas development.		
Australian Offshore Petroleum Development Policy (DISR, n.d)	Encourages the ongoing investment in, and the development of, Australia's offshore petroleum (oil and gas) resources.	Cooper Energy has an obligation to explore and develop petroleum reserves within the held title	DISR
Acoustic impact evaluation and management (NOPSEMA, 2020c)	Provides advice to titleholders to assist with preparing EPs for marine seismic survey activities, and in particular the components of an EP that relate to detailing, evaluating and managing impacts from acoustic emissions.	Advice regarding noise modelling and impact assessment.	NOPSEMA
Australian Ballast Water Management Requirements Version 8 (CoA, 2020)	The Australian Ballast Water Management Requirements set out the obligations on vessel operators with regards to the management of ballast water and ballast tank sediment when operating within Australian seas.	Provides requirements on how vessel operators should manage ballast water during the East Coast Project to comply with the Biosecurity Act.	DAFF
Australian Biofouling Management Requirements (DAFF, 2022)	The Australian biofouling management requirements set out obligations of operators of international commercial vessels for the management of biofouling when operating vessels under biosecurity control within Australian territorial seas.	Provides requirements on how operators of international commercial vessels should manage biofouling during the East Coast Project to comply with the Biosecurity Act.	DAFF
Underwater Cultural Heritage Guidance for Offshore Developments (DCCEEW, 2019)	Provides guidance on how proponents should consider the Underwater Heritage Act when applying for any State, Territory or Commonwealth planning approval for actions or developments in all coastal and offshore waters.	Guidance for the evaluation of seabed disturbance and accidental releases of hydrocarbons.	DCCEEW
The Guidelines on the application of the *Underwater Cultural Heritage Act 2018* (DCCEEW, 2024n)	Provides guidance to proponents to meet the requirements of the Australian *Underwater Cultural Heritage Act 2018.*	The Guidelines on the application of the *Underwater Cultural Heritage Act 2018* (DCCEEW, 2024n) state that 'All actions involving seabed contact, and most actions undertaken in proximity to the seabed, have potential to cause adverse impact to UCH'. Requirements include: • No adverse impact to UCH without a permit; • Notify the discovery of all suspected UCH exposed through the proposed action within	DCCEEW

Policy/Guideline	Scope	Application to Activity	Administering Authority
		21 days of discovery, and • Adhere to requirements of Protected Zones and obtain a permit to enter a Protected Zone should entry into a Protected Zone be required. An adequate process of UCH assessment, impact mitigation and management is to be undertaken ahead of (and in certain cases concurrent with and/or following) proposed actions (DCCEEW, 2024n).	
Marine Pest Plan 2018 – 2023: National Strategic Plan for Marine Pest Biosecurity (DAWR, 2018)	Australia's national strategic plan for marine pest biosecurity. It outlines a coordinated approach to building Australia's capabilities to manage the threat of marine pests over the next five years. It represents agreed priorities and actions of governments, marine industries, and other stakeholders to achieve a common purpose: to manage the risks posed by marine pests and minimise their potential harm to marine industries, communities and the environment.	Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species.	DAFF
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (CoA, 2009)	The guidance document provides recommendations for the management of biofouling hazards by the petroleum industry.	Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species.	DAFF
Antifouling and In-water Cleaning Guidelines (CoA, 2015)	Describes best practice approaches to applying, maintaining, removing and disposing of anti-fouling coatings and managing biofouling and invasive aquatic species on vessels and movable structures in Australia and New Zealand.	Guidance for evaluation of contamination and biosecurity risk of in-water cleaning; and for in-water cleaning, including suitable coatings, coating service life, methods to ensure minimal release of biological material into the water, and appropriate disposal of collected cleaning debris.	DAFF
National biofouling management guidelines for commercial vessels (CoA, 2009b)	A voluntary biofouling management guidance document which has been developed to assist industry manage biofouling risk for	Guidance for evaluation of biofouling risk of types of vessels; and on biofouling. Used as guidance for Cooper Energy's Invasive	DAFF

Policy/Guideline	Scope	Application to Activity	Administering Authority
	commercial vessels (e.g., construction vessels).	Marine Species Risk Management Process	
Reducing marine pest biosecurity risks through good practice biofouling management Information Paper (NOPSEMA, 2020d)	Clarifies biosecurity requirements relevant to offshore activities. Supports the industry's contribution to marine pest risk management consistent with Australia's Marine Pest Plan 2018-2023.	Provides guidance that is consistent with the expectations of all jurisdictions responsible for regulating biofouling management within the Australian marine environment. Used as guidance for Cooper Energy's Invasive Marine Species Risk Management Process	DAFF
National Light Pollution Guidelines for Wildlife (DCCEEW, 2023k)	The Guidelines outline the process to be followed where there is the potential for artificial lighting to affect wildlife. Applying the recommendations within this document and implementing effective controls can reduce the impact of light to sensitive receptors.	The recommendations within this document have been used to identify effective control measures that will be implemented reduce the potential impacts of light emissions from the East Coast Project.	DCCEEW
National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2017a)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna.	The recommendations within this document have been used to ensure effective controls are implemented to reduce the risk of the vessel collisions with megafauna.	DCCEEW
EPBC Policy Statement 2.1 Interaction between offshore seismic exploration and whales (DEWHA, 2008)	Provides practical standards to minimise the risk of acoustic injury to whales in the vicinity of seismic survey operations and provides a framework that minimises the risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important habitat areas or during critical behaviours.	Provides a framework for minimising acoustic disturbances to whales from seismic activities.	DCCEEW
EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (CoA, 2017)	The purpose of this policy statement is to assist proponents in avoiding, assessing and mitigating significant impacts on migratory shorebirds listed under the EPBC Act. This policy statement is a key action under the Wildlife Conservation Plan for Migratory Shorebirds (CoA, 2015b)	Provides guidance for identifying important habitat and significant impacts to migratory shorebirds or their habitat.	DCCEEW
Marine Bioregional Plans (DCCEEW, 2021e)	Designed to improve decisions made under the EPBC Act, particularly in relation to the protection of marine biodiversity and the sustainable use of our oceans and their	The plans provide information on the Australian Government's marine environment protection and biodiversity conservation	DCCEEW

Policy/Guideline	Scope	Application to Activity	Administering Authority
	resources by our marine-based industries.	responsibilities, objectives and priorities in the four marine regions.	
Matters of National Environmental Significance – Significant Impact Guidelines 1.1 (CoA, 2013b)	Provides overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under national environment law — the EPBC Act.	Impacts and risks of the petroleum activity can be demonstrated to be at an acceptable level if they do not result in a 'significant impact' as described in the Matters of National Environmental Significance – Significant Impact Guidelines.	DCCEEW
Guideline for minimizing greenhouse gas emissions (EPA Victoria, 2022).	Explains how the factor Greenhouse Gas Emissions is considered by the Environmental Protection Authority (EPA) in the environmental impact assessment (EIA) process.	Although the East Coast Project is within Commonwealth waters, the guideline has been used in evaluation of greenhouse gas emissions for potential emissions within State jurisdiction.	Environment Protection Authority Victoria (EPA Victoria)
NGER (Measurement) Determination 2008 (as amended 2019); API Compendium of GHG Emissions Methodologies (API, 2009)	Provide methods, criteria and measurement standards for calculating greenhouse gas emissions and energy data under the National Greenhouse and Energy Reporting Act 2007 (NGER Act).	Used for reporting related information to the GHG emissions estimates for the East Coast Project.	Clean Energy Regulator
National Environment Protection (National Pollutant Inventory) Measure (NPI NEPM) 1998 (CoA, 1998)	The national environment protection goals established by this measure are to: • collect a broad base of information on emissions and transfers of substances on the reporting list, and • disseminate the information collected to all sectors of the community in a useful, accessible and understandable form.	Reporting of atmospheric pollutants will occur under NPI NEPM if required to do so.	DCCEEW
Offshore Petroleum Decommissioning Guideline (DISR, 2022)	Clarifies the application, operation and interaction between components of the Commonwealth regime for decommissioning offshore petroleum infrastructure in Commonwealth waters under the OPGGS Act, associated regulations and, where applicable, other Commonwealth laws.	Complete removal of infrastructure and the plugging and abandonment of wells is the default decommissioning requirement. Options other than complete removal may be considered, however the alternative decommissioning approach must deliver equal or better environmental, safety and well integrity outcomes compared to complete removal.	DISR
Planning for proactive decommissioning Information Paper (NOPSEMA, 2021)	Encourages titleholders to begin planning for decommissioning at the earliest stage of project development.	Provides information on the level of detail required in an OPP.	NOPSEMA

Policy/Guideline	Scope	Application to Activity	Administering Authority
Maintenance and removal of property Policy (Section 572) (NOPSEMA, 2020b)	Sets out NOPSEMA's compliance and enforcement of section 572 of the OPGGS Act which requires titleholders to: • Maintain all structures, equipment and property within the title area and ensure they are in good condition and repair • Remove all structures, equipment, and property when it is neither used nor to be used in connection with operations authorised by the title.	Guidance for ongoing maintenance of property and decommissioning of property at end of development life.	NOPSEMA
Consent to surrender Title (Section 270) (NOPSEMA, 2022)	Sets out NOPSEMA's compliance of Section 270 of the OPGGS Act which requires titleholders have: • removed all property brought into the area or have made arrangements that are satisfactory to NOPSEMA • plugged or closed off all wells • provided for the conservation and protection of the natural resources in the area • restored any damage to the seabed or subsoil in the area	Assist titleholders in understanding the requirements that must be met for the Joint Authority to consent to the surrender a title.	NOPSEMA

2.2 International Agreements

The United Nations Convention on the Law of the Sea 1982 (UNCLOS) is the principle international agreement which governs petroleum operations in Commonwealth waters. Additionally, Australia is a signatory to several international conventions with relevance to the development which are detail in Table 2-7 below.

Table 2-7: Relevant International Agreements and Initiatives

Agreement/Convention	Scope	Application to Activity
International Convention for the Prevention of Pollution from ships, London, 1973/1978 (commonly known as MARPOL 73/78	Provides advice on the prevention and minimisation of accidental pollution and pollution that results from routine operations.	Guidance on the prevention of all potential and planned marine pollution associated with the OPP. The *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and subsidiary Marine Orders give effect to MARPOL 73/78 (described in Table 2-5).
International Convention of Civil Liability for Oil Pollution Damage, 1969 and 1992 (CLC 69; CLC 92)	Ensures that in the case of oil pollution damage that results from maritime casualties involving oil-carrying ships	Provides insight into the ship's liability in the case of a maritime casualty.

Agreement/Convention	Scope	Application to Activity
	that there is adequate compensation made for those affected.	The *Australian Maritime Safety Authority Act 1990* gives effect to this convention.
Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS)	Designed to create consistent guidelines for vessels operating in the sea and the responsibilities of their staff. Includes the risk of collision, a safe speed of travel and traffic separation schemes in areas of high traffic.	Provides instruction on the rules of operating vessels at sea in order to ensure safe travel. The *Navigation Act 2012* and subsidiary Marine Orders give effect to the regulations (described in Table 2-5)
Convention for the Safety of Life at Sea 1974 (SOLAS)	This convention provides internationally agreed minimum standards for the construction, equipment and operation of vessels. It is implemented in Commonwealth law by the *Navigation Act 2012* and a series of Marine Orders made under this Act (described in Table 2-5).	Provides requirements that all vessels operating within Australian waters must comply with. The *Australian Maritime Safety Authority Act 1990* gives effect to this convention.
Convention on the International Maritime Organisation 1948	Designed to promote efficient and sustainable shipping through international cooperation that focuses on safe, secure, environmentally sound practices.	Advice on how to efficiently and sustainably travel overseas in relation to navigation, maritime safety and marine pollution. The *Australian Maritime Safety Authority Act 1990* gives effect to this convention.
London Protocol and Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1996	Adopted to protect the marine environment from human activities and promote the effective control of all marine pollution.	Guidance on the prevention of marine pollution and the disposal of waste from applicable activities under this OPP. Chemical inventories onboard vessels and MODUs may potentially breach this convention if unpermitted via this OPP and deliberately discharged to the sea. The Environment *Protection (Sea Dumping) Act 1981* gives effect to the London Convention.
International Convention on Harmful Anti Fouling Systems 2001 (AFS Convention)	Designed to protect the marine environment from harmful anti-fouling systems used on ships by either prohibiting or restricting their use.	Guidance for evaluation of a vessels condition and the process of applying, maintaining, removing and disposing of anti-fouling coatings as required. The *Protection of the Sea (Harmful Anti-fouling Systems) Act 2006* and subsidiary Marine Order give effect to the Convention (described in Table 2-5).
International Convention on the Control and Management of Ship's Ballast Water and Sediment (Ballast Water Management Convention)	Adopted with aims to prevent the international spread of non-native marine species by creating standards and procedures for the regulation and control of ships ballast water and sediments.	Guidance for ballast water management to reduce the risk of transfer of IMS. The *Biosecurity Act 2015* gives effect to the Convention.
International Maritime Organization (IMO) Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic	Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species	Specific requirements that vessels have a biofouling management plan and a biofouling record book.

Agreement/Convention	Scope	Application to Activity
Species (Biofouling Guidelines)		
International Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989 (Basel Convention)	Regulates the transboundary movements of hazardous waste to ensure that they are managed and disposed of in an environmentally safe manner. There is expectation that parties will also minimise the waste created and transported.	Provides instruction on the appropriate handling, export and disposal of hazardous waste. The *Hazardous Waste (Regulation of Exports and Imports) Act 1989* gives effect to the convention.
Kyoto Protocol 1997	Designed to have industrialised countries commit to implementing policies and measures that reduce and limit their greenhouse gas emissions.	Advice on the impacts and risks associated with greenhouse gases and is used in evaluation of greenhouse gas emissions. The *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* and *Climate Change Act 2022* (Cwth) gives effect to the Protocol.
Paris Agreement 2016 under the United Nations Framework Convention on Climate Change	Objective is to limit the global temperature rise to 2 degrees while attempting to limit it even further to 1.5degrees in comparison to pre-industrial levels. Provides financial assistance to developing countries which will help them mitigate and adapt to the impacts of climate change.	Advice for the evaluation of risks and impacts associated with the activity in regard to climate change. The Australian Government is committed to developing legislation to implement the commitments made in the Paris Agreement. The *Climate Change Act 2022* (Cwth*)* gives effect to the Agreement.
UN 2030 Agenda for Sustainable Development (2030 Agenda)	Created 17 sustainable development goals that protect the planet and improve quality of life globally.	Informs acceptability evaluation for potential impacts which extend outside of Australia's jurisdiction.
United Nations Framework Convention on Climate Change 1992	Objective is to stabilise global greenhouse gas concentrations at a level that allows ecosystems to adapt naturally to a changing climate.	Advice on the impacts and risks associated with greenhouse gases, and evaluation of greenhouse gas emissions. The *Ozone Protection and synthetic Greenhouse Gas Management Act 1989* and *Climate Change Act 2022* (Cwth) gives effect to the Agreement.
Montreal Protocol on Substances that Deplete the Ozone Layer 1987	Designed to protect the ozone layer by phasing out the production and consumption of ozone depleting substances.	Guidance on the impacts and risks associated with ozone depleting substances and evaluation of greenhouse gas emissions. The *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* gives effect to the protocol.
International Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention)	An environmental treaty that utilises international coordination in the advocacy of conservation and sustainable use of migratory species, their habitats and migration routes.	Guidance on the conservation responsibilities regarding migratory species. The EPBC Act gives effect to the Bonn Convention through listing species as migratory under Part 3 of the Act.

Agreement/Convention	Scope	Application to Activity
Agreement on the Conservation of Albatrosses and Petrels (ACAP)	Multilateral agreement that coordinates international activities with a purpose to conserve albatross and petrel species and mitigate threats to these populations.	Advice on the conservation responsibilities regarding albatross and petrel species. The EPBC Act gives effect to ACAP by listing migratory albatross and petrel species conservation status under the EPBC Act.
China Australia Migratory Birds Agreement (CAMBA)	Bilateral agreement between China and Australia to provide protection and conservation of migratory birds that use the East Asian – Australasian Flyway and their important habitats.	Advice on the conservation responsibilities regarding bird species that may use the development as a migratory flyway between China and Australia. The EPBC Act gives effect to CAMBA by listing migratory birds recognised by the agreement as migratory under the EPBC Act.
Japan Australia Migratory Birds Agreement (JAMBA)	Bilateral agreement between Japan and Australia to provide protection and conservation of migratory birds that use the East Asian – Australasian Flyway and their important habitats.	Guidance on the conservation responsibilities regarding bird species that may use the development as a migratory flyway between Japan and Australia. The EPBC Act gives effect to JAMBA by listing migratory birds recognised by the agreement as migratory under the EPBC Act.
The Republic of Korea Migratory Birds Agreement (ROKAMBA).	Bilateral agreement between the Republic of Korea and Australia to provide protection and conservation of migratory birds that use the East Asian – Australasian Flyway and their important habitats.	Advice on the conservation responsibilities regarding bird species that may use the development as a migratory flyway between the Republic of Korea and Australia. The EPBC Act gives effect to ROKAMBA by listing migratory birds recognised by the agreement as migratory under the EPBC Act.
The Minamata Convention on Mercury	The convention calls on signatories to protect human and environmental health from anthropogenic releases of mercury. The Convention came into force on in 2017 and was ratified in Australia in December 2021.	The Convention covers control and reduction of mercury in a range of processes and industries and is relevant to end-of-life aspects such as waste and contaminated sites. Drilling activities can potentially result in mercury compounds being produced from wells as a by-product. Mercury may pose a risk to the environment if not managed appropriately. The convention will consider best available techniques and environmental practices to control releases of components containing mercury in future activity specific EPs.
Convention Concerning the Protection of the World Cultural and Natural Heritage 1972	Designed to acknowledge and protect areas of cultural and natural heritage across the world.	Guidance around recognising protected areas and areas of cultural and natural heritage and mitigating any potential affects

Agreement/Convention	Scope	Application to Activity
		that the development may have on them.
Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report	The IPCC released four reports relating climate change and anthropogenic influence and deducing the impact that climate change has had on ecosystems, biodiversity, humans, and cities. Convention on Climate Change.	Provides scientific knowledge that relates climate change to human influences and the use of hydrocarbon fuels. The *Climate Change Act 2022* (Cwth) gives effect to the Agreement.

3 Stakeholder Consultation

3.1 Overview

Consultation during development of the East Coast Project OPP supports the objects of the OPGGS(E) Regulations through potentially:

- aiding in early identification of complex issues
- helping to uncover unknown issues
- building relationships and setting the scene prior to development of component EPs
- gaining an enhanced understanding of the existing environment
- developing a greater understanding of values and sensitivities
- obtaining of improved clarity on acceptability criteria
- understanding whether controls are suitable and result in acceptable outcomes.

3.2 Consultation stages

The consultation comprises 2 stages:

1. pre-public comment
2. public comment.

Stage 2 is the only regulatory consultation requirement and stage 1 is considered good practice. Further consultation will follow during the development of component EPs, but that is not within the scope of this OPP.

While Cooper Energy has significant experience in operating offshore gas facilities in the Otway Basin, and has been consulting on these activities for a long period, each stage of consultation has the potential to result in improvements to the OPP.

3.2.1 Consultation stage 1 – pre-public comment

The objective of stage 1 consultation was to gain knowledge through consultation with key members of different stakeholder categories that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Having gone through this stage of consultation, the OPP was likely to be better informed when published for public comment. In practice, very few comments were received, most likely due to these being familiar activities proximate to existing production.

It is considered that the stage 1 consultation provided for reasonable representation across a number of categories of stakeholders which had potential to result in an enhanced understanding of values and sensitivities, and potential impacts and risks to the environment, including socio-economic. The OPP has been updated to incorporate comments received.

The list of stakeholders is in Table 3-1.

Table 3-1: List of stakeholders consulted

Stakeholder
Government-Commonwealth, state, local
Australian Antarctic Division (AAD) (DCCEEW)
Australian Communications and Media Authority (ACMA)
Australian Fisheries Management Authority (AFMA)
Australian Hydrographic Office (AHO)
Australian Maritime Safety Authority (AMSA)

Department of Defence – Property Management Branch (DoD-PMB)
Maritime Border Command
Parks Australia (DNP) (DCCEEW)
National Native Title Tribunal (NNTT)
Department of Climate Change, Energy, the Environment and Water (DCCEEW)
Victorian Department of Energy, Environment and Climate Action – Earth Resources Regulation (DEECA ERR)
Victorian Department of Jobs, Skills, Industry and Regions (DJSIR)
Victorian Department of Premier and Cabinet (DPC) - First Peoples State Relations
Victorian Fisheries Authority (VFA)
Corangamite Shire Council
Moyne Shire Council
Warrnambool City Council
Business, industry and research
Blue Whale Study (BWS)
Deakin University - School of Life and Environmental Sciences
Institute for Marine and Antarctic Studies (IMAS) - University of Tasmania
Victorian Tourism Industry Council (VTIC)
Interest group
Victorian Recreational Fishers Association (VRFish)
First Nations
Eastern Maar Aboriginal Corporation (EMAC)
Gunditj Mirring Traditional Owners Aboriginal Corporation (GMTOAC)
Wadawurrung Traditional Owners Aboriginal Corporation (WTOAC)
Fisheries
Australian Southern Bluefin Tuna industry Association (ASBTIA)
Commonwealth Fisheries Association (CFA)
Seafood Industry Victoria (SIV)
South East Trawl Fishing Industry Association (SETFIA)
Tasmanian Seafood Industry Council (TSIC)
Tuna Australia (TA)

3.2.2 Consultation stage 2 – public comment

The duration of the public comment period is determined by the regulator, and the opportunity to provide public comment will have been advertised in selected media prior to the period opening. The OPP is posted on the NOPSEMA website during the public comment period.

NOPSEMA provides a copy of all public comments received for consideration by Cooper Energy, and a summary report on the public comments will be produced. This report will be included as an attachment to the revised OPP and will summarise matters raised (including objections and claims), assess the merits of these comments, and note Cooper Energy's response which will include any resulting changes to the OPP that may be made.

After the OPP is revised to incorporate any changes that may result from public comment, along with any other necessary changes, it will be is submitted to NOPSEMA for acceptance.

3.2.3 Completion of consultation

Consultation will be deemed complete for the purpose of preparation of the OPP upon the closing of the public comment period. However, Cooper Energy remains open to ongoing engagement which supports our objectives of continuous improvement and relationship building.

4 Description of Project

4.1 Project Overview

The East Coast Project comprises up to 8 incremental gas development opportunities with associated wells, flowlines and manifolds, which will tie-in to the existing Otway Casino-Henry-Netherby (CHN) Development (known as the 'existing CHN facilities'). The development opportunities include:

- Confirmed resources at Annie and Henry fields
- Prospective resources at Elanora, Heera, Juliet, Nestor, Isabella, Pecten East.

Hydrocarbons from these fields will be transported to shore via the existing CHN pipeline and processed at the Athena Gas Plant situated ~6 km inland from Port Campbell.

This OPP covers the following phases:

- Surveys – activities include geophysical and geotechnical surveys of the proposed locations (Section 4.3.1).
- Well construction – activities include Mobile Offshore Drilling Unit (MODU) positioning, all drilling operations, blowout preventer (BOP) installation, cementing, subsea trees and completions, clean-up and flowback, well suspension and logging (Section 4.3.2). Only one well is drilled at a time. Multi-well drilling campaigns involve one MODU which drills each well, one well after another.
- Installation of subsea infrastructure – activities include the installation of flowline systems, umbilical control systems, testing of infrastructure and pre and post commissioning the systems (Section 4.3.3).
- Operations – activities include hydrocarbon extraction, hydrocarbon processing, inspection, maintenance and repair (Section 4.3.4)
- Decommissioning – activities include well abandonment and the decommissioning of infrastructure (Section 4.3.5)
- Support activities – including MODU operations, vessel operations, remotely operated vehicle (ROV) and helicopter operations (Section 4.3.6). Vessel types include saturation diving support vessel, installation vessels, heavy lift vessels (HLV's) and general support vessels for Inspection, Maintenance and Repair (IMR) type activities or supporting the engineering or execution programs. ROV operations may also include autonomous underwater vehicles (AUVs).

4.1.1 History

Exploration in the Otway Basin has been undertaken over the last 20+ years. Over this time the CHN development has incrementally drilled the Casino, Henry and Netherby fields to meet the continued demand of the south-east Australian market.

Refer to Section 1.2 for a detailed overview on the history of the CHN development.

4.1.2 Location

The East Coast Project is located entirely within offshore waters of the Otway Basin (Figure 1-2). All gas development opportunities are situated within Commonwealth waters in existing offshore petroleum permits VIC/L24, VIC/L30, VIC/L33, VIC/P44 and VIC/P76.

The Annie gas field is closest to shore, situated ~8 km from the coast in ~55 m water depth. The Heera prospect is the furthest offshore, situated ~35 km from the coast and in the deepest water depths of ~85 m.

The nearest settlements are Peterborough and Port Campbell (Figure 1-2).

As the project will utilise existing infrastructure, no new petroleum activities are proposed in either state waters or onshore under this OPP.

4.1.2.1 Operational area

For the purposes of this OPP, the operational area for the East Coast Project has been defined to include the extent of all petroleum activities, with a sufficient buffer to allow for flexibility in design and location of infrastructure through the project planning process.

The buffer varies depending on the well or infrastructure type and once combined, defines the operational area (Figure 4-1). Project planning and design is more advanced (and therefore locations more certain) for some of the potential gas resources. Therefore, the buffer width used to define the extent of the operational area varies.

The operational area represents the outer spatial extent of the petroleum activities included within the scope of this OPP. Throughout the phases of the East Coast Project, the footprint of activities will vary in nature and scale within the operational area. Activity footprints and the related potential impacts and risks are described in detail in the impact assessment sections.

The operational area includes:

- 3 km buffer around the outermost proposed well locations and associated flowline routes within the Annie, Juliet, Nestor and Henry fields. This is because the project planning and design for these fields is more advanced, and there is greater confidence on the infrastructure location (being within closer proximity to existing infrastructure).
- 5 km buffer around the outermost proposed well locations and associated flowline routes within Elanora, Heera, Isabella and Pecten East prospects. This is because planning for these prospects is less well advanced.
- Geophysical and geotechnical survey areas. Nominally 5 km x 5 km around proposed well sites, and along nominal pipeline corridors.

Final infrastructure locations will be confirmed in future EPs and will be within the buffers described above.

Vessels transiting to and from the operational area are not considered a petroleum activity, as they fall under other maritime legislation, including the *Commonwealth Navigation Act 2012*, and therefore are excluded from the scope of this OPP. The operation of onshore facilities required to support the proposed East Coast Project is outside the scope of this OPP (note that indirect greenhouse gas emissions are included in the impact assessment).

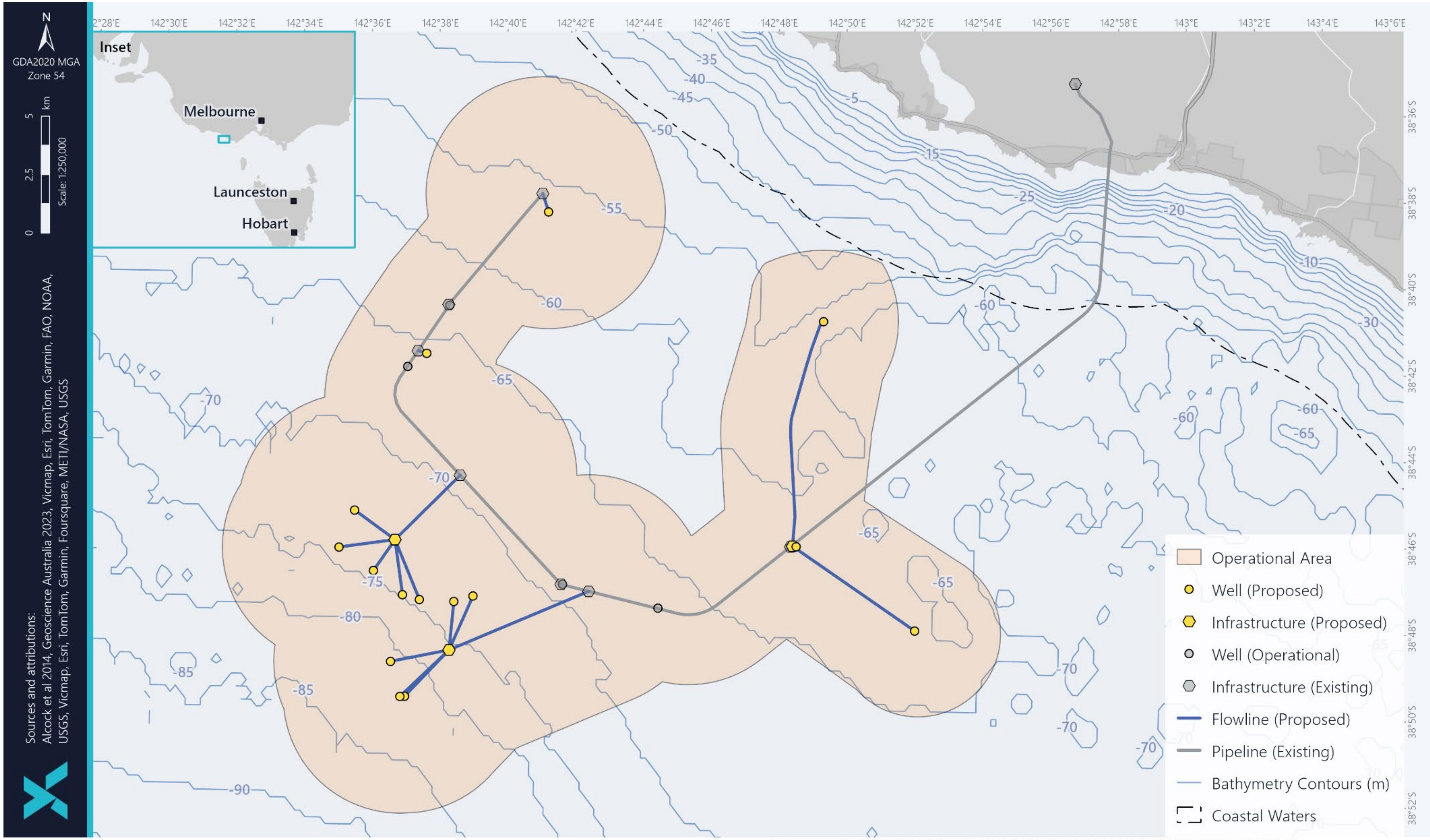


Figure 4-1: Operational area of the East Coast Project

4.1.2.2 Direct Disturbance Corridor

The exact footprint of the infrastructure to be installed will be described in detail in future EPs, once development plans are matured. Though equipment alignments and positions within the operational area may change during detailed design, the overall disturbance footprint of the East Coast Project is not expected to increase.

A conservative direct disturbance corridor, termed the long-term disturbance corridor, has been adopted for the purposes of impact assessment, to capture the nominal spatial extent and footprint of all installed infrastructure (i.e. flowlines and subsea structures). Figure 4-1 shows a field layout featuring multiple wells at Elanora, and at Heera, each connected to a manifold with an individual flowline. This layout has been used for evaluation purposes as it is expected to be conservative in terms of overall footprint and the potential duration of aspects associated with construction, maintenance and decommissioning activities for the proposal; the final facility layouts may differ from what is shown, but will be within the defined operational area which has been designed at this stage with some flexibility for layout modification during planning. This operational area also encompasses short-term disturbance resulting from project activities within the same spatial extent (e.g. disturbance from geotechnical sampling, anchoring of the MODU, temporary wet parking).

In the unlikely event that equipment must be stored temporarily on the seabed due to storm or emergency events, the area of disturbance may fall outside of the direct disturbance spatial extents described below in Table 4-1. . It is estimated this would have a temporary footprint of ~50 m x 50 m and be retrieved within the duration of the campaign (see Figure 4-3).

Table 4-1 provides details of the approximate spatial extent of direct disturbance.

Table 4-1: Direct disturbance spatial extent

Phase	Infrastructure or Purpose	Distance from the activity of potential disturbances*
Long-term		
Installed Infrastructure	Flowlines and umbilical systems Well and manifold locations	100 m corridor (radius) within which seabed disturbance could occur.
Short-term		
Well construction	Temporary moorings for the MODU during well construction.	2.5 km radius around each well site within which seabed disturbance could occur.
Well maintenance and abandonment	Temporary moorings for the MODU during well construction.	2.5 km radius around each well site within which seabed disturbance could occur.
Emergency storage	Equipment may be temporarily stored on the seabed during well construction, installation or decommissioning activities	2,500 m^2 within the operational area.

**Note: the indicative disturbance corridors presented here do not represent the total predicted area, or exact location to be disturbed, rather a nominal extent from an activity or piece of equipment within which seabed disturbance could occur. The predicted direct disturbance footprints for the activities are described in Section 8.8.*

4.1.2.3 Accommodating design changes during detailed planning

As described throughout section 4.1, the OPP contains indicative and nominal spatial extents, alignments and positions of equipment. These details may vary in subsequent approvals to accommodate additional information obtained through survey, detailed design and engineering or consultation. Any necessary contingency designs will occur within the bounds of this OPP including the operational area and overall development footprint described within this OPP.

Where the final designs fit within the parameters of the OPP assessment boundaries, the outcomes of the OPP environmental impact and risk evaluations, acceptability assessment, EPOs and control measures would continue to be appropriate.

4.1.3 Project Schedule

The East Coast Project will be staged and developed incrementally, consistent with how the existing CHN fields have been developed. Therefore, not all gas-development opportunities will be developed in a single campaign, which may result in different phases occurring concurrently. For example, Elanora, Juliet and Nestor fields could be drilled sequentially within the same campaign; flowline installation could occur concurrently with the drilling activity.

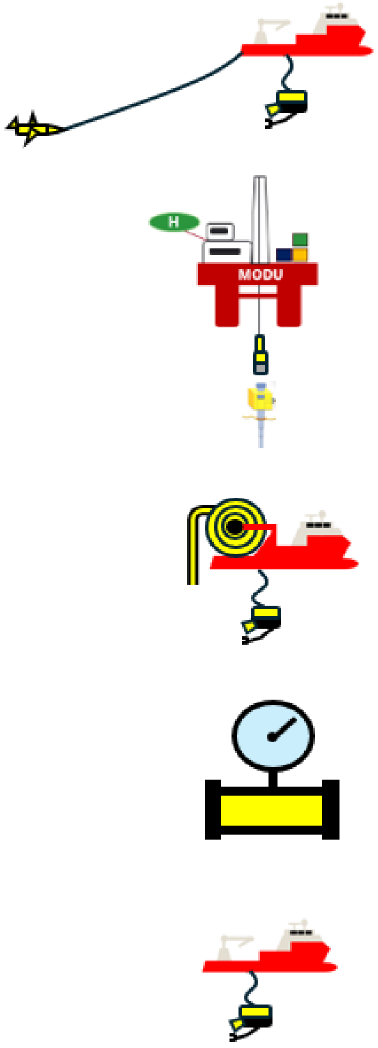
The order in which fields will be developed has not yet been finalised. For the purposes of this assessment, it is assumed that activities associated with well construction, installation and commissioning, and operations phases could all occur within the operational area concurrently, using the 3-well drilling and tie-in example described above. Additionally, pre-decommissioning and decommissioning activities are likely to commence on some fields while others are still operational, meaning there could be an overlap in these later two phases. Potential impacts from concurrent activities are assessed throughout this OPP and will be considered in detail in the subsequent EPs submitted for discreet activities and phases of the East Coast Project.

East Coast Project activities would occur throughout the year. Activity levels associated with production are minimal, with the subsea facilities being operated remotely, there is nothing visible, nor occurring above the sea surface. Higher activity levels are associated with development, maintenance and decommissioning; as these require vessels to deploy / recover equipment to/from the seabed. Figure 4-3 illustrates the individual activities necessary for the East Coast Project, and their approximate durations. Figure 4-3 illustrates the sequence and duration of these activities where combined into offshore vessel campaigns. For conservatism, it is assumed that multiple different activities may occur in direct succession. Figure 4-3 shows activities that may occur concurrently and sequentially across the development, along with the worst likely case scenarios for concurrent and sequential vessel operations for the project concept. A more detailed project schedule would be defined at the Environment Plan development stage.

These timings are indicative as the duration of each phase and activity will vary during the development. This will be due to factors such as final numbers of wells, flowline and umbilical routes, vessel availability and operational windows. Timing influences such as financing, market need, and regulatory change are not allowed for here; but would be built into project schedules where known.

The earliest timing for the pre-operation phase of the first field is 2025. IMR activities may occur during any phase of future developments detailed in this OPP. The production profile provides an indication of the duration of subsea operations, with first gas from 2027, and cessation of production around 2045.

Decommissioning and any post-decommissioning monitoring will occur following end of field life which is estimated to be by the end of 2049. Decommissioning activities could be accelerated in some circumstances (Section 4.3.5).



Site Survey	
Duration	~7-21 days per survey campaign
Required when?	Before development, after decommissioning

Well Construction, Maintenance and Deconstruction	
Duration	~60 days to drill and complete a well ~30 days for well maintenance or abandonment per well
Required when?	During development, during production, during decommissioning

Facility Installation and Removal	
Duration	~30-60 days to install, test and commission a new infield flowline and umbilical system ~30-60 days to decommission and recover an infield flowline
Required when?	During development, during decommissioning

Production Operations	
Duration	For life of field typically 5-15 years
Required when?	For life of field typically 5-15 years

Facility Inspection	
Duration	~14-30 days per inspection
Required when?	During production, during decommissioning

Figure 4-2: Indicative duration and timing of activities required as part of the East Coast Project

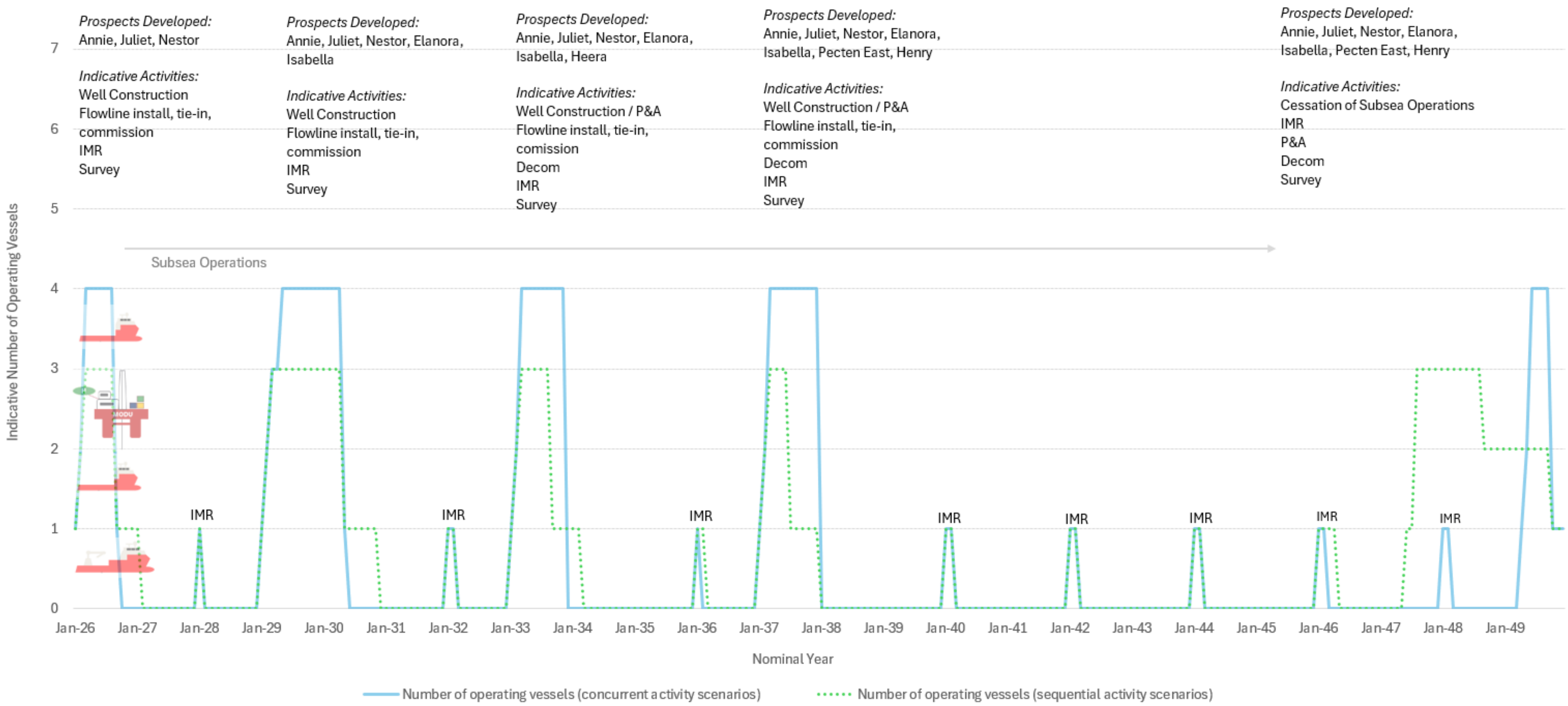


*Figure 4-3: Indicative frequency and duration of vessel-based campaigns across the life cycle of the East Coast Project**

**This chart has been developed to help illustrate the kinds of vessel numbers that could be working to install, maintain and decommission the subsea facilities, as well as give an indication as to the frequency and duration of vessel operations. Typically activities would be planned to occur sequentially from one field to another, but situations can also arise where activities occur concurrently in different fields. In all scenario's shown there are periods where there are multiple vessels operating at the facility. Where the chart shows 3 vessels, this is indicative of a well construction campaign. Where the chart shows 4 vessels, this is indicative of a well construction campaign concurrent with a subsea equipment installation campaign or similar. This chart is not a schedule; it has been developed to assist in characterising the nature and scale of potential impacts of the proposed project, including cumulative impacts from concurrent and sequential vessel activity scenarios.*

4.1.4 Reservoir Characteristics

All 4 production wells of the existing CHN development access hydrocarbons from the Waarre A or Waarre C Formation reservoirs. Reservoir conditions and gas and condensate compositions across the wells do not vary materially (Table 4-2). The condensate of wells within the offshore East Coast Project reservoirs are classified as a Group I (non-persistent) oil, except for Annie, which is classified as Group II (light persistent) oil. Classification is based on the most recent analysis from the drilling of Annie-1 exploration well.

Although the Pecten East structure has been drilled, only reservoir pressure and temperature are known. It is therefore assumed that the gas composition of the Pecten East field will be like the adjacent Netherby field as it is the nearest producing reservoir and is expected to have similar composition/pressure.

Gas development opportunities classified as prospects have not been drilled before, and therefore do not have confirmed reservoir characteristics. Hydrocarbon analogues for these prospects have been chosen based on their proximity to the prospect, geological properties (porosity) and expected composition/pressure:

- Casino-4 (Waarre A): analogue for Elanora and Heera
- Casino-5 (Waarre C): analogue for Juliet, Nestor and Isabella.

There is some uncertainty in the Condensate to Gas Ratio (CGR) values even in the discovered fields and a range has been estimated with a conservative average selected of 2 bbl/MMscf for all the exploration prospects.

During the 2021 reporting period, the Athena Gas Plant National Pollution Index (NPI) report did not identify mercury to be present in quantities that required inclusion within the annual NPI report. A Bureau Veritas gas and condensate analysis in 2022 reported total mercury levels of less than 0.1 µg/m^3 in the raw gas at Athena Gas Plant, which comprised of Casino, Henry and Netherby gases. Wells associated with the East Coast Project are anticipated to be analogous to their CHN counterparts discussed above, except for Annie, which has known properties. Well testing data of mercury at the previously drilled Annie-1 exploration well found mercury levels of 1-4 µg/m^3.

Table 4-2: East Coast Project Reservoir Conditions

Parameter	Field					Prospect					
	Casino-4 (Waarre A)*	Casino-5 (Waarre C)*	Netherby*	Henry	Annie	Pecten East	Elanora	Juliet	Nestor	Isabella	Heera
Analogue condensate	N/A	N/A	N/A	Henry-3	Annie-1	Netherby	Casino-4	Casino-5	Casino-5	Casino-5	Casino-4
Gas Specific Gravity	0.60	0.595	0.584	0.59	0.66	0.584	0.595-0.65	0.595-0.65	0.595-0.65	0.595-0.65	0.595-0.65
Condensate to Gas Ratio	Current average: 0.9 bbl/MMscf				Average of 2 bbl/MMscf	Average of 2 bbl/MMscf					

**Note: Details on these producing fields are included as they are analogues for prospective fields*

Table 4-3: East Coast Project Field Gas Compositions

Component	Casino		Netherby	Henry	Annie
	Casino 4 (Waarre A)	Casino 5 (Waarre C)	Netherby-1 (Waare A)	Henry 2 (Waarre A)	(Waarre C)
Analogue condensate	Elanora and Heera mole%	Juliet, Nestor and Isabella	Pecten East	Henry-3	Annie-2
Hydrogen sulphide	0.00	0.00	0.00	0.00	0.00
Nitrogen	0.66	0.74	0.06	0.07	0.88
Carbon Dioxide	3.15	2.18	1.16	1.59	7.60
Methane	93.67	94.50	95.66	94.82	88.29
Ethane	1.50	1.80	1.99	2.26	2.11
Propane	0.43	0.44	0.55	0.60	0.64
i-Butane	0.13	0.07	0.10	0.12	0.03
n-Butane	0.13	0.07	0.12	0.18	0.07
i-Pentane	0.04	0.02	0.04	0.04	0.04
n-Pentane	0.03	0.02	0.04	0.04	0.04
Hexane	0.05	0.02	0.05	0.07	0.11
Heptane	0.09	0.06	0.08	0.10	0.08
Octane	0.03	0.03	0.04	0.04	0.03
Nonane	0.03	0.01	0.03	0.02	0.02
Decane	0.02	0.01	0.02	0.02	0.01
Undecane	0.03	0.01	0.02	0.01	0.01
Dodecane+	0.01	0.02	0.04	0.02	0.03
TOTAL	100	100	100	100	100
Mercury	0.1 μg/m^3				1-4 μg/m^3
Naturally Occurring Radioactive Material (NORMS)	240 Bg/m^3 (Radon-222)				-

4.1.5 Production Profile

As described in Section 1.1 the East Coast Project development concept is a backfill development for the existing Athena gas plant currently serviced by the CHN field. To meet the continued demand as existing CHN fields decline Cooper Energy proposes to continue the incremental development of adjacent fields and utilise existing CHN infrastructure to maintain supply through the East Coast Project.

This scope allows for a total of 15 sub-sea production wells to be drilled over a ~20-year period. The development of all 15 wells will be subject to reservoir performance and the demand from the south east Australian domestic market. Figure 1-2 presents the gas development opportunities included in the scope of the East Coast Project with proposed well locations.

Figure 4-4 and Figure 4-5 show the production forecast for the East Coast Project.

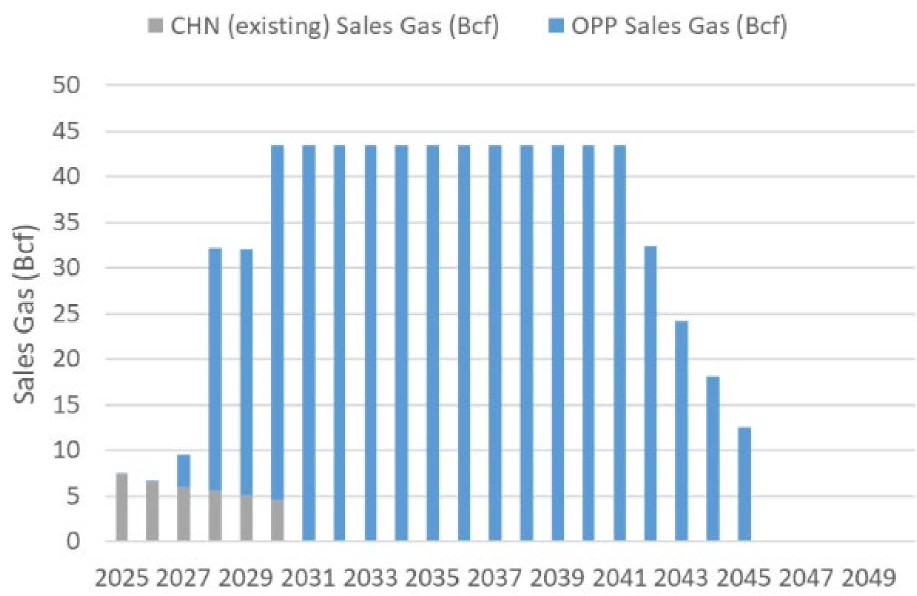


Figure 4-4: Production forecast of sales gas for Cooper Energy assets within the Otway basin

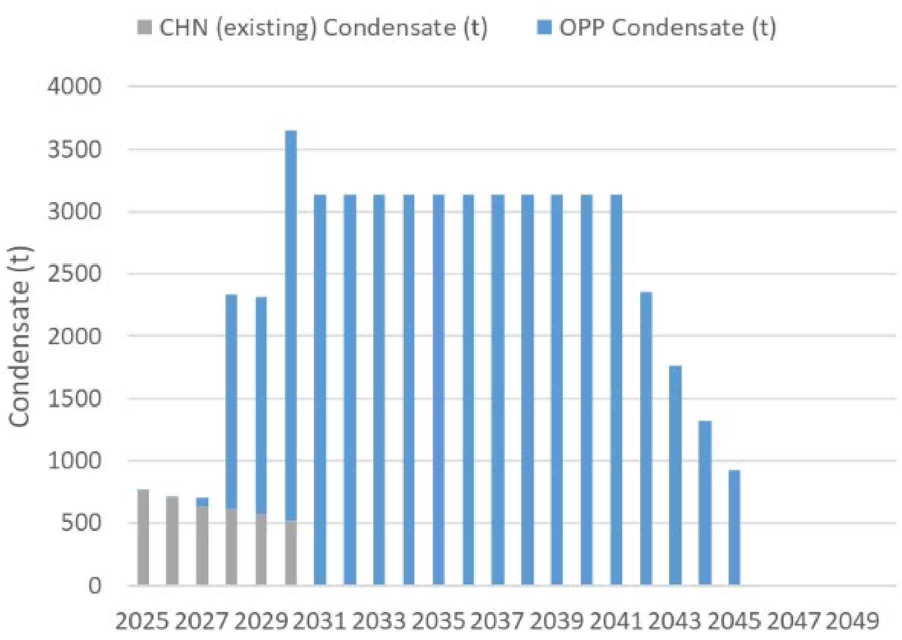


Figure 4-5: Production forecast of condensate for Cooper Energy assets within the Otway basin

4.2 Description of Hydrocarbon Infrastructure

4.2.1 Overview

The East Coast Project proposal includes the following subsea infrastructure which are described in detail in the subsections below:

- production wells
- flowline systems to link new wells to the existing CHN pipeline system
- umbilical system, comprising Electro/Hydraulic Umbilicals, jumpers or flying leads, linked to the existing CHN controls system

- other subsea infrastructure as described in Section 4.2.5.

Diverless structures and diverless trees are intended to be used in the East Coast Project, however, diver-assist manifold structures or trees may be selected where appropriate.

Indicative locations of proposed wells and infrastructure are shown in Figure 4-6. The final locations are likely to be adjusted within the operational areafollowing field surveys and detailed engineering, and will be detailed in future EPs.

Note that small structures such as umbilicals and jumpers are not shown in Figure 4-6 due to scale but would be located in close proximity to the infrastructure shown and are accounted for within the long-term direct disturbance footprint for the purposes of assessment as defined in Section 8.8.

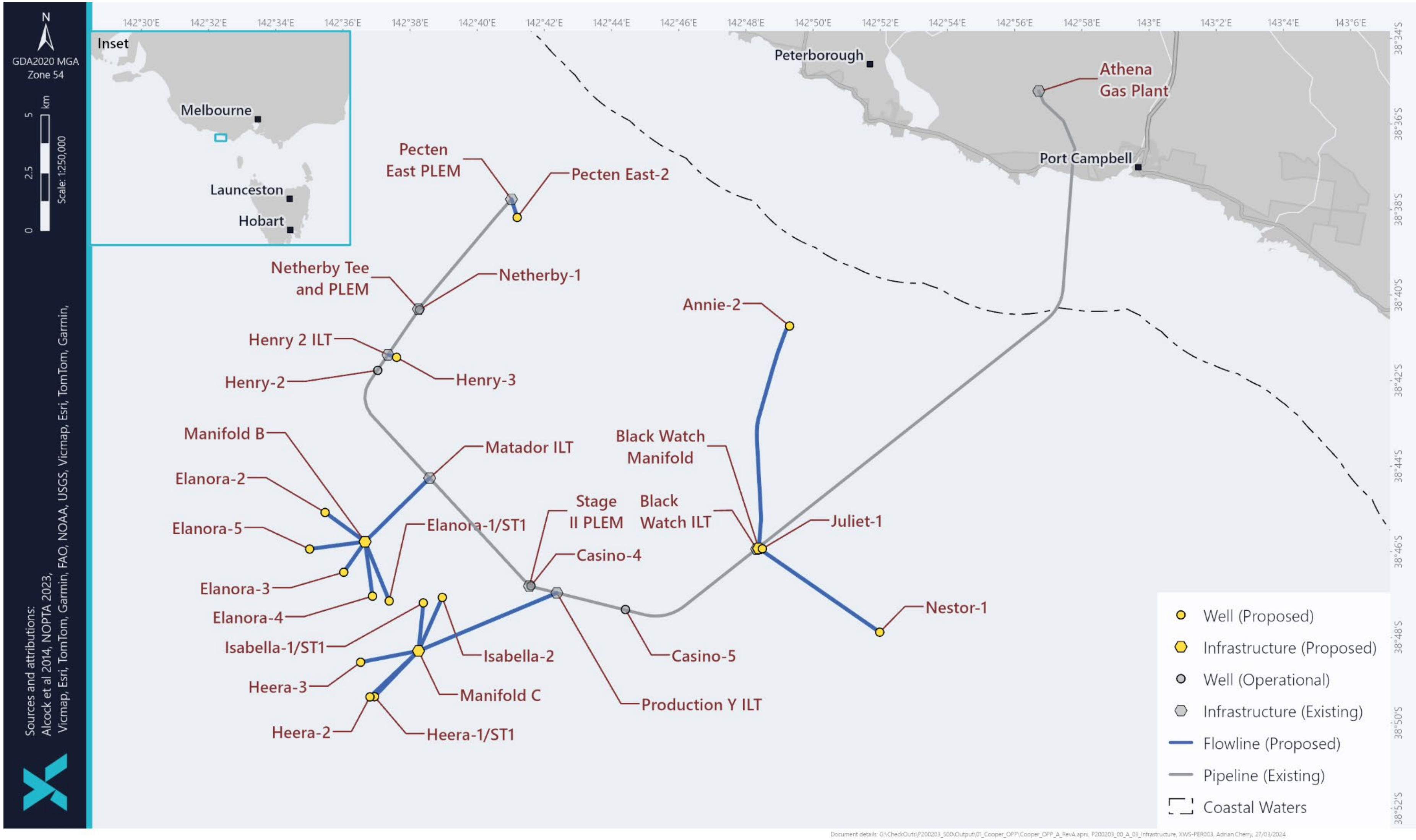


Figure 4-6: East Coast Project proposed wells and associated infrastructure

4.2.2 Wells

Up to 15 sub-sea production wells may be drilled over a ~20-year period subject to south east Australian domestic demand. In keeping with the development of the CHN fields to date, it is anticipated that the wells will be drilled incrementally in groups of 1-5 at a time. The OPP nominally assumes there could be up to 7 development well construction campaigns during that ~20-year period (depending on initial drilling outcomes, rig availability and field development planning). Figure 4-3 illustrates a 4-campaign development scenario, where 2-3 fields are developed in each campaign; this provides a conservative view as to the potential duration of the campaigns, which would be longer with more fields included. The direct footprint of the top-hole of each well is ~2 m^2.

For every well, there is the possibility of a re-spud at each top-hole location, which would be implemented within an ~10-20 m radius of the original location. In this case, the MODU would be re-positioned (kedged) within the existing mooring configuration, with no anchor movement required. The wells will be drilled either vertically or directionally (at an angle off vertical).

Within the East Coast Project, some wells are likely to be drilled via a sidetrack (ST). A ST uses the same top-hole as the existing well, where the bottom-hole section of the existing well is abandoned before an adjacent bottom-hole section is drilled and completed (or abandoned).

Each production well will be fitted with a subsea tree; this structure includes valves which can be opened and closed to control the flow of hydrocarbons from the wells.

The well design will consider the well barrier envelope during well construction, operations and production to provide two independent verifiable barriers.

The anticipated location of proposed wells and the maximum number of wells at each potential gas development are detailed in Table 4-4.

Table 4-4: Otway OPP key well characteristics

Wells[4, 5]	Eastings (GDA 2020 / MGA 54)	Northings (GDA 2020 / MGA 54)	Approximate water depth (m)
Annie-2	658,700	5,716,737	57
Juliet-1	657,525	5,707,100	62
Nestor-1	662,600	5,703,490	64
Isabella-1/ST1	642,862	5,704,756	74
Isabella-2	643,682	5,704,991	73
Heera-1/ST1	640,751	5,700,699	81
Heera-2	640,553	5,700,690	81
Heera-3	640,150	5,702,188	81
Elanora-1/ST1	641,386	5,704,839	74
Elanora-2	638,613	5,708,668	73
Elanora-3	639,419	5,706,083	74

[4] *Juliet-1, Nestor-1 and Elanora-1/ST1 are intended to be drilled as exploration wells in the first instance. Exploration drilling is not within the scope of the OPP. If exploration wells are successful in accessing commercially viable quantities of gas, then they may be suspended and retained for future production subject to the requisite approvals and licencing. Alternatively, subject to further field development planning, these wells may be drilled as development wells. The construction of these wells (as development wells), tie-in, operation and decommissioning of the wells is within the scope of this OPP (refer to Section 1.3.2).*
[5] *Well names and sequencing may change over time.*

Elanora-4	640,662	5,705,048	74
Elanora-5	637,946	5,707,085	74
Henry-3	641,705	5,715,381	66
Pecten East-2	646,922	5,721,433	57

4.2.3 Flowline systems

It is anticipated that the East Coast Project flowline system will be primarily flexible flowlines to cater for flexibility of lay routes as well as manufacturing and vessel availability. However, the rigid flowline option is also included within the scope of this OPP (see Section 5 for the alternative analysis). Dimensions of both systems are likely to be in the range of 6-8" and will be subject to flow assurance and detailed engineering studies. In the case flexible flowline systems are used, they will tie directly into the new subsea tree (SST). In the event of rigid reeled flowline systems, end terminations will be required with corresponding rigid diverless spools.

Figure 4-1 and Figure 4-6 present a single indicative route for each proposed flowline. These indicative routes present the outermost route and have been created for the purposes of impact assessment. Final flowline routes will occur within the operational area, within a footprint equivalent in area (m^2) to the proposed long-term disturbance corridors for the whole East Coast Project, as described in Section 4.1.2.2. The final flowline routes, and therefore lengths, will be confirmed during detailed design, and will be described within subsequent EPs. The Operational area has been developed to account for potential variations to routes as planning progresses.

The conceptual design uses a 25% increase in route length to estimate a conservative total length of flowlines to be installed for all fields. This includes contingency to account for final route alignment. The conservative total length of flowlines to be installed for all fields is ~65.92 km.

Should alternative engineering designs be identified as the optimal field layout during detailed engineering design, flowline lengths may be reduced. For example, should wells be joined by a common flowline and umbilical prior to connection to a manifold, and tie-in at an existing point within current infrastructure, flowline length would be reduced and located within the operational area.

The new flowline systems included in the East Coast Project will be tied-in to the existing CHN facilities via existing in-line tees (ILTs) or via existing production Y tie-in points.

Currently, the end of the Pecten East line does not have provision for diverless intervention for performing in-line inspections (ILI). To ensure long-term integrity of the existing CHN pipeline, the end of the system may be modified to provide for diverless pig launchers/receivers. This would allow cleaning of the line prior to running any internal inspection campaigns.

Final routes for the flowlines have not yet been identified; and multiple route options are being considered and will be confirmed during FEED. Proposed flowlines are not expected to cross currently existing third-party infrastructure, however crossings over the existing CHN pipeline system will occur. If a flexible flowline system is implemented, it will likely require concrete stabilisation mats placed intermittently to limit movement of the flowline system under influence of the prevailing oceanographic conditions.

Further details on the final equipment and design footprint will be provided in future activity-specific EPs. Table 4-5 provides the expected type, number and dimensions of subsea flowline system structures. All structures will be installed within an area equivalent to the proposed long-term disturbance corridor.

Table 4-5: Estimate dimensions and footprint of infrastructure associated with flowline systems

Infrastructure	Estimated number required	Approximate dimensions (m)
End termination for flexible flowline system	Assumed each flexible flowline will have end termination. Assumed there are 18 flowlines. Therefore, 36 end terminations.	1m x 1m per end termination on each end of the flowline system
*Only applicable if rigid flowlines are installed **Jumpers/spools complete with end terminations**	Assumed 2 jumpers/spools per rigid flowline system. Assumed that only four rigid flowlines could be installed given the potential lay routes and distances. Therefore, total number of jumpers / spools is 8.	15m Long x 1m wide rigid spool with end fittings Rigid spools are installed between ends of rigid flowline and tree or manifold.

4.2.4 Umbilical systems

New electrohydraulic umbilicals (EHUs) will provide hydraulic power, electric power, mono-ethylene glycol (MEG), other chemical inhibitors, and a fibre-optic communication link from existing controls systems to new SSTs and manifolds. EHUs will be installed alongside the flowlines where feasible, and all final umbilical routes will occur within an area equivalent to the proposed long-term disturbance corridors for the whole East Coast Project, as described in Section 4.1.2.2.

The conceptual design uses a 25% increase in route length to estimate a conservative total length of umbilicals to be installed for all fields. The total length of umbilicals associated with the conceptual design across all fields is ~73.79 km, which includes an umbilical from Black Watch Manifold to Casino-5. These lengths and associated operational area are indicative of a conservative engineering design as shown in Figure 4-1, and are also considered conservative for assessment purposes. These layouts may change during detailed design but any changes would not lead to an exceedance of the acceptable levels of impact defined in this OPP.

In some circumstances the EHUs will incorporate subsea umbilical distribution units (SUDUs) or subsea umbilical termination unit (SUTU) / umbilical termination assembly (UTA) at the ends of the umbilicals. These termination units allow further distribution of the hydraulics or electrics to support the operation of the SSTs. Electrical Flying Leads (EFLs) and hydraulic flying leads (HFLs) may also be used in certain circumstances between the end terminations and the subsea assets. The finalised configuration would be part of the detailed design.

The umbilical system will be designed to be stable on the seabed, however, to prevent movements induced by ocean currents stabilisation may be required in the form of concrete mattress and/or grout bags. Provisions will be made for concrete mattresses near SUDU’s for stabilisation. Stabilisation/protection via grout bags may also be required around EFLs to counter the forces of currents at depth.

Further details on the final equipment and design footprint will be provided in future activity-specific EPs. Table 4-6 provides the expected type, number and dimensions of subsea umbilical system structures. All structures will be installed within the proposed operational area.

Table 4-6: Estimate dimensions and footprint of infrastructure associated with flowline systems

Infrastructure	Estimated number required	Approximate dimensions (m)
SUDU and SUTU/UTA	Each umbilical will have some form of termination. The type of termination is subject to detailed design. Assumed there are 19 umbilicals (including Black Watch Manifold to Casino-5). Therefore, 38 SUDU’s, or UTA’s at each end of the umbilicals	Each termination could range in size. Assume average size of 2x2 m

Infrastructure	Estimated number required	Approximate dimensions (m)
EFLs and HFLs	Each umbilical should terminate direct into the tree. However, if this is not feasible there could be a requirement for 2x EFLs and 1x Hydraulic Flying Lead (HFL) per tree location. Assume 15 trees. Therefore 30 EFLs and 15 HFL's	Each EFL or HFL are circa 50m long with diameter <150 mm

4.2.5 Other Subsea Infrastructure

Other subsea infrastructure that will be installed includes:

- manifolds
- hot tap tie-in structure, as required
- double block and bleed systems and diverless hub
- subsea metering skid may be required subject to future design and fiscal requirements.
- pig launcher/receiving temporary facilities as part of commissioning activities
- over-pressure protection systems.

Three new manifolds are proposed under the East Coast Project which will allow produced hydrocarbons from multiple wells to be co-mingled before entering the in-field production flowlines. Manifolds will incorporate an in-built foundation or require a separate foundation. It is expected that any foundation design would be a skirt-based system without the requirement for piling. Foundation design and final configuration will be subject to detailed design. The proposed manifolds are:

- Black Watch Manifold (BWM) to connect Annie, Juliet and Nestor via the existing Black Watch ILT.
- Additional manifolds to connect Elanora, Isabella and Heera prospects with the Matador ILT or the production Y tie-in.

A 'hot tap' is a contingency method where a flowline system is tied into a live, producing pipeline without disrupting routine operations. Currently there is no intention to hot tap into the existing CHN pipeline, however it may be undertaken depending on the final design and integrity of existing double block and bleed valve systems.

Over-pressure protection structures provide a means to isolate certain components of the system, where required, to prevent over-pressurisation of the broader production systems above the design parameters. The subsea protection structures are generally a structure that contains isolation valves, operated via the control umbilical system.

All subsea infrastructure is in concept or design phase. Further details on the final equipment and design footprint will be provided in future activity-specific EPs. Table 4-7 provides the expected type, number and dimensions of subsea infrastructure. All structures will be installed within the operational area.

Table 4-7: Estimated dimensions and footprint of subsea infrastructure

Infrastructure	Estimated number required	Approximate dimensions (m)
Manifolds	~3	8 x 12 m for each manifold structure
SSTs (Subsea Trees)	Up to 15	3x3 m for each subsea tree; note – the SST sits on top of the wellhead

Infrastructure	Estimated number required	Approximate dimensions (m)
		generally ~1m above seabed.
Skids that house double block and bleed system, diverless hubs or fiscal meters	~5	5 x 5 m for each skid structure
Hot-tap tie-in structure	Optionally 1 as contingency	5 x 5 m for each structure
Pig launcher/receiver	Optionally 5 as temporary items for commissioning	6 x 1 m for each temporary facility
Pressure protection system	Optionally 2 as contingency	5 x 5 m for each structure

4.3 Description of Activities

The following subsections outline activities associated with each phase of the development.

Support Activities (Section 4.3.6) may apply within all phases of the East Coast Project and refers to those activities associated with contracted vessels/MODU that are common.

4.3.1 Surveys

4.3.1.1 Geophysical Survey

Geophysical surveys are required to understand seabed relief, substrate, anomalies and hazards on or below the seabed, to inform the planning of activities such as subsea installation and well construction. Surveys may be undertaken at various times during the scope of the East Coast Project. The Survey of a proposed well site may take ~7 days to complete and a survey campaign is expected to take up to ~3 weeks where multiple sites are integrated into a single campaign.

Surveys would be expected to occur over approximately 25 km^2 area per well (grid dimensions of around 5 km x 5 km) depending on MODU mooring requirements. Any direct disturbance to the seabed will be within operational area, and within an area equivalent to the proposed short-term disturbance corridor. Surveys may employ a variety of techniques including:

- Multi-beam echo sounder (MBES) - detailed measurements of bathymetry in the operational area
- Side Scan Sonar (SSS) - detects hazards such as existing pipelines, lost shipping containers, boulders, debris, unmarked wrecks, reefs and craters. Also used to help detect possible underwater cultural heritage.
- Sub-bottom Profiler (SBP) - used to investigate the layering and thickness of the uppermost seabed sediments to check for shallow hazards and anomalies.
- Magnetometer - detects large and small metallic objects on or below the seabed (e.g. buried pipelines, petroleum wellheads, shipwreck debris and dropped objects such as un-exploded ordinance, cables, anchors, chains) that may not be identified by acoustic means
- Sound Velocity Profiler (SVP) and Conductivity, Temperature and Depth (CTD) – used to calibrate survey equipment and environmental monitoring.

4.3.1.2 Geotechnical Survey

Geotechnical survey may be required within the operational area for the purposes of manifold installation or other skid structures or to assist with flowline or umbilical system designs. Sampling locations will be decided following assessment of geophysical survey results. Each piston / push sample results in a small hole (<1m^3). Approximately ~20 – 40 sample locations are expected within the scope of the OPP subject to detailed engineering requirements

Techniques that may be employed are:

- Penetration testing - The method can detect fine changes in stratigraphy
- Coring - to retrieve samples for geotechnical analysis
- Grab sampling - to retrieve surface sediments along flowline and umbilical routes, and at well sites for further analysis
- Deployment skids – deployment of geotechnical survey equipment.

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4.3.2 Well Construction

Well construction activities will be carried out using a semisubmersible rig referred to as a MODU (as evaluated in Section 5.3.1). The metocean conditions within the offshore Otway region have the potential to preclude setting a jack-up MODU on location for up to 90% of the year and have an increased risk of 'punch through' associated with the regions surficial seabed properties. Therefore, a moored MODU (or DP assist moored MODU) has been selected as the feasible and proven option for the East Coast Project. The MODU would be expected to be temporarily moored to the seabed and may be equipped with dynamic positioning (DP) systems for positioning and stabilisation during extreme weather events.

Up to 15 production wells may be drilled under the scope of the East Coast Project, which include up to 3 wells being drilled as sidetracks, as detailed in Section 4.2.2. Depending on the site and number of wells, well construction, including drilling, logging and running completions, could range between ~45 days for a single well to 180 days for campaigns involving multiple wells. This does not include additional time for unexpected delays and extreme weather events. For the purposes of impact assessment, a conservative value of 60 days for well construction (per well) is assumed.

Depending on initial drilling outcomes, rig availability and field development planning that could group multiple fields, a nominal 7 drilling campaigns are expected. Drilling may be undertaken at any time of year, though weather-related interruptions in the Otway region are typically longer and more frequent in Winter and hence could result in longer campaigns overall.

The final well design is subject to detailed engineering. The Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 requires that detailed well design and plans to manage the integrity of the wells throughout the well life cycle, is accepted by NOPSEMA before drilling can commence; this is done through the development and assessment of a detailed Well Operations Management Plan (WOMP).

The following sub-sections provide a description of drilling characteristics for a typical development well.

4.3.2.1 MODU Positioning / Installation

The MODU will be moored and may be DP-assist. The MODU may move into position under its own propulsion or be towed by one anchor handler on bridle. An additional two anchor handler vessels may be within the operational area (3 km from the MODU) connecting mooring lines from anchors on the seabed, to the MODU. The MODU will typically require between 8 and 12 anchors to maintain position during drilling. Anchors may be pre-laid on the seabed a number of weeks in advance of the MODU arriving at each well location. These anchors and associated mooring wires/chains are deployed to the seabed by the anchor handler vessels.

Typically, mooring lines extend ~2,000 m – 2,500 m from the MODU, with ~1,200 m of grounded chain. Each anchor typically occupies a total seabed area of ~60 m^2.

The number of anchor handler vessels required is subject to the needs of the selected MODU, but typically could be 2 anchor handler vessels with an additional platform support vessel (PSV) or another anchor handler vessel.

A temporary 3 km exclusion/cautionary zone will be requested around the MODU during drilling activities and a permanent (until revoked) 500 m petroleum safety zone (PSZ) around each well will be established where required for equipment integrity management and gazetted by NOPSEMA.

4.3.2.2 Drilling Operations

Once the MODU is positioned over the well location, drilling equipment is lowered to the seabed and drilling commences with the top-hole section. The top-hole sections of the wells (conductor and surface hole) are drilled without a riser system back to the MODU; which is standard practice prior to BOP installation. The cuttings (rock chips) from the wellbore and drilling fluids from this section are released at the seabed in this initial part of the drilling process. As each section of the well is progressively drilled, steel casing is installed into the hole.

To facilitate the drilling of deeper well sections the nominal sequence of installation includes the installation of a riser and blowout preventor (BOP) once the surface casing has been cemented in place. Depending on when the well is intended to be produced in the future, a drill-through SST will be installed and tested on the well. The SST will regulate the flow of gas from the reservoir once the well is tied into the flowline system and production commences. Once the riser and BOP are installed, drilling fluids and cuttings will be returned to the MODU, and the drilling fluids will be separated from the rock cuttings using solids control equipment.

The solids control equipment comprises shale shakers that remove coarse cuttings from drilling fluids. The recovered fluids that have been separated from the cuttings may be directed to centrifuges to remove the finer solids. The cuttings are usually discharged back to seabed and the reconditioned fluids are recirculated into the fluid system. The drilling fluids are ultimately discharged once they have reached the end of their operational life.

The direct disturbance footprint of each top-hole is ~2 m^2. Volumes of drill cuttings and fluids estimated from the activities are detailed in Section 4.3.2.3.

Occasionally the initial bottom-hole section of a well may require re-drilling within the reservoir. This may be managed by drilling a new bottom-hole section, via a sidetrack from an existing well. In order to drill sidetracks, the bottom-hole section of the existing well section is abandoned and the new bottom-hole section is drilled and completed as per Section 4.3.2.2 and Section 4.3.2.6. Volumes of drill cuttings and fluids estimated from the activities are detailed in Section 4.3.2.3.

4.3.2.3 Drilling Cuttings and Fluids

Drilling fluids, sometimes called drilling muds, are a specialist mix of seawater, clay (or gel) and weighting additives such as barite, salt and chalk. Drilling fluids perform several functions, including cooling and lubricating the drill bit, transporting drill cuttings out of the well, and maintaining hydrostatic pressure greater than formation pressure, thereby preventing the influx of hydrocarbons from the formation into the wellbore. Standard additives to the drilling fluids include polymer and polyamine to control fluid loss, viscosity and stabilise shales during the drilling process. The specific type and mix of drilling fluids will depend on the final proposed design and drilling requirements encountered on site.

During drilling of the conductor and top-hole sections, a combination of seawater and high-viscosity gel sweeps are typically used as drilling fluid. Subsequent intermediate and reservoir hole sections will typically be drilled with water-based drilling fluids (WBDF), with specific formulations dependent on the technical requirements of the well.

Drilling fluids, bulk dry products, brine and drill water are transferred to the MODU from supply vessels and stored in tanks and pits. Dry and liquid additives are mixed into the fluid system from sacks or containers. The specific type and mix of drilling fluid will depend on the final proposed design and drilling requirements encountered on site.

Volumes of drill cuttings and fluids discharged at the seabed will be ~150 m^3 and 1,500 m^3 respectively. Volumes of drill cuttings and fluids discharged at the surface will be ~180 m^3 and 2,000 m^3 respectively. Fluids at the seabed and surface will typically be discharged in batches of between ~10–100 m^3.

4.3.2.4 Cementing Operations

Cement is used throughout the well construction process during installation of each well section to seal the casing into place. Cement can also be used in the form of a cement plug within the well to provide a permanent or temporary well barrier.

Bulk dry cement is transported to the MODU via supply vessels and transferred to dry bulk storage tanks. During the transfer process, the holding tanks are vented to the atmosphere, resulting in residual dry cement being discharged from venting pipes located under the MODU.

After a string of casing or liner has been installed into the well, a cementing spacer is pumped to flush drilling fluids from the well. Cement slurry is pumped down the inside of the well, and into the annulus (space between the casing and surrounding rock). Displacement fluid is then pumped into the casing with a wiper plug to displace the cement out of the bottom of the casing. Cement volume excess is required to ensure sufficient cement within the annulus. The volume of excess will depend on multiple factors, ~50 m^3 cement excess may be displaced to the seabed. The direct footprint of ‘overflow’ cement on the seabed is estimated to be within a radius of between 10 m and 50 m around the well.

In the event the cement slurry pumped into the well does not place or balance properly, the cement is circulated out of the well and discharged before it sets. The volume of these kind of cement washings can be in the order of 40m^3.

The cementing equipment is tested prior to the commencement of cementing operations, resulting in a discharge of ~2.4 to 8 m^3 cement slurry to sea before it can set within the surface equipment. Upon completion of each cementing activity, the cementing equipment is flushed clean which also results in a release of ~1 m^3 of cement washings to sea.

4.3.2.5 BOP Installation and Testing

The BOP will be installed onto the SST after completion of the top-hole sections prior to drilling the bottom-hole section, for well control purposes. The BOP is comprised of a series of rams that can be closed above the well. The BOP acts as a secondary barrier and is used to “close in the well” in the event of an unwanted influx of pressure into the wellbore from the reservoir whilst constructing the well. Once well construction is complete, the BOP is replaced by long-term barriers integrated into the well and is recovered to the MODU.

When the BOP is installed, regular function and pressure tests are undertaken to relevant standards, described in the WOMP. Function testing is undertaken regularly and will result in the discharge of ~2.5 m^3 of control fluid per well per test which will be discharged to sea.

4.3.2.6 Well Completions

Completions are installed within a well to manage the flow of hydrocarbons from the reservoir into the well. Components of the well completions at reservoir depth (also called lower completions) may include perforating the casing/tubing across the reservoir section and running sand management equipment (typically screens) to minimise ingress of sand through the perforations into the well. Upper well completions involve running elements such as tubing, packers in between the tubing and well casing, downhole gauges and safety valves.

The well bore will be cleaned and displaced to filtered brine when installing completions to minimise solids within the wellbore. Returned fluids will be re-used where they are assessed as suitable for future use. Fluids that are not suitable for reuse are directed overboard to sea.

Prior to setting the packers, the tubing annulus is displaced to corrosion inhibited completion brine (e.g. sodium chloride) which will remain in the well. The tubing is contents may be displaced to a base oil (~40 m^3) ready for well clean-up and testing.

Completion brines may be sodium chloride (NaCl), or potassium chloride (KCl) treated with biocide and oxygen scavenger components and will be released during this activity. The high side volume is ~500 m^3 at the end of each well campaign.

4.3.2.7 Well Clean-up and Flowback

Following completion of each well, well testing and clean-up will be undertaken to ensure the wells are cleared of drilling fluids and brines. This is necessary before eventual production to the onshore production facility, and to also capture well data such as pressure, flowrates, reservoir composition and to characterise non-hydrocarbon constituents. Base oil acts to underbalance the well and initiate flow from the well to the MODU, controlled via valves within the well, SST and BOP stack-up. The base oil and reservoir fluids will be directed to a flare boom, via a surface well test package. Flow from the well continues until the well clean-up criteria are met (e.g. completion fluids have been removed and residual solids are nominally <2%.

Industry flares are designed to maximise burn efficiency, limiting smoke and liquid dropout. Whilst the well is flowing through the separator, samples of gas and /or liquid will be captured for laboratory analysis. Onsite analysis is also performed for non-hydrocarbon components such as H_2S, CO_2, radon and mercury).

Flowing of each well, and therefore flaring will have a duration of ~36 hours and result in ~60 MMscf being flared. Flaring requires the MODU and associated test package to be connected to the well, and hence can only occur from one well at a time.

4.3.2.8 Well Shut-in and Suspension

Following completion and well-test activities, commercially viable wells will typically be left with the SSTs installed and the wells shut-in, awaiting connection to the existing CHN facilities. For new wells to be brought online, the existing CHN wells would likely be shut-in temporarily whilst backpressure from the new wells reduces. Production from CHN wells would be expected to be reintroduced when pressures and rates from other fields allow.

To be ‘shut-in’ means the well barriers are closed, preventing the flow of hydrocarbons out of the well. Prior to well shut-in, the well and SST barriers will be tested, and fluids may be flushed to sea (e.g. MEG treated with corrosion inhibitor). Alternatively, should it be required, the wells may have an SST installed at a later date. In this instance, plugs are installed within the wells to prevent flow of hydrocarbons, and a suspension cap installed on the wellhead to prevent debris entering the well during the suspension period, prior to returning to the well to install the SST.

The suspended wells will be monitored periodically in accordance with the WOMP. Inspection intervals and activities are informed by review of well data captured during the drilling program; typically, inspection involves a single vessel and deployment of an ROV for visual and sonar survey.

The intention is that a successful discovery, following completion and well-test activities, would be developed as soon as practicable after discovery pending regulatory approvals and licencing (Figure). An activity specific development EP would be submitted prior to development activity occurring to enable this. The earliest timing for installation and commissioning are anticipated to occur within ~6-36 months of the completion of the drilling program. During this time the wells will remain shut-in.

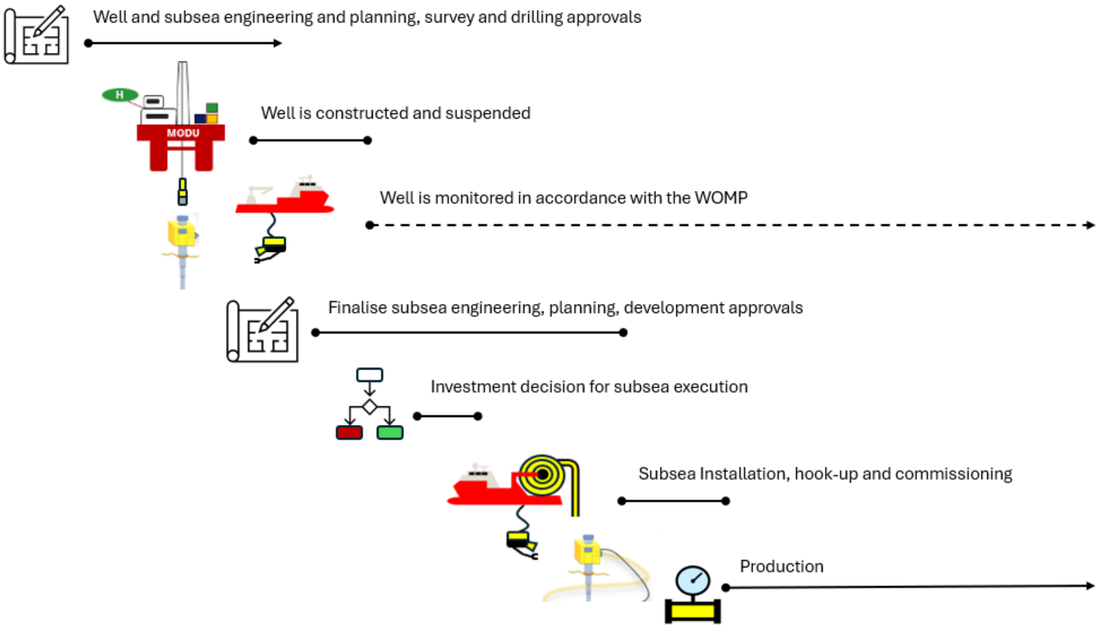


Figure 4-7 Illustration showing indicative steps between well construction / suspension and production

Well suspension duration could be outside the anticipated duration depending on planning variables such as vessel availability, equipment delivery timing, timing of onshore processing capacity and approvals. Therefore, if installation and commissioning does not eventuate during the life of the relevant active EP (5-year term), or if a decision is made not to progress with development, a revised EP will be submitted, prior to the expiry of the active EP, which includes a pathway to P&A of the suspended wells in accordance with the requirements of Section 572.

If the decision is made not to proceed with development activities, plans for decommissioning will be finalised. Plug and abandonment of suspended wells will occur within 3-years of decision not to proceed with development, or the earliest timing within 3-years of the revised EP being accepted.

In the event the wells do not confirm access commercially viable resources for potential future in-fill development, well abandonment to be carried out within the well activity duration described within the EP, directly following drilling and evaluation as described in Section 4.3.5.3. Well equipment above the seabed (i.e. wellhead) are also recovered where not in use.

4.3.2.9 Logging

During drilling, it is necessary to gather formation information for ongoing drilling operations or to inform the effective recovery of hydrocarbons from the reservoir. This information is gathered real-time from Logging Whilst Drilling (LWD) tools, or by wireline.

Vertical Seismic Profiling (VSP) will not be included as an option, avoiding introduction of associated higher intensity impulsive noise.

4.3.3 Installation and Commissioning

Installation and commissioning phases will include the installation of flowlines and other subsea infrastructure plus testing activities. During this phase, wells will be connected to a commingling manifold or other tie-in point via flexible jumpers or rigid/flexible spools. Jumpers and spools are used to connect manifolds to flowlines and flowlines to ILTs. Existing ILTs are typically integrated into a skid with necessary double block and bleed valves that can be operated by a ROV.

To transition from construction to operation, facilities will go through a process of commissioning prior to start-up. Commissioning activities will ensure components of the East Coast Project are installed, tested and function correctly. Following commissioning activities, start-up activities will introduce hydrocarbons into the rest of the system. Installation and commissioning activities will involve:

- pre-lay works
- flowline system laying
- umbilical system laying (includes SUDU/UTAs)
- installation of subsea structures
- post-lay works including making up connections and adding stabilisation where needed.
- testing, preservation and start-up.

The duration of the above activities will vary for each field due to the numbers of wells, differences in flowline length and type and quantity of additional subsea infrastructure. Section 4.1.3 provides indicative frequencies and durations for activities, however the descriptions provided do not account for unforeseen events such as delays in vessel availability and extended weather delays.

All activities will occur within the operational area, with direct seabed disturbance from installation and commissioning located within the operational area, within an area equivalent to the proposed short-term disturbance corridor the long-term disturbance corridor (Section 4.1.2.2).

In the unlikely event that equipment is stored temporarily on the seabed due to storm or emergency events, the area of disturbance may be additional to the long-term disturbance corridor. It is estimated this would have a temporary footprint of ~50 x 50 m^2.

4.3.3.1 Prey-lay works

Pre-lay works that may be required within the operational area involve the installation of concrete mattresses and/or grout bags at pipeline crossings or in locations where pipeline spans may occur.

Trenching or excavation is not planned; it has historically not been practicable to trench in the Otway Basin due to the hard seabed. It has also not been considered necessary to trench equipment below the seabed in this area of the Otway region given a historical lack of potential sources of interaction, such as with commercial trawling; this lack of trawling is also related to the characteristic hard rocky seabed which is not conducive to ground trawling.

Pre-made concrete mattresses and grout bag may be deployed by crane or A-frame and will typically be guided into position on the seabed using an ROV. Grout bags may also be installed by pumping cement slurry/grout through a hose from the vessel to fill grout bags underwater. Some excess grout is released into the sea during this process when the hose is first filled with cement, and then flushed with seawater at the completion of operations.

The total number of concrete mattresses will not be known until the pre-lay survey is performed. Each mattress will have an approximate footprint of 18 m^2. The footprint on the seabed of grout bags on the seabed is typically confined to small areas overlapping the flowline footprint. Additional mattresses and grout bags may be required post-lay, to fill in any substantial gaps between the as-laid flowline system and seabed; this is also referred to as 'span rectification'(Section 4.3.3.4).The footprint of a grout bag is a consequence of the size of the bag with selection depending on the required stabilisation or the span of rectification but will typically be ~1 m^2.

For the purposes of impact assessment, the disturbance footprint for prey-lay works is included within the conservative area estimate for the long-term disturbance corridor.

4.3.3.2 Flowlines and umbilicals

Both rigid and flexible flowlines will be considered for the East Coast Project (see Section 5 for rationale). Flowlines and umbilicals may be installed within the same campaign through similar methods in respect to seabed disturbance. Installation for the flexible flowline / umbilical systems will most likely occur through reels or carousel methods depending on the length and vessel storage capacity. Due to the length of the flowline systems, the flowlines may be transported on an installation support vessel (ISV) or a Heavy Lift vessel (HLV). In the event flowlines are transported on HLVs, the flowlines may be transferred from a HLV to an ISV via multiple lifts over the course of the installation campaign. In the event the flexible flowline system is installed from multiple reels, the inline flange connections will be made up on deck during the lay progress.

Rigid reel lay is also feasible, which installs the rigid flowline system from a single reel but may involve several interim mobilisations to a spool base in order to replenish the reel with more product.

Rigid reel lay is undertaken from an ISV generally referred to as a reel lay vessel. Reel installation involves the welding together of long pipe segments, tested and coated onshore and then spooled onto a large, usually vertically oriented pipe reel. Once the installation vessel is in position, the pipe is unspooled, straightened and lowered to the seabed as the installation vessel moves forward. A dead man anchor (DMA) may need to be temporarily installed on the seabed to facilitate the initial laying of the pipe onto the seabed.

Any free span that exceeds pipeline design parameters will be mitigated via inclusion of a free span support beneath the pipeline. The support may comprise grout injected free span supports or concrete mattresses / grout bags / log mattresses and would sit within the disturbance corridor for the final pipeline and umbilical alignments within the operational area.

The infrastructure to be installed includes a total length of (including 25% allowance):

- ~65.92 km of flowline system (rigid and/or flexible)
- ~73.79 km of umbilical system.

The long-term direct disturbance footprint of the flowline / umbilical system on the seabed has been conservatively estimated to be equivalent to a 100 m wide corridor (Section 4.1.2.2). The footprint includes any disturbance along the flowline / umbilical routes due to installation. It also takes into consideration other equipment such as, jumpers or spools and stabilisation materials (including those at existing CHN pipeline crossings).

4.3.3.3 Installation of subsea structures

Subsea infrastructure including manifolds, skids, hot-tap tie-in structures, diverless hub, block and bleed system, spools, SUDUs, flying leads and stabilisation will be installed to connect the new production wells to the existing CHN system (see Table 4-5, Table 4-6 and Table 4-7, for a list of installed subsea structures).

Before installing subsea structures, a seabed survey will likely be conducted to ensure no existing obstacles that may hinder installation activities are within the operational area. In the unlikely event of encountering a significant obstruction, the debris/obstruction would be cleared. If a significant obstruction is encountered, the subsea system may be rerouted proximal to the planned layout.

Generally, structures / skids will be installed directly onto the seabed; or onto foundations with skirts, which are typically steel skirted mud mats. Subsea infrastructure will be lifted off an ISV by an onboard crane and deployed subsea, with an ROV or diver guiding the structure into place.

The tie-in points on the existing CHN system (ILTs and production Y) currently require diver assistance. Conversion of the existing tie-in points to a diverless system (is preferred for safety purposes) which will require the installation of a diverless hub and a block and bleed system. In the unlikely event that a hot-tap is required a hot-tap tie-in structure will be installed.

Internal cavities within the structures may be flooded with inhibited water or filled with MEG via inclusion of solid inhibitor sticks placed inside to minimise corrosion risk. These fluids and inhibitors are displaced to sea during subsequent activities (see Section 4.3.3.5).

Equipment to support accurate positioning of subsea structures and ROVs may include transponders. The temporary deployment of any transponders is likely to include skids and /or frames being deployed to the seabed. This will result in a temporary disturbance of <2 m^2.

As a part of commissioning operations seawater is typically used for flooding or dewatering of flowlines whereby inhibited seawater passes through filters as part of the seawater winning, or 'water-winning' operation.

4.3.3.4 Post-lay works

After flowline and umbilical installation, the use of stabilisation may be required, which will be in the form of high-density concrete mattresses placed at intervals along the flowline / umbilical system as required to satisfy detailed design requirements.

In addition, small scale 20–40 kg stabilisation grout bags may be situated on jumpers and flying leads to assist with stability and general protection.

For the purposes of impact assessment, the disturbance footprint for post-lay works is expected to be equivalent to the estimated long-term disturbance corridor.

4.3.3.5 Testing, Preservation and Start-up

Internal cavities within the structures may be flooded with inhibited water or filled with MEG with inclusion of solid inhibitor sticks placed inside to minimise the risk of corrosion. These fluids and inhibitors may be displaced to sea during subsequent pre-commissioning activities.

Following subsea infrastructure installation, equipment is inspected and tested via pre-commissioning activities, which will be subject to detailed execution planning:

- Flooding – seawater within the flowlines is displaced to fresh or inhibited seawater via water-winning operations to prevent corrosion and marine growth within the line. The inhibited water is pumped into the subsea system via a downline from the surface vessel.
- Cleaning – involves the use of a series of gel pigs which sweep the lines. Fluids, pumped from a surface vessel via a downline, are used to buffer and push the gel and are displaced to sea along with the gel at the receiver end during the cleaning operation. The pumped fluids may include MEG, water-based gel and inhibited water.
- Hydrotest – inhibited water within the flowline is topped up to test pressure via a downline from the surface vessel. Test pressure is held for 24 hours and monitored from the vessel. Where anomalies in pressure readings indicate a leak, this is investigated. Dye is incorporated into the flowline flooding medium to enable identification of leak points.
- One or more of these activities may be repeated. Once tested, depending on timing to start-up, the subsea system may be left flooded. Preservation fluids are used to preserve infrastructure before commissioning and operations.
- Dewatering – once testing is complete, the flowlines will be in a flooded state filled with preservation fluids (inhibited seawater) via water-winning operations. Prior to start-up of production from the wells, the subsea system is dewatered by displacing the lines with nitrogen gas. Nitrogen gas will be pumped from a surface vessel via a downline into the subsea system. The inhibited water is displaced to sea (at manifold or tie-in locations), until the system is filled with nitrogen gas. Nitrogen is an inert gas that makes up ~78% of the earth's atmosphere; it carries no risk of ignition and is non-corrosive.

Following the above steps, the system is entirely connected, tested and ready for start-up. The subsea equipment is operated by the onshore gas plant via the controls system. Once the gas plant is ready to receive hydrocarbons from any of the new wells, they can be opened and gas will flow through the flowlines per normal operations, pushing the nitrogen gas back to the Athena Gas Plant as part of the commissioning process.

Conservative volume estimates for fluids displaced to the sea from commissioning activities for all flowlines associated with the East Coast Project are compiled in Table 4-8.

Table 4-8: Estimated maximum discharge volumes from commissioning of the East Coast Project

Discharge Type	Key Components	Total Volumes**
Inhibited water	Seawater with chemical additives including corrosion inhibitor, oxygen scavenger, biocide and dye	3,232 m^3
MEG*	MEG c/w water mix. The calculated volume is for the full flexibles. The finalised procedure may result in slugs being used reducing the amount to ~10% of the full volume	3,232 m^3
Nitrogen gas	Nitrogen gas	3,232 m^3

**10-100% discharged at ~seabed level*

*** An additional conservative 50% has been added*

4.3.4 Operations

The principal activity during the operational phase of the East Coast Project will be the flow and transportation of hydrocarbons from the wells to the existing CHN pipelines and then to the Athena Gas Plant onshore.

Section 572(2) of the OPGGS Act requires a titleholder to maintain in good condition and repair all structures, equipment, and other property that is within the title area and is used in connection with the operations authorised by the title. Inspection, maintenance and repair (IMR) of subsea infrastructure is undertaken to ensure that the integrity of the hydrocarbon system is maintained at or above relevant standards. IMR activities may occur at any time during operations, as well as during commissioning and start-up.

Activities associated with operations under the scope of the East Coast Project include:

- hydrocarbon extraction and transport
- inspection (external and internal)
- maintenance and repair
- well intervention.

4.3.4.1 Subsea Operations

The operation, monitoring and control of wells will be conducted remotely from the Athena Gas Plant via the umbilical system. All well functions will be monitored and controlled from the gas plant control room through a Master Control System (MCS) via a Subsea Control Module (SCM) integrated into the SST at each well. All subsea control systems are likely to be electro-hydraulic.

Isolation of the pipeline will be able to be performed at the offshore wells, the onshore main line valve site and at the inlet to the Athena Gas Plant (upstream of the Athena Gas Plant slug catcher). Isolation valves, sub-surface safety and wellhead isolation valves are tested in accordance with the WOMP and facility Integrity Management Plan (IMP).

The hydraulic component of the umbilical is open loop, with small releases to sea (in the order of a few litres) of water-based control fluid at the wells during valve functioning.

Other fluids within the umbilical include MEG and could also include chemicals such as scale and corrosion inhibitor dosed with the MEG or separately via chemical injection cores within the umbilical. Some of the fluid contents of the umbilical may be displaced to sea during maintenance and repair activities, for example during umbilical jumper replacement, or intervention and re-termination of umbilicals in the event of a fault. Additionally, methanol may be used to manage hydrates if they occur within the flowline system.

4.3.4.2 Studies, Surveys and Monitoring

Studies and surveys that may occur over the operational life of the East Coast Project are listed below:

- peer reviewed scientific research and papers will be used to support the identification of environmental studies, surveys and monitoring required in future EP submissions during the life cycle of the field.
- offshore IMR surveys and ongoing operational monitoring of produced fluids to assess infrastructure integrity
- seabed and water sampling for contaminants of concern (e.g. NORMS, mercury, etc.), where there is a pathway for the contaminant to accumulate in either the seabed or water. Study design types will align with government guidelines for fresh and marine water quality (Australian Government, 2024) or equivalent, such as changeover space whereby disturbances are characterised by spatial patterns*.
- surveys of infrastructure to assess burial status and condition, including structural integrity through to defined end states (removal being base case).
- as-left survey following decommissioning activities
- monitoring surveys, determined on a case-by-case basis, in consideration of the impacts and risks and as described within EPs* accepted by NOPSEMA.

*The project concept is of a subsea development with no ongoing continuous discharges within the operational area. Planned discharges are mainly associated with temporary offshore construction and decommissioning activities; discharges of this nature have been undertaken historically in the region, and have been shown to result in little to no impact on water or sediment quality and associated amenity (Section 6.4.6 and Section 6.4.7).

Further details of surveys will be provided in respective EPs for each phase of the East Coast Project as project and campaign designs are matured.

4.3.4.3 Inspections

Subsea inspections proactively identify maintenance or repairs required with the aim of maintaining the assets as close to their design condition as possible. Inspection generally involves an IMR vessel travelling along the route of the subsea system with an ROV (and in some cases, divers). Inspections will be undertaken with a frequency determined based on risk and informed by monitoring and previous inspection results. Typically, vessels will be on site for ~2-4 weeks every few years to undertake inspection and/or maintenance works. This frequency is adjusted according to asset integrity risk which is informed both by offshore inspections and ongoing monitoring of asset integrity management measures.

Subsea inspections typically include:

- Cathodic protection measurement – completed using ROVs or AUVs and conductivity probes or by making visual assessments of anode wastage
- General visual inspections – involves ROVs or autonomous underwater vehicles (AUVs) deployed from a vessel; may also involve divers and a dive support vessel
- Marine acoustic surveys – includes the use of side-scan sonar (SSS) and multibeam echo sounders (MBES), and typically completed using towed acoustic instruments, ROVs, or AUVs
- Non-destructive testing – includes ultrasonic testing and electrical resistance testing, which are typically undertaken using an ROV or AUV deployed from a vessel. This type of testing may be performed to validate the results of other inspection techniques.
- Inline inspections/pigging (ILI) of the existing pipelines may occur in line with the Pipeline Integrity Management Plan (PIMP) with pigs received onshore at the Athena

Gas Plant. Any ILI program will involve minor discharge at Pecten East as part of the execution program.

- Wall thickness/fatigue monitoring/inspection—where required, fatigue monitoring equipment will be installed, inspected, and/or retrieved by an ROV deployed from a vessel.
- It is not planned for new production systems to be designed to accommodate inline inspections due to the short design life of the fields and the variation in diameters of the new system compared to the existing system, though is confirmed as part of detailed design.

Inspections typically take 4–6 hrs per structure, and 1–2 days for pipelines, totalling 2–4 weeks at sea for an entire inspection program including mobilisation and demobilisation.

4.3.4.4 Maintenance and Repair

Maintenance and repair activities may need to occur during the operational life of the field to:

- Prevent deterioration and/or failure of infrastructure
- Maintain reliability and performance of infrastructure.

Maintenance and repair activities are typically conducted in response to inspection findings, engineering analyses, and/or external events. The activities are typically performed by ROV from a vessel or by divers from a dive support vessel. Activities may include:

- cathodic protection system maintenance
- leak testing
- excavation (e.g. where pipeline has become buried by shifting sands)
- marine growth and hard deposit removal
- removal of debris (e.g. fishing equipment)
- rectification of electrical or hydraulic fault
- flowline repair
- pipeline gauging
- flowline jumper replacement
- service line/hydraulic capping plate removal and reinstallation
- subsea control unit change out
- replacement of equipment on the seafloor
- stabilisation deployment
- servicing of SSTs, flowlines, well maintenance (see Well Intervention), flanges and mechanical connections.

4.3.4.5 Well Intervention

Well intervention is the action of re-entering a well for purposes other than drilling; usually to:

- evaluate a well’s condition or performance
- remove obstructions
- stimulate the well
- repair well casing / tubing.

Well intervention generally occurs within the wellbore and involves specific types of tools that can be delivered down the inside the well itself. It includes activities such as:

- slickline / wireline / coil-tubing operations
- well testing and flowback

- well workovers (mechanical or hydraulic).

The frequency of well intervention activities depends on well performance which is measured through monitoring of production and via integrity tests involving the operation of well tree valves, typically completed by the control room operators within the onshore gas plant.

4.3.5 Decommissioning

4.3.5.1 Decommissioning Approach

Decommissioning of an asset involves sealing the wells and deconstruction and removal of equipment in a safe and environmentally responsible manner. Seabed surveys are used to understand levels of residual seabed disturbance at the end of decommissioning and inform restoration activities.

Decommissioning of offshore assets is required under the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act). Section 572(3) of the OPGGS Act requires titleholders to remove all equipment and other property in their title area that is neither used, nor to be used, in connection with operations. This obligation is ongoing and covers both the removal of equipment and property at the end of production and the removal of disused infrastructure at appropriate points throughout the life of an asset.

Cooper Energy acknowledges the requirement through Section 572 of the OPGGSA and NOPSEMA Policy Section 572 Maintenance and Removal of Property (N-00500-PL1903, A720369, November 2020) for removal of all property when it is no longer in use. Options other than the complete removal of all property may be considered if acceptable under the regulations and policies at that time. In the context of current regulations and policy, where alternatives to full removal are proposed, permissioning documents must demonstrate that the alternative delivers equal or better environmental outcomes compared to complete removal, and that the approach complies with all other legislative and regulatory requirements. Therefore, for the purposes of planning, full removal is the base case under current regulatory and policy settings, unless an alternative end-state is accepted by the regulator.

In planning for decommissioning, Cooper Energy also considers the actions and obligations involved in Title relinquishment, under Section 270 of the OPGGS Act (Cth) and Section 266 of the OPGGS Act (Vic). The following principles and conditions apply:

- ecologically sustainable development
- impacts and risks are reduced to ALARP and are of an acceptable level
- wells have been plugged or closed off in accordance with section 569(1) of the OPGGS Act (Cth).
- other international and domestic requirements
- the seabed within the Title Area is cleared of property installed, or authorised to be installed by the Titleholder, except where a deviation has been accepted by the Regulator.

EPs (to be) developed for the decommissioning phases will address these principles and conditions and outline the studies and surveys required to demonstrate compliance with Section 572 and Section 270 of the OPGGS Act.

Current regulatory expectation is that all facilities, pipelines and flowlines are decommissioned, including remediation of the marine environment and making good any damage to the seabed, within 5 years of permanently ceasing production. Table 4-9 outlines the expected abandonment and decommissioning timelines for the wells. Cooper Energy acknowledge these requirements however note the following specific additional aspects in relation to timing:

- Planning for decommissioning should commence in the early stages of project development and be considered in the design of the asset. A decommissioning plan will be developed for each asset, or group of assets within an operational area. For existing assets where decommissioning plans were not undertaken as part of the design process, the development of these decommissioning plans should be prioritised based on the complexity of the asset and the remaining operational life.

- The decommissioning plan must consider, where practical, progressive decommissioning of assets where they are no longer in use or to be used, over the operating life of the project, to the approved end state as soon as practicable or otherwise as agreed by NOPSEMA. Cooper Energy will evaluate the integrity risk to determine if shut-in or redundant equipment or infrastructure needs to be decommissioned out of sequence or during campaign field decommissioning.
- Decommissioning may occur across numerous campaigns, with some elements of the facility decommissioned within interim campaigns, or within the full field decommissioning campaign. When a MODU is undertaking infill drilling or workovers within a field, Cooper Energy will also consider whether the MODU could be used to decommission wells within the field that have ceased production, are shut-in, and which do not have potential for future use.

Additionally, any proposal to permanently leave infrastructure in situ, will require a permit where applicable under the *Environment Protection (Sea Dumping) Act 1981*. Under the Sea Dumping Act, 'dumping' includes abandonment or toppling at site of platforms or other man-made structures at sea.

Key activities associated with decommissioning of infrastructure discussed within this OPP are summarised in the following sections.

Table 4-9: Indicative Decommissioning Plan

Asset	Scope	Indicative Timing	Notes	Deviation from Section 582
Offshore Wells – future production not commercially viable	Plug and Abandon Wells, recover well equipment above seabed.	Immediately following drilling and well evaluation.	In the event the wells do not confirm and access commercially viable resources for potential future in-fill development, well abandonment to be carried out within the outlined well activity duration, directly following drilling and evaluation.	No planned deviations.
Offshore Wells – future production commercially viable – development approvals (OPP, EP) submitted, development proceeding.	Plug and Abandon Wells, recover well equipment above seabed.	Within 3-years of cessation of production from all assets within a production system, or up to 10 years from production cessation from an individual well where integrity can be demonstrated, and where accepted within applicable permissioning documents. Timings may vary from described here depending on well and production	In a success case the intent is that wells will be completed and left in a suspended state to enable future within the broader Otway production system (pending regulatory approvals and licensing). In this scenario, and after receipt of relevant approvals and licenses, wells will be converted into production wells, integrated into Cooper Energy's Otway	No planned deviations. Where well integrity can be assured, the wells will be abandoned within 3-years of full field cessation. If the well(s) lose monitoring capabilities during their shut-in period awaiting field abandonment (before cessation of production), a risk assessment will be performed to determine if a separate well abandonment

		system integrity, risks to safety and the environment, and government decommissioning policy.	operations and operated, monitored and managed in accordance with the WOMP. If production ceases from wells incrementally, wells which are no longer producing will be monitored in accordance with the WOMP, until their abandonment.	campaign is required under the NORSOK D-10 classification of "temporary abandonment – without monitoring" to comply to industry standards.
Offshore Wells – future production commercially viable – development approvals not submitted, development not proceeding.	Plug and Abandon Wells, recover well equipment above seabed.	Within 3-years of decision not to proceed with development, or up to 10 years from the commencement of suspension of an individual well where integrity can be demonstrated, and where accepted within applicable permissioning documents. Timings may vary from described here depending on well and production system integrity, risks to safety and the environment, and government decommissioning policy.	In a success case the intent is that wells will be completed and left in a suspended state to enable future use within the broader Otway production system (pending regulatory approvals and licensing). If a decision is made not to proceed with development activities, plans for decommissioning will be finalised.	No planned deviations.

4.3.5.2 Surveys

Surveys within the operational area will be undertaken before and following decommissioning using ROV deployed from a vessel. Survey's aid understanding of the integrity of infrastructure, and aid retrieval planning. Techniques used are similar to that described in Section 4.3.1.

Additional monitoring may be undertaken following decommissioning and would be planned in further detail closer to the time of decommissioning, accounting for information gathered during surveys. Surveys that may apply to operational and decommissioning phases are described in Section 4.3.4.2.

4.3.5.3 Well Abandonment

Wells will be abandoned after the cessation of production, if the decision is made to not process with development activities, or in the event that wells do not confirm commercially viable resources for future in-fill development. Well abandonment activities are undertaken to isolate the reservoir section of the well and mitigate the risk of a potential release of reservoir fluids to sea. Interim well suspension activities prior to well abandonment are not expected based on current development concepts, however, should they be required, well suspensions would be undertaken as described in Section 4.3.2.8.

Residual gas in the well fluids may be bled off or flared during well abandonment. Levels of flaring would depend on pressures within the well, however at end of well life the gas within the wells would be expected to be significantly depleted. If flaring is required, it would be expected to be low levels, in the order of 1 day per well at a rate of ~18 MMscf/well/day and would only occur from one well at a time.

Activities during the well abandonment process may include:

- remove tree cap
- install pressure control equipment
- flowline flushing
- kill and suspend well
- disconnect equipment and remove SST
- installation and removal of pressure control equipment
- remove tubing and control lines
- install permanent reservoir barriers.

Plug and abandonment operations involve setting a series of mechanical plugs, then cement plugs within the wellbore, including plugs above and between any hydrocarbon bearing intervals, at appropriate barrier depths in the well and at the surface. These plugs are tested to confirm their integrity.

Cutting and removal of wellheads is common in areas where their presence may be a navigational hazard. The base case plan will be to remove the wellheads, however if a wellhead is cemented beyond the cutting tool limits, the wellhead may be left in-situ subject to regulatory approval.

The method for installation and appraisal of the barriers for abandonment will be the same regardless of whether the wellhead remains in place or not.

Well abandonment operations will be assisted by a moored, or DP assisted moored MODU, and are expected to last ~25 days and result in cement discharge of ~8 m^3 per well.

All plug and abandon operations will be conducted in accordance with relevant standards, as detailed within a NOPSEMA-accepted WOMP.

4.3.5.4 Flowline and Umbilical Decommissioning

Prior to removal of flowline systems, best endeavours will be made to clean and flush the flowline systems via pushing the production fluids back into the production wells, or alternatives such as flushing to shore facilities where fluids will be recovered and treated according to local requirements. The recovery method for flowlines will depend on whether they are rigid or flexible. In general terms there are two viable options for recovering flowlines and umbilicals which are dependent on their material composition:

- Option 1: Recovery via ‘reverse reel or carousel’. This method is likely only suitable for flexible flowlines and umbilicals. It involves the recovery of materials onto a reel or carousel located on the deck of a vessel using a hub drive and tensioner system. If the flowlines are rigid and installed via reel lay method, then a reverse reeling scenario may be a feasible solution.
- Option 2: Recovery via ‘recover and cut’. This retrieval method is only suitable for flexible flowlines and umbilicals. It involves the recovery of materials to the vessel deck, secured through tensioners and cut into manageable pieces on the vessel deck.
- Option 3: Recovery via ‘cut and recover’. This retrieval method is only suitable for rigid flowlines. It involves the subsea cutting of infrastructure using an ROV and cutting tool prior to recovering the materials to the vessel.

Either option, a combination or all, may be used as part of decommissioning (Section 5). Further, it should be noted that over the course of operational life, technology advancements and opportunities for different approaches will be continually investigated and evaluated.

Flushing and cleaning of flowlines may result in discharge to sea. Preference is typically to discharge volumes downhole to the production wells before they are abandonment. Following well abandonment, the remaining contents of the flowline will be released to sea post-disconnection of the flowlines from the wells. See Table 4-10 for estimated maximum discharges from flushing and cleaning of all flowlines associated with the East Coast Project.

Table 4-10: Estimated maximum discharge from flushing and cleaning of flowlines

Discharge Type	Key Components	Total Volumes*
Inhibited water	Seawater with chemical additives including corrosion inhibitor, oxygen scavenger, biocide and dye.	3,232 m^3
MEG/Water	MEG and water mix. The finalised method may result in slugs being used which would reduce the volume by ~90%.	3,232 m^3
Nitrogen gas	Nitrogen gas for decommissioning is unlikely to be used for dewatering of the flowline system as part of recovery but will be subject to engineering as part of execution phase. The finalised method may result in reduction of this volume to zero	3,232 m^3

** An additional conservative 50% has been added*

4.3.5.5 Removal of Remaining Subsea Infrastructure

The remaining subsea infrastructure will also require decommissioning; this includes spools and jumpers, subsea structures, controls structures, stabilisation equipment and so on. Prior to removal the condition of subsea infrastructure at the time will be assessed. Structures may need to be modified subsea to facilitate removal. The seabed around structure foundations may need to be excavated if they have become buried, or structures may need to be toppled to break sediment suction and cutting may also be required. Equipment such as well heads will be cut at or below seabed level and recovered to a vessel.

A vessel with suitable crane capacity and deck space for marine spread and recovered equipment will be used for the above activities. It should be noted that over the course of operational life, technology advancements and opportunities for different approaches will be continually investigated and evaluated.

All decommissioning activities will occur within the operational area, within an area equivalent to the long-term disturbance corridor (Section 4.1.2.1). However, in the unlikely event that equipment is stored temporarily on the seabed due to storm or emergency events the area of temporary disturbance may be additional to the long-term disturbance corridor. It is estimated this would have a temporary footprint of ~50 x 50 m.

4.3.5.6 Title Relinquishment

Section 270(3)(c) to (f) of the OPGGS Act requires titleholders to meet obligations with respect to property and the environment to the satisfaction of NOPSEMA in support of consent to surrender title. This includes the requirement to:

- plug all wells
- remove property or implement accepted alternative arrangements
- make good any damage to the seabed or subsoil
- make provisions for conserving and protecting natural resources.

Accordingly, Cooper Energy undertakes decommissioning planning and decision-making with due consideration to obligations related to title relinquishment and understand that in addition to well P&A and property removal, seabed remediation may also be required.

NOPSEMA Policy document on Section 270 Consent to surrender title (2022) describes the EP as the key permissioning document under which arrangements in relation to property, conservation and protection of natural resources, and making good any damage to the seabed or subsoil prior to surrender of the title can be addressed by a titleholder and accepted by NOPSEMA. The well operations management plan (WOMP) is the key permissioning document under which arrangements in relation to permanently abandoning a well or wells prior to the surrender of the title can be addressed by a titleholder and accepted by NOPSEMA. As such, it is these regulatory plans, EPs and WOMPs, and the regulatory acceptance of these plans, that would demonstrate how Cooper Energy will meet the permit surrender requirements. EP performance reporting and well abandonment reporting to the regulator provides a means of confirming permit surrender requirements are met.

4.3.6 Support Activities

Support activities associated with the scope of the East Coast Project are likely to include a MODU, vessels, helicopters and ROVs or AUVs, and are specific to each phase (Table 4-11).

Table 4-11: Support activities for each development phase

Support Activity		Development Phase				
		Surveys	Drilling	Installation and Commissioning	Operations	Decom
MODU			✓		✓*	✓*
Support vessels	Survey vessels	✓		✓	✓	✓
	Heavy lift vessel (HLV)			✓		✓*
	Installation vessel (ISV)			✓	✓	✓
	Reel lay vessel			✓		✓
	IMR vessel		✓*		✓	✓*
	Anchor handler vessels		✓		✓*	✓
	Platform Supply vessel (PSV)		✓		✓*	✓
	General supply vessel		✓	✓	✓	✓
	Diver support vessel (DSV)			✓	✓	✓
Helicopter			✓	✓	✓	✓
ROV / AUV		✓	✓	✓	✓	✓

**if required*

Indicative duration and frequencies of support activities across the life cycle of the East Coast Project are shown in Figure 4-3.

4.3.6.1 MODU Operations

Cooper Energy will contract a MODU for drilling, well abandonment and (if required) intervention/workover activities during the operations phase. The market for MODUs is global, hence MODU's may be brought in from overseas or from within Australian waters depending on the levels of well activity elsewhere within the Australian offshore industry. To best suit the conditions of the Otway region and the depth of the East Coast Project, the MODU will be either be a moored MODU or a DP-assist moored MODU (see Section 5 for further rationale).

The MODU is moored to the seabed with ~8-12 anchors, which are tethered to the MODU with mooring lines.

The MODU may use DP systems for initial positioning at site or will otherwise be towed into position at the well location by one or more support vessels. The MODU is fitted with various equipment to support operations including:

- pressure control equipment capable of sealing the well such as a BOP
- derrick with rotating equipment and drill pipe
- wireline unit for well logging
- flowback package providing flaring capability
- cement unit
- work class ROV(s)
- mooring system (possible DP assist)
- power generation systems
- cooling water and freshwater systems
- drainage, effluent and waste systems
- bulk storage tanks for cement and weighting agents
- sack room for storage of drilling fluid additives
- mud pits (tanks to store and maintain drilling fluids) – in the order of 1000 m^3 combined capacity
- solids control equipment used in drilling to separate the solids and drilling fluids (this may include shale shakers, centrifuging systems and cuttings driers).

Non-drilling activities occurring on the MODU include:

- bunkering / bulk transfer of fuel, chemicals, and supplies
- transfer of waste to supply vessels
- discharge of:
  - sewage, greywater and food waste
  - cooling water and reverse osmosis (RO) brine
  - deck drainage and bilge
- helicopter operations (expected to be ~5–8 round trips per week from the mainland to the MODU).

Refuelling of the MODU and bunkering will be required during the activity and is managed under the MODU's control of work systems.

A MODU will be in the operational area throughout the drilling phase, during well abandonment and will be used as needed for well intervention during the operations phase. There are typically up to ~140 to 200 personnel on board (POB) the MODU.

4.3.6.2 Vessel Operations

Vessels may be contracted from international or Australian suppliers and will vary depending on the proposed activity, phase and vessel availability. The expected vessel types include:

- survey vessels
- HLV
- ISV
- reel lay vessel
- IMR vessel will be dependent on the work scope.
- anchor handler vessel
- general supply vessel / platform supply vessel
- DSV.

Activities associated with these vessels include:

- bunkering and bulk transfer of fuel, chemicals and supplies to the MODU
- collection and treatment of waste from the MODU
- discharge / management of:
  - sewage, greywater and food waste
  - cooling water and brine
  - deck drainage and bilge
- vessel positioning
- towing the MODU
- conduct IMR activities
- perform installation and decommissioning activities
- support diver operations
- mooring installation.

Vessels will use light marine fuel such as marine diesel oil (MDO) or marine gas oil (MGO), instead of heavy fuel oil (HFO).

All vessels will initially mobilise and demobilise at ports outside of the operational area. Crew changes for smaller vessels (anchor handler vessels) will typically be conducted at local ports outside of the operational area.

The MV Silver Star has been used as an analogue to inform the potential specifications of the smallest vessel which may be contracted to complete service activities between phase specific vessels or a MODU. This type of vessel has been used for survey work within the Otway region around the East Coast Project Fields. This vessel has a length overall of <40 m, can accommodate around 20 POB and has a total fuel tank capacity of ~45 m^3.

The Siem VS491 CD (AHTS) has been used as an analogue to inform the potential specifications of the AHTSs that may support MODU activities. This vessel has a length overall of 91 m, can accommodate a total of 60 POB and the largest single fuel tank is approximately 165 m^3 (Siem Offshore, n.d). AHTS vessels are expected to occur within the operational area more consistently during drilling, installation, IMR and decommissioning activities when phase specific vessels or a MODU are required. Supply vessels undertaking resupply could be expected to remain on station using DP for ~6 hours per day.

The Skandi Acergy (an ISV) has been used as an analogue to inform the potential specifications of the largest vessel which may be contracted to complete installation activities as described in the Section 4.3.3. This vessel has a length of 157m, can accommodate a total of 140 POB and the largest single fuel tank is approximately 600 m^3 (Subsea 7, 2024). During installation the ISV is expected to occur within the operational area for ~45 days per campaign.

Larger vessels (i.e. reel-lay) will be serviced by helicopters. Outside of drilling, a maximum of one ISV and 2 support vessels may be in the operational area at a given time.

Vessels will typically use main or multiple thrusters on DP to maintain position, but in an emergency, anchoring may be required. A vessel anchored within water depths greater than 70 m with a single anchor could result in a total disturbance area of up to 1,300 m^2 (NERA, 2018).

All vessels contracted under the East Coast Project will comply with relevant legislative requirements such as MARPOL. An assessment of the accidental release of MDO from project vessels is assessed in Section 9.5.

Vessels transiting to and from the operational area are managed under the *Commonwealth Navigation Act 2012* and therefore this activity is excluded from the scope of the OPP.

4.3.6.3 Helicopter Operations

Helicopters will be used during the drilling and installation activities, primarily for crew change and medevac, and occasionally equipment and material transfers. Helicopter flights will peak during drilling, decommissioning and installation and commissioning phases and are expected to occur ~5 -8 times per week.

Frequency will depend on the progress of the drilling program, subsea installation and logistical constraints.

4.3.6.4 ROV Operations

Inspection and / or work-class ROVs are required for IMR activities (AUVs may also be used). A ROV is a tethered underwater vehicle operated by a crew aboard the vessel or MODU. They are linked by either a neutrally buoyant tether or often when working in rough conditions, deeper water or with large payloads, a load carrying umbilical cable is used along with a tether management system. An AUV is an untethered underwater vehicle operated in a similar manner to an ROV.

ROVs are equipped with a video camera and lights. Additional equipment may include positioning[6] and survey equipment, and various apparatus to support installation and IMR activities. ROVs may utilise electric control system or a closed loop hydraulic control system. ROVs may be required to park or moor on the seabed and may temporarily sit on the seabed as part of execution activities. Any such temporary parking would be expected to occur within the spatial extent of direct disturbance.

4.3.6.5 Diver Operations

Diving may be required during installation or maintenance activities. A saturation DSV would be utilised to support diving and would have a diving bell to transport divers to and from the surface to the work area.

[6] Ultra-Short Baseline (USBL) positioning systems use high frequency-short-range acoustic signals. The signals are produced by a small battery-operated beacon which may be attached to ROVs, deployed by ROVs to subsea equipment and the seabed. The USBL system sends / receives and interprets signals in real time to establish precise locations of equipment and vessels.

5 Alternatives Analysis

Section 7(2)(f) of the OPGGS(E)R, requires the proponent of an OPP to provide:

'a description of any feasible alternative to the project, or an activity that is part of the project, including:

(i) a comparison of the environmental impacts and risks arising from the project or activity and the alternative; and

(ii) an explanation, in adequate detail, of why the alternative was not preferred.'

Consideration of alternatives for the East Coast Project has been conducted in accordance with NOPSEMA's current OPP content requirements (N-04790-GN1663 A473026, January 2024).

This section addresses this requirement by undertaking an analysis of the feasible alternatives for the:

- project concept (Section 5.2)
- design and activities of the selected concept (Section 5.3).

5.1 Methodology

The comparative assessment which influenced Cooper Energy's selection of feasible alternatives considered the following focus areas:

- environmental
- technical feasibility
- safety
- commercial
- social
- cultural.

The alternatives assessment was conducted utilising a two-step process:

(1) Comparison of alternatives against environmental criteria to identify the option(s) with the least environmental impact

(2) Further comparison of alternatives against other criteria (technical, safety, commercial, social and cultural).

Each focus area was broken down further into specific assessment criteria (Table 5-1) which allowed for a qualitative assessment of identified options.

Because the development concept alternatives include some onshore impacts and risks, there are additional criteria for Section 5.2.1, shown in Table 5-1 with an asterisk.

Table 5-1: Assessment Criteria used in Alternatives Analysis

Focus Area		Criteria
Environment	Impacts	Seabed disturbance Ground disturbance* Underwater sound emissions Atmospheric emissions / GHG Light emissions Planned liquid and solid discharges Life-of-field
	Risks	Accidental releases Interaction with marine fauna

Focus Area		Criteria
		Interaction with terrestrial fauna* Introduction of invasive marine species (IMS) Introduction of terrestrial non-indigenous species* Fire*
Technical Feasibility	Operability and feasibility risk	Technical feasibility and ability to operate and maintain
	Technical readiness	Acceptable technology readiness level
	Constructability	Feasibility to construct Reusability Feasibility of decommissioning
Safety	Safety and risk	OHS & risk exposure Process safety
Commercial	Schedule risk	Ability to meet the development timeline
	Cost risk	Economic viability
	Future flexibility risk	Ability to accommodate future developments
Social	Socioeconomic impacts	Impact to landholders* and marine and coastal users
	Reputation	Social licence to operate
Cultural	Cultural heritage	Impact to cultural heritage sites Impact to First Nations people's cultural heritage

**Only relevant for development concepts 2 and 3*

Identified options are assessed against the criteria and assigned a score between 1 and 5 to allow for differentiation between them. Table 5-2 shows the qualitative ranking scale developed for the alternative assessment. Where there is no material differentiation between options, they are each given a score of 3.

If criteria are not relevant for an option, they are given N/A (not applicable) – in particular 'life-of-field' is only relevant for the development concept alternatives (Section 5.2).

Subtotals of the scores are provided for environmental criteria and "other" criteria. This results in a qualitative total which represents all potential project drivers; with the lowest score giving the best outcome.

Table 5-2: Qualitative Ranking Scale for Alternative Options

Score	Guidance
1	Substantially better compared to other options
2	Marginally better compared to other options
3	Options are equal when compared to each other
4	Marginally worse compared to other options
5	Substantially worse compared to other options

5.2 Analysis of Concept Alternatives

Cooper Energy has considered 6 different development options during the alternative analysis comparative assessment process. This assessment identifies the benefits, impacts and potential risks that correspond with each development concept. A brief overview of each concept is provided in Table 5-3.

Table 5-3: Overview of Development Concept Alternatives

Development Concept	Overview
Option 1 – Subsea tie-back to existing subsea facilities	Selected concept (described in detail in Section 4). Uses a MODU and vessels to drill and install subsea production wells, control system and production gathering system. New subsea infrastructure tied-in to the existing infrastructure in CHN fields. Well fluids gathered via flowline which ties into existing CHN pipeline and are transported for processing onshore at the Athena Gas Plant.
Option 2 – Subsea tie-back via new trunkline to onshore facility	Uses a MODU and vessels to drill and install subsea production wells, control system and production gathering system. Well fluids gathered via flowline and tied into a new pipeline. Installation of new subsea pipeline to the Athena Gas Plant onshore. Requires a new shore crossing and onshore pipeline.
Option 3 – Subsea tie-back to onshore facility via third-party infrastructure	Uses a MODU and vessels to drill and install subsea production wells, control system and production gathering system. Well fluids gathered via flowline and tie into a new pipeline, using existing local shore crossing infrastructure (owned by a third-party). Requires a new onshore pipeline to transport fluids to Athena Gas Plant for processing.
Option 4 – Offshore fixed facility	Uses an offshore fixed structure. Well fluids produced are transported through flowlines and risers to the fixed facility. From the fixed facility, well fluids will be transported via flowline and tied into the existing CHN pipeline for processing onshore at the Athena Gas Plant.
Option 5 – Floating, production, storage and offloading facility (FPSO)	Uses an FPSO facility. Well fluids produced are transported through flowlines and risers to the FPSO facility where they are stored, separated and treated. From the FPSO well fluids will be transported via flowline and tied into the existing CHN pipeline for distribution via the onshore Athena Gas Plant.
Option 6 – No development	No development.

Development concept 4 – Offshore fixed facility was discounted during early screening and was determined to not be commercially or economically viable. Development of a new offshore fixed facility is avoidable due to the close proximity of the East Coast project to existing onshore processing (AGP) with a readily available distribution pipeline present. Introducing a permanent offshore fixed facility not being used for processing, would duplicate the nearby plant processing functionality. The shallow water depth, variable metocean conditions and configuration of fields and prospects within the East Coast Project make the use of a fixed facility commercially unfeasible to design and execute. Additionally, the incremental volumes of gas (and hence project life) expected from the East Coast Project are not sufficient to justify the cost or level of activity required to install and operate a fixed offshore facility. Therefore, this concept was de-selected at an early stage and has not been assessed further.

Development concept 5 – FPSO was discounted early during screening and determined to not be commercially or economically viable. FPSOs are most suited to deep / ultradeep waters distant from processing facilities, with hydrocarbons being processed and offloaded onto a tanker for transportation ashore to negate the need to build permanent structures. The East Coast Project is located in close proximity to existing onshore processing (AGP) with a readily available distribution pipeline present. Introducing a FPSO would needlessly duplicate plant processing functionality. Similar to *development concept 4*, the incremental volumes of gas (and hence project life) expected from the East Coast Project do not justify the establishment of an FPSO as the cost and level of activity required to operate the facility are not considered proportionate. Therefore, this concept was de-selected at an early stage and has not been assessed further.

Development concept 6 – No development was de-selected at an early stage. Developing the petroleum resources aligns with the Australian Government's offshore development policy to explore and develop offshore petroleum resources, which provides benefits to the community including royalties, taxation revenue, employment, national energy security and regional development. The base case concept aligns with the DSIR Future Gas Strategy (2024), by continuing to provide energy via existing supply networks, from sources close to the domestic energy market, thereby minimising emissions associated with shipping and import of interstate or international sources of gas (Section 1.3.1).

In order to satisfy offshore title and permit requirements, as the titleholder, Cooper Energy has an obligation to pursue the development of commercially viable hydrocarbon reserves. In this context, selection of the 'no development' alternative at this stage of planning, is not consistent with the legal obligations placed on a Titleholder, or the commercial objectives of Cooper Energy. As demonstrated in this OPP, Cooper Energy considers that the environmental impact and risks can be managed to an acceptable level. Therefore, this concept was not considered further.

5.2.1 Comparative Assessment of Development Concepts

The layout of the project proposed is shown within the Activity description in Figure 1-2. The layout of alternative concepts 2 and 3 is shown below in Figure 5-1 and Figure 5-2 (respectively) for the readers context and to help hypothetical comparison of proposed project and alternative concept footprints, Typical activities associated with each concept were identified, grouped and assessed against environmental criteria, as displayed in Table 5-4.

Table 5-5 provides a comparative assessment of the development concept alternatives against the criteria explained in Table 5-1.

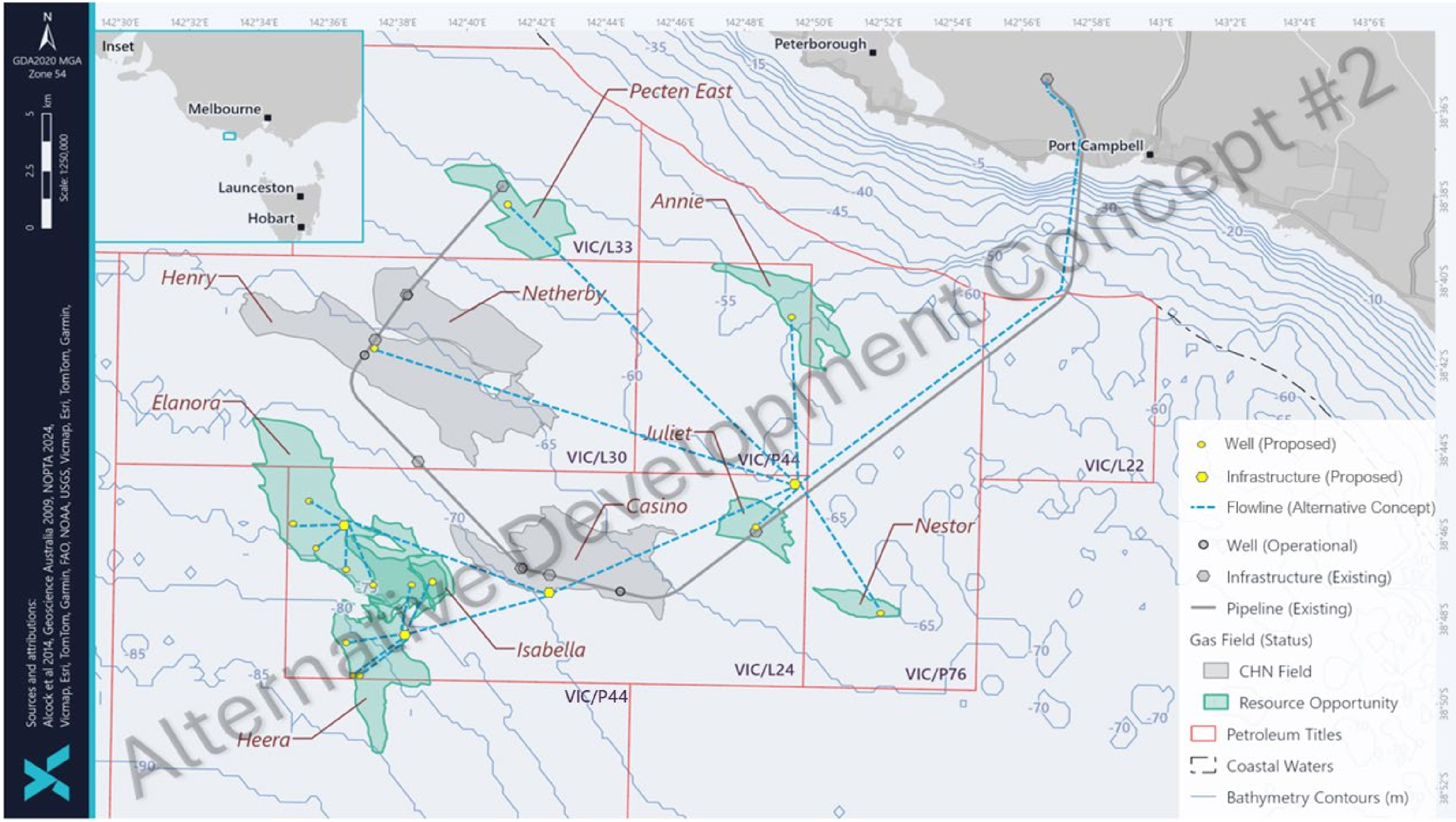


Figure 5-1: Location and Layout of Alternative Development Concept #2

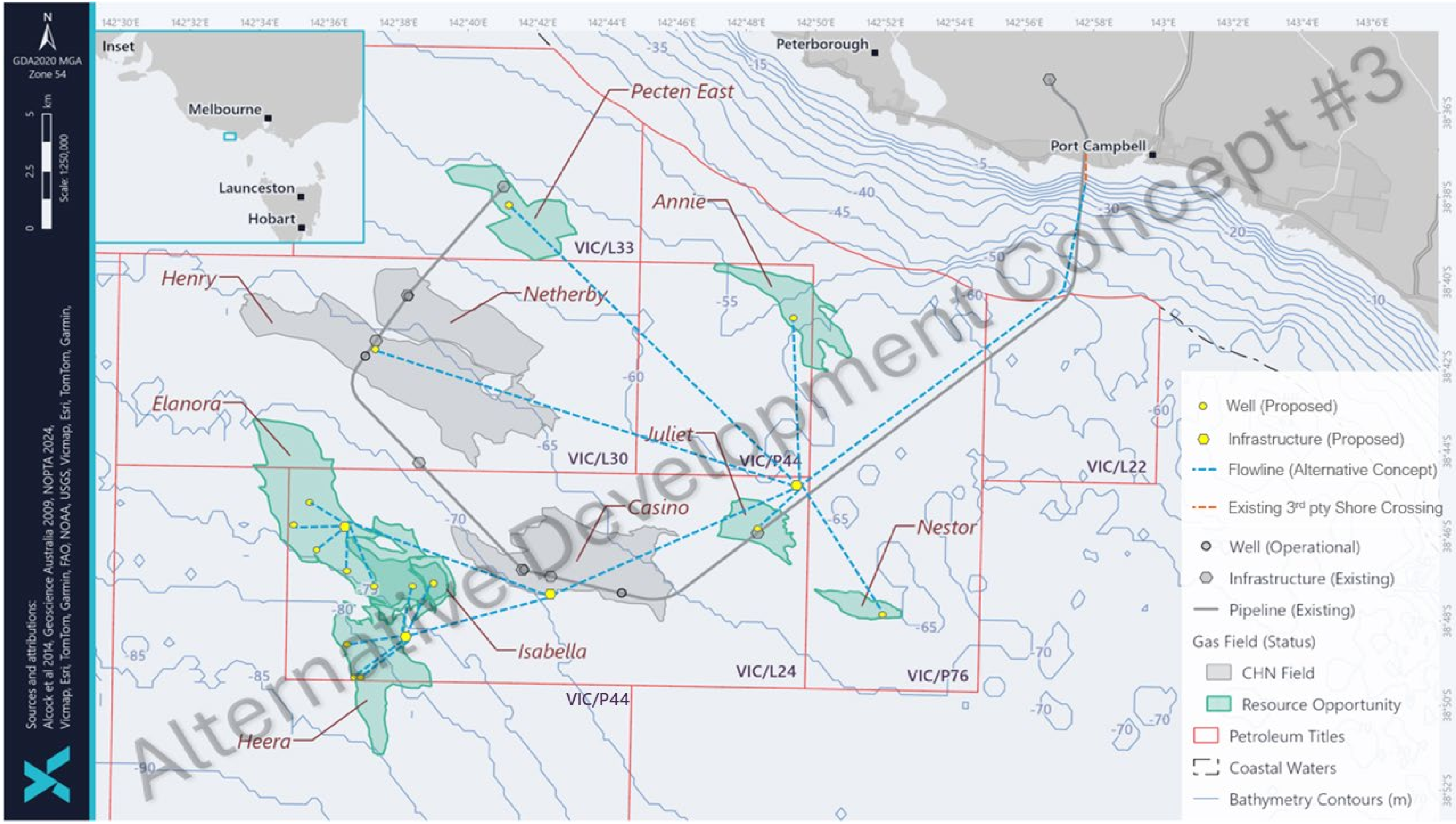


Figure 5-2: Location and Layout of Alternative Development Concept #3

Table 5-4: Environmental Criteria Related to Activities Associated with each Development Concept

Activity	Related Concept	Impacts					Risks						
		Seabed Disturbance	Ground Disturbance	Underwater Sound Emissions	GHG and Atmospheric Emissions	Light Emissions	Planned Discharges	Interaction with Marine Fauna	Interaction with Terrestrial Fauna	Introduction of IMS	Introduction of terrestrial Non-indigenous Species	Fire	Accidental Releases
Site Surveys													
Geophysical survey	1,2,3			✓			✓						
Geotechnical survey	1,2,3	✓		✓			✓						
Onshore survey	2,3		✓						✓			✓	
Well Construction Activities													
Mobilisation / demobilisation of MODU	1,2,3	✓					✓	✓		✓			✓
Drilling of wells	1,2,3	✓		✓			✓						✓
Well clean-up	1,2,3				✓	✓	✓						✓
Installation, hook-up and commissioning													
Installation and commissioning of flowlines	1,2,3	✓					✓	✓					✓
Onshore construction and commissioning													
Clearing and site preparation	2,3		✓		✓				✓		✓	✓	✓
Shore crossing	2,3		✓						✓		✓		✓
Installation of onshore pipeline	2,3		✓						✓		✓	✓	✓
Operations													
Inspection, Maintenance and Repair	1,2,3	✓					✓			✓			✓
Well Intervention	1,2,3				✓	✓	✓						✓
Decommissioning													
Plug and abandon wells	1,2,3	✓		✓	✓	✓	✓	✓		✓			✓
Removal of infrastructure	1,2,3	✓		✓			✓	✓		✓			✓
Decommissioning and closure	2,3		✓				✓		✓				✓
Rehabilitation	2,3	✓		✓			✓	✓	✓	✓			✓
Support Operations													
Onshore equipment operation	2,3		✓		✓	✓			✓		✓	✓	✓
Vessel operations	1,2,3	✓		✓	✓	✓	✓	✓		✓			✓
ROV operations	1,2,3	✓						✓					✓
Aircraft operations	1,2,3			✓	✓			✓					✓

Table 5-5: Comparative Assessment of Development Concepts

	Criteria	Evaluated Concepts					
		(1) Subsea tie-back to existing subsea facilities		(2) Subsea tie-back via new pipeline to onshore facility		(3) Subsea tie-back to onshore facility via third-party infrastructure	
		Score	Rationale	Score	Rationale	Score	Rationale
Environmental Impacts	Seabed disturbance	1	Minor disturbance due to subsea development extension and flowline installation to existing CHN pipeline.	5	Largest disturbance footprint of all options due to additional footprint of new pipeline to shore, and shore crossing	4	Moderate disturbance footprint resulting from new pipeline. Less coastal disturbance than Option 2 due to use of existing shore crossing infrastructure.
	Ground disturbance	1	No onshore component.	5	Largest footprint of ground disturbance onshore from a new shore crossing and new onshore pipeline to Athena Gas Plant.	4	Requires some ground disturbance from a new onshore pipeline to Athena Gas Plant; however existing shore crossing infrastructure can be used.
	Underwater sound	1	No permanent surface facilities. Noise generated primarily during temporary vessel and MODU-based activities offshore.	3	No permanent surface facilities. Noise generated primarily during temporary vessel and MODU-based activities offshore. Additional noise emissions due to extended pipelay campaign, particularly nearshore in shallow water where marine mammal sensitivities are known to occur (i.e., southern right whale reproduction BIA)	3	No permanent surface facilities. Noise generated primarily during temporary vessel and MODU-based activities offshore. Additional noise emissions due to extended pipelay campaign.
	Atmospheric and GHG	1	Minor fugitive emissions, with processing undertaken at the existing Athena Gas Plant. Less emissions from construction and decommissioning activities due to shorter tie-ins and shorter durations compared to other options.	5	Additional emissions from construction and decommissioning activities due to longer pipeline, and extended installation and decommissioning periods. Additional emissions generated from clearing and onshore works.	4	Additional emissions from construction and decommissioning activities due to extended installation and decommissioning periods. Some clearing and onshore works required.
	Light	1	Minor temporary impact due to use of artificial light during drilling,	4	Additional emissions from construction and decommissioning activities due to	4	Additional emissions from construction and decommissioning activities due to extended installation and decommissioning periods.

	Criteria	Evaluated Concepts					
		(1) Subsea tie-back to existing subsea facilities		(2) Subsea tie-back via new pipeline to onshore facility		(3) Subsea tie-back to onshore facility via third-party infrastructure	
		Score	Rationale	Score	Rationale	Score	Rationale
			construction and decommissioning.		extended installation and decommissioning periods. Works required nearshore.		Works required nearshore.
	Planned discharges	1	Typical discharges from development, operational and decommissioning activities.	4	Additional discharge volumes from operational activities due to extended development and decommissioning campaigns of additional infrastructure.	4	Additional discharge volumes from operational activities due to extended development and decommissioning campaigns of additional infrastructure.
	Life-of-field	1	Minor source of environmental risk and impact, with smallest physical offshore footprint.	5	Larger physical onshore and offshore footprint. Additional resources consumed for extra installation and decommissioning.	2	Moderate physical nearshore and offshore footprint.
Environmental Risks	Accidental releases	3	No material difference in risk of subsea well or flowline loss of containment	3	No material difference in risk of subsea well or flowline loss of containment	3	No material difference in risk of subsea well or flowline loss of containment.
	Interaction with marine fauna	1	No surface facilities. Potential fauna interaction during construction and decommissioning.	5	No surface facilities. Higher potential for fauna interaction during extended construction and decommissioning. Additional risk for coastal species.	4	No surface facilities. Higher potential for fauna interaction during minor extension for construction and decommissioning. Additional risk for coastal species.
	Interaction with terrestrial fauna	1	No onshore component.	5	Risk of injury/mortality to terrestrial fauna due to onshore equipment and excavations.	4	Risk of injury/mortality to terrestrial fauna due to onshore equipment and excavations.
	Introduction of IMS	3	Risks associated with construction, decommissioning and IMR fleets.	3	Risks associated with construction, decommissioning and IMR fleets.	3	Risks associated with construction, decommissioning and IMR fleets.
	Introduction of NIS	1	No onshore component.	5	Risk of introduction of NIS from onshore equipment and ground-disturbing works. Including coastal area to construct a new shore crossing.	4	Risk of introduction of NIS from onshore equipment and ground-disturbing works.
	Fire	1	No onshore component.	5	Fire risk on from onshore equipment and hot works.	4	Fire risk on from onshore equipment and hot works.

	Criteria	Evaluated Concepts					
		(1) Subsea tie-back to existing subsea facilities		(2) Subsea tie-back via new pipeline to onshore facility		(3) Subsea tie-back to onshore facility via third-party infrastructure	
		Score	Rationale	Score	Rationale	Score	Rationale
					Including coastal area to construct a new shore crossing.		
Subtotal - Environment		17		57		47	
Technical feasibility	Technical feasibility	1	Feasible and least complex option.	4	Feasible, however significant challenges associated with approvals and HDD construction.	4	Feasible, depending on HDD integrity and procurement of title.
	Technology readiness	3	Subsea tiebacks are deployable ubiquitously worldwide.	3	Subsea tiebacks are deployable ubiquitously worldwide.	3	Subsea tiebacks are deployable ubiquitously worldwide.
	Feasibility to construct	1	Least complex option for installation.	5	High complexity associated with HDD installation.	4	Moderate complexity associated with tying into existing HDD.
	Reusability	3	Reusability within the development is feasible.	3	Reusability within the development is feasible.	3	Reusability within the development is feasible.
	Feasibility of decommissioning	1	Least infrastructure to be decommissioned.	5	Most infrastructure to be decommissioned.	4	Additional infrastructure to be decommissioned.
Safety	OHS and risk exposure	1	No additional offshore crewed facilities however, there are personnel hours offshore to develop, maintain and decommission the new equipment.	2	No additional offshore crewed facilities however, there are additional personnel hours to install additional flowlines, trunkline and shore crossing compared to Option 1.	4	Additional personnel hours to install additional flowlines, trunkline and shore crossing. Increased potential for diver operations to be required.
	Process safety	1	Subsea infrastructure only – no topside facilities to be crewed. Network isolations are manual. Therefore, any major leaks from the network would result in the full flowline inventory being impacted.	1	Subsea infrastructure only – no topside facilities to be crewed.	2	Integrity verification of the third-party shore crossing infrastructure is required.
Commercial	Ability to meet development timeline	1	Lowest risk of delays due to a small equipment inventory requirement and minimal commercial complexities	5	Pipeline/shore crossing in State waters requires State approval, which adds to approvals complexity and potentially extends project lead times.	5	Title and infrastructure are owned by a third party. Time and cost associated with transfer of title.

	Criteria	Evaluated Concepts					
		(1) Subsea tie-back to existing subsea facilities		(2) Subsea tie-back via new pipeline to onshore facility		(3) Subsea tie-back to onshore facility via third-party infrastructure	
		Score	Rationale	Score	Rationale	Score	Rationale
							Construction in State waters which adds to approvals complexity and potentially extends project lead times.
	Economic viability	1	Lower costs associated with development as backfill would occur to an existing facility and utilise existing infrastructure.	5	Higher cost associated with additional installation and decommissioning activities.	4	Additional costs associated with construction required to connect to HDD.
	Future development accommodation	3	No difference identified between options.	3	No difference identified between options.	3	No difference identified between options.
Social	Impact to land owners and marine and coastal users	1	Restrictions on marine activities relatively small around wells and temporarily around vessels and MODU in Cwth waters only.	5	Additional potential disruption to coastal water users depending on shore crossing location.	5	Additional potential disruption to coastal water users at crossing location.
Social	Social license to operate	1	Consistent with existing project with modest additional infrastructure.	4	Consistent with existing project however requires construction activities nearshore which are more visible to communities.	4	Consistent with existing project however requires construction activities nearshore which are more visible to communities.
Cultural	Cultural heritage	1	Consistent with existing project with modest additional infrastructure and associated footprint.	5	Higher potential impact due to higher seabed/shore disturbance and additional noise associated with extended pipelay and decommissioning campaigns.	4	Additional potential impacts due to higher seabed/shore disturbance and additional noise associated with extended pipelay and decommissioning campaigns.
Subtotal – Other		19		50		48	
Total – All Project Drivers		36		107		96	

The comparison of environmental criteria shows that there is a large range between scores, particularly between Option 2 and Option 1. The assessment shows that the most favourable concept, environmentally, is *Option 1 – Subsea tie-back to existing subsea facilities*.

The comparison of "other" criteria is similar, as there is a large range between the scores of Option 2 and Option 1. The assessment shows *Option 1 – Subsea tie-back to existing subsea facilities* to be the most favourable option.

Across all criteria *Option 1 - Subsea tie-back to existing subsea facilities* was deemed the most favourable development concept. The use of existing infrastructure within the area minimises environmental disturbance. Environmental impacts and risks are less than other options due to the smaller scale of activities required to develop the new fields and subsequent decommissioning of associated infrastructure at the end of the facility life. Additionally, the costs associated with Option 1 are also expected to be less compared to the alternative options, again related to the development scale. Feasibility is expected to be highest for option 1, with options 2 and 3 being technically and commercially more challenging, and with higher approval complexity.

In summary, development concepts listed below were not selected for these primary reasons:

- *Option 2 – Subsea tie-back via new trunkline to onshore facility* was deemed unfavourable given the incremental volumes of gas and project life do not support the cost or impact of additional offshore infrastructure. Option 2 results in comparatively high disturbance onshore and offshore with substantially higher commercial costs associated with installation and decommissioning.
- *Option 3 – Subsea tie-back to onshore facility via third-party infrastructure* was deemed unfavourable due to the commercial feasibility associated with the transfer of title and the risks associated with verifying third-party infrastructure integrity for the proposed mode of use. Additionally, Option 3 results in higher disturbance offshore and within the coastal environment.

Table 5-6 provides a summary of the key reasons which have impacted the evaluation outcomes of rejection or adoption for the development concept alternatives.

Table 5-6: Summary of Assessment of Alternative Development Concepts

Development Concept		Summary of Assessment	
1	Subsea tie-back to existing subsea facilities	Does not require the deployment of any emerging or new technology and is technically feasible due to the use of existing infrastructure with tie-back to the existing CHN pipeline. Utilisation of existing infrastructure avoids the environmental and commercial impacts associated with a new trunkline or shore crossing.	✓
2	Subsea tie-back to onshore facility	The size of the development field and field life are not sufficient to support the associated costs. A larger development footprint is associated with the trunkline and new shore crossing to onshore facilities.	X
3	Subsea tie-back to third party facility	The size of the development field and field life are not sufficient to support the associated costs. A larger development footprint associated with the trunkline in the offshore environment and nearshore environment. Schedule and commercial risks associated with the need for agreements/contracts between Cooper Energy and the third-party owner.	X

5.3 Analysis of Design/Activity Alternatives

Once the overall development concept was selected (*Option 1 – Subsea tie-back to existing subsea facilities*), alternatives were considered for the design and activities associated with the chosen concept.

This section describes the key alternative options that were considered and compared for the selected concept.

Design and activity elements of the East Coast Project include:

- MODU type
- flowline material
- hydrotest discharge
- new well functionality
- gas treatment.

Within the following subsections each element and their associated alternatives are evaluated via a comparative assessment.

5.3.1 MODU Type

Cooper Energy will contract a MODU for drilling, well abandonment and intervention/workover activities (if required). Three options were considered, and two alternatives were assessed within Table 5-7. Alternatives assessed are applicable for all activities.

- Option 1 – **Moored MODU** (or DP assist Moored MODU): The MODU is towed into position and moored to the seabed with anchors. Approximately 8-12 anchors are required, which are tethered to the MODU with mooring lines. Each location has a total estimated footprint of approximately 0.00606km^2.
- Option 2 – **Jack up MODU:** The MODU is towed into position and legs are lowered to the seabed, jacking up MODU hull above sea level. Typically, 3 legs are used, each with an estimated footprint of approximately 1,500 m^2.
- Options 3 – **DP MODU**: A DP positioned MODU uses thrusters to maintain position. In order to safely conduct operations, when connected to the seabed (via wellhead/XT and a marine riser above the BOPs), a “watch circle” is implemented, which dictates the amount off offset from well centre (at seabed) is allowable before a risk to well operations and safety (riser angle exceeding a limit off vertical which may induce component failure) is to occur. In deeper water and more benign metocean conditions, the effective distance off centre can be greater before riser angle exceeds said limits, however, in shallow water, even a small movement off centre can lead to a significant increase in riser angle (off vertical) and require a disconnect from the well. Given the shallow water depths and variable metocean conditions in the East Coast Project, utilising a DP vessel to maintain such a small watch circle (needed to safely conduct operations when connected to bottom) is not feasible and as such is discounted as an option for the full well execution. DP positioning may be utilised in an emergency station keeping scenario (i.e. mooring failure) or during approach to location and mooring hook-up, where watch circle criticality is lessened. Therefore, this option will not be carried through the comparative assessment process.

Project drivers were assessed using the method and criteria described in Section 5.2.1. Table 5-7 provides a comparison of criteria for each option.

Table 5-7: Comparative Assessment of Criteria for MODU Options

	Criteria	Evaluated Concepts			
		Moored (or DP assist) MODU		Jack up MODU	
		Score	Justification	Score	Justification
Environmental	Seabed disturbance	2	There will be seabed disturbance associated with anchors of ~720 m^2 per well.	4	Disturbance associated with jack up feet totalling ~1,500 m^2 each time the facility positions on the seabed.

	Criteria	Evaluated Concepts			
		Moored (or DP assist) MODU		Jack up MODU	
	Underwater sound	4	Additional noise from limited use of DP system (if a DP MODU case) to maintain station keeping in adverse weather scenarios or during move onto location.	2	Noise emissions will be generated by onboard machinery.
	Atmospheric and GHG	4	Additional impact due to extra support vessel requirement. Limited use of DP system (if a DP assist MODU case) to maintain station keeping in adverse weather scenarios or during move onto location will generate more emissions from diesel use.	2	One less support vessel required in the field than option 1; resulting in slightly lower impacts.
	Light	4	Additional impact due to extra support vessel requirement.	2	One less support vessel required in the field than option 1; resulting in slightly lower impacts.
	Planned discharges	4	Additional impact due to extra support vessel requirement.	2	One less support vessel required in the field than option 1; resulting in slightly lower impacts.
	Life-of-field	-	N/A	-	N/A
Environmental Risks	Accidental releases	4	Additional risk due to extra support vessel requirement.	2	One less support vessel required in the field than option 1; resulting in slightly lower risk.
Environmental Risks	Interaction with marine fauna	4	Additional risk due to extra support vessel requirement.	2	One less support vessel required in the field than option 1; resulting in slightly lower risk.
Environmental Risks	IMS	3	Risk relates to mooring chains and anchor spread on seabed. No difference identified between options.	3	Risk relates to spud can contact with the seabed. No difference identified between options.
Subtotal - Environment		29		19	
Technical feasibility	Technical feasibility	1	No concerns identified. Considered common practice within the region and industry.	5	Higher risk associated with potential “punch through” of jack-up legs through the thin calcarenite substrate, destabilizing the MODU. Instances where punch through have occurred within the region.
Technical feasibility	Technology readiness	3	No difference identified between options.	3	No difference identified between options.
Technical feasibility	Feasibility to construct	1	No concerns identified. Considered common practice within the region and industry.	5	Metocean conditions may preclude jack-up/jack down operations for approximately 60-90% of the year.
Technical feasibility	Reusability	3	No difference identified between options.	3	No difference identified between options.
Technical feasibility	Feasibility of decommissioning	3	No difference identified between options.	3	No difference identified between options.

	Criteria	Evaluated Concepts			
		Moored (or DP assist) MODU		Jack up MODU	
Safety	OHS and risk exposure	2	Requirement of anchor handler vessels increase the occupational exposure from anchor handling and winching activities.	5	Significant concerns if punch through occurs. Worst case credible scenario where jack-up topples or is inundated.
Safety	Process safety	1	No concerns identified. Considered common practice within the region and industry.	5	Significant concerns if punch through occurs. Worst case credible scenario where jack-up topples or is inundated.
Commercial	Ability to meet development timeline	2	No concerns identified. Considered common practice within the region and industry.	4	Typically, must be able to withstand >2.5m Hs – suitability limited to “ultra-harsh environment” Jack-Up rigs (limited rigs have this capability) and are less available in Australian waters. Additionally, typically a geotechnical survey, coring and CPT testing is required before mobilisation of the Jack-up MODU.
Commercial	Economic viability	4	Higher costs associated with this option.	2	Slightly lower costs associated with this option due to lower jack-up spread rates and reduced support vessel quantity.
Commercial	Future development accommodation	3	No difference identified between options.	3	No difference identified between options.
Social	Impact to marine and coastal users	3	No differential impact identified between options.	3	No differential impact identified between options.
Social	Social license to operate	3	No differential impact identified between options.	3	No differential impact identified between options.
Cultural	Cultural heritage	3	Higher impact associated with underwater noise emissions. No difference identified between options.	3	Higher impact associated with seabed disturbance. No difference identified between options.
Subtotal - Other		32		47	
Total – All Project Drivers		61		66	

The comparison of environmental criteria shows that *Option 1 – Moored MODU* is expected to have slightly higher environmental impacts than *Option 2 – Jack up MODU*. This is solely due to slight environmental impacts and risks associated with Option 1’s requirement for an additional vessel than is required for Option 2.

The comparison of “other” criteria shows that *Option 1 – Moored MODU* is ranked substantially better than *Option 2 – Jack up MODU*. This is largely due to the technical feasibility and safety risks associated with Option 2, in particular the risk of punch through of Jack-up legs through the relatively thin hard calcarenite substrate, which can destabilise the Jack-up MODU. This has occurred in the region previously, and the substrate within the Cooper Energy Title Areas are known to comprise a hard (and relatively thin) calcarenite layer; hence Jack-up MODU’s are typically avoided. Additionally, the metocean conditions typical of the region preclude the jacking up/down of the facility for a significant portion of the year due to wave height. This issue could be mitigated via use of a harsh environment Jack-up, but procurement of such a facility is considered unlikely. Given these factors, moored semi-submersible MODUs are generally selected for drilling in this particular region.

The total qualitative ranking score for each concept against all assessment drivers and criteria (including environmental criteria) shows that Option 1 is ranked slightly better than Option 2.

A moored MODU is the base case option and has been selected over the Jack-up based on historical wells drilled in the region, the local seabed and metocean conditions. Therefore, although Option 1 results in slightly higher environmental impacts and risks associated with the use of an additional vessel, Option 2 is essentially ruled out for technical and safety reasons.

5.3.2 Flowline Material

Cooper Energy will install subsea flowlines to transport gas (and associated condensate) to the onshore Athena Gas Plant. Two types of flowlines were considered and are assessed within Table 5-8.

- Option 1 – **Rigid Flowline**: Flowlines are made of stiff materials that have limited capacity to bend. There is no requirement for stabilisation materials to hold the flowline in place.
  - Installation: Due to weather constraints associated with the Otway region installation of rigid flowline would occur through a reel lay method.
  - Retrieval: Due to cost and weather constraints associated with the Otway region, retrieval of rigid flowlines will occur through a subsea cut and recover method.
- Option 2 – **Flexible Flowline:** Flowline is made of malleable materials that can bend. There is a requirement for stabilisation materials (i.e. concrete mattresses) to be installed to hold the flowline in place.
  - Installation: Will occur by either reel or carousel lay.
  - Retrieval: Will occur by either reverse reel or carousel or recover and cut on deck.

Due to the similarities between installation and retrieval methods for each option over both criteria categories (environmental and other) they have not been taken through individual comparative assessments. Therefore, consideration of installation and retrieval methods for each option have been acknowledged and incorporated into this design alternative assessment.

Project drivers were assessed using the method and criteria described in Section 5.2.1. Table 5-8 provides a comparison of criteria for each option.

Table 5-8: Comparative Assessment of Criteria for Pipeline Options

	Criteria	Evaluated Concepts			
		Rigid Flowline		Flexible Flowline	
		Score	Justification	Score	Justification
Environmental Impacts	Seabed disturbance	3	No material differentiation between options for installation. Cut and recover during decommissioning will require significantly more seabed disturbance at each cut location. Disturbance expected to be broadly similar between options.	3	Requirement to install mattresses for stabilisation results in greater seabed disturbance. However, there is less seabed disturbance during retrieval if reverse reel or carousel methods can be used. Disturbance expected to be broadly similar between options.
	Underwater sound	3	Overall vessel time in field likely to be broadly similar across life of the project.	3	No differential impact identified between options.
	Atmospheric and GHG	3	Overall vessel time in field likely to be broadly	3	No differential impact identified between options.

	Criteria	Evaluated Concepts			
		Rigid Flowline		Flexible Flowline	
		Score	Justification	Score	Justification
			similar across life of the project.		
	Light	3	Overall vessel time in field likely to be broadly similar across life of the project.	3	No differential impact identified between options.
	Planned discharges	3	Overall vessel time in field likely to be broadly similar across life of the project.	3	No differential impact identified between options.
	Life-of-field	-	N/A	-	N/A
Environmental Risks	Accidental releases	3	Overall vessel time in field likely to be broadly similar across life of the project.	3	No differential impact identified between options.
	Interaction with marine fauna	3	Overall vessel time in field likely to be broadly similar across life of the project.	3	No differential impact identified between options.
	IMS	3	Overall vessel time in field likely to be broadly similar across life of the project.	3	No differential impact identified between options.
Subtotal - Environment		24		24	
Technical feasibility	Technical feasibility	4	Design is suited to longer lengths.	1	Design is suited to shorter tie-back lengths; more suitable for the requirements of the development.
	Technology readiness	3	No difference identified between options. General design principles are common within the industry.	3	No difference identified between options. General design principles are common within the industry.
	Feasibility to construct	3	Duration of vessel in the field is similar between both options.	3	Duration of vessel in the field is similar between both options.
	Reusability	4	Reelable flowline can't be re-used.	1	It is feasible that the flowlines could be recovered and re-used in the field.
	Feasibility of decommissioning	3	Duration of vessel in the field may be shorter, as recovery of stabilization materials is not required. However, in the event of cut and recover the overall duration in the field may be longer. Therefore, the duration in the field is expected to be similar.	3	Recovery of mattresses will increase duration of vessel/s in the field. However, the recovery of the flexibles will be quicker. Overall, the duration in the field is expected to be similar.
Safety	OHS and risk exposure	3	No difference identified between options as	3	No difference identified between options as overall

	Criteria	Evaluated Concepts			
		Rigid Flowline		Flexible Flowline	
		Score	Justification	Score	Justification
			overall time in field likely to be similar across project lifecycle.		time in field likely to be similar across project lifecycle.
	Process safety	3	No difference identified between options.	3	No difference identified between options.
Commercial	Ability to meet development timeline	4	Bespoke requirements for reel lay vessels resulting in potential availability/access constraints.	2	Less vessel access constraints to option 1.
	Economic viability	4	Generally higher costs associated with installation and requirement for a larger more costly vessel. Neutral decommissioning costs.	2	Flexible flowlines are generally more expensive to procure; but are generally quicker to install Neutral decommissioning costs.
	Future development accommodation	3	No difference identified between options.	3	No difference identified between options.
Social	Impact to marine and coastal users	3	No difference identified between options.	3	No difference identified between options.
	Social license to operate	3	No difference identified between options.	3	No difference identified between options.
Cultural	Cultural heritage	3	No differential impact identified between options. Similar seabed/Sea Country disturbance. No differential impact on ability to continue cultural practices identified between options.	3	No differential impact identified between options. Similar seabed/Sea Country disturbance. No differential impact on ability to continue cultural practices identified between options.
Subtotal - Other		43		33	
Total – All Project Drivers		67		57	

The comparison of environmental criteria shows that both *Option 1– Rigid flowline* and Option 2 – Flexible flowline ranked very similarly when considering environmental impacts due to the overall duration in the field of vessels over the project lifecycle being broadly similar.

The comparison of "other" criteria shows that *Option 1 – Rigid flowline* is ranked slightly worse than *Option 2 – Flexible flowline*. This is largely due to the comparison between costs associated with the materials and method of installation. Additionally, the layout of the fields and current design of the CHN development which the East Coast Project will be tied into is suited to shorter tie-back lengths and Option 2 is therefore more suitable.

The total qualitative ranking score for each concept against all assessment drivers and criteria (including environmental criteria) shows that both options are ranked relatively similar with *Option 2 – Flexible* flowline having a slight edge.

Further design and engineering work are required to understand the benefits and cost of each option, particularly in relation to the stabilisation requirements of *Option 2 - Flexible flowline*. The final decision for selection of flowline type will be based on technical feasibility, safety and cost; and a combination of both may be used.

As *Option 2 - Flexible flowline* presents the slightly greater environmental risk it has been used as the base case for impact assessment in Section 8.

5.3.3 Hydrotest Discharge

Hydrostatic testing is completed to determine the integrity of subsea infrastructure prior to authorising production to occur, using water inhibited with chemical additives. Once testing is complete, these fluids require removal from the flowline system. Two options have been considered for the removal of hydrotest fluids for the East Coast Project.

- Option 1 – Displace hydrotest fluids to sea
- Option 2 – Displace hydrotest fluids to shoreside facilities

During the consideration of *Option 2 – Displace hydrotest fluids to shoreside facilities* it was determined that this would be an unfeasible alternative due to the inability to direct pigs through the flowline and the existing CHN system to shore due to variations in pipeline diameter and overall layout with the flowlines branching into various tie-in points on the main CHN trunkline. Therefore, the inhibited seawater is unable to be displaced to shoreside facilities.

In addition to this technical complication, there are currently no onshore treatment or disposal facilities that can treat large amounts of water as part of the production system or within proximity of the Athena Gas Plant.

Although discharge to sea will cause temporary and localised changes to water quality, the impacts and risks can be managed to ALARP and acceptable levels. It is considered common practice within the industry and is a feasible alternative to attempting to transfer the fluids to shore. Therefore, although Option 1 results in a slightly higher environmental impact within the marine environment, the technical complications associated with Option 2 make Option 2 an unfeasible alternative.

5.3.4 New Well Functionality

Umbilicals provide electrical power and hydraulic control to the subsea equipment, and chemical injection capacity at the production wells. Currently Cooper Energy’s CHN facilities are serviced by an umbilical which connects the existing subsea wells to the onshore Athena Gas Plant. The main umbilical is run from an onshore HDD to the Casino-4 well offshore. This includes approximately 1.6 km of umbilical onshore (to HDD exit) and 28.6km offshore, 6.34 km of which is located in Victorian state waters. The current umbilical system can support up to 10 wells at a given time. Considering the scope of the project (up to 15 wells) in addition to the current 4 wells producing in the CHN development an alternative has been considered.

The controls system configurations considered are:

- Option 1 – **Existing umbilical**: Utilise the existing main umbilical which would limit production up to 10 wells at a given time.
- Option 2 – **New umbilical**: Allow for the addition of a secondary main umbilical which would provide sufficient terminals for all wells within the development concurrently.

For either option, additional in-field umbilicals would be installed to connect up new wells and manifolds. These have been excluded from the assessment of options as they would be expected to be the same or very similar layout and footprint.

Project drivers were assessed using the method and criteria described in Section 5.2.1. Table 5-9 provides a comparison of criteria for each option.

Table 5-9: Comparative Assessment of Criteria of New Well Functionality Concepts

	Criteria	Evaluated Concepts			
		Utilise Existing Main Umbilical		Install New Secondary Umbilical	
		Score	Justification	Score	Justification
Environmental Impacts	Seabed disturbance	1	No associated disturbance footprint.	5	Additional disturbance (~5.72 km^2 offshore and ~1.6 km onshore) due to installation of new umbilical and HDD.
	Underwater sound	1	No impact identified.	4	Additional noise emissions associated with the operation of a vessel to install and retrieve.
	Atmospheric and GHG	1	No impact identified.	4	Additional noise emissions associated with the operation of a vessel to install and retrieve.
	Light	1	No impact identified.	4	Additional noise emissions associated with the operation of a vessel to install and retrieve.
	Planned discharges	1	No impact identified.	4	Additional planned discharges associated with the operation of a vessel to install and retrieve.
	Life-of-field	-	N/A	-	N/A
Environmental Risks	Accidental releases	1	No risk identified.	4	Additional risk of accidental release consistent with the operation of a vessel.
	Interaction with marine fauna	1	No risk identified.	4	Additional risk of interacting with marine fauna consistent with the operation of a vessel.
	IMS	1	No risk identified.	4	Additional risk of introducing and IMS consistent with the operation of a vessel.
Subtotal - Environment		8		33	
Technical feasibility	Technical feasibility	3	Feasible.	3	Feasible.
	Technology readiness	3	Utilisation of umbilicals is considered common practice.	3	Utilisation of umbilicals is considered common practice.
	Feasibility to construct	3	No associated risk/impact identified	3	Installation of umbilicals is considered common practice.
	Reusability	3	Expected to be similar between options.	3	Expected to be similar between options.
	Feasibility of decommissioning	1	No additional risks/impacts identified.	4	Additional safety concerns associated with added decommissioning.
Safety	OHS and risk exposure	1	No risks/impacts identified.	4	Additional safety concerns associated with installation and decommissioning.
	Process safety	3	No additional risks were identified.	3	No additional risks were identified.
Commercial	Ability to meet development timeline	1	No risk identified.	4	Minor risk as it requires the procurement of long lead items.
	Economic viability	1	No additional cost.	5	High costs associated with installation and decommissioning of new umbilical.

	Criteria	Evaluated Concepts			
		Utilise Existing Main Umbilical		Install New Secondary Umbilical	
		Score	Justification	Score	Justification
	Future development accommodation	5	Limitations to production (up to 10 wells at a given time).	1	Allow for more than 10 wells to be producing at one time. Would accommodate all potential wells within the project description at once.
Social	Impact to marine and coastal users	3	Expected to be similar between options.	3	Expected to be similar between options.
Social	Social license to operate	1	No associated concerns.	4	Requires a state accepted EP which would include an onshore crossing and new HDD.
Cultural	Cultural heritage	1	No associated disturbance footprint.	5	Substantial additional disturbance (5.72 km^2) offshore and (~1.6 km^2) onshore, mainly in the coastal environment leading to greater risk of impacting cultural heritage.
Subtotal - Other		29		45	
Total – All Project Drivers		37		78	

The comparison of environmental criteria shows that *Option 1 – Utilising the existing umbilical* is ranked substantially better than *Option 2 – installing a new umbilical*. This is largely due to onshore and offshore disturbance that would result from the installation of a new umbilical. Additionally, installation of a new umbilical would require the use of a vessel. Although this would likely be grouped with other installation activities, alternatives are assessed exclusively, and the use of a vessel increases environmental impacts and risks across all criteria.

The comparison of "other" criteria shows that *Option 1 – Utilising the existing umbilical* is again ranked substantially better than *Option 2 – installing a new umbilical*. This is largely due to the substantial costs associated with the installation and subsequent additional decommissioning of a new umbilical. Further, as highlighted in the paragraph above, Option 1 would result in disturbance to the ground both onshore and offshore and carries an increased risk of disturbance to cultural heritage.

The total qualitative ranking score for each concept against all assessment drivers and criteria (including environmental criteria) shows that Option 1 is ranked significantly better than Option 2.

Option 1 does not allow for the concurrent production of future fields to the same extent as Option 2 due to the limitations of the existing umbilical. In an event where the umbilical is at capacity it will limit the production of the development. Cooper Energy has factored in this limitation and recognises that this can be managed in line with developing the wells in stages. Wells are generally required to stay connected to the umbilical termination assembly post cessation to allow for control and monitoring of the well until well abandonment occurs; though there may be alternate remote monitoring solutions which could be considered in future. Cooper Energy's decommissioning strategy, which follows NOPSEMAs planning for proactive decommissioning guideline (NOPSEMA, 2021), plans for wells to be abandoned within 3 years of production cessation. Ideally, dual purpose campaigns for drilling and well abandonment will occur. This will allow for wells to be disconnected from the umbilical during the well abandonment process, and the umbilical subsequently reconnected to new wells. This concept of staged development will avoid the need to install a new main umbilical, minimising environmental impact and risk, while meeting internal production targets and decommissioning requirements. Therefore, *Option 1 - Utilising the existing umbilical* was selected over *Option 2 – Installing a new umbilical*.

Note: umbilicals are installed and retrieved by similar methods as flexible flowlines. Assessment of installation and decommissioning methods has been included in Section 4.3.5.4.

5.3.5 Gas Recovery

During well construction activities, the wellbore must be displaced to remove residual well construction and wellbore fluids; the well must be flowed to ensure the well is appropriately displaced. In addition to residual well construction fluids, reservoir fluids, including gas are recovered from the wellbore. Two options have been considered for the processing of gas from well clean-up activities associated with the East Coast Project:

- **Option 1** – **Gas is flared:** volumes of gas from well clean-up activities would be released via flaring offshore at the MODU.
- **Option 2** – **Gas is processed onshore via AGP**: gas from well clean-up activities is recovered and processed at AGP for flaring and/or possibly for domestic export.

During the consideration of *Option 2 –Gas is processed onshore via AGP* it was determined that if gas resulting from well clean-up was sent onshore through the subsea system to AGP it would be contaminated by liquids such as brine and base oil. This poses a flow assurance and integrity risk to the production system and there is a higher risk of the initial flowback of fluids impacting production equipment at the gas plant. The gas plant is designed for dry gas (minimal liquid), so influx of liquids can cause damage to the production systems. Rather than risk damaging equipment, the gas may need to be directed to the flare system at the gas plant until the flow from the well is cleared of well construction fluids. This scenario would have the effect of transferring the aspects associated with flaring in an offshore area, to an onshore coastal area in the same region, it would not eliminate the aspects. It is also the case that MODU's do not have capability to compress and store gas, and therefore could not substantially export the gas from the MODU to AGP.

Although gas emissions could cause temporary and localised changes to air quality, the impacts and risks can be managed to ALARP and acceptable levels. Flaring is considered common practice within the industry and is feasible. Therefore, although Option 1 results in a slightly higher environmental impact within the marine environment, the technical complications associated with Option 2 make Option 2 an unfeasible alternative.

6 Existing Environment

This section provides a detailed description of the environment that may be affected (EMBA), regional setting and a summary of the key ecological, social and cultural receptors.

6.1 Regional Context

The OPGGS(E) Regulations 2023 define 'environment' as *'ecosystems and their constituent parts, natural and physical resources, the qualities and characteristics of locations, places and areas, and the heritage value of places; and includes the social, economic and cultural features of those matters'*. In accordance with Section 21(2) of the OPGGS(E) Regulations, this document describes the physical (Section 6.3), ecological (Section 6.4), social (Section 6.5 and 6.6) and cultural (Section 6.7) components of the environment.

A greater level of detail is provided for those particular values and sensitivities as defined by Section 21(3) of the OPGGS(E) Regulations which states that particular relevant values and sensitivities may include any of the following:

(a) the world heritage values of a declared World Heritage property within the meaning of the EPBC Act;

(b) the National Heritage values of a National Heritage place within the meaning of that Act;

(c) the ecological character of a declared Ramsar wetland within the meaning of that Act;

(d) the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act;

(e) the presence of a listed migratory species within the meaning of that Act;

(f) any values and sensitivities that exist in, or in relation to, part or all of:

i. a Commonwealth marine area; or

ii. Commonwealth land.

With regards to 21(3)(d) and (e) more detail has been provided where threatened or migratory species have a spatially defined biologically important area (BIA), habitat critical to survival or identified biologically important behaviour such as breeding, foraging, resting or migration.

BIAs are areas and times used by protected marine species for carrying out critical life functions as listed above (DCCEEW, 2024o). BIAs can be located anywhere within the Australian marine environment and may also be designated over terrestrial areas (i.e., turtle nesting beaches). BIAs are:

- Designed to inform decision making about actions which may impact protected species
- Described in conservation plans for protected marine species including statutory recovery plans, wildlife conservation plans, and conservation advice documents (DCCEEW, 2024o).

It is important to note that BIAs do not represent the species full range and that areas without BIAs may still support biologically important behaviours (DCCEEW, 2024o).

BIAs within this document have been described and defined by using the downloadable DCCEEW BIA shapefile dataset (DCCEEW, 2024p), this includes data for the updated BIAs for the southern right whale as per the recently released National Recovery Plan (DCCEEW, 2024l).

With regards to 21(3)(f) more detail has been provided for:

- Key Ecological Features (KEFs) as they are considered as conservation values under a Commonwealth Marine Area
- Australian Marine Parks (AMPs) as they are enacted under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

Important habitat for migratory species is defined within the Matters of National Environmental Significance Significant Impact Guidelines 1.1 (CoA, 2013b) as:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- habitat that is of critical importance to the species at particular life-cycle stages, and/or
- habitat utilised by a migratory species which is at the limit of the species range, and/or
- habitat within an area where the species is declining.

6.2 Environment that may be affected

The environment that may be affected (EMBA) has been defined as an area where a change to ambient environmental conditions may potentially occur as a result of planned activities or unplanned events. A change does not always imply that an adverse impact will occur; for example, a change may be required over a particular exposure value or over a consistent period of time for a subsequent impact to occur.

Table 6-1 and Figure 6-1 detail the project areas associated with the activity that are used to describe the environmental context relevant to the activity and support the impact and risk assessments.

Consistent with existing operations, the largest spatial extent of potential impact associated with the East Coast Project is from an accidental release. Spill modelling was conducted for an accidental release of hydrocarbons; for both MDO and condensate. The worst-case spatial extent from an accidental release is associated with condensate – therefore, for the purpose of the description of environment, the EMBA described in Section 6 is based on an accidental release of condensate and is termed the monitoring EMBA. Ecological and Social EMBAs have been defined for both types of hydrocarbon and release scenarios and are used to inform Section 9.5 and 9.6.

Light and underwater sound emissions also have specific EMBAs for specific potential impacts; these are characterised and assessed in relevant impact assessment section (Sections 8.1, 8.2 and 8.3).

Table 6-1: East Coast Project operational area and EMBA descriptions

Project Area	Description
Operational Area	The operational area includes: • 3 km buffer around the outermost proposed well locations and associated flowline routes within the Annie, Juliet, Nestor and Henry fields. • 5 km buffer around the outermost proposed well locations and associated flowline routes within Elanora, Heera, Isabella and Pecten East prospects.
Ecological EMBA*	The Ecological EMBA is used to identify ecological receptors which have the potential to be exposed to harmful impacts associated with an accidental release of hydrocarbons. The boundary of the ecological EMBA has been defined by an accidental release of condensate. A moderate threshold exposure value for each oil type was used to define the spatial extent. • Floating (10 g/m^2) • Shoreline (100 g/m^2) • In-water: Dissolved (50 ppb) and Entrained (100 ppb)* *Entrained oil does not have a moderate threshold; therefore, the high threshold is used. Relevant ecological receptors are detailed in Section 6.5. Impacts to ecological receptors within the ecological EMBA are assessed in Section 9.5 and Section 9.6.
Social EMBA*	The Social EMBA is used to identify receptors which have the potential to be subject to visual or economic impacts associated with an accidental release of hydrocarbons. The boundary of the social EMBA has been defined by an accidental release of condensate. A low threshold exposure value for visible oil types (floating and shoreline) and a moderate threshold exposure value for in-water oil types were used to define the spatial extent. • Floating (1 g/m^2) • Shoreline (10 g/m^2) • In-water: Dissolved (50 ppb) and Entrained (100 ppb)*

Project Area	Description
	Relevant social receptors are detailed between Section 6.6 and Section 6.8. Impacts to social receptors within the social EMBA are assessed in Section 9.5 and Section 9.6.
Monitoring EMBA	The Monitoring EMBA characterises the geospatial extent where hydrocarbons may potentially be detectable, however impacts are not expected to be detectable to these extents. Applying this conservative threshold enables the identification of physical, biological, conservation values and sensitivities, social and cultural receptors which may fall within spill response monitoring programs and are described in the sections below. The boundary of the monitoring EMBA has been defined by an accidental release of condensate. A low threshold exposure value for each oil type was used to define the spatial extent. • Floating (1 g/m^2) • Shoreline (10 g/m^2) • In-water: Dissolved (10 ppb) and Entrained (10 ppb)

**Note: Ecological and Social EMBAs have also been defined by an accidental release of MDO which fall within the contours of the condensate EMBA's. The MDO EMBA's are referred to for the MDO impact assessment (Section 9.5).*

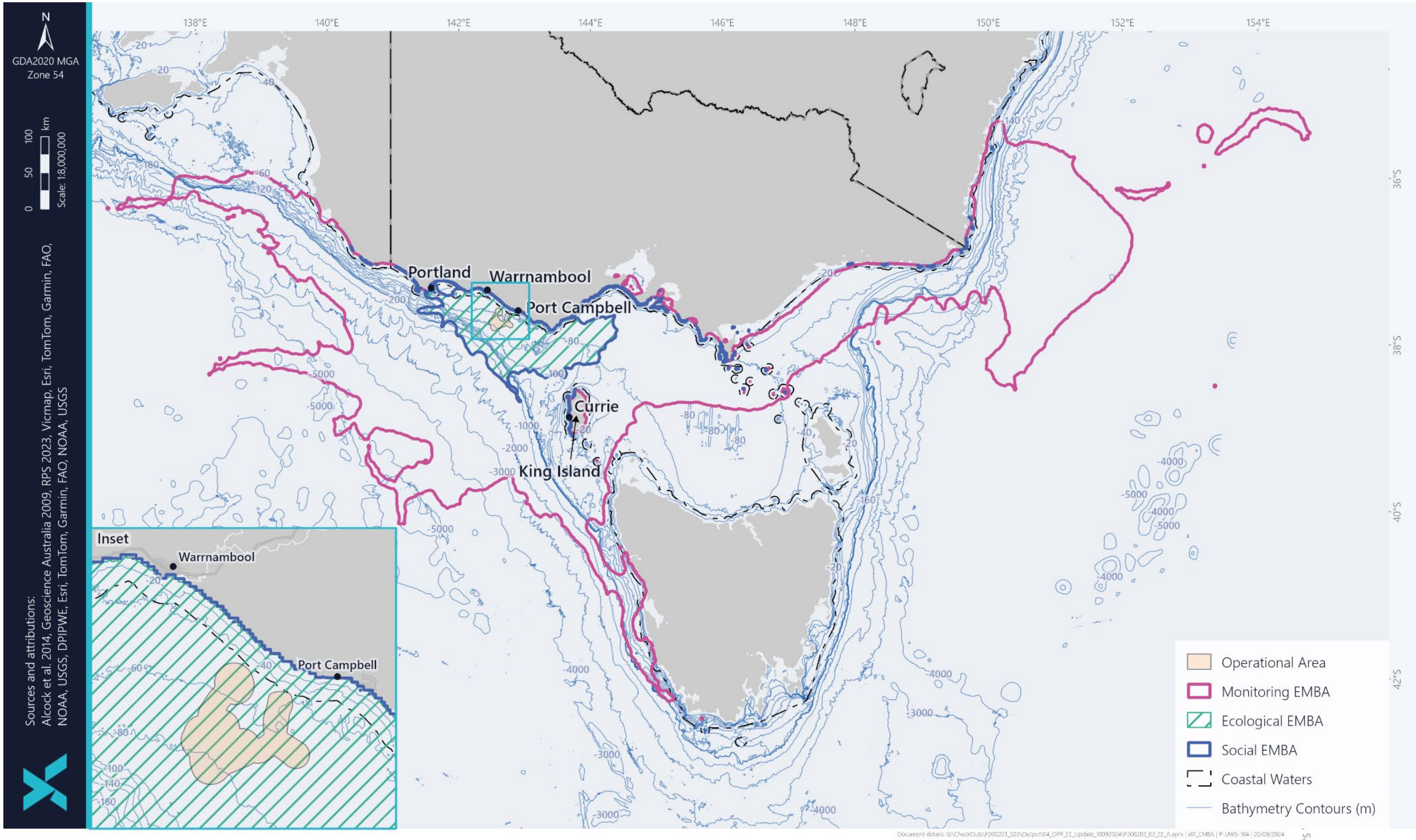


Figure 6-1: East Coast Project operational area and EMBAs to inform hydrocarbon spill risk

6.3 Regional Setting

Six marine regions have been identified in Commonwealth waters around Australia. Two of these regions intersect with the monitoring EMBA, one of which, the south-east marine region, is intersected by the operational area.

6.3.1 South-east Marine Region

As its name suggests, the south-east marine region spans the south-east commonwealth waters of Australia, including state waters of South Australia, Victoria, Tasmania and NSW. The south-east marine region is further divided into 11 provincial bioregions and is representative of 17 different seafloor types (CoA, 2015a). The region is relatively low in nutrients however, features such as the east Tasmania subtropical convergence zone, Upwelling east of Eden, Seamounts south and east of Tasmania and the Bonney coast upwelling result in localised areas of relatively high productivity and biodiversity. These areas support biologically important behaviours, such as foraging, for a variety of EPBC Listed species like the Australian sea-lion, white shark, Australasian gannet, fairy prion, black-faced cormorant, little penguin, crested tern, and several species of albatross, petrel and shearwater (CoA, 2015a). The region is also a known migration route and foraging area for the pygmy blue whale and supports reproductive and migration areas for the southern right whale.

In addition, the south-east marine region features cultural sites of significance including historic shipwrecks, First Nations heritage sites and places of spiritual connection and built European heritage are discussed in Section 6.8.

6.3.1.1 Otway Marine Bioregion

The East Coast Project is located within the Otway marine bioregion which extends from Cape Otway (Vic) to Cape Jaffa (South Australia) and includes the western islands of the Bass Strait.

The Otway basin is well mixed given it is a higher-energy environment exposed to frequent storms and significant waves. The region is characterised by very steep to moderate offshore gradients, high wave energy and cold temperate waters subject to upwelling events (i.e., the Bonney Upwelling) (IMCRA, 1998). Upwelling water is nutrient rich and corresponds with increases in the abundance of zooplankton, which attracts baleen whales and other species (including EPBC-listed species) that feed on the plankton swarms (krill). The Bonney upwelling is seasonal, occurring west of Portland, >100 km west of the East Coast Project, therefore upwelling around the operational area is considered to be unlikely or occasional (Huang and Wang, 2019).

The seabed on the Otway shelf is comprised exhumed limestone, is generally rocky with relief that varies substantially including some areas of flat limestone and some of crevices, gutters, pillars and overhanging shelves. Whilst there are some areas of thin overlying sediment (comprising fine-coarse grained sand and calcarenite fragments), the region is starved of terrigenous sediment (Santos 2004; Ramboll, 2020b).

The coastline is generally rocky, with tall cliffs and rock outcrops, some sandy beaches, inlets and settlements. Shoreline habitats of the Otway coastline, including offshore islands, provide for a range of fauna including penguin colonies, fur-seal colonies and bird nesting sites. Offshore islands identified within the monitoring EMBA including, but not limited to, Deen Maar, Griffiths Island, Middle Island and Lawrence Rocks provide important nesting habitat for EPBC listed seabird and shorebird species (Harris and Norman, 1981).

- Deen Maar, previously known as Lady Julia Percy Island, is a particularly important rookeries for shearwater species and the little penguin (Dann and Norman, 2006) which are known to breed extensively over the island (Pescott, 1976).
- Griffiths Island has been identified as an important rookery for the short-tailed shearwater which arrives to the island to breed in September each year (Bowker, 1980). Historically the island was also known to support a population of little penguins however they have since disappeared presumably due to predation (Dann and Norman, 2006).
- Middle Island has been identified as a breeding colony for the black-faced cormorant and possible breeding location of silver and pacific gulls (Tingay and Tingay, 1982). The island

also supports a small population of little penguins whose breeding numbers have increased following the implementation of the Maremma dog project which protects the species from predation (Wallis et al., 2017).

- Lawrence Rocks is classified as an important bird area by BirdLife International and contains > 10% of the global population of the Australasian Gannet (2024). Historically Lawrence Rocks was also known to support small populations of breeding little penguins and fairy prions (Pescott, 1980).

Shipwreck Coast Biogeographical Unit

A further regional classification down from IMCRA bioregions are called biogeographical units or biounits. Biounits are defined by their physiographical setting including oceanography, geomorphology and the ecosystem types present (Young et al., 2022). In Victoria biounits have been classified in state waters. The biounit adjacent to the East Coast Project runs from the east of Port Fairy to the west of Cape Otway and is termed Shipwreck Coast. The physiographic features of Shipwreck Coast include:

- cliff dominated coastlines with stacks, islands and small bays
- extreme to very high exposure to the prevailing weather with strong winds and swells
- deep reefs with terraces, scarps and pinnacles as well as low complexity and veneer reef systems (Edmunds and Flynn, 2018).

6.3.2 Temperate-east Marine Region

The temperate-east marine region spans from the southern boundary of the Great Barrier Reef Marine Park south to Bermagui, NSW and includes the eastern waters surrounding Lord Howe and Norfolk Islands (CoA, 2012). Defining physical features associated with the marine region include the East Australian Current, the Tasman Front and significant benthic features such as seamount chains and the canyons of the eastern continental slope (CoA, 2012). The East Australian Current is the dominant oceanographic influence within the region, bringing warm waters from the Coral Sea down the continental shelf, extending the range of tropical species into subtropical and temperate waters which supports high species richness and diversity (Director of National Parks (DNP), 2018). This region supports biologically important behaviours, such as foraging, for a variety of EPBC Listed species like the sooty tern and several species of albatross, petrel and shearwater (CoA, 2012). The region is also a known migration route for the grey nurse shark and humpback whale and supports reproductive and migration areas for the southern right whale.

The temperate-east marine region supports established industries such as commercial fishing, shipping and a range of recreational and tourism-based activities such as fishing, snorkelling, diving and boating. Further, Traditional Owners have used Sea Country within the marine region for thousands of years and continue to manage the coastal and marine environments of the region as a resource and to maintain cultural identity, health and wellbeing. Fishing, hunting and the maintenance of culture and heritage through ritual, stories and traditional knowledge continue as important uses of near shore and adjacent areas (DNP, 2018).

6.4 Physical Environment

6.4.1 Air Quality

Historical air quality data is available from the Environment Protection Authority (EPA) Victoria air quality monitoring stations, and Cape Grim Baseline Air Pollution Station on Tasmania’s west coast, which is one of the three premier baseline air pollution stations in the World Meteorological Organisation-Global Atmosphere Watch (WMO-GAW) network, measuring greenhouse and ozone depleting gases and aerosols in clean air environments.

The Victorian air quality data is collected at 15 performance monitoring stations representing predominantly urban and industrial environments in the Port Phillip and Latrobe Valley regions of Victoria. Results are assessed against the requirements of the National Environment Protection (Ambient Air Quality) Measure for the pollutants carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulphur dioxide (SO_2), lead (Pb), particles less than 10 micrometres in diameter (PM_{10})

and particles less than 2.5 micrometres in diameter ($PM_{2.5}$). The most recent annual air monitoring report shows Victoria's air quality in 2020 was generally good with AAQ NEPM (Ambient Air Quality National Environmental Protection Measure) goals and standards being met for carbon monoxide (CO), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) (EPA Victoria, 2021). There were some exceedances for pollutants such as Ozone (O_3) and ($PM_{2.5}$).

6.4.2 Bathymetry

The geomorphology of Australia's continental margin is varied, with a number of different geomorphic features present, including basins, canyons, terraces, seamounts and plateaus. In the south-east, the continental shelf is broad, extending offshore to approximately 200 m water depth (Figure 6-3) (Harris et al., 2005). Some of the notable seabed features of the continental shelf in the south-east marine region include the Otway Depression and Otway Shelf, King Island Rise and the Bass Basin. Geomorphic features on the continental slope and abyssal plain include: Bass Canyon, East Tasman Saddle and East Tasman Plateau, South Tasman Rise, Stradbroke Seamount and Moreton Seamount.

Bass Basin, a seaway separating the mainland and Tasmania, is a shallow depression approximately 120 km by 400 km, with water depths up to approximately 90 m (average water depth of approximately 60 m). Within the Bass Basin, the Bassian Rise (eastern margin) separates Bass Basin from the Gippsland Basin and is associated with the Furneaux Islands and the King Island Rise (western margin) includes the shallow (<40 m water depth) Tail Bank, and King Island itself; and separates Bass Basin from Otway Basin. To the southwest, there is a relatively narrow, 60 m-deep channel between King Island and Tasmania. Sandwaves and tidal current ridges occur on the seabed of both Bassian and King Island Rises. The largest of the tidal sand ridges, Moriarty Bank, lies east of Clarke Island and is approximately 20 km long and 4 km wide, orientated east-west, sub-parallel to the flow of tidal currents (Harris et al., 2005).

In the locale of the East Coast Project, bathymetry is characterised by overall gradual increase in depth with distance from shore, and localised variability around ridges, channels, escarpments and some areas of sand. megaripples and rubble. Figure 6-2 shows the bathymetry around the 2018 planned Annie-1 well location, and and 2018 planned Elanora well site.

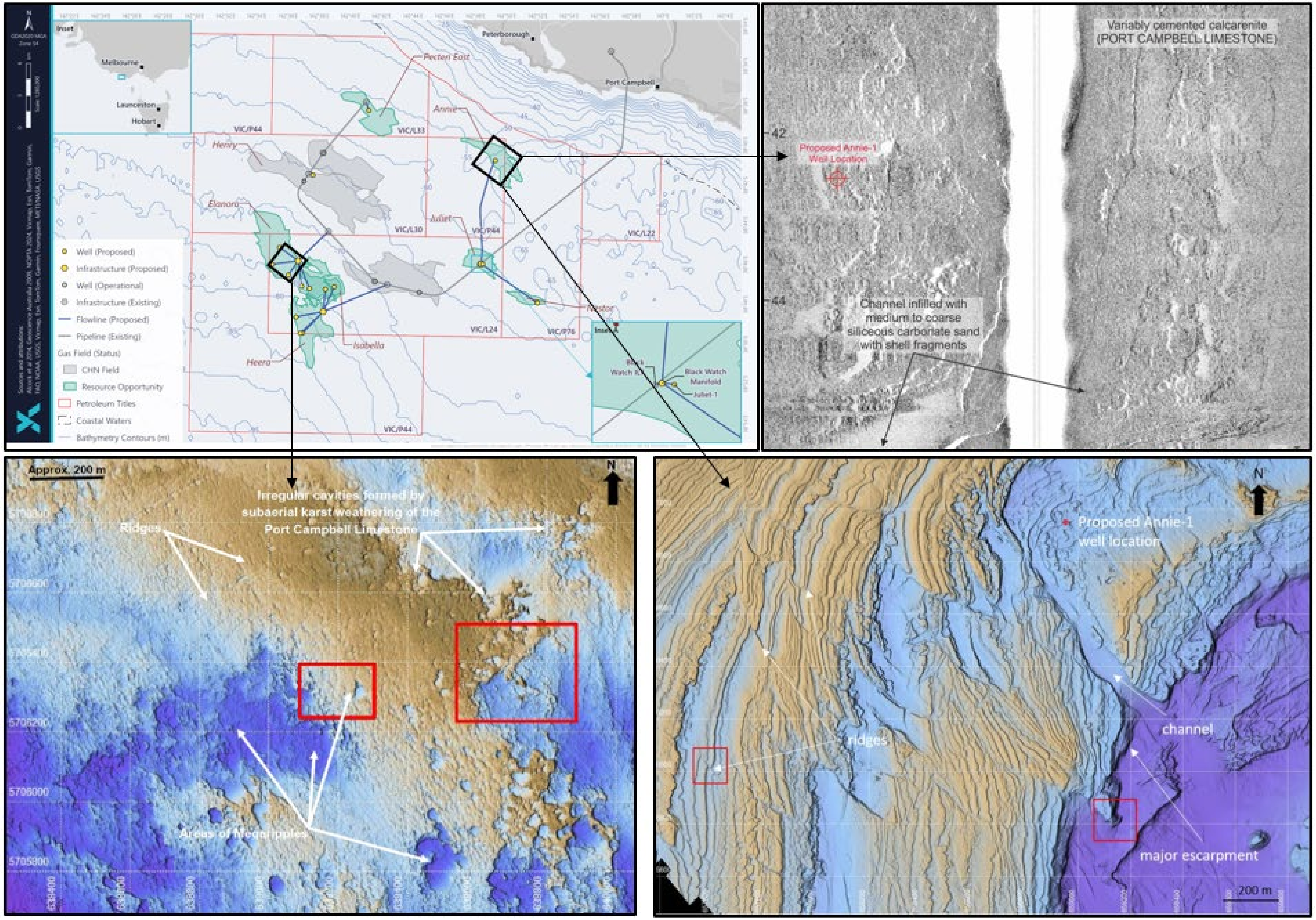


Figure 6-2: Bathymetry within the East Coast Project Operational Area – 2018 planned Annie-1 and Elanora-1 well locations

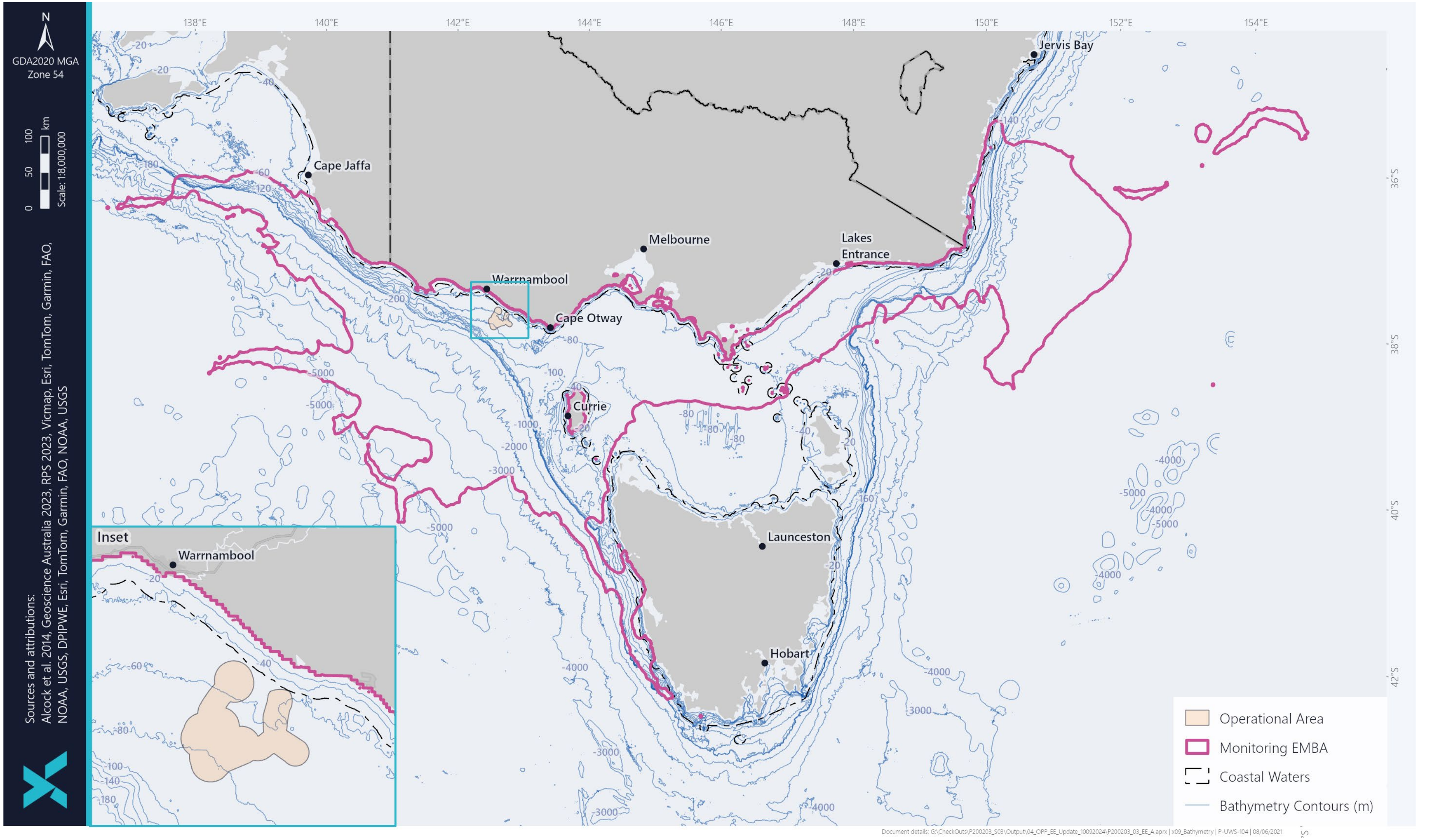


Figure 6-3: Bathymetry of Bass Strait

6.4.3 Climate

Australia's size and geography gives rise to a diverse range of climate patterns across the continent and offshore islands. The south-eastern coast (Victoria, Tasmania, New South Wales) is primarily described as being 'temperate'. There are seasonal variations in mean temperatures and rainfall with southern Australia having high winter rainfall in comparison to summer.

Victoria's climate in particular can be characterised as cool temperate, with cool wet winters and cool summers. The conditions are primarily influenced by weather patterns originating in the Southern Ocean. It is dominated by sub-tropical high-pressure systems in summer and sub-polar low-pressure systems in winter. The low-pressure systems are accompanied by strong westerly winds and rain-bearing cold fronts that move from west to east across the region.

6.4.4 Winds

Bass Strait is located on the northern edge of the westerly wind belt known as the Roaring Forties. Hindcast modelled wind data from the National Centres for Environmental Predictions Climate Forecast System Reanalysis for the period 2008 to 2012 (inclusive), showed winds were typically from a westerly (west-southwest to west-northwest) direction, with average monthly wind speeds ranging from 14.1–16.5 knots. In winter, when the subtropical ridge moves northwards over the Australian continent, cold fronts generally create sustained west to south-westerly winds and frequent rainfall in the region (McInnes and Hubbert, 2003). In summer, frontal systems are often shallower and occur between two ridges of high pressure, bringing more variable winds and rainfall.

Occasionally, intense mesoscale low-pressure systems occur in the region, bringing very strong winds, heavy rain, and high seas. These events are unpredictable in occurrence, intensity, and behaviour, but are most common between September and February (McInnes and Hubbert, 2003). Wind speeds in the area are typically in the range of 10–30 km/hr, with maximum gusts reaching 100 km/hr.

RPS (2024) acquired high-resolution wind data across their modelling domain from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR). Monthly wind rose distributions from 2010 to 2019 (inclusive) derived from CFSR data for selected nodes nearby each release location are shown in Figure 6-4 to Figure 6-6.

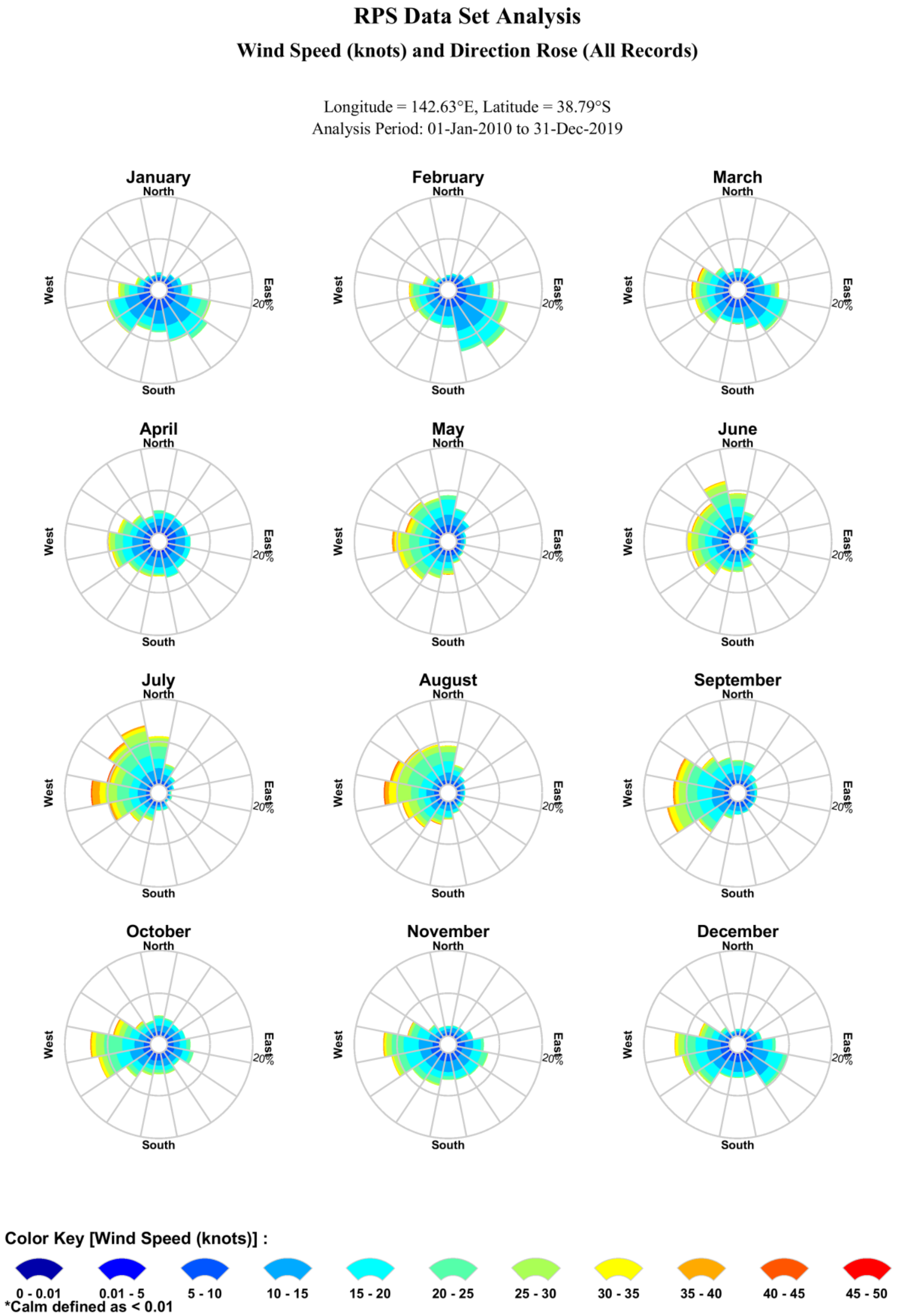


Figure 6-4: Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the Elanora-ST1 (Isabella) well

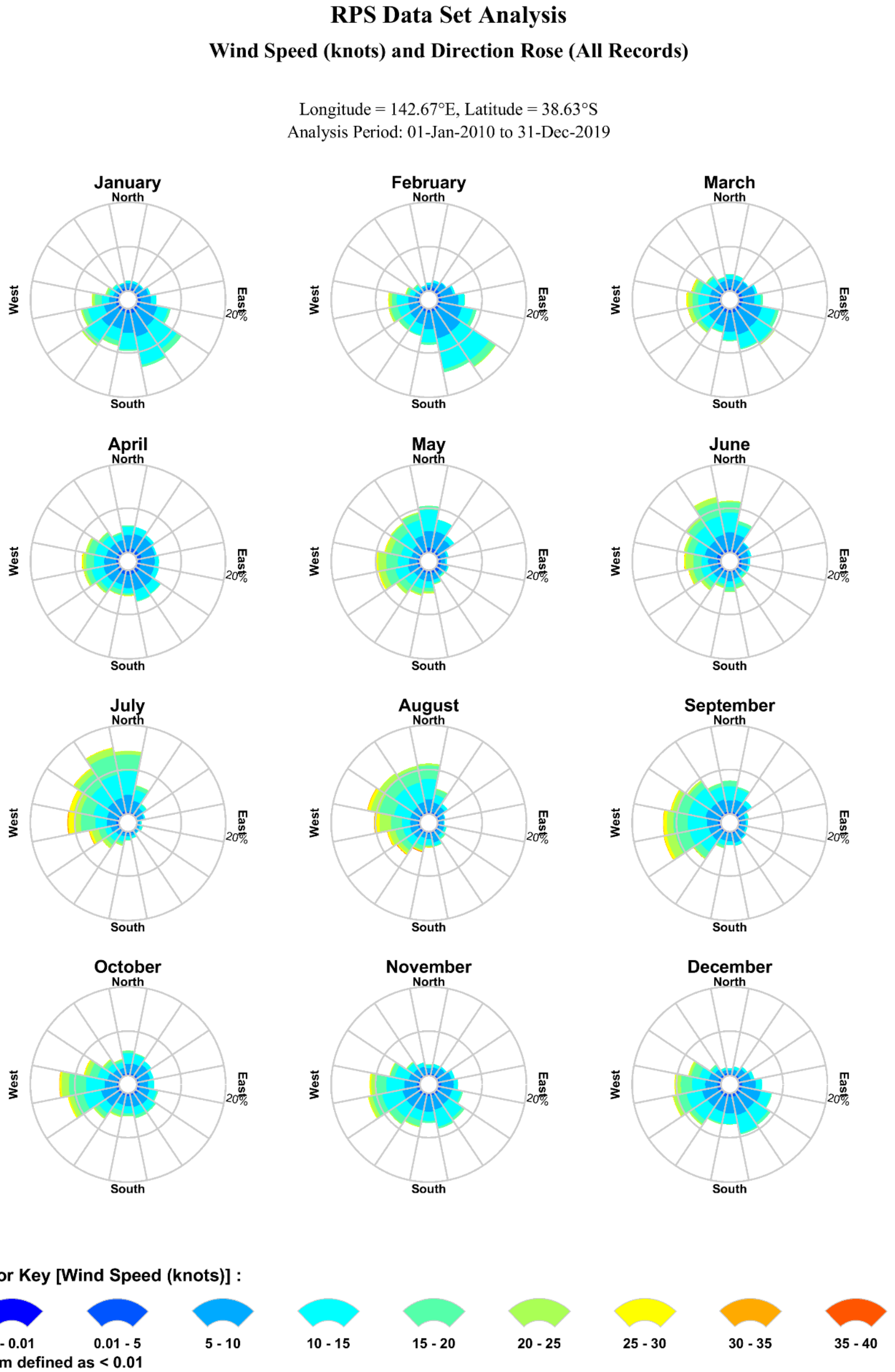


Figure 6-5: Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the Pecten East-2 well

RPS Data Set Analysis

Wind Speed (knots) and Direction Rose (All Records)

Longitude = 142.82°E, Latitude = 38.68°S
Analysis Period: 01-Jan-2010 to 31-Dec-2019

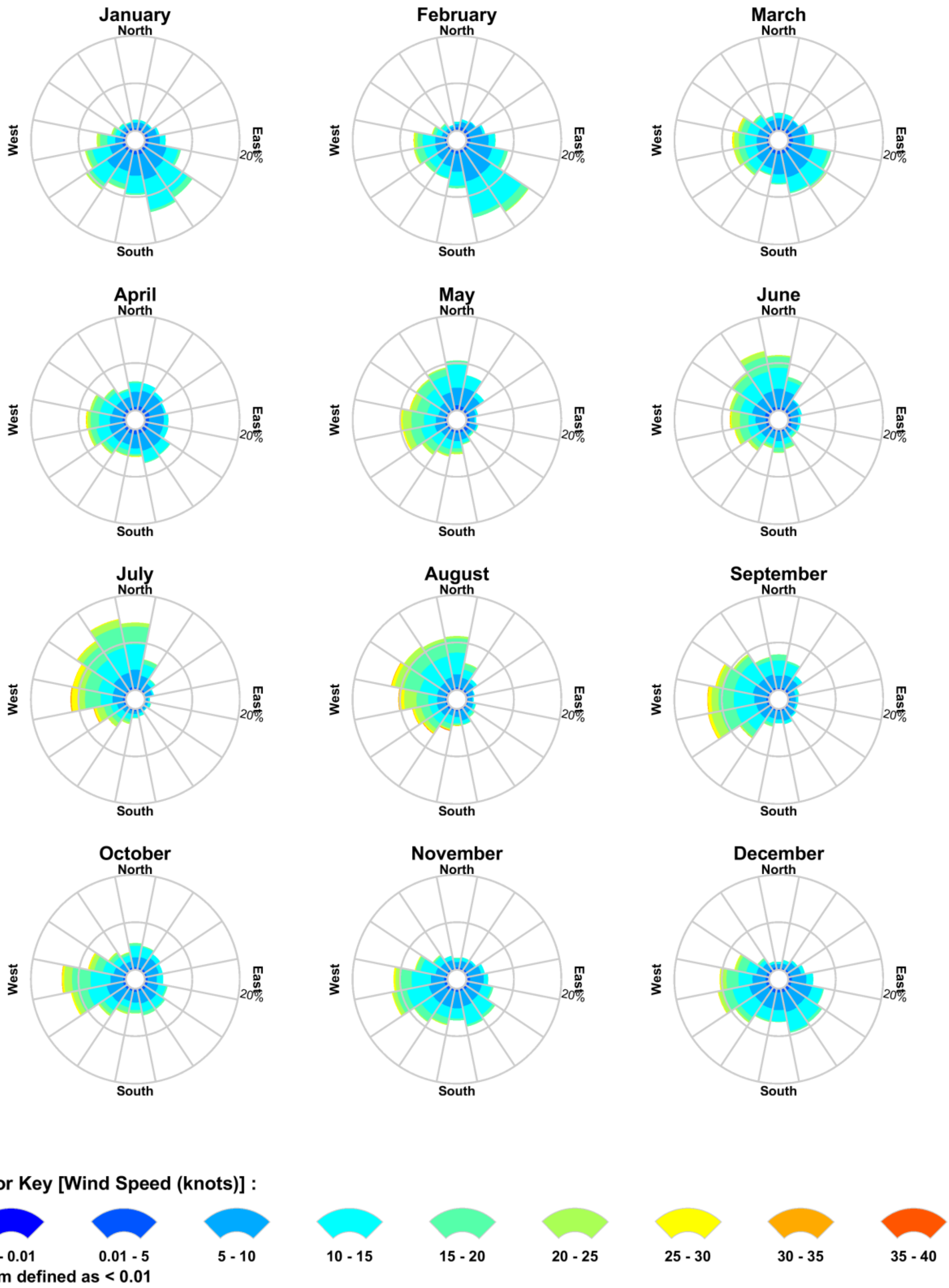


Figure 6-6: Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the Annie-2 well

6.4.5 Oceanography

6.4.5.1 Currents

Australia is heavily influenced by four major currents: East Australian Current, Leeuwin Current, Indonesian Throughflow, and the Antarctic Circumpolar Current. These currents have a driving influence on the conditions and biodiversity in Australian oceans and coastal environments. There are also a number of smaller and more complex current systems (Figure 6-7). All these ocean features can change from season to season, and may be more or less extensive and energetic, depending on climate factors.

The Bass Strait region has a reputation for high winds and strong tidal currents (Jones, 1980). Currents within the Strait are primarily driven by tides, winds and density driven flows. Tides are semi-diurnal with some diurnal inequalities, generating tidal movements with a predominantly north-east to south-west orientation; with speeds ranging 0.1–2.5 m/s (Fandry, 1983). Tidal flows in Bass Strait come from the east and west during a rising (flood) tide, and flow out to the east and west during a falling (ebb) tide. During winter there is a strong eastward water flow in the Bass Strait due to the strengthening of the South Australian Current (fed by the Leeuwin Current in the Northwest Shelf), which bifurcates with one extension moving though the Bass Strait, and another forming the Zeehan Current off western Tasmania (Sandery and Kämpf, 2007). During summer, water flow reverses off Tasmania, King Island and the Otway Basin travelling eastward, as the coastal current develops due to south-easterly winds. Average current speeds in the area range between 0.15 m/s to 0.24 m/s, with maximum current speeds in a range between 0.66 m/s (Feb) to 1.10 m/s (Sept) (RPS, 2024). In winter and spring, waters within the strait are well mixed with no obvious stratification, while during summer the central regions of the strait become stratified (RPS, 2017).

Bass Strait is a high-energy environment exposed to frequent storms and significant wave heights. The Otway coast has a predominantly south-westerly aspect and is highly exposed to swell from the Southern Ocean. Storms in Bass Strait can generate wave heights of 5 m or more (Cooper Energy 2019). In-situ wave measurements in the northern portion of the Casino pipeline, showed 2.0–3.5 m waves occur for 50% of the time, and waves over 7.6 m can occur during winter (Santos, 2004).

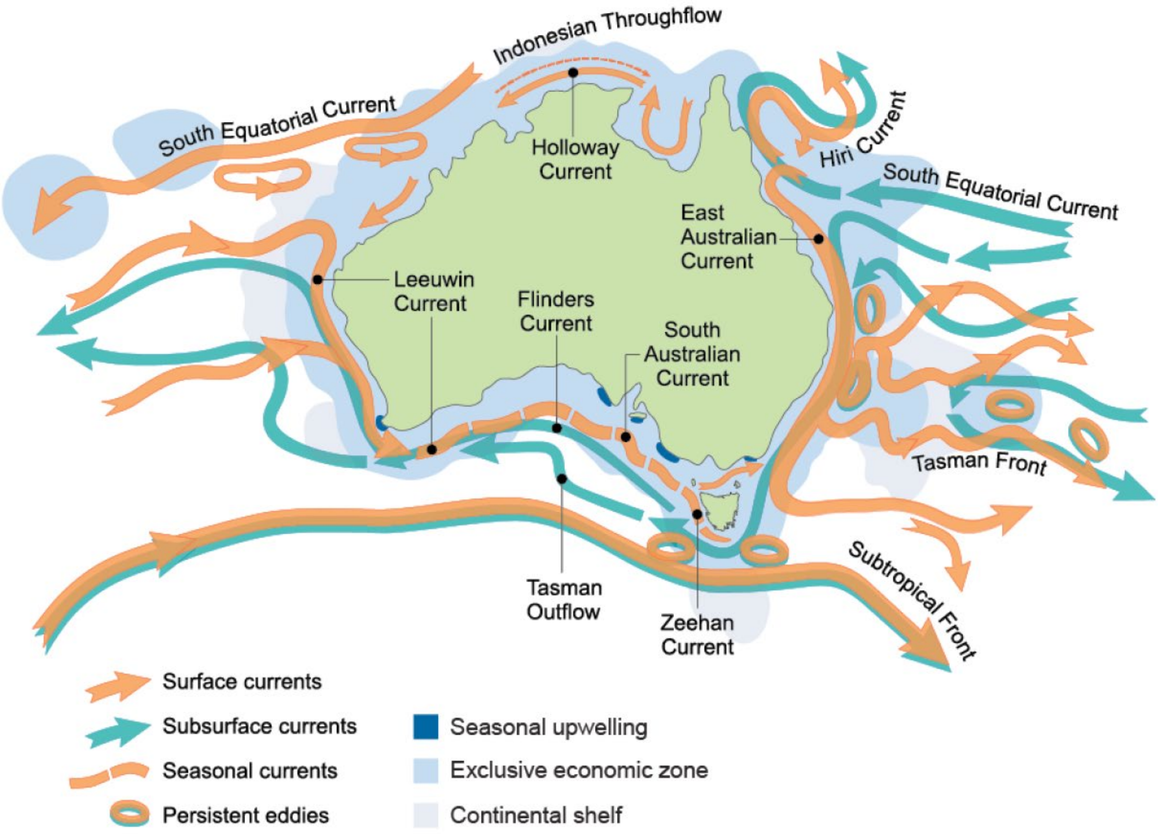


Figure 6-7: Major Ocean Currents and Features of Australia's Marine Environment

6.4.5.2 Sea Temperature and Salinity

Sea-surface water temperatures vary seasonally from ~13.3°C (Sept) to ~18.6°C (Jan/Feb/Mar) (RPS, 2024).

Typically, seawater temperature decreases with depth, particularly in the summer months, while during the winter months the shallower continental shelf waters of the Otway Basin become well mixed due to the strong winds and high waves which results in a small temperature variation between the surface and seabed (RPS, 2023a). Variation in temperature and salinity seasonally and over depth at the modelled locations is shown in Figure 6-8, Figure 6-9 and Figure 6-10.

The southwest region of Victorian area has significant upwelling of colder, nutrient rich deep-water during summer (i.e. the Bonney Coast Upwelling KEF) that can cause sea surface temperatures to decrease by 3°C compared with offshore waters (Butler et al., 2002).

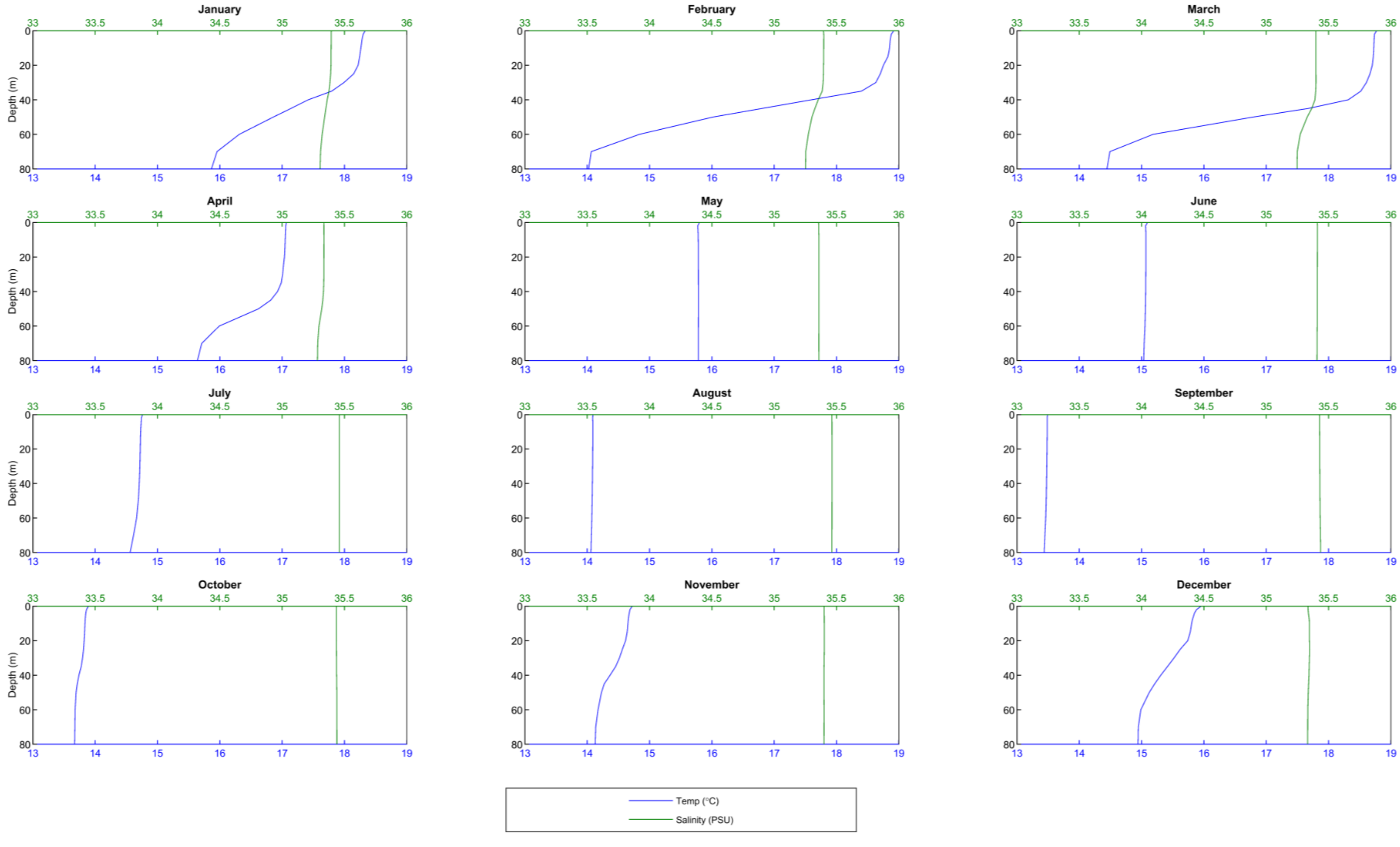


Figure 6-8: Temperature and salinity profiles nearby the Elanora-1 ST1 well

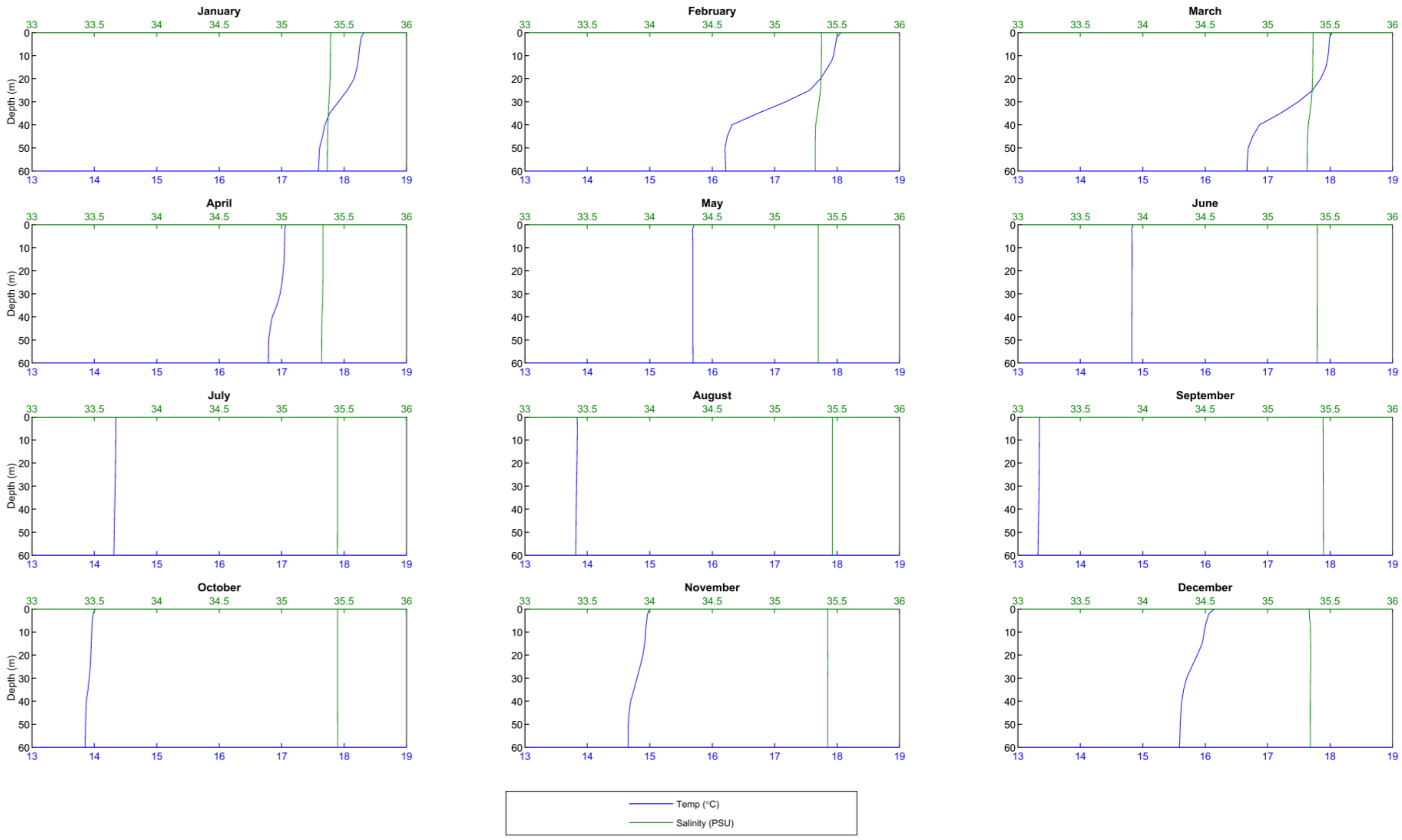


Figure 6-9: Temperature and salinity profiles nearby the Pecten East-2 well

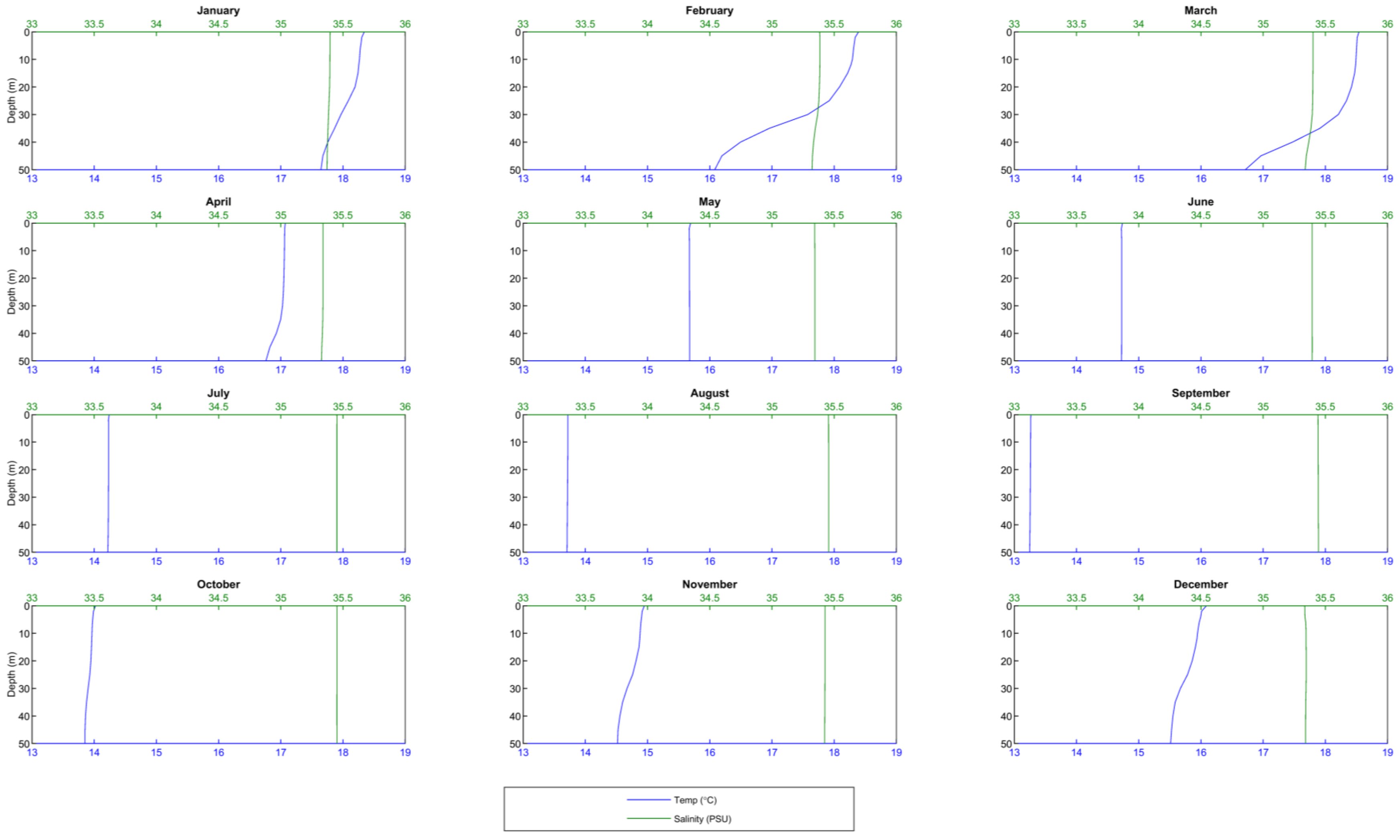


Figure 6-10: Temperature and salinity profiles nearby the Annie-2 well

6.4.6 Water Quality

Water quality within the monitoring EMBA is expected to be consistent with the waters of the Otway Basin which is characterised by high water quality with low background concentrations of trace metals and organic chemicals (Ramboll, 2020a). The greater Bass Strait is known for a complex, high energy wave climate and strong ocean currents. Water column turbidity on the Victorian coastline is subject to high natural variability. Weather conditions in the coastal environment around Port Campbell and Port Fairy are known to influence offshore hydrodynamic conditions and are a driver of sediment dynamics, impacting benthic and pelagic habitats and changing water column turbidity. Wave-driven sediment resuspension generates high turbidity levels within coastal zones, commonly exceeding 50 mg/L. Further, water quality may be influenced (sometimes episodically) in nearshore areas through anthropogenic input of nutrients, chemicals and oils from coastal/port towns or rivers, which drain catchments dominated by stock grazing and small settlements (EPA Victoria, 2024).

In late 2019 and early 2020, water sampling was conducted within a neighbouring Title Area in the Otway offshore region <20 km from the CHN offshore facilities. Sampling locations included the Artisan field (inactive at the time of survey) and the Thylacine field (active at the time of survey). Samples were collected at water depths of 33 m and 52 m from fields in water depths of 66 m and 105 m and were analysed for the presence and/or concentration of TSS, chlorophyll a, metals, hydrocarbons and nutrients such as nitrates, ammonia and phosphorus (Ramboll, 2020a). It was found that no water samples exceeded the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000) trigger values (Ramboll, 2020a) indicating an undisturbed mid-depth environment. Dissolved oxygen and pH were between their respective lower and upper limits for marine waters in all samples and the range of oxidation-reduction potential (ORP) measurements indicated a well oxygenated, ecologically healthy environment (Ramboll, 2020a). One nutrient Zinc (Zn) had concentrations that variously exceeded the 95 or 99% ANZECC protection level, but never exceeded the 90% protection level (Ramboll, 2020a). These findings are consistent with a slightly disturbed marine system, described in (ANZECC, 2000) as an ecosystem in which biodiversity may have been affected to a small degree by human activity.

It is considered that the findings of water quality sampling from this survey (Ramboll, 2020a) are comparable to the quality which would be expected to be found within the East Coast Project operational area and surrounds considering the proximity to sampling locations, similarity in water depths and the similarity of activities previously conducted within the fields.

6.4.7 Sediment Quality and Characteristics

Substrate across the broader Bass Strait (inclusive of the monitoring EMBA) comprises a variety of sediment types (Figure 6-13), with the sediment particle size associated with the region's tidal currents and wave energy. Boreen et al. (1993) examined 259 sediment samples collected over the Otway Basin and the Sorell Basin of the west Tasmanian margin during two research cruises (January / February 1987 and March / April 1988). Based on assessment of the sampled sediments it was concluded the Otway continental margin is a swell-dominated, open, cool-water, carbonate platform. A conceptual model was developed that divided the Otway continental margin into five depth-related zones – shallow shelf, middle shelf, deep-shelf, shelf edge and upper slope (Figure 6-11).

Within Victorian State waters substrate was classified (see Figure 6-12) to identify habitat representation across Victorian marine parks. Seafloor mapping of the Shipwreck Coast biounit (as described in section 0) is at approximately 91% (Young et al., 2022). Utilising existing data sources the percentage of reef and sediment coverage across the coastline was identified. The percentage of reef cover for Shipwreck coast was found to be highest in water depths of 30 – 40 m and 40 – 50 m while the percentage of sediment cover was found to be the higher in water depths of 50 – 60 m (Young et al., 2022).

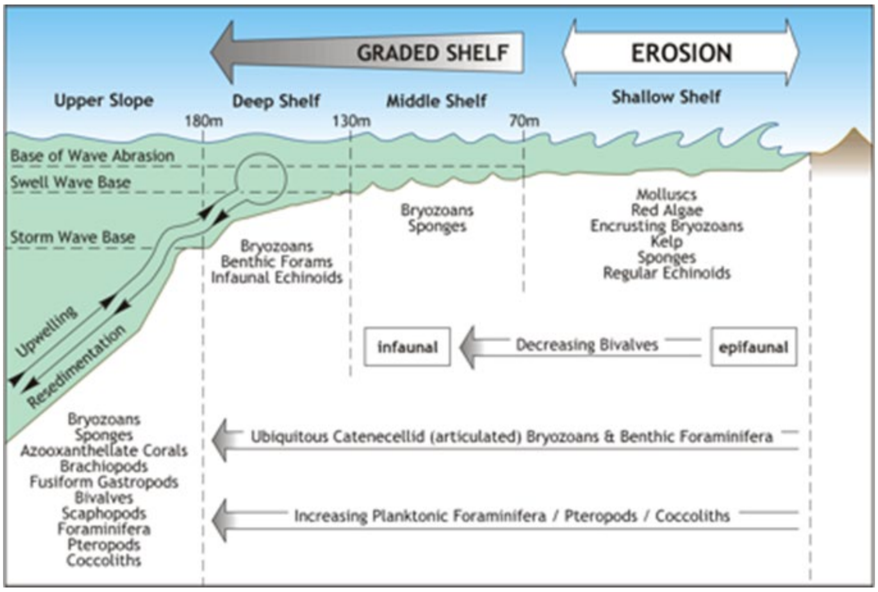
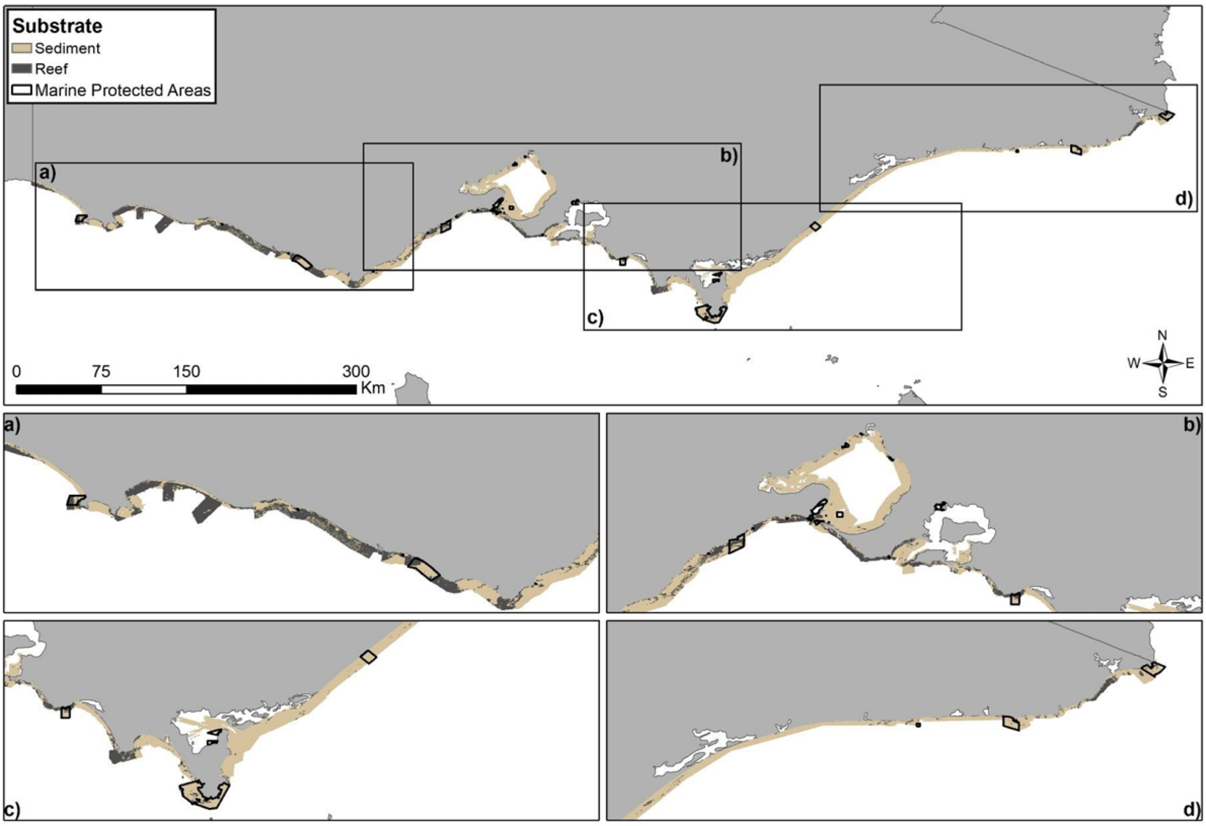


Figure 6-11: Model of the geomorphology of the Otway Shelf



Source: Young et al., 2022

Figure 6-12: Sediment and reef classification of the seafloor mapping data in the state waters of Victoria. Inset A includes the Shipwreck Coast biounit

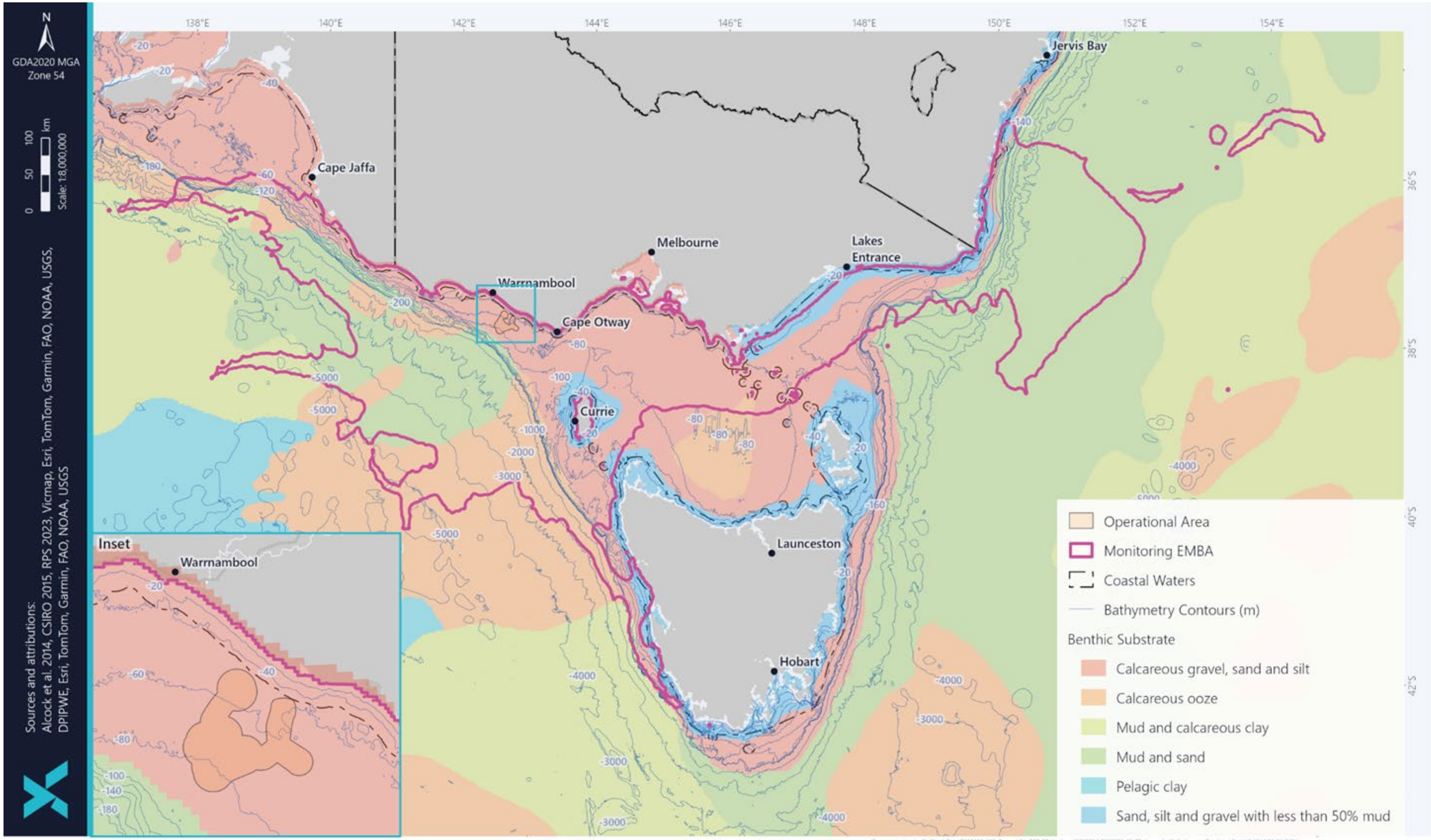


Figure 6-13: Benthic substrate characterisation across south-east Australia

In late 2019 and early 2020, sediment sampling was conducted within a neighbouring Title Area in the Otway offshore region <20 km from the CHN offshore facilities (see Figure 6-14). Sampling locations included the Artisan field (inactive at the time of survey) and the Thylacine field (active at the time of survey). Samples were collected at water depths of 72 – 75 m and 104 –105 m and were analysed for the presence and/or concentration of total organic carbon (TOC), metals (including cadmium, chromium, cooper, lead, mercury, nickel, tin and zinc), hydrocarbons and nutrients such as silicon, nitrate and phosphorus (Ramboll, 2020a). Particle size was also identified. The composition of sediment samples was predominately sand across both locations with very little silt and clay. Sediments samples were analysed and were found to have a high ORP and low or undetectable levels of toxicants (listed above) indicating an unmodified seabed environment (Ramboll, 2020a). It is considered that the findings of sediment quality sampling from this survey are comparable to the quality which would be expected to be found within the East Coast Project operational area and surrounds considering the proximity to sampling locations, similarity of water depths and the similarity of activities previously conducted within the fields.

Further, seabed characteristics of the East Coast Project operational area is predicted to be comparable to that of the existing CHN facilities. Particularly between water depths of 60 to 70 m where grab samples were taken as part of an environmental sampling survey conducted in association with the existing CHN infrastructure (Ramboll, 2020b; Appendix 2). A number of these grab samples happen to have been taken within and around the operational area of the East Coast Project (see Figure 6-14). A summary of the sediment composition at each grab sample, including visual representations of samples are detailed in Table 6-2. General observations of the survey included:

- large tracts of exposed caprock (hard calcarenite), some fine to coarse grained sand with variable density
- beyond 60 m water depth, the seabed comprises outcrops of hard substrate with very low relief and structural complexity separated by gullies of sand or fine gravel.
- low relief rock outcrop with no significant sediment cover in water depths varying from 65 to 70 m
- diversity of epifauna and infauna communities (see section 6.5.1).

No significant items of debris or major sediment obstruction were identified during historical video, acoustic (multibeam, sidescan) and seabed sampling surveys in the Title areas (Ramboll, 2020b; Appendix 2). Figure 6-2 provides an SSS image of the sediment characteristics at the historical Annie-1 well located within the vicinity of the East Coast Project.

The description of sediment type and quality from these surveys (Ramboll, 2020a; Ramboll, 2020b) are consistent with other reports for the wider Bass Strait region. Dominant substrate, sand and gravel, cover the shelf except for areas of silty sand in central Bass Strait with the sediment tending to become coarser with increasing distance from shore (Ramboll, 2020b; Barton et al., 2012; Murray-Wallace and Woodroffe, 2014; Jones and Davies, 1993).

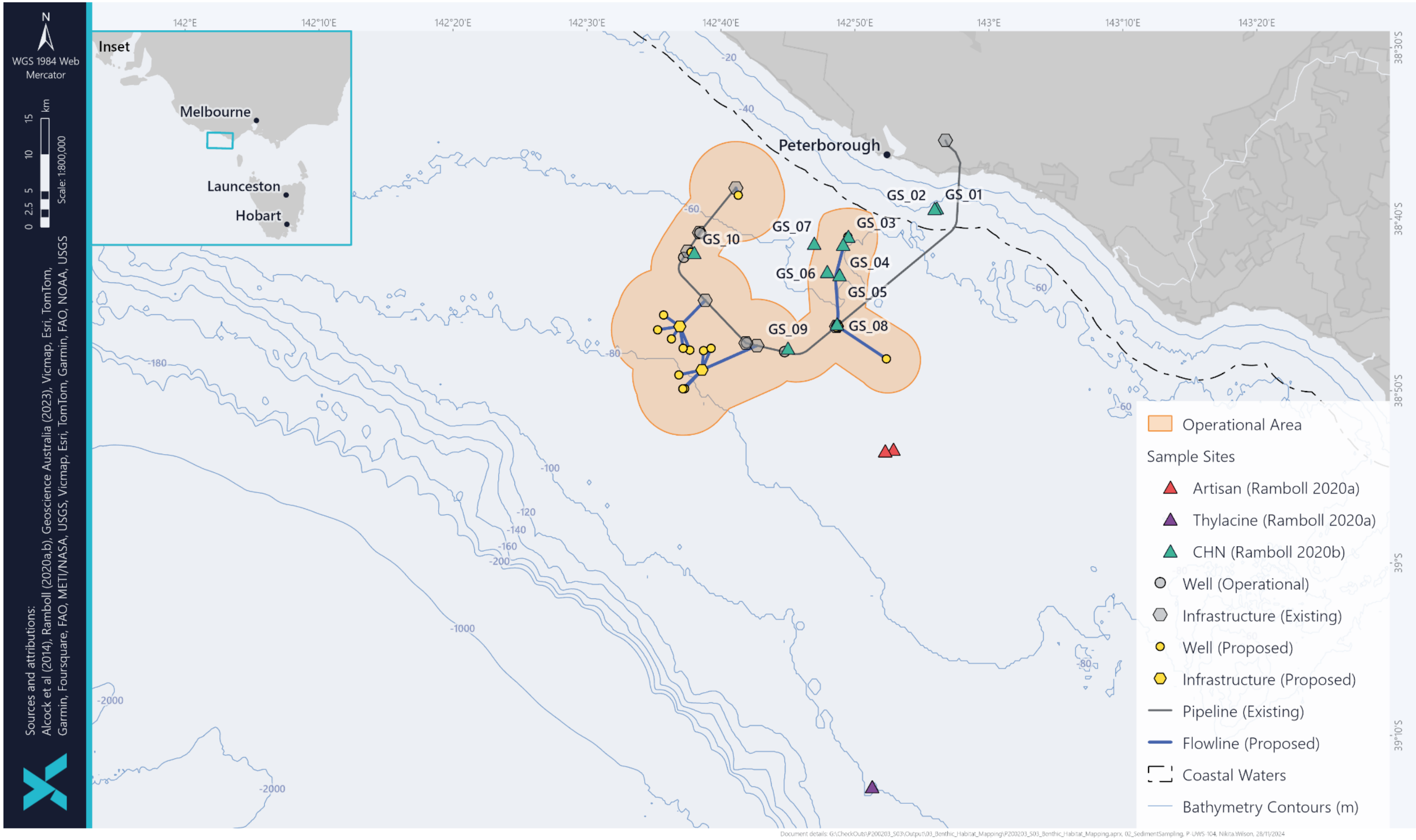
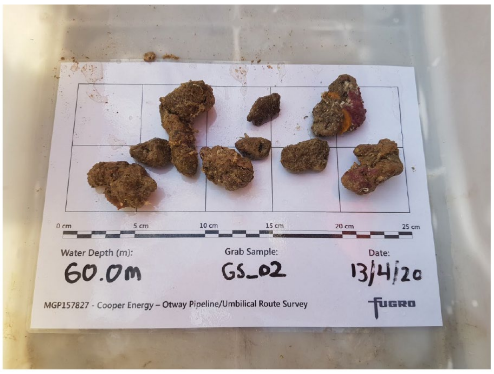
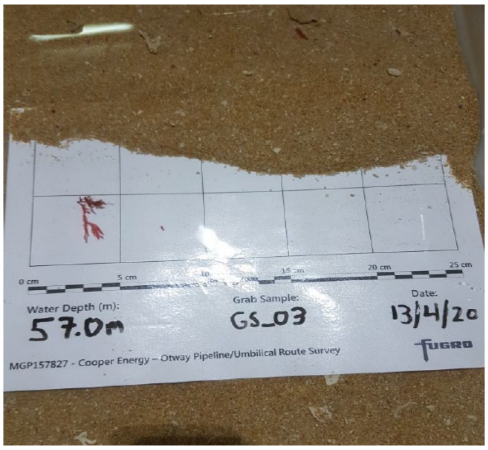
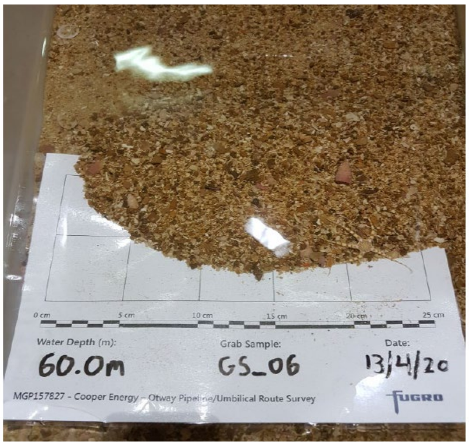
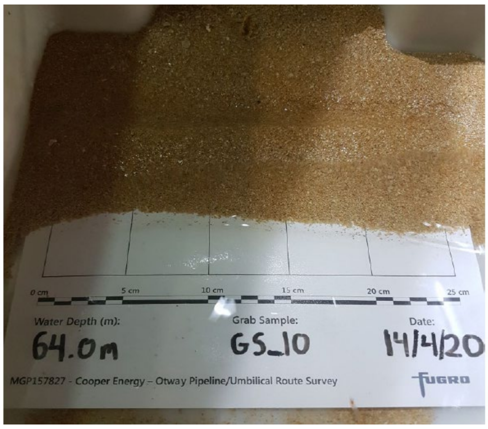


Figure 6-14: Grab sample locations from the Ramboll 2020a and Ramboll 2020b environmental surveys relevant to the operational area

Table 6-2: Sediment types observed in grab samples within and/or adjacent to the operational area

Grab Sample Location	Sediment Description	Sediment Sample
GS_01	Fine-grained carbonate sand with silt. Sand is pale yellowish orange, well sorted, fine grained and composed primarily of mixed carbonates.	
GS_02	Cobble-sized limestone fragments.	
GS_03	Fine-medium carbonate sand. Sand is dark yellowish orange, well sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.	

Grab Sample Location	Sediment Description	Sediment Sample
GS_04	Coarse gravelly carbonate sand. Sand fraction varies from white to reddish olive-brown, poorly sorted, medium to coarse grained and composed primarily of mixed carbonates. Major fraction shell fragments.	
GS_05	Fine-medium carbonate sand. Sand is light yellowish orange, moderately sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.	
GS_06	Carbonate sand and gravels. Sand is light yellowish orange, fine to coarse grained and composed primarily of mixed carbonates. Gravels are reddish brown and poorly sorted with sand and shell fragments. Minor fraction of shell pieces.	
GS_07	Four attempts were made; however, no sample was recovered. Small limestone rock was caught in grab on first attempt, prohibiting the grab from closing and it was not retained.	N/A

Grab Sample Location	Sediment Description	Sediment Sample
GS_08	Carbonate sand and gravels. Sand is light yellowish orange, fine to medium grained and composed primarily of mixed carbonates. Moderately sorted with shell fragments. Fraction of shell pieces and lacy bryozoan fragments (*Phidoloporidae*).	
GS_09	Carbonate gravels and sand. Gravels are light gray to grayish orange in color, very poorly sorted amongst fine to coarse grained sands composed primarily of mixed carbonates. Large fraction of shells, shell pieces and lacy bryozoan fragments (*Phidoloporidae*).	
GS_10	Fine-medium carbonate sand. Sand is dark yellowish orange, well sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.	

Source: Ramboll, 2020b

6.4.8 Ambient Light

Ambient light is classified as light currently present within an environment. Ambient artificial light sources associated with offshore activities exist in the Otway region, including both permanent (e.g., onshore/offshore developments) and temporary (e.g., vessels, road traffic) light sources.

Within the operational area sources of artificial light include the temporary light from Otway offshore activities including intermittent vessel and MODU activity, and infrequent flaring during historical development campaigns.

6.4.9 Underwater Noise

Physical and biological processes contribute to natural background sound. Physical processes include that of wind and waves whilst biological noise sources include vocalisations of marine mammals and other marine species.

Iceberg calving, shoaling and disintegration has recently been identified as a dominant source of low frequency (<100 Hz) noise in the Southern Ocean. Wind is also a major contributor to noise between 30–100 Hz and can reach 85-95 dB re 1μPa^2/Hz under extreme conditions (WDCS, 2004). Rain may produce short periods of high underwater sound with a flat frequency spectrum to levels of 80 dB re 1μPa^2/Hz and magnitude four earthquakes have been reported to have spectral levels reaching 119 dB re 1μPa^2/Hz at frequency ranges 5-15 Hz. It is noted that earthquakes of this magnitude are relatively frequent along Australia's continental shelf in the southern margin (i.e. tens of small earthquakes per year) (McCauley and Duncan, 2001). Figure 6-15 provides generalised ambient noise spectra attributable to varies sources completed by Wenz (1962; cited in Richardson et al. 1995).

The South-east Marine Region is one of the busiest shipping regions in Australia and the Bass Strait is one of Australia's busiest shipping routes (see Section 6.7.3.1 for further detail on shipping activities within the monitoring EMBA). Typical predominant frequencies of commercial shipping occur within the range of 10 Hz to 1 kHz with some frequencies reaching the tens of kHz (Southall et al., 2017). A study of multiple vessel classes commissioned by the Vancouver Fraser Port Authority (2018) measured and was able to attribute source levels to those different classes of vessels. The quietest vessel class were naval vessels, with a lowest radiated noise level of 160.9 dB re: 1 μPa^{2}m^2.s. The loudest class was container ships over 200 m in length. The highest mean (average) radiated noise level at 189.7 dB re: 1 μPa^{2}m^2.s and loudest recorded ship in class of 204.2 dB re: 1 μPa^{2}m^2.s The typical vessel types used for the East Coast Project are expected to have monopole source levels around 187.6 dB re: 1 μPa^{2}m^2.s (for an ISV) associated with vessel broadband acoustic energy (Jasco, 2022) which is comparable to other ships within the extensive merchant fleet[7].

Since 2009 (paused 2017-2018 due to funding gap), the Integrated Marine Observing System (IMOS) has been recording underwater sound south of Portland, Victoria (38° 32.5' S, 115° 0.1' E). Prominent sound sources identified in recordings include blue and fin whales at frequencies below 100 Hz, ship noise at 20 to 200 Hz and fish at 1 to 2 kHz (Erbe et al. 2016).

Within the operational area existing sources of anthropogenic noise will include passing ships commercial and recreational fishing boats, as well as vessels used intermittently for IMR during ongoing production operations. Vessel-based seismic survey, scientific surveys and geophysical surveys have also been undertaken in the region and temporarily contribute to background noise levels.

[7] *Radiated noise levels for vessel can be slightly louder than monopole source levels due to less consideration of the environment in the calculation process. Although radiated noise level and source levels (i.e. monopole source levels) are not fully equivalent, for comparison purposes it is reasonable to do so.*

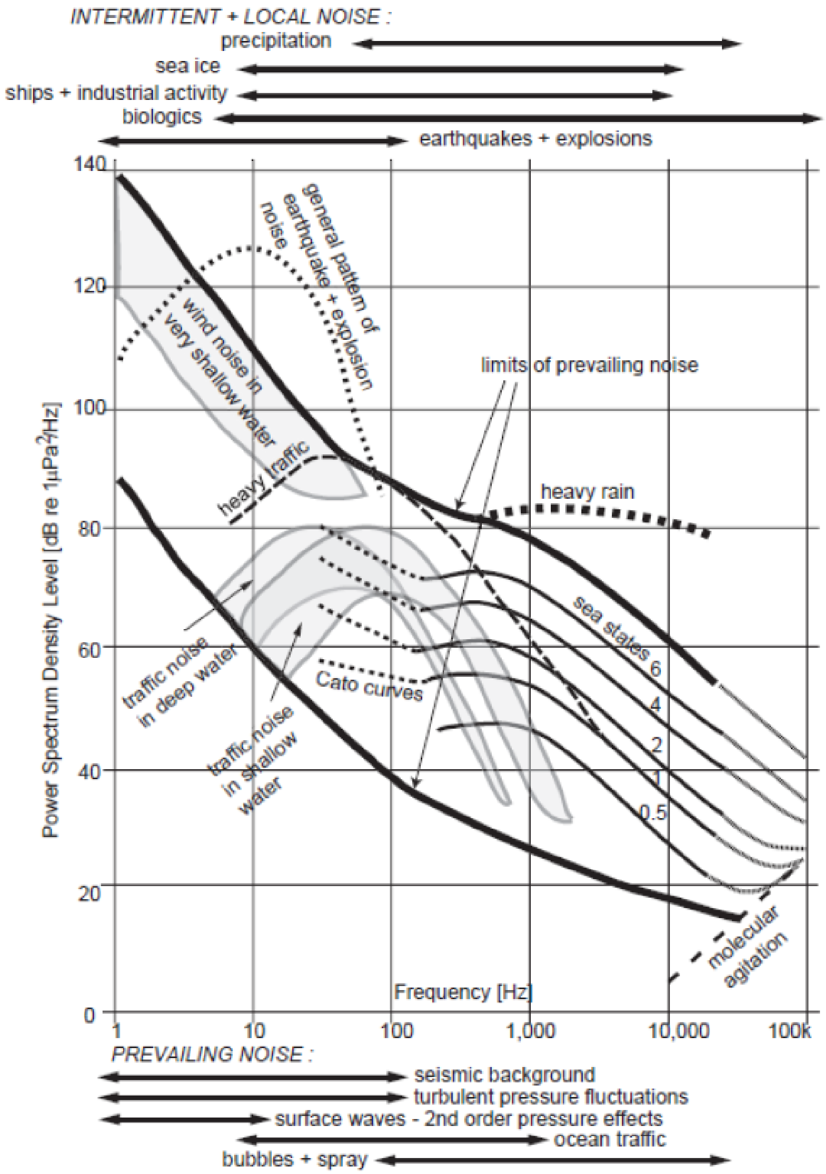


Figure 6-15: Generalised ambient noise spectra

6.5 Ecological Environment

6.5.1 Benthic Assemblages

Benthic assemblages are biological communities which inhabit the seabed; their composition is influenced by the physical properties of the seabed and overlying waters, as well as inputs such as sunlight and nutrients. Seabed substrates can range from unconsolidated sand to hard substrates such as limestone. Typically, within the euphotic zone, benthic communities are composed of a combination of light-dependent taxa and consumer taxa. Species such as algae, seagrass or mangroves which obtain their energy primarily from photosynthesis are consumed by species such as molluscs, sponges and worms. Benthic assemblages are an important component of marine ecosystems and the ecological services they provide (Rife, 2018).

Between 1979 and 1984 a series of benthic surveys were conducted by the Victorian Museum on the continental shelf of the Bass Strait (Poore et al., 1985; Wilson and Poore, 1987). The surveys involved sediment sampling and recovery of marine benthic organisms across hundreds of sites from the western to eastern Bass Strait. Within those sites there were examples of diverse benthic communities comprising infauna and epifauna such as sponges, octocorals, ascidians and bryozoans. Sediment types ranged across the Bass Strait with generally more and finer sediment in the east and with depth, and generally higher proportion of bare calcarenite in the west.

Surveyed benthic environments of the existing CHN facilities are expected to be representative to those found within the East Coast Project operational area and surrounds considering the proximity to sampling locations, similarity of water depths and the similarity of activities previously conducted within the fields. These studies are described in more detail below.

ROV surveys conducted in 2004 to assist the development of the Casino project found that the following benthic environments occur between the shore and the existing CHN facilities (Santos, 2004):

- Intertidal environment (0 to 2 m):
  - rock platform
  - cliff face
  - sandy beach

  See Section 6.5.2 for detail.
- Shallow environments (2 to 8 m):
  - contiguous kelp reefs
  - patch sandy reefs
  - sand

  See Section 0 for detail.
- Mid-depth environment (8 to 20 m):
  - *Ecklonia*-dominated reef
  - sand

  See Section 6.5.1.2 for detail.
- Deep environment (20 to 70 m):
  - sponge-dominated reef
  - sand

  See Section 6.5.1.3 for detail.

Table 6-3 and Figure 6-16 identifies and illustrates the types of benthos identified in the title areas (Figure 6-16) relative to the existing CHN facilities in Cwth waters, and historical Annie-1 well location. The images show colonisation of the existing facilities and natural burial of some sections of the main pipeline since the installation of the CHN facilities in the early-mid 2000’s.

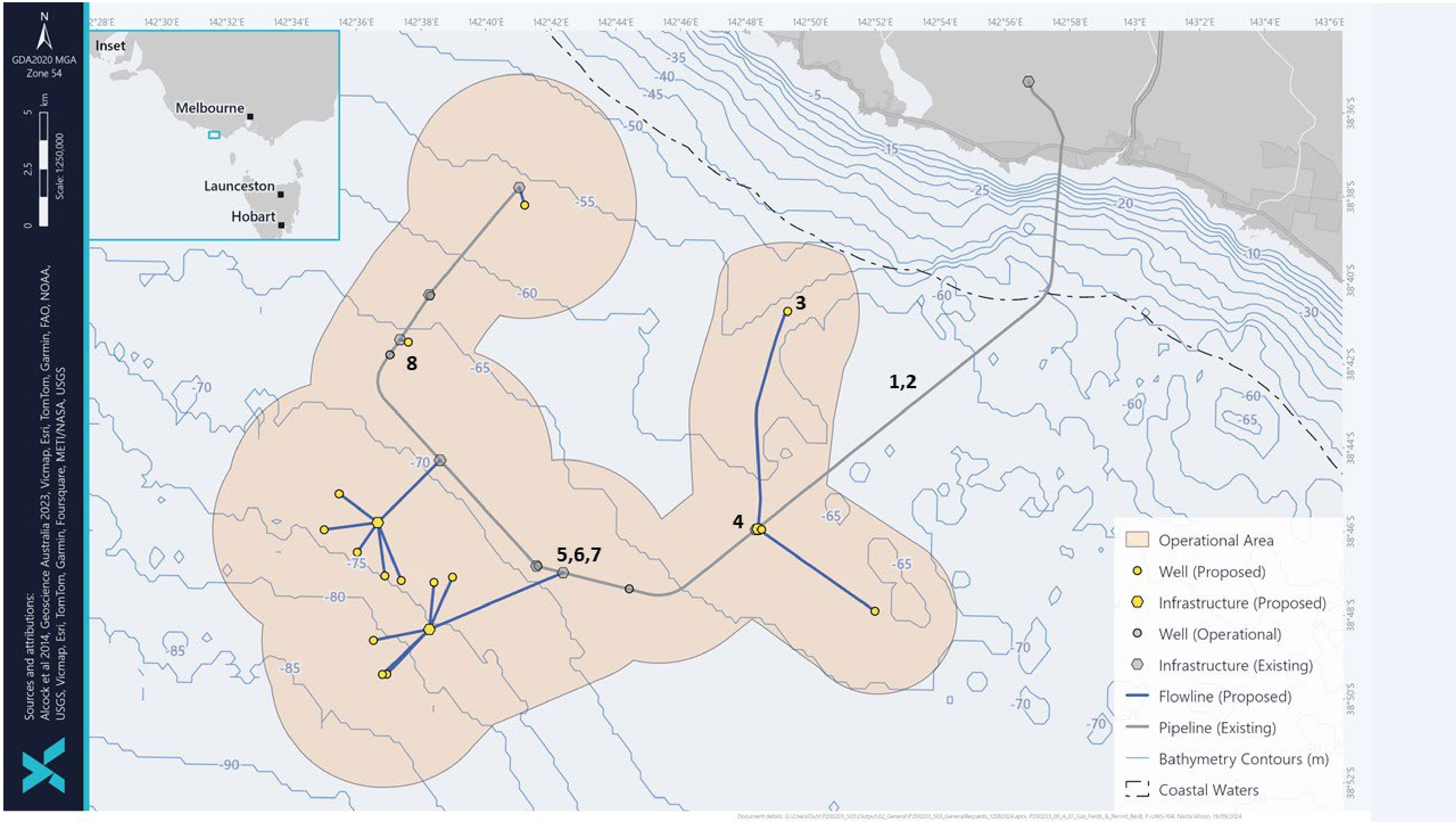


Figure 6-16: Examples of seabed and benthos in the East Coast Project operational area

Table 6-3: Benthos observed in images of existing infrastructure within and/or adjacent to the operational area

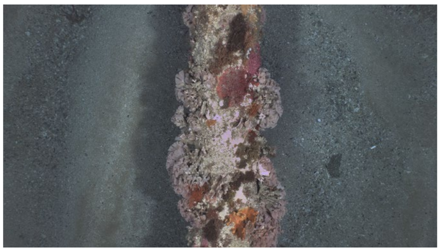
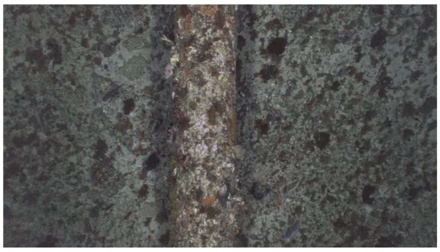
Image Reference Number	Description	Image
1	Stage I: Pipeline under shifting sand. Vicinity of KP19, Cwth waters	
2	Stage I: Pipeline overlaying shifting sand. Vicinity of KP19, Cwth waters	
3	Seabed: Cwth waters Vicinity of Annie	
4	Seabed: Cwth waters Vicinity Black Watch T	
5	Stage I: 12-inch pipeline. Vicinity of Casino-4	
6	Stage I: 12-inch pipeline. Vicinity of Casino-4	

Image Reference Number	Description	Image
7	Stage II: umbilical repair (2019 install) Vicinity of Casino-4	
8	Stage II: 12-inch pipeline Vicinity of Netherby	

Image #3 collected by ROV during 2019 Annie-1 drilling campaign. All other images collected in 2020 during facility inspection.

6.5.1.1 Shallow Environment (2-8m)

Surveys found that the areas extending from the shoreline are comprised of contiguous kelp reef consisting of large areas of hard substrate dominated by large brown algae (bubble weed, *Phyllospora comosa* and bull kelp, *Durvillaea potatorum*). In some areas, kelp reef rises close to the surface and waves may break on these features. Epifauna such as sponges, ascidians and molluscs, including abalone, are also associated with this habitat. Fishes such as wrasse, leatherjacket, scalyfin and morwong are also likely to inhabit contiguous kelp reef (Santos, 2004).

Small patches of non-contiguous reef dominated by large brown algae (bubble weed, *Phyllospora comosa* and bull kelp, *Durvillaea potatorum*) or a turf of red and brown algae interspersed with the green algae *Caulerpa* sp. and *Codium* sp. also occurs in the shallow environment. Tracts of open sand separate these small patch reefs and similar species of epifauna and fish to those occurring on contiguous reef are likely to occur here (Santos, 2004).

Shallow reefs give way to open sand further offshore. The sand areas in the shallow environment are characteristically devoid of significant epifauna but may contain significant infaunal communities including bivalves, crustaceans and polychaetes. The infauna provides food resources for some foraging fish such as bream and flounder and cephalopods such as octopus that may inhabit these areas. Shallow sand areas typically have coarse-grained sand forming sand waves caused by wave action. This environment is likely to be similar for sandy shores that are interspersed among the rocky shorelines of this part of the southwest Victorian coast (Santos, 2004).

The operational area of the East Coast Project does not overlap with the shallow environment as it is located wholly within commonwealth waters in depths ranging from ~55 – 85 m. Overlap does occur within the monitoring EMBA.

6.5.1.2 Mid-depth Environment (8-20m)

The mid-depth environment is the most extensive and is relatively uniform throughout the region and is dominated by sand. Open sand in this environment comprises a range of grain sizes although sand is usually finer and sand waves of lower crest height and inter-crest distance than in the shallower environment. BHP–Santos (1999) identified intermittent patch reefs dominated by the brown alga, *Ecklonia* sp. Red algae and coralline algae were also identified on these reefs, in addition to epifauna including echinoderms, ascidians, bryozoans and sponges. These isolated reefs probably represent centres of high species diversity and abundance of epifauna, and fish compared to the open sand (Santos, 2004).

The operational area of the East Coast Project does not overlap with the mid-depth environment as it is located wholly within commonwealth waters in depths ranging from ~55 – 85 m. Overlap does occur within the monitoring EMBA.

6.5.1.3 Deep Environment (20-70m)

As discussed in Section 6.4.6 the seabed in this deep environment is characterised by sand or gravelly / rubble and hard platform substrates (Ramboll, 2020b). In addition to sediment sampling the Ramboll (2020b) environmental survey also investigated the benthic and epibenthic ecology associated with existing CHN infrastructure (Ramboll, 2020b; Appendix 2). Grab samples were analysed for both sediment characteristics (Table 6-2) and benthic fauna (Table 6-4), a number of which were taken within and around the operational area of the East Coast Project (see Figure 6-14). A summary of the benthic fauna found at each grab sample site are detailed in Table 6-4. General observations of the survey were that there was very little conspicuous fauna found in the sediment grab samples, which is likely to reflect the relatively course nature of the sediment collected, characteristic of the wider region (Ramboll, 2020b).

Table 6-4: Benthic fauna observed in grab samples within and/or adjacent to the operational area

Grab Sample Site Code	Benthic Fauna Description
GS_01b	Polychaete tubes visible.
GS_02	Limestone fragments covered with crustose coralline algae (Rhodophyta). Also, colonial tunicates (ascidians) visible (*Botryllinae*, possibly *Botryllus stewardensis*). Presence of calcified tube worm casings (*Serpulidae*, possibly *Galeolaria caespitosa*) and colonial hydroids (possibly *Leptothecata*).
GS_03d	Few pieces of red algae (Rhodophyta, possibly *Hemineura frondosa*).
GS_04	No fauna present.
GS_05	No fauna present.
GS_06	Single live Brittle star (*Ophiuridae*, Genus *Ophionereis*, possibly *Ophionereis schayeri*).
GS_07	Four attempts were made; however, no sample was recovered.
GS_08	No fauna present.
GS_09a	No fauna present.
GS_10	No fauna present.

Source: Ramboll, 2020b

In addition to grab samples the epibenthic ecology of the surrounds was investigated from seabed video footage taken along 4 routes, covering approximately 1.8 to 2.8 km of seabed associated with the existing CHN infrastructure. A number of these video transect routes were taken within and around the operational area of the East Coast Project (see Figure 6-17). A summary of the benthic features observed along each video transect route is detailed in Table 6-5 with visual representations of drop camera footage represented in Figure 6-18 to Figure 6-24. General observations of the video transects included:

- Scattered areas of hard ground supporting patchy areas of abundant epibiota, typically bryozoans, gorgonian, cnidarians and sponges.
- Various epibenthic organisms such as crustaceans and molluscs are likely to be associated with this habitat.
- No species or ecological communities listed as threatened under the EPBC Act were observed and no areas of high relief, reefs, sponge beds or shipwrecks were noted
- While sponges were present, they were not so highly abundant or morphologically diverse as a taxonomic group to be considered as a sponge bed, rather sponges were interspersed throughout the patchy epifaunal covering.

- The patchy epifauna and the presence of hard platform is consistent with the description of a key ecological feature (KEF) of the South-East bioregion, that is, shelf rocky reefs and hard substrates. However, epifauna was also noted to occur in sand, gravel and rubble substrates (Ramboll, 2020b).

It is important to note that although the sediment sample results were notably different to the observations of abundant epibiota during the video transects, the difference is likely due to the sampling method of the grabber that is unable to penetrate hard substrate which is the preferred habitat of the epifauna located within survey location (Ramboll, 2020b).

Overall findings based on the assessment of epifauna using seabed video transects and photographs, found the seafloor to be an unmodified marine environment that supports a patchy complex of prostrate and branching or erect epibiota (i.e., bryozoans, gorgonian cnidarians and sponges) (Ramboll, 2020b). These findings are consistent with the environmental survey report conducted within a neighbouring Title Area in the Otway offshore region <20 km from the CHN offshore facilities (Ramboll, 2020a) which also found the seafloor to be an unmodified marine environment that supports a patchy complex of branching epibiota based on grab samples for benthic fauna and drop camera images. For example, drop camera images at Hercules (H), located in a similar water depth to the proposed Elanora, Isabella and Heera prospects, showed epibiota coverage of ~24% (Ramboll 2020a). Locations of these sample sites have been provided in Figure 6-14 and Figure 6-17 for context.

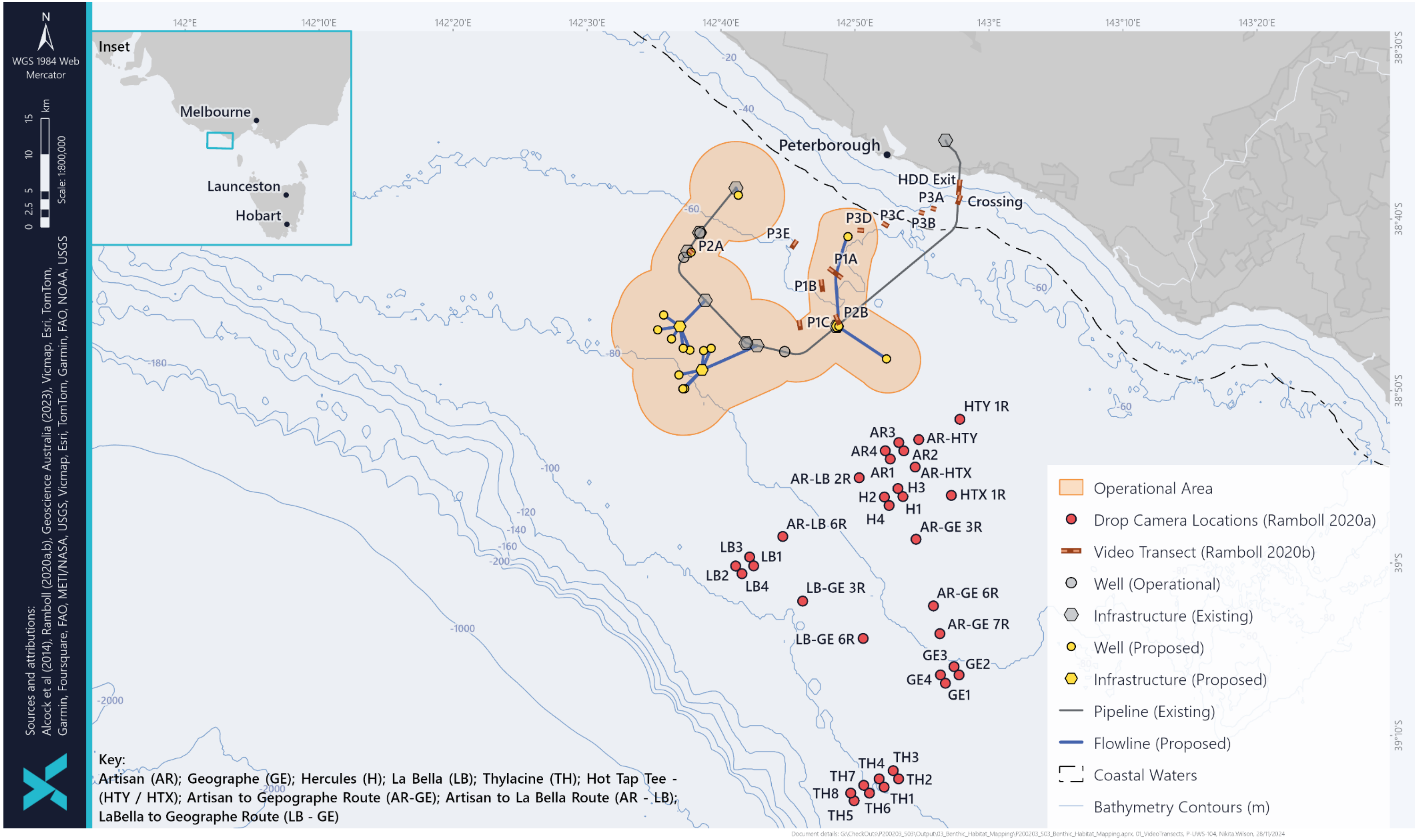


Figure 6-17: Video transect (Ramboll, 2020b) and drop camera (Ramboll, 2020a) locations from environmental surveys relevant to the operational area

Table 6-5: Benthic features observed in video transects within and/or adjacent to the operational area

Video Transect Location	Description	Figure reference
P2A – Located near existing Henry well within the operational area	Starting at the beginning of Route 1 in the vicinity of the "Henry" well sites, the epifauna was generally prostrate epifauna with some occasional patches of erect epifauna throughout the entire transect P2A. The abundance of epifauna ranged from occasional to frequent coverage with three instances of highly abundant fauna. Two crinoids (feather stars) and one teleost fish were noted.	Figure 6-18
P2B – Located near existing black watch ILT within the operational area	The epifauna type, abundance and patchiness of transect P2B, between the 'Henry' well sites and "Annie 2", was largely similar to that described for transect P2A, with the exception that no hard platform was present. Observations included several snapper, file fish, other teleost fish and starfish. Man-made pipes were observed on the seabed surface, covered in epifauna.	Figure 6-19
P3C and P3D – Located near Annie prospect within operational area (P3D only)	The epifauna in closest proximity to "Annie 2", at transect P3D, was less abundant covering <25% of the seabed and was only present as prostrate epifauna. Occasional teleost fish were observed. The epifauna at transect P3C, between "Annie 2" and "HDD/Iona", was very similar.	No drop camera footage presented in Ramboll report for transect (2020b)
P3A and P3B – Located in state waters outside of the operational area	A greater abundance of erect epifauna was noted along transects P3B and P3A, between "Annie 2" and "HDD/Iona", but generally epifauna remained patchy as for other transects. Rubble substrate was often associated with erect epifauna, which would be providing attachment opportunities for such fauna.	No drop camera footage presented in Ramboll report for transect (2020b)
P3E – Located between Annie and Henry outside of the operational area	Between "Annie 2" and "Henry" well sites the epifauna was generally prostrate epifauna with some occasional patches of erect epifauna. But generally epifauna remained patchy aligning with the other transects. Occasional teleost fish were observed in hard platform areas and gravelly (shelly) sand. The sediment composed mostly of gravelly (shelly) sand, with occasional patches of sand with rubble and areas of hard platform/sand and hard platform with gravel.	Figure 6-20
P1A, P1B and P1C – Located between Annie and Casino fields within the operational area	Between "Casino" and "Annie 2" well sites, in transects P1A, P1B (Figure 10) and P1C, the epifauna was present for most of each transect with only small patches (1-2 m length) where epifauna was absent. Epifauna was various prostrate and erect with not specific pattern or relationship to the sediment. The sediment was more varied along these transects than those described above, including hard platform (usually with a covering of sand), rubble, and gravel or shell gravel.	Figure 6-21 Figure 6-22 Figure 6-23
P1B – Located between Annie and Casino fields within the operational area	Epifauna in the vicinity of the "Black Watch" tee site, in transect P1B, was highly to frequently abundant and was both prostrate and erect, over a sediment bed consisting largely of sand with some hard platform.	Figure 6-22
"Crossing" and "HDD Exit" – Located in near shore state waters (outside the operational area) where the existing CHN pipeline enters the seabed before crossing beneath the shoreline.	At the end of this route, near "HDD/Iona", within transects labelled as "Crossing" and "HDD Exit", there was a notable lack of epifauna compared to other transects described along this route. No epifauna was observed along the "Crossing" transect or and very occasional patches of prostrate epifauna was noted along the "HDD Exit" transect. Sand was the predominant substrate type in these transects.	Figure 6-24

Source: Ramboll, 2020b

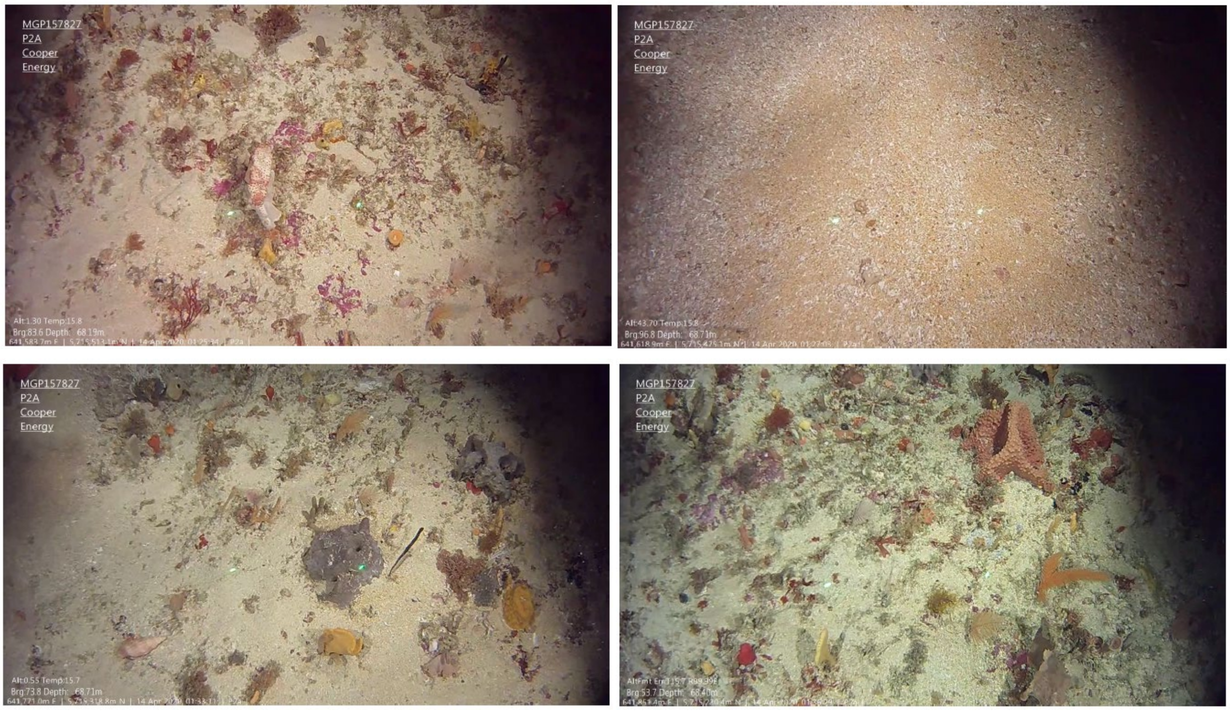


Figure 6-18: Representative photographs from the video transect at the P2A location

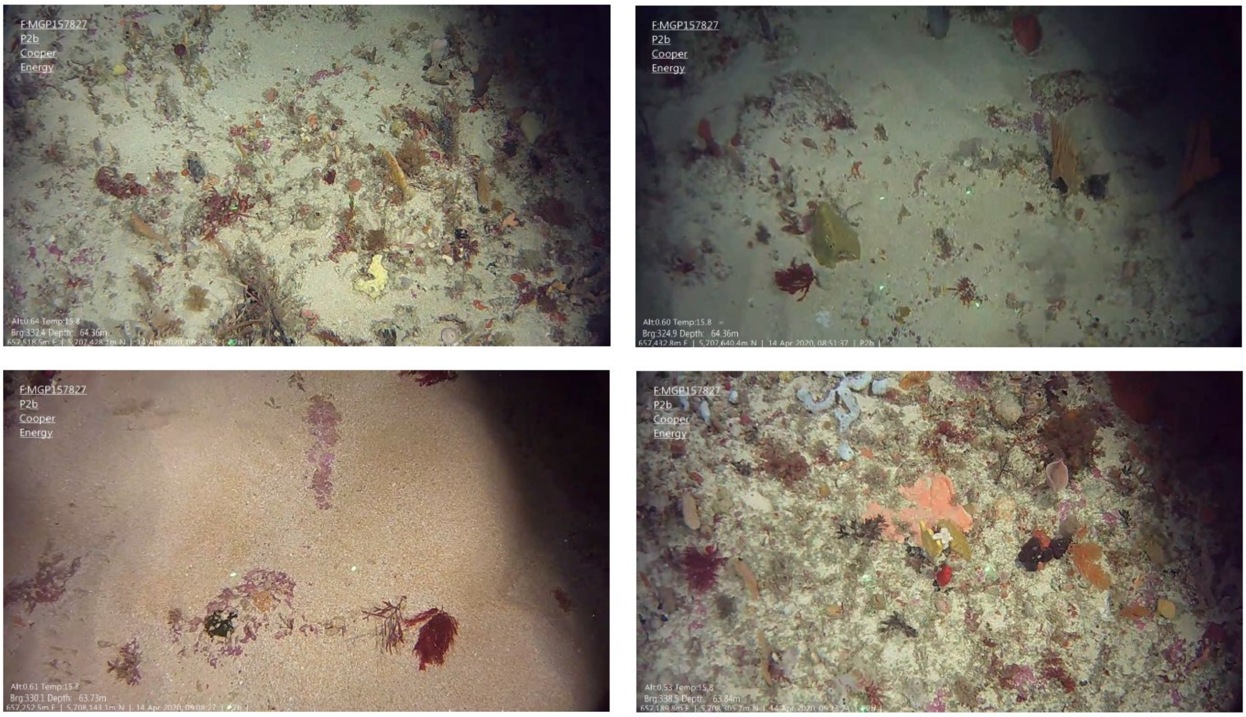


Figure 6-19: Representative photographs from the video transect at the P2B location

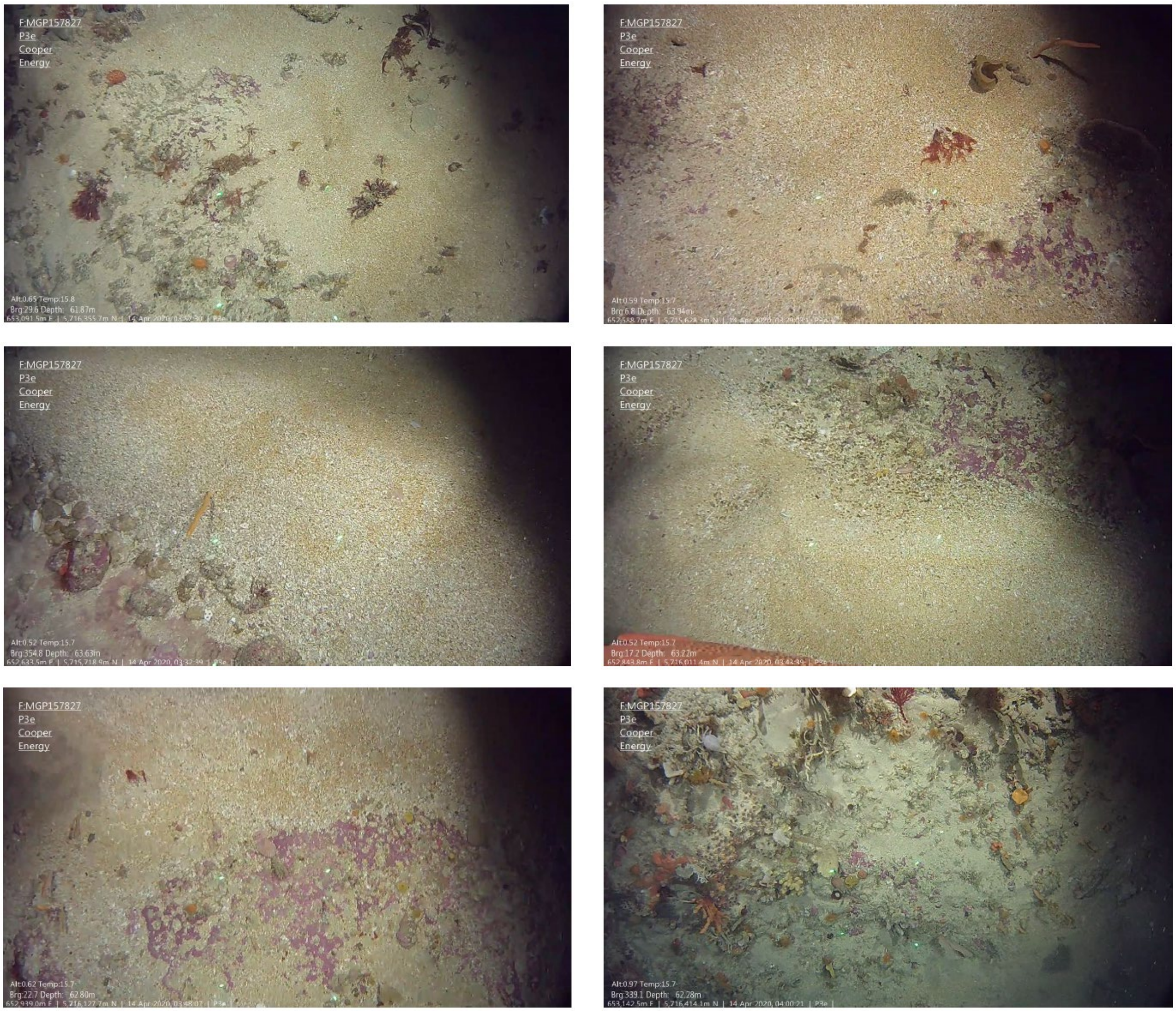


Figure 6-20: Representative photographs from the video transect at the P3E location

Figure 6-21: Representative photographs from the video transect at the P1A location

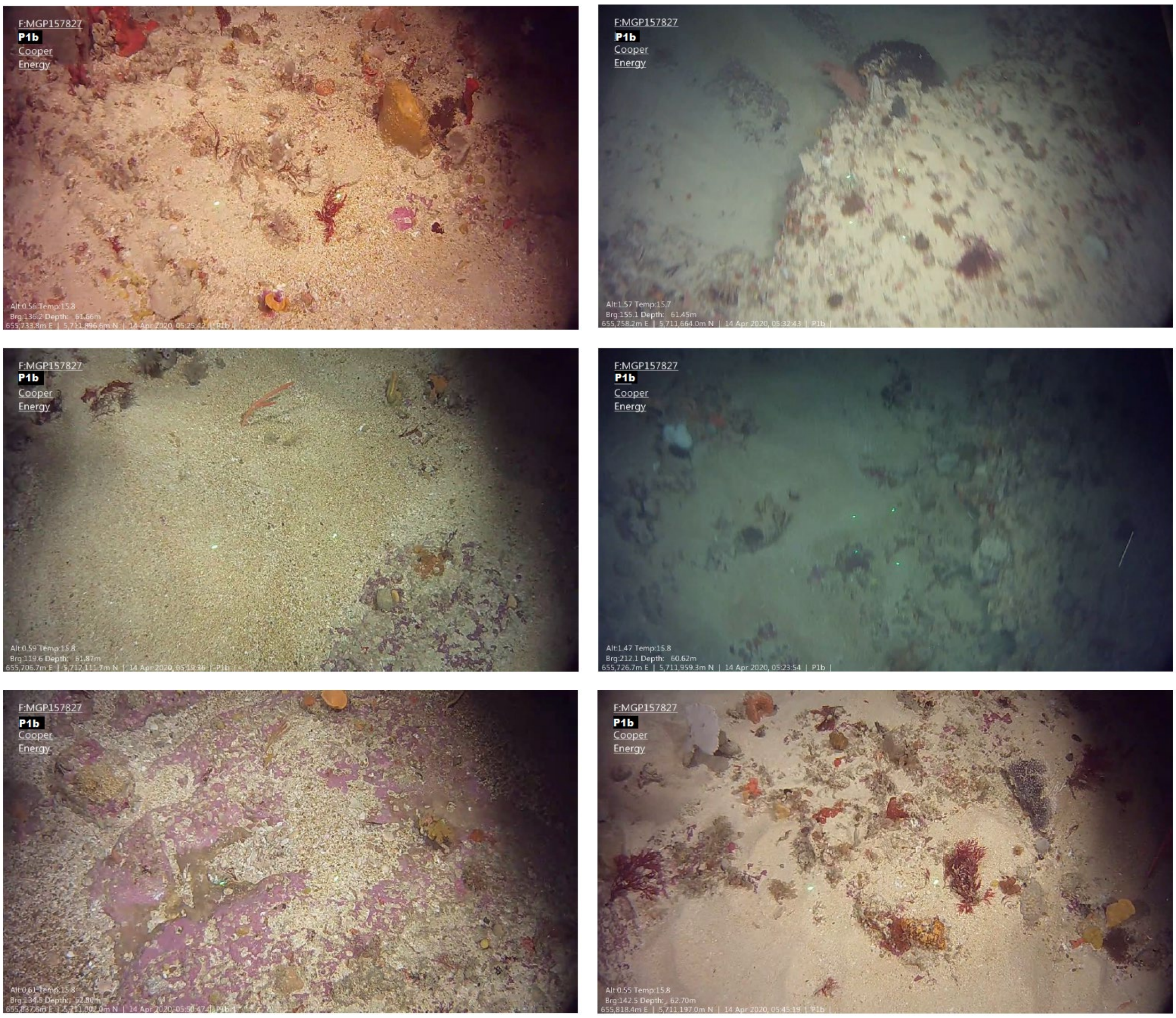


Figure 6-22: Representative photographs from the video transect at the P1B location

Figure 6-23: Representative photographs from the video transect at the P1C location

Figure 6-24: Representative photographs from the video transect at the Crossing and HDD Exit location

6.5.2 Coastal Habitats

6.5.2.1 Shorelines

The coastal environment throughout south-eastern Australia is varied, and includes areas of rocky cliffs, sandy beaches, and tidal flats. Each of these shoreline types has the potential to support different flora and fauna assemblage due to the different physical factors (e.g. waves, tides, light etc.) influencing the habitat.

There is no potential for shoreline habitats to occur within the operational area as it is located offshore in commonwealth waters, however they will occur within the monitoring EMBA (Figure 6-25).

Rocky Shoreline

Hard and soft rocky shores, including bedrock outcrops, platforms, low cliffs (<5 m) and scarps. Depending on exposure, rocky shores can be host to a diverse range of flora and fauna, including barnacles, mussels, sea anemones, sponges, sea snails, starfish and algae. Australian fur-seals are also known to use rocky shores for haul-out and/breeding.

This is common shoreline along southern and eastern Australian coasts, including the limestone coast and features along the Great Ocean Road, Victoria.

Sandy Beaches

Beaches are dynamic environments, naturally fluctuating in profile and particle distribution in response to external forcing factors (e.g., waves, currents etc). Sandy beaches are characterised by sand-sized (0.063–2 mm) particles and can also include mixed sandy beaches (i.e. sediments may include muds or gravel, but sand is the dominant particle size). The variation of sand particles in size, structure and mineral content; this in turn affects the shape, colour and inhabitants, of the beach. Sandy beaches can support a variety of infauna and provide nesting and/or foraging habitat to shorebirds and seabirds and pinnipeds.

This shoreline type is very common along the Victorian coast, including Ninety Mile Beach (East Gippsland, Victoria), Apollo Bay (east of Cape Otway, Victoria), and the stretch of coast between Portland and Port Fairy. The Convincing Ground cultural heritage site is located along the stretch of sandy beaches between Portland and Port Fairy, which is described further in Section 6.8.3.7.2.

6.5.2.2 Mangroves

Mangroves have been recorded in all Australian coastal states except Tasmania. Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie et al., 2006). Mangrove forests can help stabilise coastal sediments, provide a nursery ground for many species of fish and crustacean, and provide shelter or nesting areas for seabirds (McClatchie et al., 2006). The ‘Mangrove Dominated’ habitat class includes areas with greater than 10% coverage of mangroves (Mount and Bricher, 2008; OzCoasts, 2015b).

The mangroves in Victoria are found mostly along sheltered sections of the coast within inlets or bays, are the most southerly extent of mangroves found in the world (MESA, 2015). One species of mangrove, the white or grey mangrove (*Avicennia marina*) is the only species found in Victoria and is known to occur at Western Port and Corner Inlet, and also at larger estuaries like the Yarran and Barwon Rivers.

There is no potential for mangrove communities to occur within the operational area as it is located offshore in commonwealth waters, however they are known to occur within the monitoring EMBA (Figure 6-25).

6.5.2.3 Saltmarsh

Saltmarshes are terrestrial halophytic (salt-adapted) ecosystems that mostly occur in the upper-intertidal zone and are widespread along the coast. The ‘Saltmarsh Dominated’ habitat class includes areas with greater than 10% coverage of saltmarshes (Mount and Bricher, 2008; OzCoasts 2015b).

Typically, these communities are dominated by dense stands of halophytic plants such as herbs, grasses and low shrubs. The vegetation in these environments is essential to the stability of the saltmarsh, as they trap and bind sediments. The sediments are generally sandy silts and clays and can often have high organic material content. Saltmarshes provide a habitat for a wide range of both marine and terrestrial fauna, including infauna and epifaunal invertebrates, fish and birds.

Saltmarsh is found along many parts of the Victorian coast, although is most extensive in western Port Phillip Bay, northern Western Port and within the Corner Inlet-Nooramunga complex. Saltmarsh environments are much more common in northern Australia (e.g. Queensland), compared to the temperate and southern coasts (i.e. New South Wales, Victoria, Tasmania) (Boon et al., 2011).

There is no potential for saltmarsh communities to occur within the operational area as it is located offshore in commonwealth waters, however they are known to occur within the monitoring EMBA (Figure 6-25).

6.5.2.4 Macroalgae

Macroalgae communities are generally found on intertidal and shallow subtidal rocky substrates and can occur throughout the Australian coast. Macroalgal systems are an important source of food and shelter for many ocean species; including in their unattached drift or wrack forms (McClatchie et al., 2006). Macroalgae are divided into three groups: *Phaeophyceae* (brown algae), *Rhodophyta* (red algae), and *Chlorophyta* (green algae). Brown algae are typically the most visually dominant and form canopy layers (McClatchie et al., 2006). The principal physical factors affecting the presence and growth of macroalgae include temperature, nutrients, water motion, light, salinity, substratum, sedimentation and pollution (Sanderson, 1997). Macroalgae assemblages vary, but *Ecklonia radiata* and *Sargassum* sp. can be found in waters up to 45m depth (Pocklington, 2011). Known areas of macroalgae communities within Victoria include Port Philip Bay (Victoria) and various localities in the Otway region including Port Campbell, Warrnambool and Port Fairy (ALA, 2024).

There are no known macroalgae communities within the East Coast Project operational area and it is unlikely any occur given the reported depth range of macroalgae along the Victorian coastline of <45m (Pocklington, 2011). However macroalgae communities do occur within the monitoring EMBA (Figure 6-25).

6.5.2.5 Seagrass

Seagrasses are marine flowering plants which generally grow in soft sediments within intertidal and shallow subtidal waters where there is sufficient light and are common in sheltered coastal areas such as bays, lees of islands and fringing coastal reefs (McClatchie et al., 2006; McLeay et al., 2003). Seagrass meadows are important in stabilising seabed sediments, and providing nursery grounds for fish and crustaceans, and a protective habitat for the juvenile fish and invertebrates species (Huisman, 2000; Kirkman, 1997). There is a distinction between tropical and temperate seagrasses with about 30 species total found in Australian waters (Huisman, 2000). While seagrass meadows are present throughout southern and eastern Australia particularly in Corner Inlet, Port Phillip Bay and Western Port Bay (Victoria), the proportion of seagrass habitat within the south-eastern sector is not high compared to the rest of Australia (Kirkham, 1997). The ‘Seagrass Dominated’ habitat class includes areas with greater than 5% coverage of seagrass (Mount and Bricher, 2008; OzCoasts 2015b).

There are no known seagrass communities within the East Coast Project operational area, and it is unlikely any occur given the reported depth range of seagrass along the Victorian coastline of <30m (Pocklington, 2011). However seagrasses do to occur within the monitoring EMBA (Figure 6-25).

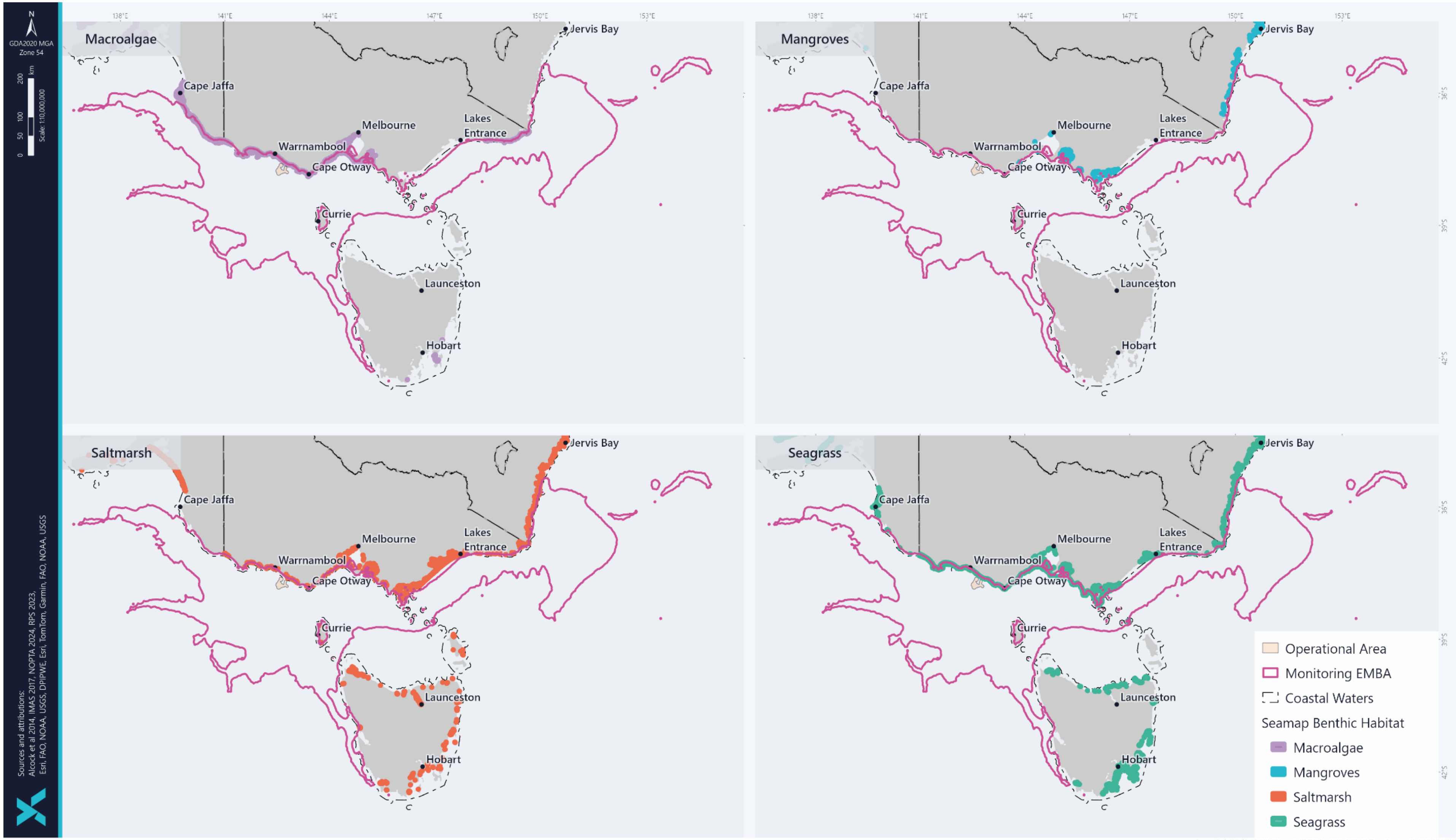


Figure 6-25: Shoreline habitats within the monitoring EMBA of the East Coast Project

6.5.3 Plankton

Plankton species, phytoplankton and zooplankton, are a key components of oceanic food chains.

Phytoplankton are autotrophic planktonic organisms living within the photic zone; and are the start of the food chain in the ocean (McClatchie et al., 2006). Phytoplankton communities are largely comprised of protists, including green algae, diatoms, and dinoflagellates (McClatchie et al., 2006). Diatoms and dinoflagellates are the most abundant of the micro and nanoplankton size classes and are generally responsible for the majority of oceanic primary production (McClatchie et al., 2006). Phytoplankton are dependent on oceanographic processes (e.g. currents and vertical mixing), that supply nutrients needed for photosynthesis. Thus, phytoplankton biomass is typically variable (spatially and temporally), but greatest in areas of upwelling (e.g. Bonney Coast Upwelling), or in shallow waters where nutrient levels are high. Gill et al., (2011) describes the Bonney Coast Upwelling as generally starting in the eastern part of the Great Australian Bight and spreading eastwards to the Otway Basin. At the height of the upwelling during February and March, its area of influence often exceeds 12,000 km^2, while its sea surface temperature often exceeds 1°C, and the chlorophyll-a concentrations are often >1.5x adjacent areas (Huang and Wang, 2019).

Zooplankton are the faunal component of plankton, comprised of small protozoa, crustaceans (e.g. krill) and the eggs and larvae from larger animals. Zooplankton include species that drift with the currents and also those that are motile. More than 170 species of zooplankton have been recorded in eastern and central Bass Strait, but it has been found that seven dominant species make up 80% of individuals (Esso, 2009).

Data collected by the Integrated Marine Observing System (IMOS; Davies et al. 2022) includes biomass and diversity of phytoplankton in the different oceanic regions that surround Australia. This data indicates highest seasonal abundance of phytoplankton within the cooler waters of the Southern Ocean, followed by south-east and eastern zones whereas diversity of phytoplankton is greatest in the warmer Coral Sea. In addition, data indicated that the highest abundance of copepods is found in the Southern Ocean and south-east regions, with diversity highest in the Temperate east and Coral Sea, depending on time of year. The make-up of plankton, their distribution and abundance are also highly variable within the region. Figure 6-26 shows a snapshot of chlorophyl-a (indicator of phytoplankton abundance) off the southern coast of Australia on 15 January 2019. Increased productivity can be seen in the south-east in the major embayment's and also the Bonney coast upwelling KEF (a feature derived through review of enhanced chlorophyll occurrence in summer (DCCEEW, 2023l) to the west of the East Coast Project. By 31 January levels of chlorophyl A around the Bonney Coast upwelling KEF had returned to lower levels (Figure 6-27).

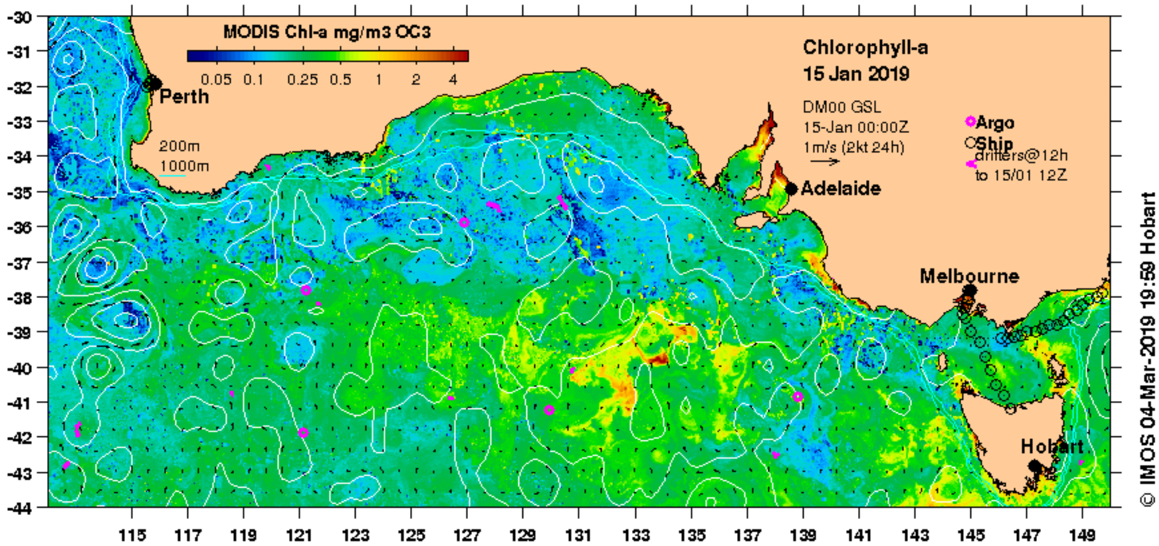


Figure 6-26: Southern Australia chlorophyll-a snapshot 19 January 2024 (IMOS, 2024)

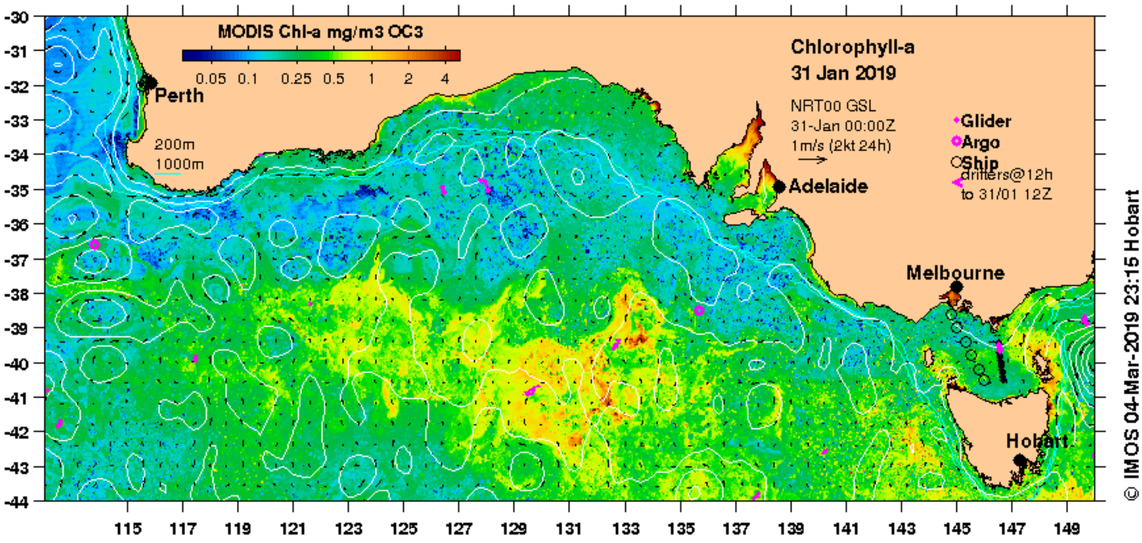


Figure 6-27: Southern Australia chlorophyll-a snapshot 31 January 2024 (IMOS, 2024)

Within the operational area and monitoring EMBA plankton populations are expected to be highly variable both spatially and temporally and to comprise the plankton make-up characteristic of the south-east region described.

6.5.4 Invertebrates

Marine invertebrates are comprised of many groups of different organisms and occur from the sea surface to the seafloor and into the substrate. Their size ranges from tiny, microscopic organisms to several metres in length. Additionally, some marine invertebrates are commercially important, e.g., oysters, prawns, and scallops, whilst others, such as corals, can be a major attraction for tourists.

Within the south-east marine region, shelf rocky reef is identified as a key ecological feature (see Section 6.6.6 for further detail) which provides habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity by increasing the structural diversity of shelf ecosystems (DCCEEW, 2023l; Young, et al., 2022).

Marine invertebrates typical of the region include:

- Porifera (e.g., sponges)
- Cnidarians (e.g., jellyfish, corals, anemones, sea pens)
- Bryozoans (microscopic filter feeders)
- Arthropods (e.g., sea spiders)
- Crustaceans (e.g., rock lobster, krill)
- Molluscs (e.g., bivalves, sea slugs, gastropods, abalone)
- Echinoderms (e.g., urchins, sea cucumbers) and
- Annelids (e.g., polychaete worms).

Studies by the Museum of Victoria (Wilson and Poore, 1987; Poore et al., 1985) found that invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions. Shallower inshore sediment sampling by Parry et al. (1990) also showed high diversity and patchy distribution. However, in these areas, crustaceans, polychaetes and molluscs were dominant.

A past survey of the CHN development, parts of which are overlapped by the East Coast Project operational area, found seabed communities consistent with this description with observations at 60 to 70 m depths showing a patchy presence of epifauna such as bryozoans, gorgonian cnidarians and sponges with observed colonisation of existing infrastructure (Ramboll, 2020). See Section 6.5.1 for a further detail on the findings of this survey.

In 2022 Parks Victoria published results of predictive modelling of fish species richness offshore Victorian coastline; the modelling inputs included physical and biological attributes of the coastline, with reef and associated invertebrate communities strongly linked to high fish species richness (Young et al., 2022). Within the Otway region adjacent the operational area species richness was assessed and Low-moderate (Figure 6-28).

Marine invertebrates expected to be located within the vicinity of the East Coast Project are detailed below.

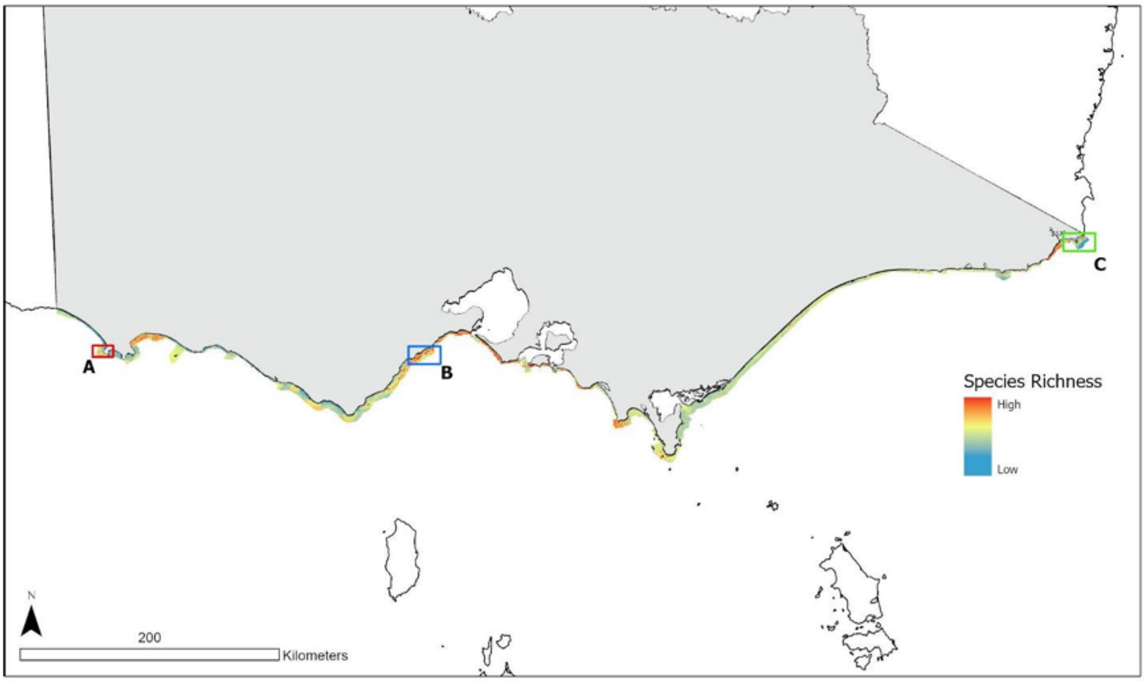


Figure 6-28: Predicted statewide species (fish) richness in Victoria, Australia

6.5.4.1 Porifera

Porifera, or sponges, are sessile, multicellular organisms that have bodies full of pores and channels allowing water to circulate through the organism and provide food and oxygen and removes wastes. The flow is actively generated by the beating of flagella and filter bacteria and phytoplankton from the water which passes through them (Bond and Harris, 1988). Porifera flourish in waters where water movement is strong (Butler et al., 2002). Sponges do not have nervous, digestive or circulatory systems and reproduce by asexual and sexual means. Increasing temperature is generally accepted as a major environmental factor regulating the onset of reproduction activity particularly in regions of large seasonal change (spring / summer) (Fromont, 1993). Sponges are efficient colonisers of marine hard surfaces although they will not typically colonise a newly cleared surface as rapidly as some other groups (e.g. bryozoans). Once established sponges are effective competitors in retaining living space through asexual reproduction and by using chemicals to deter competitors and predators (Butler et al., 2002).

As discussed in Section 6.5.1.3 video transects and sediment samples within and adjacent to the operational area saw scattered areas of hard ground supporting patchy areas of abundant epibiota such as sponges (Ramboll, 2020b). While sponges were present, they were not highly abundant or morphological diverse as a taxonomic group to be considered as a sponge bed, rather sponges were interspersed throughout the patchy epifaunal covering which included other invertebrate species such as bryozoans and hydroids (Ramboll, 2020b). Therefore, it is known that porifera will be present within the operational area of the East Coast Project.

6.5.4.2 Hydrozoans

Species are found in almost every marine habitat type except heavy surf zones. They are most abundant and diverse in warm shallow waters likely reflecting food abundance.

Most species have a planktonic larval stage which is pelagic before settling onto benthic substrates and developing a polyp, A founding polyp produced new polyps by budding. In many colonies, polyps are polymorphic with different structures reflecting different functions. Polyps produce “adult” sexually-reproducing medusae which are free-swimming and release sperm and eggs in the water (broadcast spawners) where fertilisation occurs. Colonies are usually sessile benthic, but some notably the siphonophores are pelagic floaters.

Most hydrozoans are predators or filter-feeders. Filter feeders trap small zooplankton; pelagic hydrozoans show selectivity in prey types taking mainly fish larvae, soft bodied invertebrates or micro-crustaceans. Predators can include snails, worms, fish and crustaceans (University of Michigan, 2017).

As discussed in Section 6.5.1.3 video transects and sediment samples within and adjacent to the operational area saw scattered areas of hard ground supporting patchy areas of abundant epibiota such as colonial hydroids (Ramboll, 2020b). Therefore, it is known that hydrozoans will be present within the operational area of the East Coast Project.

6.5.4.3 Bryozoans

Bryozoans are sessile, aquatic invertebrate filter feeding animals which attach to hard substrates and form lace-like colonies. They have no respiratory organs, heart, or blood vessels. Instead, they absorb oxygen and eliminate carbon dioxide through the body wall. Colonies of bryozoans are started by a single individual that, after its larval existence, settles onto a substrate and begins to reproduce asexually (by budding) after settlement. Bryozoans are hermaphrodites and fertilisation can be external in the water column or internal with embryos brooded in the body (as do ascidians) fertilised with sperm brought in on the feeding current. The larvae which are hatched are then released and swim but do not feed; they swim towards the light then after a few hours swim down to the sea floor to colonise. For species which do not brood but release eggs, fertilised eggs become part of the plankton stream for ~2 months until they are large enough to descend and start a new colony (Earthlife, 2014). Temperature controls all aspects of bryozoan life. In spring, rising water temperatures and increased intensity of light stimulate phytoplankton growth which initiates active budding in bryozoans and to some degree sexual reproduction (Smithsonian Institute, 2014). Most bryozoans use chemicals as well as spines as a predator deterrent and thus have only relatively few specialised predators (Butler et al., 2002).

As discussed in Section 6.5.1.3 video transects and sediment samples within and adjacent to the operational area saw scattered areas of hard ground supporting patchy areas of abundant epibiota such as bryozoans which were a common species observed (Ramboll, 2020b). Therefore, it is known that bryozoans will be present within the operational area of the East Coast Project.

6.5.4.4 Molluscs

Gastropods (Abalone)

Univalve gastropods can live up to 20 years growing to a shell length of over 200 mm. Abalone feed on algae and are prey for crabs, rock lobster, octopi, fish and rays. Blacklip abalone is the predominant species fished along the Victorian coastline area although greenlip abalone is also present. Blacklip abalone is found in shallow depths between 5-20 m and can be found in caves, on crevices and on sheltered reefs. Greenlip abalone is found in shallow reef habitats (5-40 m) and rough water at the base of steep granite cliffs. Abalone is a broadcast spawner; the species spawns from spring to autumn (Kailola et al., 1993).

Both blacklip and green abalone are target species of state fisheries including the Victorian Abalone Fishery. Habitat suitability for the blacklip abalone was mapped along the western Victorian coastline in an attempt to capture an effective footprint of the Victorian Abalone Fishery (Ierodiaconou et al., 2014). Results indicated that highly suitable regions were characterised by highly rugose seafloor structure (i.e. high-profile reefs), with the most suitable areas occurring at depths of around 10 m, and a gradual decline in suitability to depths of 20 m (Ierodiaconou et al., 2014). Colonisation success was identified to likely be driven by ecological factors such as resources and competition and physical factors such as exposure to wave energy and benthic currents (Ierodiaconou et al., 2014).

Considering the species preferred habitat occurs in water depths <20 m, it is unlikely that the species will be present in within the vicinity of the East Coast Project.

Cephalopods

Cephalopods (squid, octopus and cuttlefish) are active mobile predators. Generally, cuttlefish and octopus eat crustaceans (including lobsters) living on or near the seabed while squid eat crustaceans and fish. Cephalopods have a high growth rate, their lifespan is short and there is a single reproductive season (Boyle and Rodhurst, 2005).

The species actively swim by jet propulsion and propagate by sexual reproduction. The individual size and number of eggs (released in a jelly like egg mass) during a reproductive season is variable and ranges from a few large eggs (<30 mm long) attached to the seabed to numerous (>1 million) small eggs drifting in the plankton. The incubation period is highly temperature dependent and is completed with the hatching of the larval stage which resembles a miniature adult. After breeding the adults die within a short time and in species with a highly synchronised breeding population this can result in conspicuous mass mortality (Boyle and Rodhurst, 2005).

An important commercial cephalopod within the Otway region is the arrow squid which is endemic to southern Australia (Koopman et al, 2018) and inhabits waters from estuaries to ocean depths of about 500 m but are most abundant over the continental shelf from 50 m to 200 m (Kailola et al., 1993). Arrow squid are schooling and tend to aggregate near the seabed during daylight and disperse through the water column at night, migrating to the surface to feed. Arrow squid spawn throughout their distribution; spawning occurs in all months although there are 2 -3 peaks in spawning activity during the year. Peak catches and catch rates of squid have occurred during summer months, with peak catch timings moving earlier over time (February, March) particularly off Western Australia (Koopman et al, 2018). After eggs are released, they hatch within 1-2 months post fertilisation with the larvae most abundant in continental shelf waters of 50 – 200 m. Arrow squid are relatively short-lived reaching a maximum age of 12 months and are the prey of a number of fish species (Kailola et al., 1993).

Considering recent catch effort data (see section 6.7.2) and the species preferred habitat, there is potential that the species will be present in within the vicinity of the East Coast Project.

6.5.4.5 Crustaceans

Rock Lobster

Rock lobsters live in a variety of reef habitats on the continental shelf in water depths between 1 and 200 m. In Victoria, the abundance of rock lobsters reduces from west to east reflecting a decreasing area of suitable rocky reef habitat (VFA, 2023a). The species is carnivorous and eats molluscs, small crustaceans, echinoderms and other benthic invertebrates. Major predators of the rock lobster are octopus, gummy shark, southern rock cod, flathead, wrasse, morwongs and rock ling (Kailola et al., 1993).

The lifecycle of the southern rock lobster is complex – after mating in autumn, fertilized eggs are carried under the tail of the female for approximately three months before hatching typically between September and November / December (DPI, 2009; Kailola et al., 1993). Egg hatching typically occurs earlier in the southern waters of the species distribution (Kailola et al., 1993). A female lobster with a carapace length of 124 mm can carry up to 400,000 eggs (Kailola et al., 1993).

The eggs hatch into larvae (or phyllosoma) which undergo eleven developmental stages over a period of 12-24 months in pelagic environments while being dispersed and distributed by oceanic currents to distances at least 1,100 km from land (Kailola et al., 1993). Given the long-lived nature of the SRL larval phase, there can be up to two cohorts of larvae present in shelf waters at any one time. Larval distribution is initially in shelf waters with currents quickly dispersing larvae along shore and into offshore waters. Mixing of larvae and loss of regional integrity of larvae is prevalent in southeast SA, Tasmania and eastern Victoria given the net drift east. Additionally, phyllosoma are found over a variety of water depths and are assumed to have no affective horizontal swimming capacity in the marine environment (Bruce et al., 2007). Phyllosoma are observed to rise to surface waters (~0-20 m) during night hours and sink during the daylight hours (~50-200 m) (Bruce et al., 2007).

During metamorphosis juvenile rock lobsters shift from a planktonic (phyllosoma) to a benthic existence (termed puerulus) (DPI, 2009) settling into coastal and shelf habitats. Historically the southern rock lobster was thought to be a highly resident species, remaining in one area for extensive periods of time. Movement patterns of the species in Victorian waters were analysed and found that the region and water depth were the greatest drives of southern rock lobster movement (Skeer et al., 2020). Results suggest that the movement of individuals off the Warrnambool and Apollo Bay regions (within close proximity to the East Coast Project operational area) was primarily in the offshore direction towards deeper water (Skeer et al., 2020). However, a maximum depth range of 50 – 60 m was observed with few recaptures observed beyond this (Skeer et al., 2020).

The southern rock lobster is the key target species of a number of state fisheries including the Victorian Rock Lobster Fishery. The most productive fishing grounds for the southern rick lobster occur in the waters adjacent to South Australia which support the largest fishery for the species, followed by Tasmania and then Victoria (VFA, 2023a). Considering recent catch effort data (see section 6.7.2) and the species preferred habitat (<60 m), there is potential for individuals to be present within the vicinity of the East Coast Project.

Giant Crab

The giant crab occurs in oceanic waters of southern Australia along the continental shelf, typically found in water depths between 140 and 270 m (Levings et al., 2001). The giant crab movement is dependent on water temperature. This species lacks internal temperature control mechanisms and lives where the steep terrain of the continental margin offers easy access to a cooler or a warmer environment (Levings et al., 2001). Their growth and reproduction are linked with the food resources and physical character of where they live.

The giant crab reproduces annually. Females produce eggs in April/May and will carry eggs until October/November when they are released. Females carry approximately 1.5 million eggs on average (IMAS, 2023). Dispersal of larvae is considered to be localised due to the short planktonic phase of the species lifecycle. Survival of larvae may be dependent on factors such as prevailing currents, vertical migration (movement through the depths of the water column), temperature, light intensity, gravity, change in pressure, predator pressures, food availability, thermoclines and salinity (IMAS, 2023).

The giant crab is the key target species of a number of state fisheries including the Victorian Giant Crab Fishery. Considering the preferred habitat occurs along the edge of the continental shelf (<100 m), it is unlikely that the species will be present in high densities within the vicinity of the East Coast Project.

6.5.4.6 Annelids

Annelids are a large phylum of segmented worms, including polychaetes, clitellates, ragworms, earthworms and leeches.

Polychaetes are brightly coloured segmented worms. Most are less than 10 cm long, although they can range from 1 mm to 3 m and include forms such as sand worms, tube worms and clam worms. They are found in all habitats from the supra-littoral to the deepest parts of the ocean. Some such as the feather-duster worms are sedentary, living in tubes buried in sand/mud and feed by trapping food particles in mucus or by ciliary action. Others such as the clam worm are active mobile predators which capture prey in jaws (University of Michigan, 2017).

Most polychaetes have separate sexes - male and female and the sperm and eggs are released into the surrounding water through ducts or openings. The fertilised eggs hatch into larvae, which float among the plankton, and eventually metamorphose into the adult form by adding segments (MESA, 2015b).

As discussed in Section 6.5.1.3 video transects and sediment samples within and adjacent to the operational area saw scattered areas of hard ground supporting patchy areas of abundant epibiota (Ramboll, 2020b). Polychaete tubules were visible in one sediment sample (Table 6-4) suggesting that marine annelids have the potential to be present within the operational area of the East Coast Project.

6.5.4.7 Ascidians

All ascidians (commonly known as sea squirts) are sessile, sac-like marine invertebrate filter feeders and include both solitary and colonial species. Ascidians occur from intertidal to deep (>2,000 m) subtidal waters and can occur in high concentrations (Butler et al., 2017). A study conducted on the distribution of ascidians along Victoria's coast at identified rocky reef locations, which identified 37 different species found in the intertidal environment (Bathie and Pett, 2020). No rocky reef locations within the vicinity of the East Coast Project were surveyed. The closest was the Dutton Way biounit north of Portland. The species has a digestive, circulatory and nervous system however lacks any special sensory organs. Reproduction includes both asexual budding and sexual reproduction with a free-living larval stage. The species are hermaphrodites and fertilisation can be external with development in the water column (solitary species) or internal with embryos brooded in the body (colonial species). Solitary larvae are free-swimming for periods of 1-24 hours and prior to hatching have been floating free in the water for up to 3 days. They are therefore subject to current dispersal which contributes to gene flow and removes risks of isolation. The colonial species are seldom free swimming for more than one hour and attach to substrates rapidly. In temperate and cold seas, breeding is usually seasonal and restricted to the warmer season but in tropical waters it may continue throughout the year (Shenkar, 2008). Only limited information on predators is available but they include some fish, molluscs and sea-stars. While some species are known to contain toxins which deter predators and settling larvae, most solitary species tough tests and colonial species a great ability to rapidly repair any damage through vegetative growth (Butler et al., 2002).

Considering the species prefers hard rocky reef habitat and may be found in water depths from the intertidal zone out to the deep ocean, there is potential that ascidians will be present within the vicinity of the East Coast Project.

6.5.5 Fish

PMST reports were generated for the operational area, ecological EMBA and monitoring EMBA to identify EPBC listed fish species (or species habitat) that may occur within the EMBA (Appendix 1). Table 6-7 identifies the presence and protection status of fish species for each EMBA. There are 56 EPBC listed fish species (or species habitat) that may occur within the monitoring EMBA, 36 of which belong to the Syngnathidae family. Of the species within the monitoring EMBA, 32 occur within the operational area.

For the purpose of the OPP, only species listed as threatened or migratory under the EPBC Act which are known or likely to occur or have either a BIA or habitat critical to their survival, within the monitoring EMBA are considered to have conservation significance warranting further discussion. Due to the number of Syngnathids which may occur within the operational area and EMBA a brief discussion has been included in section 6.5.5.2. Three fish species identified in the PMST Reports are freshwater species, eastern dwarf galaxias, Yarra pygmy perch and the variegated pygmy perch. As they will be outside of the spatial extent potentially affected by the activity they are not discussed further.

Commercially important fish species are known to occur within the operational area and EMBA. Although all commercially important species may not be EPBC listed they provide important economic services to ecological and social environment. Commercially important fish species which may occur within the operational area have been identified through Table 6-19 and Table 6-20 and are described in section 0.

BIAs were identified for 2 species of fish, white shark and grey nurse shark, within the monitoring EMBA as displayed in Figure 6-29 and Figure 6-30.

There is no defined habitat critical to the survival of fish species within the operational area or EMBAs.

Table 6-6: Fish species or habitat that may occur within the operational area and ecological and monitoring EMBA

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Sharks and rays									
Carcharodon carcharias	White Shark	V	✓		*Recovery Plan for the White Shark (Carcharodon carcharias) (DSEWPaC, 2013)*	*	KO*[m]	FKO*[d, f]	BKO*[d, f, b]
Carcharhinus longimanus	Oceanic Whitetip Shark		✓				-	MO	MO
Carcharias taurus	Grey Nurse Shark (east coast population)	CE			*Recovery Plan for the Grey Nurse Shark (Carcharias Taurus) (DoE, 2014a)*	*	-	-	AKO*[m, f]
Centrophorus harrissoni	Harrisson's Dogfish	CD					-	-	LO
Centrophorus uyato	Little Gulper Shark	CD					-	LO	LO
Galeorhinus galeus	School Shark	CD					MO	LO	LO
Isurus oxyrinchus	Shortfin Mako		✓				LO	LO	LO
Lamna nasus	Porbeagle, Mackerel Shark		✓				LO	LO	LO
Manta birostris	Giant Manta Ray		✓				-	-	KO
Rhincodon typus	Whale Shark	V	✓		*Conservation Advice for Rhincodon typus (Whale Shark) (TSSC, 2015k)*		-	MO	MO
Fish and Syngnathids									
Epinephelus daemelii	Black Rockcod	V			*Conservation Advice for Epinephelus daemelii (Black Rock-cod) (DSEWPaC, 2012e)*		-	-	LO
Galaxiella pusilla	Eastern Dwarf Galaxias	E			*National recovery plan for the Dwarf Galaxias (Galaxiella pusilla) (Saddlier et al., 2010)* *Conservation Advice for Galaxiella pusilla (dwarf galaxias) (DCCEEW, 2024j)*		-	MO	KO
Hoplostethus atlanticus	Orange Roughy	CD					-	LO	LO
Nannoperca obscura	Yarra Pygmy Perch	E			*National recovery plan for the Yarra Pygmy Perch (Nannoperca obscura) (Saddlier and Hammer, 2010a)* *Conservation Advice for Nannoperca obscura (Yarra pygmy perch) (DCCEEW, 2023b)*		-	KO	KO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Nannoperca variegata	Variegated Pygmy Perch	V			*National recovery plan for the Variegated Pygmy Perch (Nannoperca variegate) (Saddlier and Hammer, 2010b)*		-	-	KO
Prototroctes maraena	Australian Grayling	V			*National Recovery Plan for Australian Grayling (Backhouse et al., 2008)* *Conservation Advice Prototroctes maraena Australian Grayling (TSSC, 2021)*		MO	KO	KO
Rexea solandri (eastern Australian population)	Eastern Gemfish	CD					-	-	LO
Seriolella brama	Blue Warehou	CD					KO	KO	KO
Thymichthys politus	Red Handfish	CE			*Conservation Advice for Thymichthys politus (Red Handfish) (DSEWPaC, 2012f)* *Recovery Plan for the Three Handfish Species (CoA, 2015c)*		-	-	MO
Brachiopsilus ziebelli	Ziebell's Handfish	V			*Recovery Plan for Three Handfish Species: Spotted Handfish (Brachionichthys hirsutus), Red Handfish (Thymichthys politus), and Ziebell's Handfish (Branchiopsilus ziebelli) (CoA, 2015c)*		-	-	LO
Acentronura australe	Southern Pygmy Pipehorse			✓			-	-	MO
Acentronura tentaculate	Shortpouch Pygmy Pipehorse			✓			-	-	MO
Campichthys tryoni	Tryon's Pipefish			✓			-	-	MO
Cosmocampus howensis	Lord Howe Pipefish			✓			-	-	MO
Heraldia nocturna	Upside-down Pipefish			✓			MO	MO	MO
Hippocampus abdominalis	Big-belly Seahorse			✓			MO	MO	MO
Hippocampus berviceps	Short-head Seahorse			✓			MO	MO	MO
Hippocampus minotaur	Bullneck Seahorse			✓			-	MO	MO
Histiogamphelus briggsii	Crested Pipefish			✓			MO	MO	MO
Histiogamphelus cristatus	Rhino Pipefish			✓			MO	MO	MO
Hypselognathus rostratus	Knifesnout Pipefish			✓			MO	MO	MO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Kaupus costatus	Deepbody Pipefish			✓			MO	MO	MO
Kimblaeus bassensis	Trawl Pipefish			✓			-	MO	MO
Leptoichthys fistularius	Brushtail Pipefish			✓			MO	MO	MO
Lissocampus caudalis	Australian Smooth Pipefish			✓			MO	MO	MO
Lissocampus runa	Javelin Pipefish			✓			MO	MO	MO
Maroubra perserrata	Sawtooth Pipefish			✓			MO	MO	MO
Mitotichthys mollisoni	Mollison's Pipefish			✓			-	MO	MO
Mitotichthys semistriatus	Halfbanded Pipefish			✓			MO	MO	MO
Mitotichthys tuckeri	Tucker's Pipefish			✓			MO	MO	MO
Notiocampus ruber	Red Pipefish			✓			MO	MO	MO
Phycodurus eqques	Leafy Seadragon			✓			MO	MO	MO
Phyllopteryx taeniolatus	Common Seadragon			✓			MO	MO	MO
Pugnaso curtirostris	Pugnose Pipefish			✓			MO	MO	MO
Solegnathus robustus	Robust Pipehorse			✓			MO	MO	MO
Solegnathus spinosissimus	Spiny Pipehorse			✓			MO	MO	MO
Solenostomus cyanopterus	Robust Ghostpipefish			✓			-	-	MO
Stigmatopora argus	Spotted Pipefish			✓			MO	MO	MO
Stigmatopora nigra	Widebody Pipefish			✓			MO	MO	MO
Stipecampus cristatus	Ringback Pipefish			✓			MO	MO	MO
Syngnathoides biaculeatus	Double-end Pipehorse			✓			-	MO	MO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Urocampus carinirostris	Hairy Pipefish			✓			MO	MO	MO
Vanacampus margaritifer	Mother-of-pearl Pipefish			✓			MO	MO	MO
Vanacampus phillipi	Port Phillip Pipefish			✓			MO	MO	MO
Vanacampus poecilolaemus	Longsnout Pipefish			✓			MO	MO	MO
Vanacampus vercoi	Verco's Pipefish			✓			-	-	MO

<u>*Threatened Species:*</u>
CD Conservation Dependent
V Vulnerable
E Endangered
CE Critically Endangered

<u>Biologically Important Area</u> (Designation shown where relevant in each spatial extent column)
** BIA Present*
d Distribution
f Foraging
b Breeding (nursery area)
m Migration

<u>*Type of Presence:*</u>
MO Species or species habitat may occur within area
LO Species or species habitat likely to occur within area
KO Species or species habitat known to occur within area
FKO Foraging, feeding or related behaviour known to occur within area
BKO Breeding known to occur within area
AKO Congregation or aggregation known to occur within area

6.5.5.1 Cartilaginous Fish

White Shark

The white sharks range extends from central Queensland, around the south coast, to northwest Western Australia (DSEWPaC, 2013). This species is primarily found on the continental shelf and in coastal waters, including inshore waters around oceanic islands. Although the white shark is not evenly distributed throughout its range, the entire South-east Marine Region, including the operational area, is considered a BIA (distribution) for the species with observations more frequent in some areas, including those around fur-seal or sea-lion colonies (Figure 6-29) (DSEWPaC, 2013). South-east Marine Region waters surrounding pinniped colonies are considered foraging BIAs for the species, none of which occur within the operational area but do overlap with the monitoring EMBA (Figure 6-29). Juvenile sharks appear to aggregate seasonally in key areas, including Wilsons Promontory (Victoria), and along the coast between Newcastle and Forster, NSW (DSEWPaC, 2013). Recent studies have found that juvenile white sharks (<3 m) occupy estuaries at Port Stephens, NSWs and Corner Inlet, Victoria during October to January (Harasti et al., 2017). A BIA for breeding (nursery ground) has been established in the coastal region extending from Wilsons Promontory to Lakes Entrance (outside of the operational area within the monitoring EMBA). The white shark moves seasonally along the south and east Australian coasts, moving northerly along the coast during autumn and winter, and returning to southern Australian waters by early summer. The white shark is not known to form and defend territories; however, its seasonal return implies a degree of site fidelity (DSEWPaC, 2013).

The species is likely to occur in the vicinity of the East Coast Project and is known to forage within the monitoring EMBA.

Grey Nurse Shark (east coast population)

The grey nurse shark (east coast population) is broadly distributed around the world primarily in subtropical to cool temperate coastal waters. In Australia, the grey nurse shark is regularly reported in southern Queensland and along the NSW coastline (DoE, 2023). The east coast population covers a range extending from the Capricornia coast (central Queensland) to Narooma in southern New South Wales (DoE, 2014a). The grey nurse shark generally occurs as solitary individuals or in small schools; larger aggregations of individuals may occur for courtship and mating (DoE, 2014a). Key aggregation sites and habitat critical for the survival of the grey nurse shark have been identified within the monitoring EMBA (Montague Island and Tollgate Island). The grey nurse shark migrates within its range, making seasonal north–south movements to form aggregations at critical habitat sites, thought to be related to breeding (DoE, 2023). This migration pathway is overlapped by the monitoring EMBA and displayed in Figure 6-30. The precise timing of mating and pupping in Australian waters is unknown; however, in South Africa mating occurs between late-October and late-November (DoE, 2023). A BIA for foraging has been identified for the grey nurse shark within the monitoring EMBA along the east coast of Australia (Figure 6-30).

The species is not identified as occurring in the vicinity of the East Coast Project. The grey nurse shark (east coast population) may occur in the monitoring EMBA where it extends off the coast of southern NSW.

Shortfin Mako

The shortfin mako has a circum-global distribution inhabiting tropical and temperate waters where it is rarely encountered in waters with temperatures below 16°C. The shortfin mako shark has been recorded in offshore waters all around the Australian coastline except for the Arafura Sea, Gulf of Carpentaria and Torres Strait in the north (DoE, 2014b). It is a pelagic species, primarily occurring in offshore, oceanic waters (Last and Stevens, 2009). The shortfin mako is highly migratory and can cover large distances, migrating from Australian waters to areas well beyond the Australian Exclusive Economic Zone (Rogers et al., 2009). The shortfin mako inhabits depths down to 600 m, with a slight trend indicating the species spend the majority of the night in shallow water, and the majority of daylight hours in deeper waters

(Rogers et al., 2009). Satellite tracking data for shortfin makos showed a potential for year-round occupation of the Otway, Bass Strait and Gippsland Basins (Rogers and Bailleul, 2015).

The waters of Bass Strait are not known feeding, resting or reproductive grounds for the shortfin mako, although feeding may occur opportunistically where sufficient prey is present.

Porbeagle

The porbeagle is a wide-ranging species that inhabits oceanic waters around the edge of the continental shelf in temperate, subarctic and subantarctic waters of the North Atlantic and Southern Hemisphere (DoE, 2023). In Australia this species typically occurs in oceanic waters between southern Queensland south to south-west Australia. The porbeagle may temporarily move into coastal waters and are known to utilises a broad vertical range of the water column diving to depths exceeding 1,300 m (DoE, 2023). This species is known to undertake seasonal migrations; however, they are not well understood. Individuals in the Southern Hemisphere are thought to give birth off New Zealand and Australia in winter (DoE, 2023).

The waters of Bass Strait are not known feeding, resting or reproductive grounds for the porbeagle, although feeding may occur opportunistically where sufficient prey is present.

Giant Manta Ray

The giant manta ray is a migratory species that is found worldwide in tropical, subtropical, and temperate bodies of water. The species can inhabit a variety of marine environments such as, oceanic waters, coastal areas, estuarine waters, oceanic inlets, and within bays and intercoastal waterways (NOAA, 2023). The giant manta ray is a filter feeder and consumes a large quantity of zooplankton. They are seasonal visitors to productive coastlines which appear to correspond with the movement of zooplankton, current circulation and tidal patterns, seasonal upwelling, seawater temperature, and possibly mating behaviour (NOAA, 2023).

The waters of Bass Strait are not known feeding, resting or reproductive grounds for the giant manta ray, although feeding may occur opportunistically where sufficient prey is present.

Harrissons Dogfish

The Harrisson's dogfish is a species of gulper shark that are relatively small, deepwater sharks (DSEWPaC, 2013e). The species is mainly recorded in water depths between 200-650 m (Last and Stevens, 2009) but have been captured in depths down to 1,050 m (Daley et al., 2002). The distance that an individual can travel is not known but the species is identified to occur from the north of Evans Head in NSW, through waters off the coast of Victoria, to Cape Hauy in Tasmania (Williams et al., 2012). The Harrisson's dogfish diet consists mainly of fish and invertebrates including mesopelagic prey such as lanternfish and squid (Daley et al., 2002; Graham and Daley, 2011). The species also exhibits slow growth, late maturity age, and low fecundity, which makes them vulnerable to overfishing (Stobutzki et al., 2011).

The waters of the Bass Strait are not known feeding, resting or reproductive grounds for the Harrisson's dogfish, although feeding may occur opportunistically where sufficient prey is present. Considering the depth of the operational area (~85 m at its deepest) and the species preferred habitat (200 - 600 m), it is considered unlikely for the species to be present within the vicinity of the East Coast Project.

Little Gulper Shark

The little gulper shark, commonly known as the southern dogfish, are small, deepwater sharks (DSEWPaC, 2013f). The species is endemic to Australia in habitats on the upper-slope between 180 m to 900 m of the southern continental shelf (Williams et al., 2012). There are likely three distinct stocks of the little gulper shark: eastern stock (Australian east coast down to eastern Tasmania), central stock (west Tasmania to the Great Australian Bight), and a western stock (western Great Australian Bight to south Western Australia) (USDSWG, 2012; Williams et al., 2012). However, the species is absent in southern Tasmania through to the Bass Strait (DSEWPaC, 2013f). Similar to the Harrisson's dogfish, the little gulper shark is also vulnerable to overfishing due to its slow growth, late maturing age, and low fecundity (Stobutzki et al., 2011).

The little gulper shark is not recorded to be present within the Bass Strait and their reproductive migration is relatively unknown (Musick, 2011). Considering the depth of the operational area (~85 m) and the species preferred habitat depth of 180 - 900 m, it is considered unlikely for the species to be present within the vicinity of the East Coast Project.

School Shark

The school shark is a globally widespread species that occurs in temperate waters offshore eastern United States, Hawaii, South America, South Africa, Europe, and New Zealand (Last and Stevens, 1994; McLoughlin, 2007). In Australian waters, the species is found in offshore waters from Moreton Bay, QLD to Perth, WA, including the offshore waters of Tasmania and Lord Howe Island (DEWHA, 2009b). However, the species moves more extensively in waters off southern Australia with individual migrations of up to 1,400 km recorded (DEWHA, 2009b). The school shark is primarily a demersal species and have been recorded at depths of 500 m during the day and then moving up during the night to about 100 m (McLoughlin, 2007). Female and juvenile sharks typically use inshore coastal areas around Victoria, Tasmania, and parts of South Australia for nursery areas (Pogonoski et al., 2002).

The school shark is a key commercial species that is primarily caught in the Gillnet, Hook, and Trap sector of the Commonwealth Southern and Eastern Scalefish and Shark Fishery (SESSF) (DEWHA, 2009b). The species was historically the primary target within the fishery, but biomass was reduced below the limit reference point around 1990 (Davis et al., 2023). However, the school shark remains the second most economically important stock in the fishery despite being classified as overfished (Davis et al., 2023).

The waters of the Bass Strait are not known feeding, resting or reproductive grounds for the school shark, although pups and juveniles are known to aggregate in shallow, inshore waters during the spring and summer (AFMA, 2024a). Considering the depth of the operational area (55 - 85 m) and the species preferences, it is considered that the presence of school sharks within the operational area would only be of a transitory nature during movements between deep offshore waters and nursey grounds within the breeding season.

Oceanic Whitetip Shark

The oceanic whitetip shark is a pelagic species generally found offshore in the open ocean across the globe in tropical and subtropical waters. Although they have been recorded up to depths <1,000 m, they typically live in the upper part of the water column, from the surface to around 200 m (NOAA, 2024). The species are considered a surface-dwelling shark, showing a strong preference for the surface mixed layer in warm waters above 20°C (NOAA, 2024). Within Australian waters, the oceanic whitetip sharks range extends from Cape Leeuwin, WA north through parts of the Northern Territory, down the east coast of Queensland and NSW to Sydney (FRDC, 2019). The oceanic whitetip shark is considered an opportunistic forager, feeding primarily on bony fish and cephalopods, such as squid.

Considering the species known range which only extends as far south as Sydney on the east and Cape Lewin on the west it is considered unlikely for the species to be present within the vicinity of the East Coast Project.

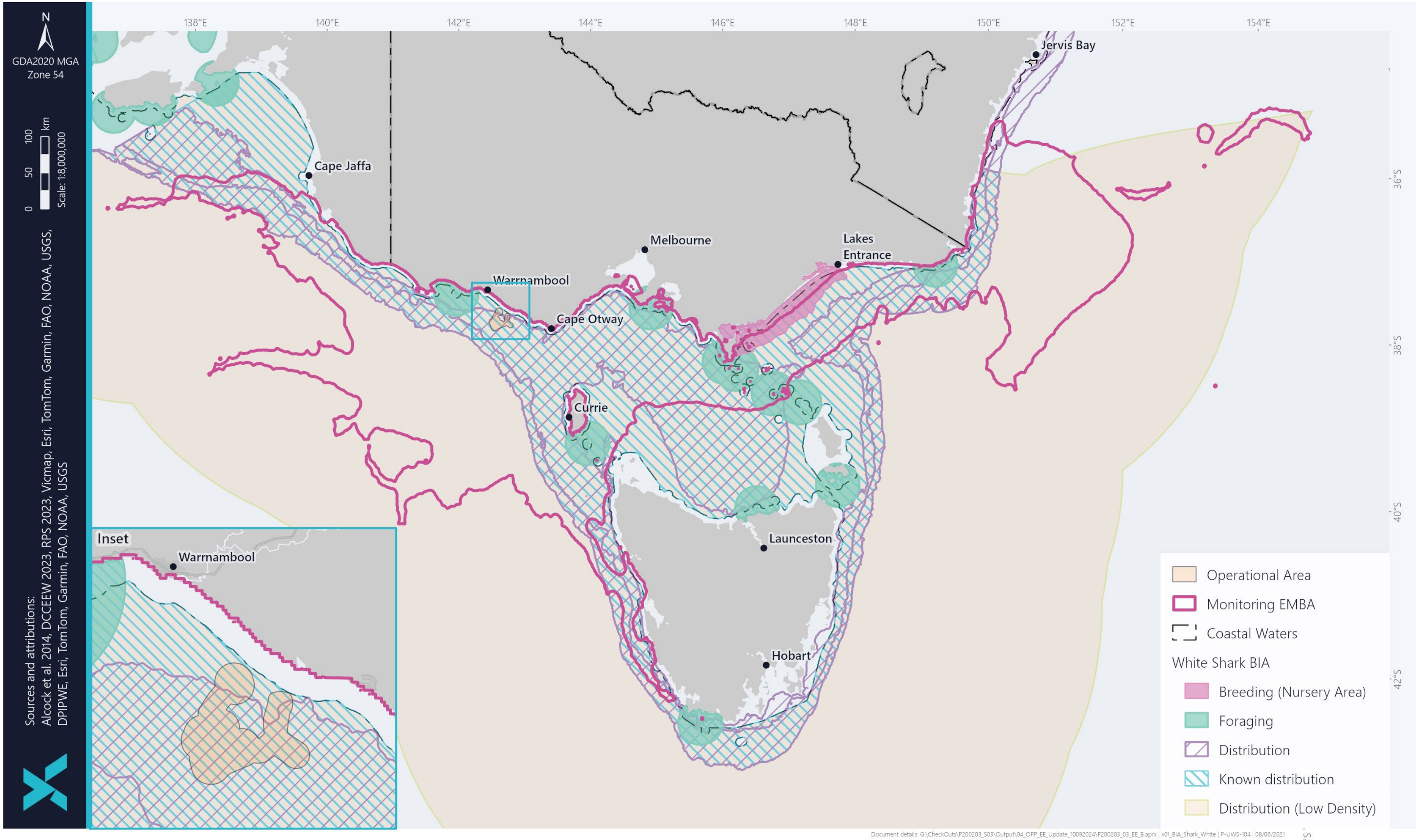


Figure 6-29: White Shark BIAs overlapped by the monitoring EMBA

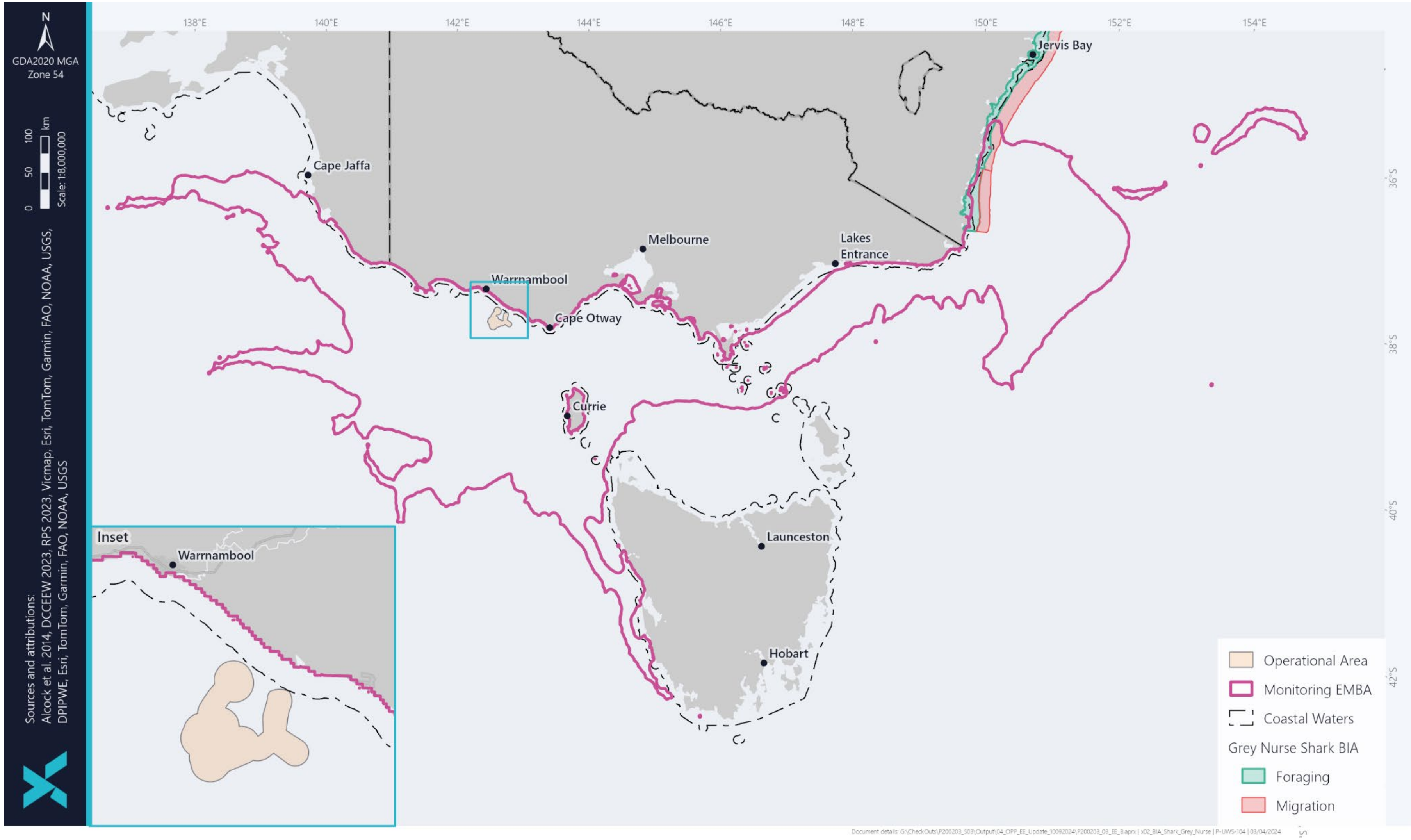


Figure 6-30: Grey Nurse Shark BIAs overlapped by the monitoring EMBA

6.5.5.2 Ray-finned Fish

Black Rock-cod

The range of the black rock-cod includes warm temperate and subtropical waters of the southwestern Pacific, including south-eastern Australia and some Islands of New Zealand. However, the NSW coastline forms the species main range, both in Australia and internationally (DSEWPaC, 2012e). The species typically inhabits near shore rocky reefs and offshore coastal reefs up to 50 m deep (DSEWPaC, 2012e). Coastal habitats include rock caves, rock gutters and rock reefs. Young juveniles are often found in coastal rock pools while slightly older juvenile black cod are often found in estuary systems which is thought to potentially be an important part of the ecology of juvenile black cod, in NSW waters (DSEWPaC, 2012e).

The species is not expected to be found within the vicinity of the East Coast Project as its main range occurs in NSW state waters.

Australian Grayling

The Australian grayling is endemic to south-eastern Australia and occurs in coastal rivers and streams in NSW, Victoria and Tasmania. This is a dimorphous, migratory species that inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults (Backhouse et al., 2008). The Australian grayling will spend the majority of its life in freshwater and can penetrate far inland (has been recorded up to 100 km upstream from the sea) (Backhouse et al., 2008). Precise marine habitats are not well known. Spawning occurs in freshwater form late summer to winter and is thoughts to be initiated by an increase in river flow and a potential drop in water temperature (DoE, 2023). Once eggs hatch, they drift downstream and out to sea where they remain for ~6 months.

Juvenile Australian grayling may be found within the vicinity of the East Coast Project, with recent surveys of Victoria recording the species in almost all coastal rivers east of and including the Hopkins River catchment near Warrnambool (TSSC, 2021).

Ziebell's Handfish

Handfish are relatively small (60–151 mm) marine fishes with distributions restricted to the temperate waters of south-eastern Australia, predominantly concentrated in Tasmania (Last and Gledhill, 2009). They are demersal, generally cryptic in nature. Lacking a swim bladder, they prefer to use their 'hands' to 'walk' across the sea floor, rather than swim (although can do so over short distances when disturbed).

Ziebell's handfish is the largest known handfish species and is typically found on soft bottomed habitat with patches of rock that support sponge and algae communities (CoA, 2015c). The species is restricted to the coastal waters of southern and eastern Tasmania and is most often found at depths of 10-20 m. Habitat critical to the survival of the species is located in the Waterfall Bay area of the Tasman Peninsula, located outside of the monitoring EMBA (CoA, 2015c).

The species is not expected to be found within the vicinity of the East Coast Project as it is restricted to eastern and southern Tasmanian state waters, in water depths of 3 to 20 m (Stuart-Smith et al., 2020).

Short-finned Eels

The short-finned eel in adult and glass eels forms have the potential to occur within the operational area and associated monitoring EMBA during offshore spawning migration period. A study tracked downstream spawning migration of adult short-finned eels released from south-western Victoria (Hopkins and Fitzroy River estuaries) and observed the adult eels moved east or south along the Australian continental shelf exiting the Bass Strait to the east to migrate north to spawning grounds in tropical waters of the Coral Sea (Koster et al., 2021). From the spawning site in the Coral Sea, migration of short-finned eel larvae is influenced by ocean currents that carry the larvae from the Coral Sea south along the east Australian current and transport the developing larvae (glass eels) through the Bass Strait to the Victorian Coast (VFA, 2022a). Based on the observed migratory route of short-finned eels, short-finned eels in adult and glass eel forms may pass the operational area.

Short-finned eels in the Otway Basin and Bass Strait have a seasonal presence. During late summer and autumn adult eels will enter the Otway Basin and Bass Strait to commence their migration to the Coral Sea. During mid-winter to late spring Short-finned eel in larvae and glass eel forms will enter Victorian estuaries to complete the upstream migration (VFA, 2022a).

Orange Roughy

The orange roughy is a high-value commercial, deepwater species that is associated with pinnacles, seamounts, such as the Lord How Rise, and other features where its prey aggregates (CoA, 2012b). In Australia, the species is commonly found on the continental slope at depths of 700 - 1,400 m (AFMA, 2024b) between southern WA and central NSW, including Tasmania. (CoA, 2012b). The orange roughy forms dense spawning aggregations in winter, usually 5 - 10 m above the seabed (AFMA, 2024b).

The orange roughy is a commercially important species and a key target in the South East Trawl Sector of the SESSF (AFMA, 2024b).

The waters of the Bass Strait are not known feeding, resting or reproductive grounds for the orange roughy, although feeding may occur opportunistically where sufficient prey is present. Considering the depth of the operational area (~85 m at its deepest) and the species preferred habitat (700 - 1,400 m), it is unlikely for the species to be present within the vicinity of the East Coast Project.

Eastern Gemfish

Gemfish are found throughout temperate waters in southern Australian waters (Pogonoski et al., 2002). The eastern population of gemfish extends from offshore Cape Moreton in southern QLD to the western edge of the Bass Strait (DEWHA, 2009c). The species is a bottom-dwelling species and generally found in large schools at depths of 100 - 800 m on the continental shelf and upper slope (AFMA, 2024c). The eastern gemfish migrates up the southern east coast of Australia before spawning, commencing off the eastern Bass Strait in early June. The species travels north, parallel to the coast to then spawn off central and northern NSW in mid-August (Pogonoski et al., 2002; Morison et al., 2007).

The eastern gemfish is incidentally caught in the eastern zone of Commonwealth Trawl Sector and the Gillnet Hook and Trap Sector apart of the SESSF (AFMA, 2024c).

The waters of the Bass Strait are not known feeding, resting or reproductive grounds for the eastern gemfish, although feeding may occur opportunistically where sufficient prey is present. Considering the depth of the operational area (~85 m at its deepest) and the species preferred habitat (100 - 800 m), it is unlikely for the species to be present within the vicinity of the East Coast Project.

Blue Warehou

The blue warehou is a school fish that usually aggregate close to the seabed and is confined to Australian and New Zealand waters (Kaschner et al., 2010). In Australia, the species predominantly occurs in the coastal shelf, upper continental slope, and seamount waters offshore from NSW, Tasmania, Victoria and South Australia (Bruce et al., 1998; Gomon, 2008). The species is recorded at depths between 50 - 500 m (bray and Gomon, 2011; AFMA, 2024d), although it is more abundant in waters shallower than 200 m (TSSC, 2015a). Juvenile fish can sometimes be found schooling close to the surface in estuaries, often in association with jellyfish (AFMA, 2024d). The blue warehouse is a migratory species but shows preference for relatively warmer waters of between 10 and 15^{o}C (TSSC, 2015a).

Commercial fisheries are not permitted to target blue warehou, but the species is incidentally caught within the Gillnet, Hook and Trap Sector, Commonwealth Trawl Sector, and the Great Australian Bight Trawl Sector of the SESSF (AFMA, 2024d).

The waters of the Bass Strait are not known feeding, resting or reproductive grounds for the blue warehou, although feeding may occur opportunistically where sufficient prey is present.

The blue warehou can be found within the Bass Strait but has primarily been incidentally caught on the east and west coast of Tasmania (AFMA, 2024d).

Syngnathids

Syngnathidae is a group of bony fishes that includes seahorses, pipefishes, pipehorses and sea dragons; the closely related Solenostomidae family includes ghost pipefish. These species occupy a range of habitats, however, generally display a preference for seagrass and macroalgal beds, coral reefs, mangroves or sponge gardens (i.e. a habitat offering a protective environment) (DSEWPaC, 2012g). Syngnathids are typically carnivorous, feeding in the water column on or near the sea floor; their diet including small crustaceans, invertebrates, and zooplankton.

In Victoria, Tasmania, South Australian and NSW it is an offence to collect or harvest any species of seahorse, seadragon, pipefish, or pipehorse without a permit (Baker, 2006). Habitat that supports syngnathid populations is generally patchy, so populations of syngnathid species may be dispersed and fragmented (DSEWPaC, 2012g). There are 15 pipefish species, 2 seahorses, and 2 seadragon species which have known distribution or habitat within the Otway and Bass Strait, (Baker, 2006).

6.5.5.3 Commercially Important Fish Species

A number of commercial fisheries have previously operated within the operational area and monitoring EMBA as described in section 6.7.2. Key target species (i.e., species with high monetary value) with reported fishing activity in the operational area that are not EPBC listed have been identified, a number of which are described below.

Gummy shark

The gummy shark is distributed throughout the temperate waters of Australia, from Port Stephens in NSW to Geraldton in WA, including Tasmania (Marton et al., 2014). The gummy shark is a demersal species that occurs on the continental shelf from the near shore region to depths of 80 - 350 m (AFMA, 2024e). The species remain either on or near the seabed with females traveling longer distances as their age increases (AFMA, 2024e).

The gummy shark is a commercially important species and a key target in the Gillnet, Hook and Trap Sector of the Commonwealth SESSF (AFMA, 2024e). The species became the main target of the fishery from 1986 due to the adoption of monofilament gillnets and the concern surrounding mercury poisoning from large school sharks and declining school shark catches (Davis et al., 2023).

The gummy shark has primarily been caught nearshore Tasmania, Victoria and South Australia (AFMA, 2024e). The waters of the Otway are not known feeding, resting, or reproductive grounds for the gummy shark, however, considering their preferred habitat (80-350 m), there is potential for the species to be present within the vicinity of the East Coast Project.

Sawshark

Sawsharks are a common demersal species that inhabit the continental shelf and upper slope (AFMA, 2024f). There are three species of sawsharks that are frequently caught in Australian waters: the common, southern, and the delicate sawshark (Raoult et al., 2020). The southern and common sawshark have overlapping distributions and occur down to 630 m (Last and Stevens, 2009). However, the depth where these two sawfish species are most common is not known (Raoult et al., 2020).

The sawshark is incidentally caught within the Gillnet Hook and Trap Sector and the Commonwealth Trawl Sector of the SESSF, and state managed fisheries (AFMA, 2024f). In Commonwealth waters, the highest total catches of sawshark were observed on the north-eastern side of Bass Strait (Raoult et al., 2020) approximately 90% of catch within the SESSF (Davis et al., 2023).

Considering the preferred habitat of sawshark (down to 650 m) and recent catch efforts, there is potential for sawsharks to be found within the vicinity of the East Coast Project.

Wrasse

Species of wrasse have different lifestyle characteristics such as diets (ranging from highly specialised diets to highly opportunistic carnivores), use different habitats, and occurrence across different depths (Berkstrom et al.,2012). Wrasses are key target species for the Victorian Wrasse (Ocean) Fishery. The bluethroat wrasse and purple wrasse are the most caught species within the fishery, comprising of approximately 90% of the commercial Victorian wrasse harvest (VFA, 2021a). Small catches of rosy, senator, and southern Maori wrasse are also caught within the fishery (VFA, 2021a).

The wrasse species targeted in Victoria can occur down to depths of 160 m. However, species are mostly caught in depth shallower than 30 m to reduce loss due to barotrauma (where the swim bladder expands and damages the fish brought to the surface) (VFA, 2021a).

Considering the preferred habitat of the wrasse species targeted in Victoria (down to 160 m) and recent catch efforts, there is potential for wrasse species to be found within the vicinity of the East Coast Project.

Flathead

Flathead species are bottom-dwelling fish that are distributed in tropical and temperate waters around Australia (VFA, 2021b). There are many species of flathead but the southern blue-spotted, sand, rock, tiger, and dusky flathead are the most commonly target species by recreational fisheries (VFA, 2021b). The tiger flathead is also caught within the Commonwealth Trawl and Scalefish Hook Sector of the SESSF (Emery et al., 2023). The tiger flathead is endemic to Australia and found on sandy or muddy substrates in the continental shelf and upper-slope waters from Coffs Harbour in NSW through Bass Strait and around Tasmania to south-east South Australia (Emery et al., 2023). Majority of the commercial catch for the tiger flathead comes from depths between 50 m and 200 m (Emery et al., 2023).

Considering the catch effort for the tiger flathead occurring at depths between 50 - 200 m, there is potential for flathead species to be found within the vicinity of the East Coast Project.

Pink ling

The pink ling is a demersal species that can be found along the continental shelf and slope, occurring at depths between 20 – 1,000 m (AFMA, 2024g). However, juveniles are generally found in shallower locations than adults (Bessell-Browne et al., 2021). In Australia, the species is found from central NSW to the south-west coast of WA (Bessell-Browne et al., 2021).

The pink ling is a commercially important species and a key target in the Gillnet, Hook and Trap Sector and the South East Trawl Sector of the Commonwealth SESSF (AFMA, 2024g). The species has been commercially caught in southern Australia since the 1970s by both Commonwealth and state fisheries (Bessell-Browne et al., 2021).

Considering the preferred habitat of the pink ling at depths between 20 m to 1,000 m, and recent fishing effort, there is potential that the pink ling may be present within the vicinity of the East Coast Project.

Blue grenadier

The blue grenadier is a deepwater species and is found in the continental slope, occurring at depths between 200 - 700 m (AFMA, 2024h). The species is found from NSW around southern Australia, including Tasmania, to WA (Castillo-Jordan and Tuck, 2018).

The blue grenadier is a commercially important species and a key target in the South East Trawl Sector of the SESSF (AFMA, 2024h). The species is primarily caught off western and eastern Tasmania and mostly during winter (AFMA, 2024h), which coincides with peak spawning (Castillo-Jordan and Tuck, 2018).

Considering the species preferred habitat (200 - 700 m) and commercial catch history, it is unlikely for the species to be present within the vicinity of the East Coast Project.

6.5.6 Marine Reptiles

PMST reports were generated for the operational area, ecological EMBA and monitoring EMBA to identify EPBC listed marine reptile species (or species habitat) that may occur within the EMBA (Appendix 1). Table 6-7 identifies the presence and protection status of all marine reptile species for each EMBA. There are 5 EPBC listed marine reptile species (or species habitat) that may occur within the monitoring EMBA. Of these, 3 occur within the operational area.

For the purpose of the OPP, only species listed as threatened or migratory under the EPBC Act which are known or likely to occur or have either a BIA or habitat critical to their survival within the monitoring EMBA are considered to have conservation significance warranting further discussion.

There are no defined BIAs or habitat critical to the survival of marine turtle species within the operational area or EMBAs.

Table 6-7: Marine reptile species or habitats which may occur within the operational area and ecological and monitoring EMBA

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Caretta caretta	Loggerhead Turtle	E	✓	✓	*Recovery Plan for Marine Turtles in Australia, 2017-2027 (CoA, 2017)*		LO	FKO	FKO
Chelonia mydas	Green Turtle	V	✓	✓			MO	KO	FKO
Dermochelys coriacea	Leatherback Turtle	E	✓	✓	*Approved Conservation Advice for Dermochelys coriacea (Leatherback Turtle) (DEWHA, 2008)* *Recovery Plan for Marine Turtles in Australia, 2017-2027 (CoA, 2017)*		LO	FKO	FKO
Eretmochelys imbricata	Hawksbill Turtle	V	✓	✓	*Recovery Plan for Marine Turtles in Australia, 2017-2027 (CoA, 2017)*		-	BLO	FKO
Natator depressus	Flatback Turtle	V	✓	✓			-	-	KO

Threatened Species:
V Vulnerable
E Endangered

Type of Presence:
MO Species of species habitat may occur within area
LO Species or species habitat likely to occur within are
KO Species or species habitat known to occur within area
BLO Breeding likely to occur within area
FKO Foraging, feeding or related behaviour known to occur within area

6.5.6.1 Marine Turtles

Adult marine turtles spend the majority of their lives in the ocean, typically only coming onshore to nest. Females can lay (on average) between two and six clutches per season (CoA, 2017); with the period between clutches known as the internesting period. Female turtles typically remain close to the same nesting site during an internesting period. Hatchlings disperse into oceanic currents, and the juveniles will stay in pelagic waters until large enough to settle into coastal feeding habitats. Leatherback turtles are an exception to these general patterns, often exhibiting larger internesting zones, and travelling vast distances to forage rather than settling in a coastal habitat (CoA, 2017). Flatback turtles also lack an oceanic phase and remain in the surface waters of the continental shelf.

There are no marine turtle BIAs or habitat critical to the survival of marine turtles located within the operational area or monitoring EMBA including adjacent coastline.

Loggerhead Turtle

The loggerhead turtle has a global distribution throughout tropical, sub-tropical and temperate waters. In Australia the species is typically found in waters around coral and rocky reefs, seagrass beds, or muddy bays throughout eastern, northern and western Australia and is rarely seen off the Victorian, Tasmanian of South Australian coasts (CoA, 2017). While the species has a broad foraging range throughout Australian waters, nesting is only known to occur on sandy beaches on the central western and eastern coasts outside of the monitoring EMBA (DoE, 2023).

The loggerhead is a carnivorous turtle, feeding primarily on benthic invertebrates in habitat ranging from nearshore to 55 m depth (DoE, 2023). Loggerhead turtles will migrate over distances in excess of 1,000 km between breeding and foraging grounds each season showing strong fidelity to these important areas (Limpus, 2008).

Although this species may occur within the monitoring EMBA it is expected to only be of a transient nature due to the absence of suitable coastal habitat.

Leatherback Turtle

The leatherback turtle has the widest distribution of any marine turtle, occurring in tropical to sub-polar oceans (DEWHA, 2008). In Australia, the leatherback turtle has been recorded foraging in all Australian states, but no large nesting populations have been recorded (DEWHA, 2008).

Unlike other marine turtles, the leatherback turtle utilises cold water foraging areas, with the species most commonly reported foraging in coastal waters between southern Queensland and central NSW, southeast Australia (Tasmania, Victoria and eastern SA), and southern WA (DoE, 2023). This species is an occasional visitor to the Otway shelf and has been recorded only 9 times in Victoria, most recently in March 2024 where an individual was found deceased onshore in Port Phillip Bay (SWIFFT, 2024). It is mostly a pelagic species, and, away from its feeding grounds, is rarely found inshore (DoE, 2023).

Although this species may occur within the monitoring EMBA it is expected to only be of a transient nature due to the absence of suitable coastal habitat.

Green Turtle

The green turtle is typically found in tropical and subtropical waters throughout the world, however, may stray into temperate waters (DoE, 2023). The species is predominantly found in Australian waters off the Northern Territory, Queensland, and WA coastlines with more limited numbers in NSW, Victoria and South Australia (CoA, 2017).

The first 5-10 years of the green turtles life is spent drifting on ocean currents, consuming plankton, crustaceans and algae (DoE, 2023; CoA, 2017). Once they reach an adequate size the species moves to shallow foraging grounds. The species is primarily herbivorous, foraging on algae, seagrass and mangroves (CoA, 2017). The green turtle migrates between foraging and nesting locations seasonally, which varies between states.

Although this species may occur within the monitoring EMBA it is expected to only be of a transient nature due to the absence of suitable coastal habitat.

Hawksbill Turtle

The hawksbill turtle is found in tropical, subtropical and temperate waters across the world; however, nesting is typically confined to tropical beaches (DoE, 2023). Within Australia nesting for the hawksbill turtle is concentrated along the northern coastlines of Queensland, Northern Territory and WA. However, the species has been recorded as far south as northern NSW where foraging is believed to occur (CoA, 2017).

The first 5-10 years of the hawksbill turtles life is spent drifting on ocean currents, consuming plankton (DoE, 2023). Once they reach an adequate size the species moves to reef foraging grounds feeding on sponges, soft bodied invertebrates, seagrass and algae (DoE, 2023; CoA, 2017). The hawksbill turtle migrates between foraging and nesting locations seasonally, which varies between states.

Although this species may occur within the monitoring EMBA it is expected to only be of a transient nature due to the absence of suitable coastal habitat. The extent of the hawksbill turtle distribution typically as far as southern NSW is supported by recorded sightings within the Atlas of Living things with infrequent sighting in waters offshore Victorian or South Australia.

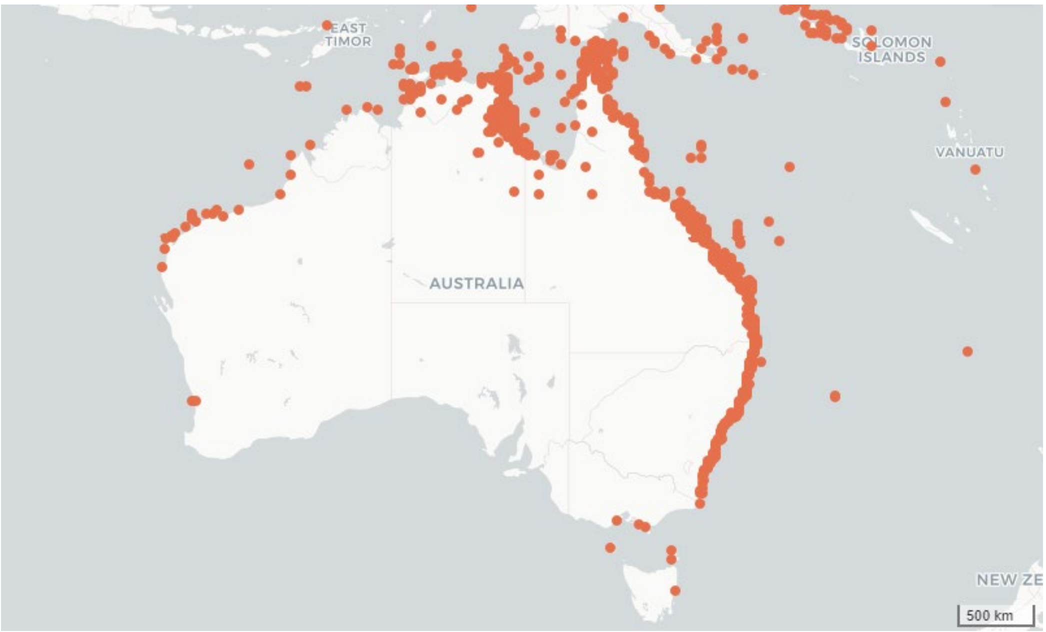


Figure 6-31: Sightings of Hawksbill Turtles around Australia (Atlas of Living Australia, 2024)

Flatback Turtle

The flatback turtle is only found in the tropical waters of northern Australia and is one of only two species of sea turtle without a global distribution (DoE, 2023). All known nesting locations for this species are located within Australia where the nesting occurs across northern Queensland, the Northern Territory and WA (CoA, 2017). The flatback turtle forages over the Australian continental shelf into continental waters off Papua New Guinea and Indonesia. This species is primarily carnivorous, feeding on soft-bodied invertebrates; juveniles eat gastropod molluscs, squid, siphonophores (CoA, 2017).

Although this species may occur within the monitoring EMBA it is expected to only be of a transient nature due to the absence of suitable coastal habitat.

6.5.7 Seabirds and Shorebirds

PMST reports were generated for the operational area, ecological EMBA and monitoring EMBA to identify EPBC listed bird species (or species habitat) that may occur within the EMBA

(Appendix 1). Table 6-8 identifies the presence and protection status of all bird species for each EMBA. There are 133 EPBC listed seabird and shorebird species (or species habitat) that may occur within the monitoring EMBA. Of these, 34 occur within the operational area.

For the purpose of the OPP, effort has been targeted towards species listed as threatened or migratory under the EPBC Act which are known or likely to occur or have either a BIA or habitat critical to their survival within the monitoring EMBA.

Eighteen bird species identified in the PMST Reports are listed terrestrial (brown treecreeper (south-eastern), regent honeyeater, southern whiteface, King Island brown thornbill, King Island scrubtit, gang-gang cockatoo, south-eastern red-tailed black-cockatoo, south-eastern glossy black-cockatoo, diamond firetail, pilotbird, green rosella (King Island), plains-wanderer, south-eastern hooded robin, malleefowl, painted honeyeater, grey falcon, eastern bristlebird and the masked owl (Tasmanian). These species inhabit terrestrial environments, outside of the operational area and monitoring EMBA, but were identified within the PMST search due to the application of a nominal buffer and are therefore not discussed further.

BIAs were identified for 24 species of seabirds: antipodean albatross, Australasian gannet, black petrel, black-browed albatross, black-faced cormorant, Buller’s albatross, Campbell albatross, common diving-petrel, crested tern, flesh-footed shearwater, great-winged petrel, Indian yellow-nosed albatross, little penguin, northern giant petrel, short-tailed shearwater, shy albatross, soft-plumage petrel, sooty shearwater, southern giant petrel, wandering albatross, wedge-tailed shearwater, white-capped albatross, white-faced storm-petrel and the Wilson’s storm petrel, within the monitoring EMBA (Figure 6-33 to Figure 6-40).

There is no defined habitat critical to the survival of bird species within the operational area or EMBAs.

Table 6-8: Seabird and Shorebird species or habitats which may occur within the operational area and ecological and monitoring EMBA

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Diomedia antipodensis	Antipodean Albatross	V	✓(M)	✓	*National Recovery Plan for Albatross and Petrels (2022) (DCCEEW, 2022e)*	*	FLO*f	FLO*f	FLO*f
Diomedea antipodensis gibsoni	Gibson's Albatross	V		✓			-	FLO	FLO
Diomedia epomophora	Southern Royal Albatross	V	✓(M)	✓			FLO	FLO	FLO
Diomedia exulans	Wandering Albatross	V	✓(M)	✓		*	FLO*f	FLO*f	FLO*f
Diomedia sanfordi	Northern Royal Albatross	E	✓(M)	✓			FLO	FLO	FLO
Phoebetria fusca	Sooty Albatross	V	✓(M)	✓			LO	LO	LO
Thalassarche bulleri	Buller's Albatross	V	✓(M)	✓		*	FLO*f	FLO*f	FLO*f
Thalassarche bulleri platei	Northern Buller's Albatross	V		✓			FLO	FLO	FLO
Thalassarche carteri	Indian Yellow-nosed Albatross	V	✓ (M)	✓		*	LO*f	LO*f	LO*f
Thalassarche cauta	Shy Albatross	E	✓(M)	✓	*Conservation Advice Thalassarche cauta Shy Albatross (TSSC, 2020)* *National Recovery Plan for Albatross and Petrels (2022) (DCCEEW, 2022e)*	*	FLO*f	FLO*f	FLO*f
Thalassarche chrysostoma	Grey-headed Albatross	E	✓(M)	✓	*Conservation Advice for Thalassarche chrysostoma (grey-headed Albatross) (DEWHA, 2009)* *National Recovery Plan for Albatross and Petrels (2022) (DCCEEW, 2022e)*		MO	MO	MO
Thalassarche eremita	Chatham Albatross	E	✓(M)	✓			-	FMO	FMO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Thalassarche impavida	Campbell Albatross	V	✓(M)	✓	*National Recovery Plan for Albatross and Petrels (2022) (DCCEEW, 2022e)*	*	FLO *f	FLO*f	FLO*f
Thalassarche melanophris	Black-browed Albatross	V	✓(M)	✓		*	FLO *f	FLO*f	FLO*f
Thalassarche salvini	Salvin's Albatross	V	✓(M)	✓			FLO	FLO	FLO
Thalassarche steadi	White-capped Albatross	V	✓(M)	✓		*	FKO	FKO	FKO*f
Halobaena caerulea	Blue Petrel	V		✓	*Conservation Advice for Halobaena caerulea (Blue Petrel) (TSSC, 2015b)*		MO	MO	MO
Macronectes giganteus	Southern Giant Petrel	E	✓(M)	✓	*National Recovery Plan for Albatross and Petrels (2022) (DCCEEW, 2022e)*	*	MO	FLO	FLO*f
Macronectes halli	Northern Giant Petrel	V	✓(M)	✓		*	FLO	FLO	FLO*f
Pterodroma cervicalis	White-necked Petrel			✓			-	MO	BLO
Pterodroma heraldica	Herald Petrel	CE			*Conservation Advice Pterodroma heraldica (Herald petrel) (TSSC, 2015l)*		-	-	MO
Pterodroma leucoptera leucoptera	Gould's Petrel	E			*Gould's Petrel (Pterodroma leucoptera leucoptera) Recovery Plan (DEC, 2006)*		MO	MO	BKO
Pterodroma mollis	Soft-plumaged Petrel	V		✓	*Conservation Advice for Pterodroma mollis (Soft-plumaged Petrel) (TSSC, 2015g)*	*	MO	MO	BKO*f
Pelagodroma marina	White-faced Storm-Petrel			✓		*	-	*f	BKO*f, b
Pelecanoides urinatrix	Common Diving-Petrel			✓		*	*f	BKO*f	BKO*f, b
Pterodroma macroptera	Great-winged Petrel			✓		*	-	-	FKO*f

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Pterodroma neglecta neglecta	Kermadec Petrel (western)	V			*Lord Howe Island Biodiversity Management Plan (DECC, 2008)* *Norfolk Island Region Threatened Species Recovery Plan (DEWHA, 2010c)*		-	-	FMO
Procellaria parkinsoni	Black Petrel		✓(M)	✓		*	-	-	*f
Fregetta grallaria grallaria	White-bellied Storm-Petrel (Tasman Sea)	V			*Lord Howe Island Biodiversity Management Plan (DECC, 2008)*		-	LO	LO
Oceanites oceanites	Wilsons Storm Petrel		✓(M)	✓		*	-	-	*m
Actitis hypoleucos	Common Sandpiper		✓(W)	✓			MO	KO	KO
Calidris acuminata	Sharp-tailed Sandpiper	V	✓(W)	✓	*Approved Conservation Advice for Calidris acuminata (sharp-tailed sandpiper) (DCCEEW, 2024c)*		MO	RKO	RKO
Calidris ferruginea	Curlew Sandpiper	CE	✓(W)	✓	*Conservation Advice for Calidris ferruginea (Curlew Sandpiper) (DCCEEW, 2023q)*		MO	KO	KO
Calidris melanotos	Pectoral Sandpiper		✓(W)	✓			MO	KO	KO
Limicola falcinellus	Broad-billed Sandpiper		✓ (W)	✓			-	-	RKO
Tringa glareola	Wood Sandpiper		✓ (W)	✓			-	RKO	RKO
Xenus cinereus	Terek Sandpiper	V	✓ (W)	✓	*Approved Conservation Advice for Xenus cinereus (Terek sandpiper) (DCCEEW, 2024e)*		-	-	RKO
Puffinus carneipes	Flesh-footed Shearwater		✓(M)	✓		*	LO	KO	KO*f
Puffinus griseus	Sooty Shearwater	V	✓(M)	✓	*Conservation Advice for Ardenna grisea (sooty shearwater) (DCCEEW, 2023c)*	*	MO	LO	BKO*f, b
Puffinus pacificus	Wedge-tailed Shearwater		✓(M)	✓		*	*f	*f, b	BKO*f, b

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Ardenna tenuirostris	Short-tailed Shearwater		✓(M)	✓		*	-	BKO*f, b	BKO*f, b
Hydroprogne caspia	Caspian Tern		✓(M)	✓			-	-	BKO
Onychoprion fuscatus	Sooty Tern			✓			-	-	BKO
Sterna striata	White-fronted Tern			✓			FLO	FLO	FLO
Sternula albifrons	Little Tern		✓ (M)	✓			-	MO	BKO
Sternula nereis	Fairy Tern			✓			-	-	BKO
Sternula nereis nereis	Australian Fairy Tern	V			*Conservation Advice for Sternula nereis nereis (Fairy Tern) (DSEWPaC, 2011)* *National Recovery Plan for the Australian Fairy Tern (Sternula nereis nereis) (DAWE, 2020)*		FLO	KO	KO
Thalasseus bergii	Greater Crested Tern		✓ (W)	✓		*	-	BKO	BKO* f, b
Charadrius bicinctus	Double-banded Plover		✓ (W)	✓			-	RKO	RKO
Charadrius leschenaultii	Greater Sand Plover	V	✓ (W)	✓	*Conservation Advice for Charadrius leschenaultia (Greater Sand Plover) (TSSC, 2016b)*		-	LO	KO
Charadrius mongolus	Lesser Sand Plover	E	✓ (W)	✓	*Conservation Advice for Charadrius mongolus (Lesser Sand Plover) (TSSC, 2016h)*		-	RKO	RKO
Charadrius ruficapillus	Red-capped Plover			✓			-	RKO	RKO
Pluvialis fulva	Pacific Golden Plover		✓ (W)	✓			-	RKO	RKO
Pluvialis squatarola	Grey Plover	V	✓ (W)	✓	*Approved Conservation Advice for Pluvialis squatarola (grey plover) (DCCEEW, 2024e)*		-	-	RKO
Thinornis cucullatus	Hooded Plover			✓			-	KO	KO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Thinornis cucullatus cucullatus	Eastern Hooded Plover	V		✓	*Conservation Advice for Thinornis rubricollis rubricollis (Hooded Plover, Eastern) (TSSC, 2014)*		-	KO	KO
Anous stolidus	Common Noddy		✓ (M)	✓			-	LO	LO
Haliaeetus leucogaster	White-bellied Sea-Eagle			✓			-	BKO	BKO
Apus pacificus	Fork-tailed Swift		✓ (M)	✓			LO	LO	LO
Phaethon lepturus	White-tailed Tropicbird		✓ (M)	✓			-	-	MO
Himantopus himantopus	Pied Stilt						-	RKO	RKO
Calidris canutus	Red Knot	V	✓ (W)	✓	*Conservation Advice for Calidris canutus (Red Knot) (DCCEEW, 2024a)*		MO	KO	KO
Calidris tenuirostris	Great Knot	V	✓ (W)	✓	*Conservation Advice for Calidris tenuirostris (Great Knot) (DCCEEW, 2024b)*		-	-	RKO
Fregata ariel	Lesser Frigatebird		✓ (M)	✓			-	-	MO
Fregata minor	Great Frigatebird		✓ (M)	✓			-	-	MO
Numenius madagascariensis	Eastern Curlew	CE	✓ (W)	✓	*Conservation Advice for Numenius madagascariensis (far eastern curlew) (DCCEEW, 2023r)*		MO	KO	KO
Larus dominicanus	Kelp Gull			✓			-	-	BKO
Larus pacificus	Pacific Gull			✓			-	BKO	BKO
Chroicocephalus novaehollandiae	Silver Gull			✓			-	BKO	BKO
Morus capensis	Cape Gannet			✓			-	BKO	BKO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Morus serrator	Australasian Gannet			✓		*	-	BKO*[f, a]	BKO*[f, a]
Stercorarius antarcticus	Brown Skua			✓			MO	MO	MO
Eudyptula minor	Little Penguin			✓		*	-	BKO	BKO*[f, b]
Anseranas semipalmata	Magpie Goose			✓			-	MO	MO
Bubulcus ibis	Cattle Egret			✓			-	MO	MO
Lathamus discolor	Swift Parrot	CE		✓	*Conservation Advice for Lathamus discolour (Swift Parrot) (TSSC, 2016d)* *National Recovery Plan for the Swift Parrot (Lathamus discolor) (DCCEEW, 2024m)*		-	KO	KO
Merops ornatus	Rainbow Bee-eater			✓			-	MO	MO
Calidris subminuta	Long-toed Stint		✓ (W)	✓			-	-	KO
Numenius minutus	Little Curlew		✓ (W)	✓			-	RLO	RLO
Numenius phaeopus	Whimbrel		✓ (W)	✓			-	RKO	RKO
Tringa incana	Wandering Tattler		✓ (W)	✓			-	-	RKO
Tringa brevipes	Grey-tailed Tattler		✓ (W)	✓			-	RKO	RKO
Tringa nebularia	Common Greenshank	E	✓ (W)	✓	*Conservation Advice for Tringa nebularia (Common Greenshank) (DCCEEW, 2024f)*		-	KO	KO
Tringa stagnatilis	Marsh Sandpiper		✓ (W)	✓			-	RKO	RKO
Pandion haliaetus	Osprey		✓ (W)	✓			-	KO	KO
Limosa lapponica	Bar-tailed Godwit		✓ (W)	✓			-	KO	KO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Limosa lapponica baueri	Nunivak Bar-tailed Godwit	E			*Conservation Advice for Limosa lapponica baueri (Alaskan bar-tailed godwit) (DCCEEW, 2024j)*		-	KO	KO
Limosa limosa	Black-tailed Godwit	E	✓ (W)	✓	*Conservation Advice for Limosa limosa (Black-tailed Godwit) (DCCEEW, 2024g)*		-	-	RKO
Gallinago hardwickii	Latham's Snipe	V	✓ (W)	✓	*Conservation Advice for Callinago hardwickii (Latham's Snipe) (DCCEEW, 2024h)*		-	KO	KO
Gallinago megala	Swinhoe's Snipe		✓ (W)	✓			-	RLO	RLO
Gallinago stenura	Pin-tailed Snipe		✓ (W)	✓			-	RLO	RKO
Arenaria interpres	Ruddy Turnstone	V	✓ (W)	✓	*Conservation Advice for Arenaria interpres (Ruddy Turnstone) (DCCEEW, 2024i)*		-	RKO	RKO
Calidris alba	Sanderling		✓ (W)	✓			-	RKO	RKO
Calidris ruficollis	Red-necked Stint		✓ (W)	✓			-	RKO	RKO
Calidris subminuta	Long-toed Stint		✓ (W)	✓			-	-	KO
Phalaropus lobatus	Red-necked Phalarope		✓ (W)	✓			-	-	RKO
Philomachus pugnax	Ruff (Reeve)		✓ (W)	✓			-	-	RKO
Chalcites osculans	Black-eared Cuckoo			✓			-	KO	KO
Cuculus optatus	Oriental Cuckoo, Horsfield's Cuckoo		✓ (T)				-	-	KO
Stiltia isabella	Australian Pratincole			✓			-	-	KO
Neophema chrysogaster	Orange-bellied Parrot	CE		✓	*National Recovery Plan for the Orange-bellied Parrot (Neophema chrysogaster) (DELWP, 2016)*		MLO	KO	BKO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Neophema chrysostoma	Blue-winged Parrot	V		✓	*Conservation Advice for Neophema chrysostoma (blue-winged parrot) (DCCEEW, 2023d)*		-	KO	KO
Phalacrocorax fuscescens	Black-faced Cormorant			✓		*	-	BKO	BKO*f, b
Recurvirostra novaehollandiae	Red-necked Avocet			✓			-	RKO	RKO
Rostratula australis	Australian Painted Snipe	E		✓	*Conservation Advice for Rostratula australis (Australian painted snipe) (DSEWPaC, 2013b)* *National Recovery Plan for the Australian Painted Snip (Rostratula australis) (DCCEEW, 2022g).*		-	KO	KO
Pachyptila turtur	Fairy Prion			✓			MO	KO	KO
Pachyptila turtur subantartica	Fairy Prion (southern)	V			*Conservation Advice for Pachyptila turtur subantartica (Fairy Prion Southern) (TSSC, 2015d)*		MO	KO	KO
Motacilla cinerea	Grey Wagtail		✓ (T)	✓			-	-	KO
Motacilla flava	Yellow Wagtail		✓ (T)	✓			-	MO	KO
Myiagra cyanoleuca	Satin Flycatcher		✓ (T)	✓			-	BKO	BKO
Monarcha melanopsis	Black-faced Monarch		✓ (T)	✓			-	LO	KO
Rhipidura rufifrons	Rufous Fantail		✓ (T)	✓			-	KO	KO
Symposiachrus trivirgatus	Spectacled Monarch		✓ (T)	✓			-	-	KO
Hirundapus caudacutus	White-throated Needletail	V	✓ (T)	✓	*Conservation Advice Hirundapus caudacutus White-throated Needletail (TSSC, 2019b)*		-	KO	RKO
Acanthiza pusilla magnirostris	King Island Brown Thornbill, Brown Thornbill (King Island)	E			*Conservation Advice for Acanthiza pusilla magnirostris (King Island brown thornbill) (DCCEEW, 2023e)*		-	-	KO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
					King Island Biodiversity Management Plan (DPIPWE, 2012)				
Acanthornis magna greeniana	King Island Scrubtit, Scrubtit (King Island)	CE			*Conservation Advice for Acanthornis magna greeniana (King Island scrubtit) (DCCEEW, 2023f)* *King Island Biodiversity Management Plan (DPIPWE, 2012)*		-	-	KO
Anthochaera phrygia	Regent Honeyeater	CE			*National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia) (DoE, 2016)* *Conservation Advice Anthochaera phrygia regent honeyeater (TSSC, 2015h)*		-	FLO	KO
Aphelocephala leucopsis	Southern Whiteface	V			*Conservation Advice for Aphelocephala leucopsis (southern whiteface) (DCCEEW, 2023g)*		-	MO	KO
Aquila audax fleayi	Tasmanian Wedge-tailed Eagle	E			*Threatened Tasmanian Eagles Recovery Plan 2006-2010 (Threatened Species Section, 2006)*		-	-	KO
Botaurus poiciloptilus	Australasian Bittern	E			*Conservation Advice Botaurus poiciloptilus Australasian Bittern (TSSC, 2019)* National Recovery Plan for the Australasian Bittern (*Botaurus poiciloptilus*) (DCCEEW, 2022h).		-	KO	KO
Callocephalon fimbriatum	Gang-gang Cockatoo	E			*Conservation Advice for Callocephalon fimbriatum (Gang-gang Cockatoo) (DAWE, 2022)*		-	KO	KO
Calyptorhynchus banksii graptogyne	South-eastern Red-tailed Black-Cockatoo	E			*National Recovery Plan for the South-Eastern Red-tailed Black-Cockatoo Calyptorhynchus banksii graptogyne (CoA, 2007)*		-	-	KO
Calyptorhynchus lathami lathami	South-eastern Glossy Black-Cockatoo	V			*Conservation Advice for Calyptorhynchus lathami lathami (South-eastern Glossy Black Cockatoo) (DCCEEW, 2022d)*		-	MO	KO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Ceyx azureus diemenensis	Tasmanian Azure Kingfisher	E			*Conservation Advice for Ceyx azureus diemenensis (Tasmanian Azure Kingfisher) (DEWHA, 2010a)*		-	-	KO
Climacteris picumnus victoriae	Brown Treecreeper (south-eastern)	V			*Conservation Advice for Climacteris picumnus victoriae (brown treecreeper (south-eastern)) (DCCEEW, 2023h)*		-	MO	KO
Dasyornis brachypterus	Eastern Bristlebird	E			*National Recovery Plan for Eastern Bristlebird Dasyornis brachypterus (CoA, 2022c)*		-	KO	KO
Falco hypoleucos	Grey Falcon	E			*Conservation Advice Falco hypoleucos Grey Falcon (TSSC, 2020b)*		-	LO	LO
Grantiella picta	Painted Honeyeater	V			*Conservation Advice Grantiella picta painted honeyeater (TSSC, 2015i)* *National Recovery Plan for the Painted Honeyeater (Grantiella picta) (DAWE, 2021a)*		-	KO	KO
Leipoa ocellata	Malleefowl	V			*National Recovery Plan for Malleefowl (Benshemesh, 2007)*		-	-	LO
Melanodryas cucullata cucullata	South-eastern Hooded Robin	E			*National Recovery Plan for the South-Eastern Red-tailed Black-Cockatoo Calyptorhynchus banksii graptogyne (CoA, 2007)*		-	MO	MO
Pedionomus torquatus	Plains-wanderer	CE			*Conservation Advice Pedionomus torquatus plains-wanderer (TSSC, 2015j)* *National Recovery Plan for the Plains-wanderer (Pedionomus torquatus) (CoA, 2016)*		-	MO	LO
Pezoporus occidentalis	Night Parrot	E			*Conservation Advice Pezoporus occidentalis night parrot (TSSC, 2016i)*		-	-	MO
Platycercus caledonicus brownii	Green Rosella (King Island)	V			*Conservation Advice Platycercus caledonicus brownii green rosella (King Island) (TSSC, 2015m)*		-	-	KO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Pycnoptilus floccosus	Pilotbird	V			*Conservation Advice for Pycnoptilus floccosus (Pilotbird) (DAWE, 2022a)*		-	KO	KO
Stagonopleura guttata	Diamond Firetail	V			*Conservation Advice for Stagonopleura guttata (diamond firetail) (DCCEEW, 2023j)*		-	KO	KO
Strepera fuliginosa colei	Black Currawong (King Island)	V			*Conservation Advice Strepera fuliginosa colei black currawong (King Island) (TSSC, 2015n)*		-	-	BLO
Tyto novaehollandiae castanops (Tasmanian population)	Masked Owl (Tasmanian)	V			*Conservation Advice for Tyto novaehollandiae castanops (Tasmanian Masked Owl) (DEWHA, 2010b)*		-	-	KO

<u>*Threatened Species:*</u>
V *Vulnerable*
E *Endangered*
CE *Critically Endangered*
<u>*Migratory Species:*</u>
M *Marine*
W *Wetland*
T *Terrestrial*
<u>Biologically Important Area (Designation shown where relevant in each spatial extent column)</u>
✓ *BIA Present*
f *Foraging*
a *Aggregation*
b *Breeding*
m *Migration*

<u>*Type of Presence:*</u>
MO *Species of species habitat may occur within area*
LO *Species or species habitat likely to occur within area*
KO *Species or species habitat known to occur within area*
MLO *Migration route known to occur within area*
FMO *Foraging, feeding or related behaviour may occur within area*
FLO *Foraging, feeding or related behaviour likely to occur within area*
FKO *Foraging, feeding or related behaviour known to occur within area*
BLO *Breeding likely to occur within area*
BKO *Breeding known to occur within area*
RLO *Roosting likely to occur within area*
RKO *Roosting known to occur within area*

6.5.7.1 Seabirds

Albatross and Petrels

There are 14 species of albatross that may occur within the operational area, with an additional 2 that may occur within the monitoring EMBA. Of the 14 species with potential presence in the operational area, 7 have BIAs (identified by an asterisk in the list below). Of the 16 species with potential presence in the monitoring EMBA, 15 are listed as threatened or migratory under the EPBC Act and are known or likely to occur or have a BIA or habitat critical to their survival and are listed below. Those with BIAs are displayed in Figure 6-33 and Figure 6-40.

- Antipodean albatross – Foraging BIA*
- Wandering albatross – Foraging BIA*
- Buller's albatross – Foraging BIA*
- Indian yellow-nosed albatross – Foraging BIA*
- Shy albatross – Foraging BIA*
- Campbell albatross – Foraging BIA*
- Black-browed albatross – Foraging BIA*
- White-capped albatross – Foraging BIA
- Gibson's albatross
- Southern royal albatross
- Northern royal albatross
- Sooty albatross
- Northern Buller's albatross
- Chatham albatross
- Salvin's albatross.

Albatross species exhibit a broad range of diets and foraging behaviours; this combined with their ability to cover vast oceanic distances, means all waters within Australian jurisdiction can be considered foraging habitat for this species (DCCEEW, 2022e). However, the most critical foraging habitat is considered to be in waters south of 25°S where most species spend the majority of their foraging time (DCCEEW, 2022e). Therefore, albatross are likely to fly through and forage within the operational area and monitoring EMBA.

Albatross's typically feed offshore, mainly along the edge of the continental shelf and over open waters, where they catch fish and cephalopods (e.g. squid, cuttlefish) by diving into the water (DSEWPaC, 2012a).

No habitats critical to the survival of threatened albatross species occur within the operational area or monitoring EMBA, this includes known nesting sites or migrating sites.

The **Shy Albatross** is the only albatross endemic to Australia. The species breeds annually over an 8-month period between September and April on 3 islands located off the coast of Tasmania with Albatross Island located in the western Bass Strait, Mewstone and Pedra Branca located in the southern Bass Strait (ACAP, 2023). These islands are listed as Critical Habitat for the shy albatross, however, are all outside of the operational area and monitoring EMBA. Individuals can be found at the colonies year-round exhibiting high site fidelity (TSSC, 2020). Adult individuals predominantly occur in waters adjacent to Tasmanian and southern Australia, while juveniles range extends across the Indian Ocean to southern Africa and potentially the south-western Atlantic Ocean (TSSC, 2020). This species feeds by surface seizing, however they have been observed to dive for prey and can swim down to 7 m (ACAP, 2023).

Figure 6-32 Shy albatross with common dolphins observed from IMR vessel offshore Victoria in Gippsland region, 2023. Photo attributed to Claudia Hartmeier, Marine Fauna Observer.

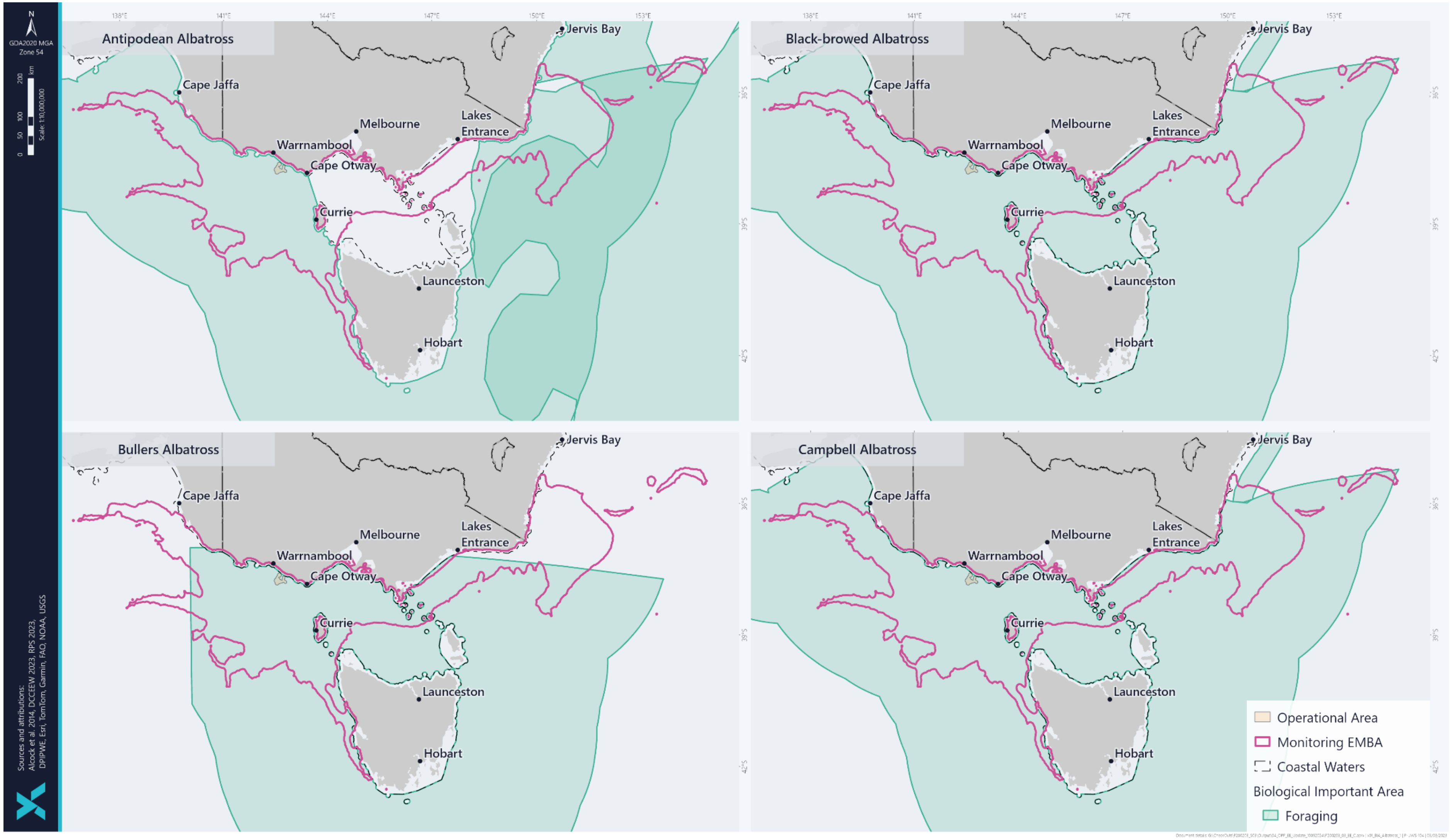


Figure 6-33: Albatross species with BIAs within the monitoring EMBA (1)

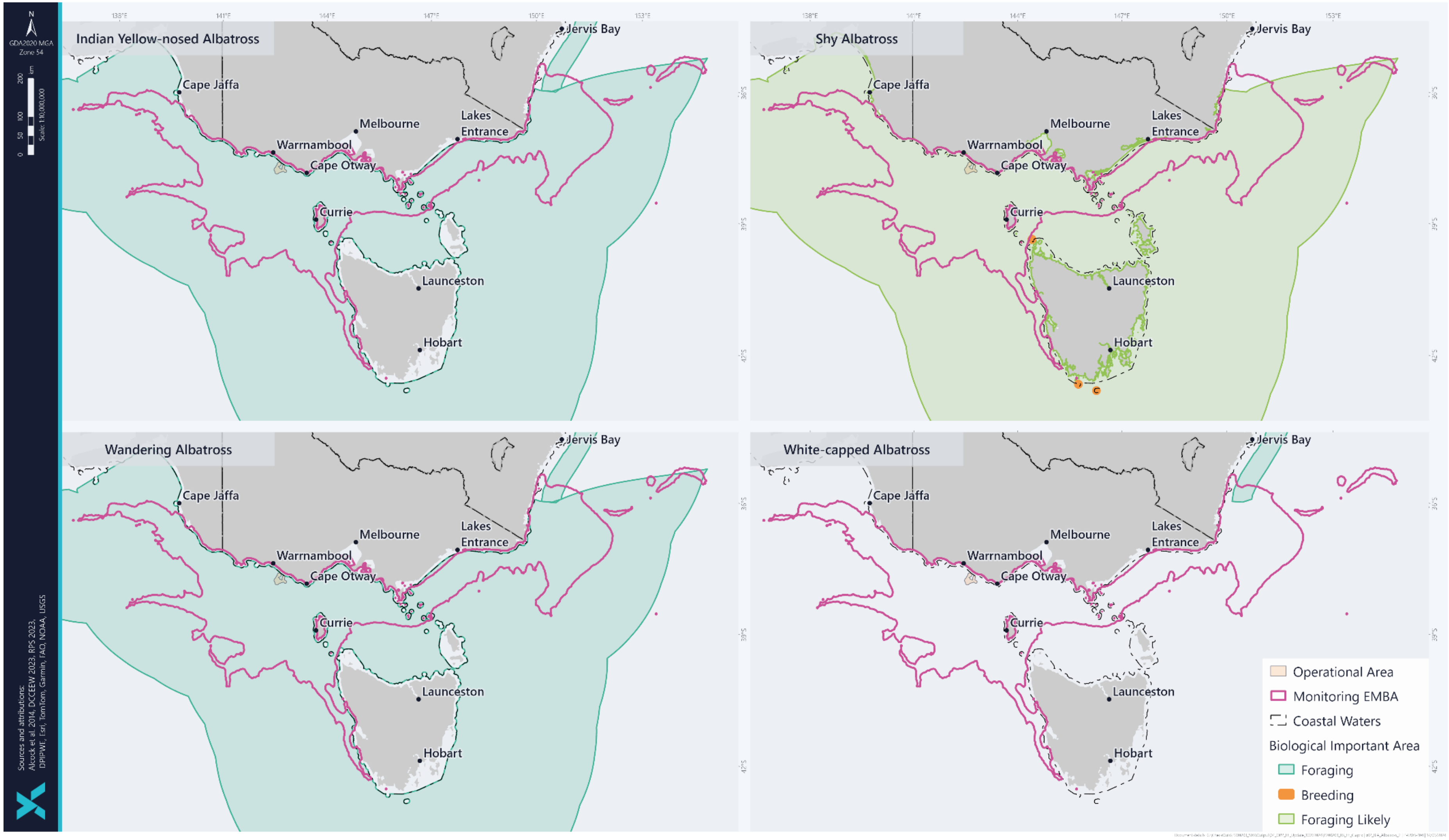


Figure 6-34: Albatross species with BIAs within the monitoring EMBA (2)

There are 5 species of petrel that may occur within the operational area, with an additional 9 that may occur within the monitoring EMBA. Of these species only one, the common-diving petrel, has a BIA which overlaps the operational area (identified by an asterisk in the list below). Of the 14 species with potential presence in the monitoring EMBA, 12 are listed as threatened or migratory under the EPBC Act and are known or likely to occur or have a BIA or habitat critical to their survival and are listed below. Those with BIAs are displayed in Figure 6-35 and Figure 6-36.

- Black petrel – Foraging BIA
- Northern giant petrel – Foraging BIA
- Southern giant petrel – Foraging BIA
- Great-winged petrel – Foraging BIA
- Common-diving petrel – Foraging* and Breeding BIA
- White-faced storm petrel – Foraging and Breeding BIA
- Soft-plumage petrel – Foraging
- Wilsons storm petrel – Migration BIA
- Kermadec petrel (western)
- Gould's petrel
- Blue petrel
- White-bellied storm-petrel (Tasman Sea).

Similar to albatrosses, the petrels have a diverse foraging range, and all waters within Australian jurisdiction can be considered foraging habitat for this species (DCCEEW, 2022e). Typical diet for petrels includes cephalopods (e.g. squid) and fish, and prey is predominately caught by surface-seizing (DSEWPaC, 2011a). Therefore, petrels are likely to overfly and may forage within the operational area and monitoring EMBA.

Petrels are considered to mainly be nocturnal at their breeding places making them susceptible to light emissions when they commute from their onshore colonies to the sea (Chevillion et al., 2022). One of the most critical phases in the life of petrels occurs during fledging (Rodriquez et al., 2017). Fledging is the juvenile's first flight from colony to sea which typically occurs within the first two hours after sunset during the fledging period (Gineste, 2016 cited in Chevillion et al., 2022). Survival rates during the first few weeks as a fledging are the lowest as there is no parental care and young petrels will need to learn how to fly, search and capture food, and maintain plumage alone (Menkhorst, 2010). This biologically sensitive period can be impacted by light and can cause fledgling grounding or fallout events, sometimes leading to mortality (Atchoi et al., 2024). Impacts to fledglings from light emissions are assessed in Section 8.3.4.5.

Neither the common-diving petrel or the white-faced storm petrel are listed as threatened species under the EPBC Act. These species have large populations within Australia, accounting for 5% and 25% respectively of the global population (CoA, 2015a). The common diving-petrel breeds on islands off south-east Australia and Tasmania; there are 30 sites with significant breeding colonies (defined as more than 1,000 breeding pairs) known in Tasmania, and 12 sites in Victoria (including Seal Island, Wilsons Promontory and Deen Maar) (CoA, 2015a). There are 15 sites with significant breeding colonies in Tasmania, and three sites with Victoria, for the white-faced storm petrel (CoA, 2015a).

No habitats critical to the survival of EBPC listed threatened petrel species occur within the operational area or monitoring EMBA, this includes known nesting sites or migrating sites.

The Wilson's storm petrel is one of the most abundant seabirds and has an extremely large range, however it is most often seen over the continental shelf (DoE, 2023). This species breeds in Antarctic waters and undergoes a trans-equatorial migration, where most individuals spend the non-breeding season in the north Atlantic and north Indian Oceans (CoA, 2020). During migrations individuals will typically stay far out at sea.

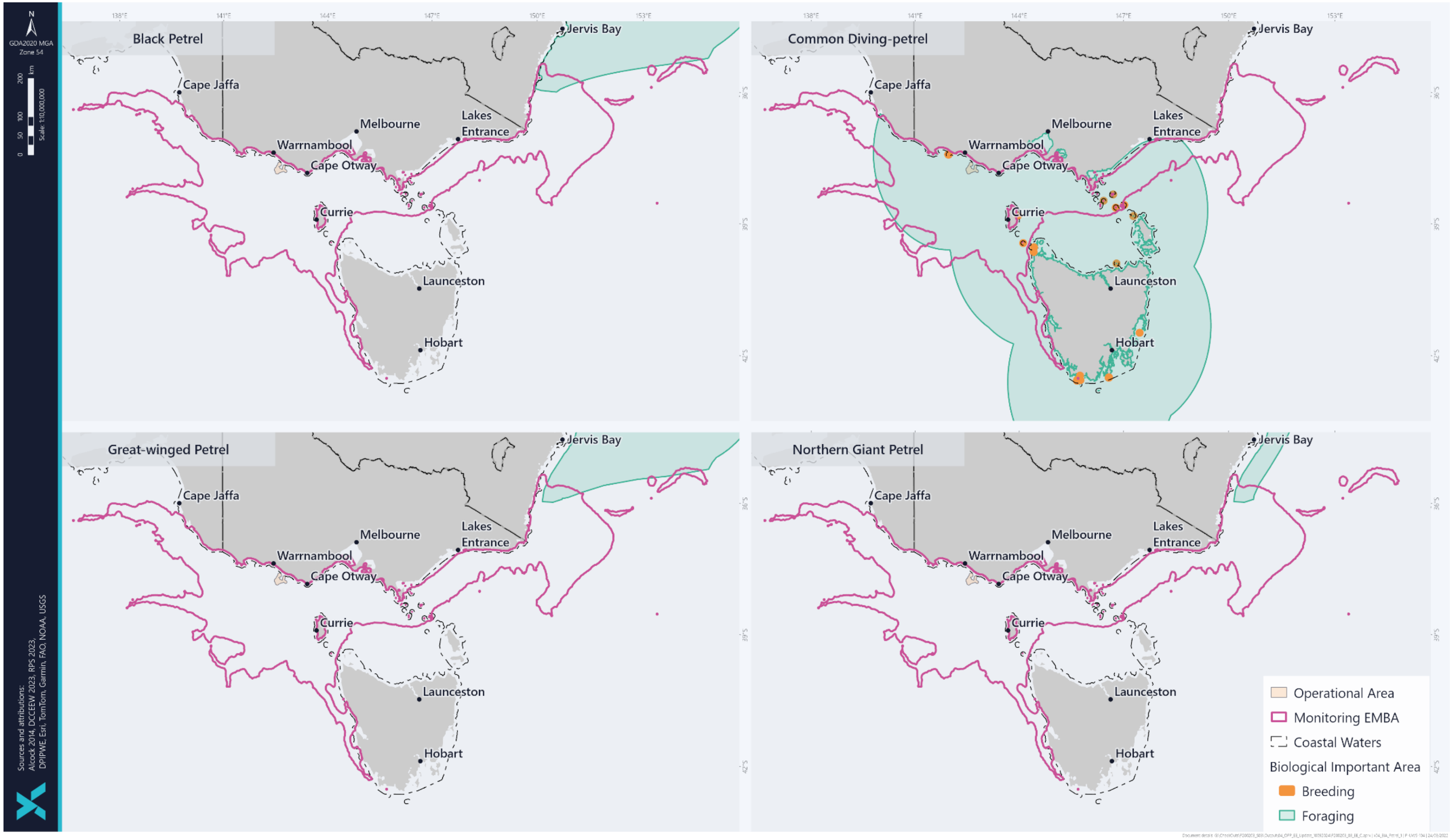


Figure 6-35: Petrel species with BIAs within the monitoring EMBA (1)

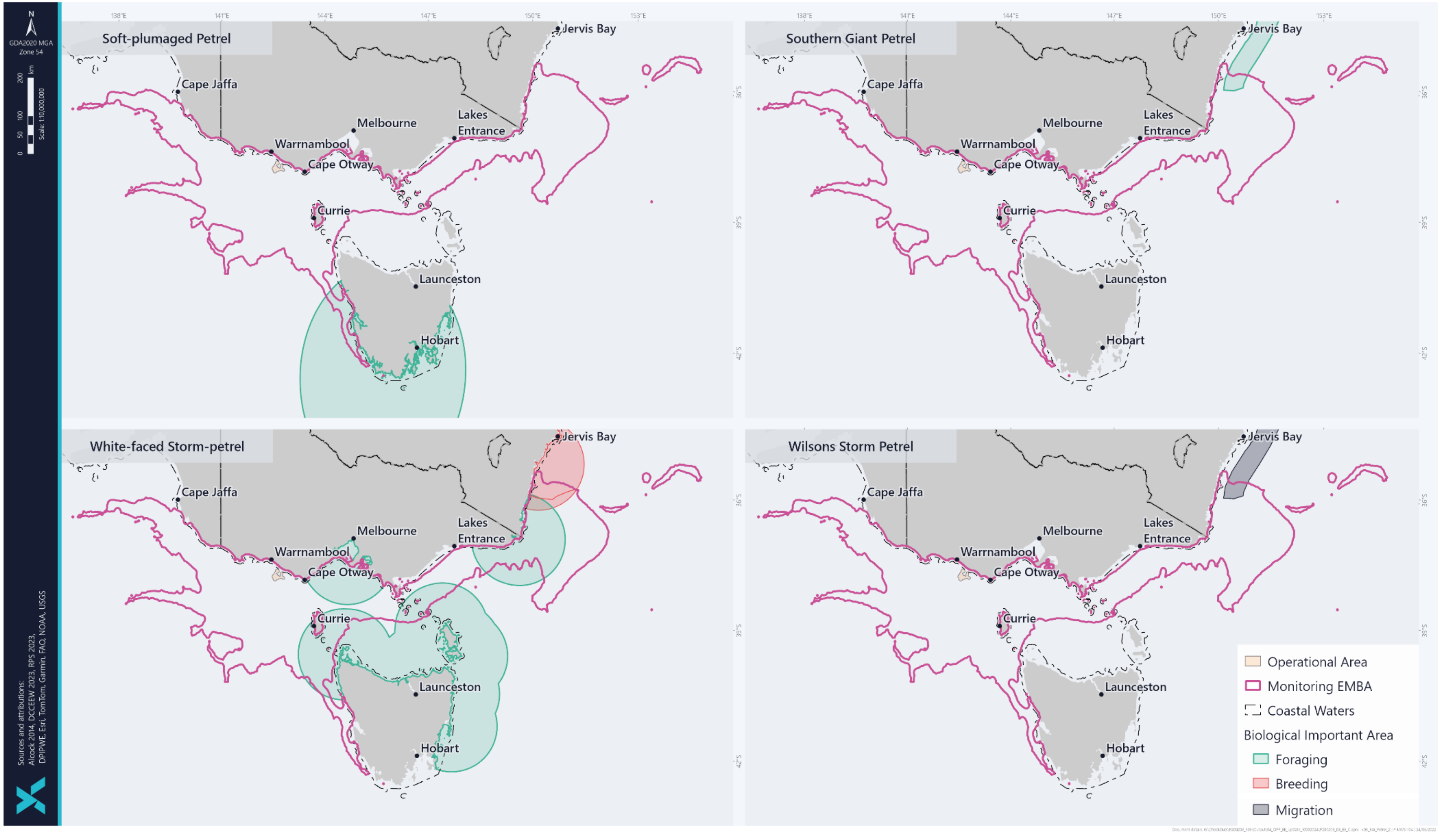


Figure 6-36: Petrel species BIAs within the monitoring EMBA (2)

Shearwaters

The shearwaters represent the most abundant seabird in Australia. There are 2 species of shearwater that may occur within the operational area, with an additional 2 that may occur within the monitoring EMBA. Of these species only one, the wedge-tail shearwater, has a BIA which overlaps the operational area (identified by an asterisk in the list below). Of the 4 species with a potential presence in the monitoring EMBA, , all have BIAs which are listed below and displayed in Figure 6-38.

- Flesh-footed shearwater – Foraging BIA
- Sooty shearwater – Foraging and Breeding BIA
- Wedge-tailed shearwater – Foraging* and Breeding BIA
- Short-tailed shearwater – Foraging and Breeding BIA.

Shearwaters are typically pelagic species, except during breeding seasons where they are found on remote islands or coastal headlands. The breeding season in eastern and south-eastern Australia for shearwaters is typically over summer; late-August/early-September to May (DoE, 2023). Shearwater nests are usually in burrows or rock crevices. Known breeding locations for Shearwater species within the monitoring EMBA include:

- Northern-central Bass Strait (e.g. Phillip island)
- Western Victoria (e.g., Griffiths Island, Deen Maar)
- New South Wales oceanic islands (e.g., Montagu Island)
- Tasmanian oceanic islands (e.g., Kent Group Islands, Hogan Group Islands).

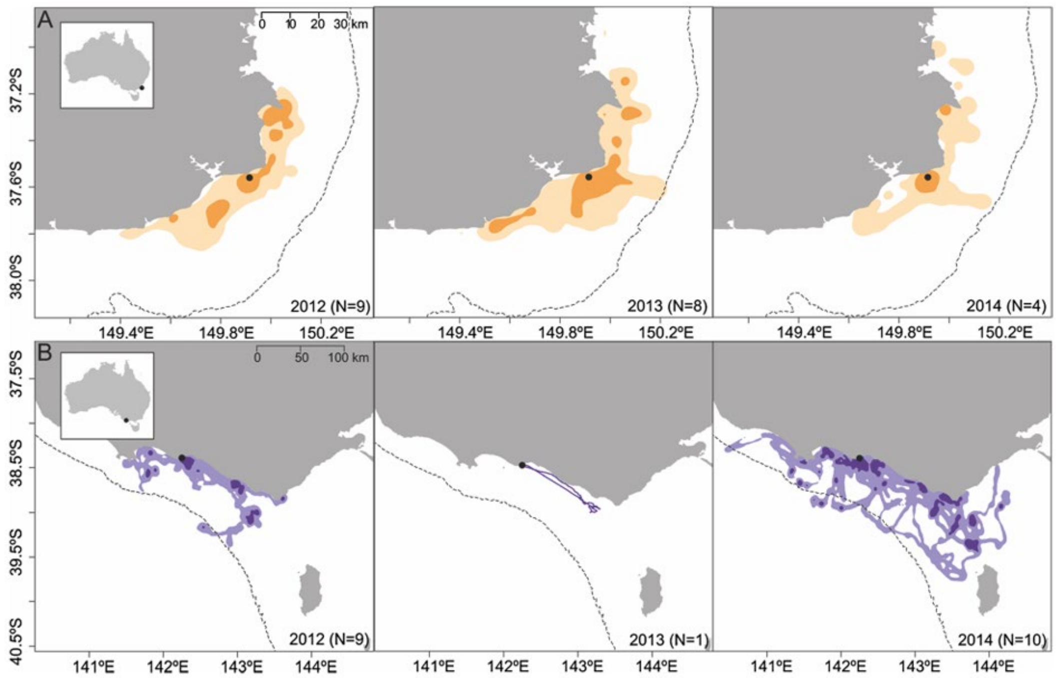
Similar to petrels, shearwaters are considered to mainly be nocturnal at their breeding places making them highly sensitive when they commute from their colonies to the sea (Chevillion et al., 2022). The fledgling phase for shearwaters is also considered a critical phase (Rodriquez et al., 2017). The fledging season may vary between species; however it is known to occur over a short period of time and the first flight typically occurs within the first two hours after sunset (Gineste, 2016 cited in Chevillion et al., 2022). For example, the wedge-tailed shearwater has a very synchronized breeding regime with all fledglings leaving nests within a very short period of time (less than one lunar cycle) (Chevillion et al. 2022). Further, it is widely accepted that the fledging period of the short-tailed shearwater occurs between the third week of April and the first week of May each year (Skira, 1991; Rodriguez et al., 2014; Price, 2022). Known breeding locations located in the vicinity of the operational area include Griffiths Island and Deen Maar ~58.8 km and ~41.5 km, respectively, at the closest points. This biologically sensitive period can be impacted by light which can cause fledgling grounding or fallout events, sometimes leading to mortality (Atchoi et al., 2024). This issue has been recorded within shearwater populations of Phillip Island, where lights from urbanised areas and traffic nearby breeding colonies (<10 km away) been associated with groundings and road mortality (birds being struck by cars) (Rodriguez et al., 2014) Victoria's Phillip Island, which is 195 km northeast of the operational area is home to the world's largest colonies of migratory short-tailed shearwaters, with more than 6% of the global population supported at this nesting site (DCCEEW, 2023k). Impacts to fledglings from light emissions are assessed in Section 8.3.4.5

Shearwaters are known to forage for a variety of pelagic prey, including krill, cephalopods, fish and crustaceans. Food is usually taken by pursuit-plunging, surface plunging or surface-seizing; however other methods (e.g., hydroplaning, deep plunging) may be used. South-eastern Australia is characterised by contrasting oceanic conditions which can influence the foraging decisions of breeding short-tailed shearwaters. During the chick-rearing period, many shearwater species use a dual foraging strategy, generally involving short trips close to the breeding grounds and longer trips extending to highly productive areas, such as the Southern Ocean (Berlincourt and Arnould., 2015). The short-tailed shearwater has been observed foraging at Griffith Island in inshore habitat and over the continental shelf edge (20-240 km from the colony) (Figure 6-37) (Berlincourt and Arnould., 2015). A similar strategy was found by Raymond et al., 2010 who noted that breeding adult sooty and short-tailed shearwaters typically forage locally to the colony to provide for their chicks, but periodically undertake long foraging trips to Antarctic waters. This strategy is used to efficiently maintain parental body reserves while provisioning young, however, during years with lower food availability, it is likely that short-tailed shearwaters will extend out their foraging ranges to find profitable prey (Berlincourt and Arnould., 2015). Therefore, considering the proximity of known shearwater breeding islands it is considered that they would be likely to overfly and forage within the operational area and monitoring EMBA.

The timing of the incubation phase for shearwaters occurs between 21-24 November (±8 days) (Beaver., 2022). The arrival through to the incubation phase for wedge-tailed shearwaters use areas close to the colony using habitat south of Montague Island into the western edge of Bass Strait (Beaver., 2022). During the chick-rearing phase, occurring from 10-13 January (± 10 days), shearwaters are known to use areas further south past Bass Strait into south-east of Tasmania (Beaver., 2022).

The Short-tailed Shearwater is one of few native birds that is still commercially harvested to this day. Short-tailed shearwaters, or "Muttonbird" are harvested annually in Tasmania under the regulation of the Tasmanian government (CoA, 2020). Harvesting muttonbirds is a traditional activity that Tasmanian Aboriginal peoples have participated in for thousands of years. There are 3 separately managed harvests that occur in Tasmania:

- Indigenous commercial harvest - occurs on 3 islands in the Bass Strait (Trefoil Island, Great Dog (or Big Dog) Island and Babel Island). This harvest is licensed by the Tasmanian Government but entirely self-managed with no set quotas, just a restricted season duration.
- Indigenous cultural harvest – undertaken under permit on a couple of small sites including South Arm and Cape Queen Elizabeth on Bruny Island. The Tasmanian Government monitors the South Arm colony, the number of harvesters is restricted, and daily bag limits apply. There is also a small unreported cultural harvest on indigenous-owned islands.
- Recreational harvest – undertaken under licence between 38 and 44 of Tasmania's known 209 colonies and is open to anyone eligible for purchasing a recreational licence. Harvest areas include the Bass Strait Island of King Island, Hunter Island Group and the Furneaux Island Group. The season generally runs for 16 days with a daily bag limit of 25 birds (15 on the west coast) (CoA, 2020).



Source: (Berlincourt and Arnould., 2015)

Figure 6-37: Distribution of short-tailed shearwater foraging in the Bass Strait from (a) Gabo Island and (b) Griffith island breeding colonies . Darker shaded colours represent the core foraging area while light colours represent the home range.

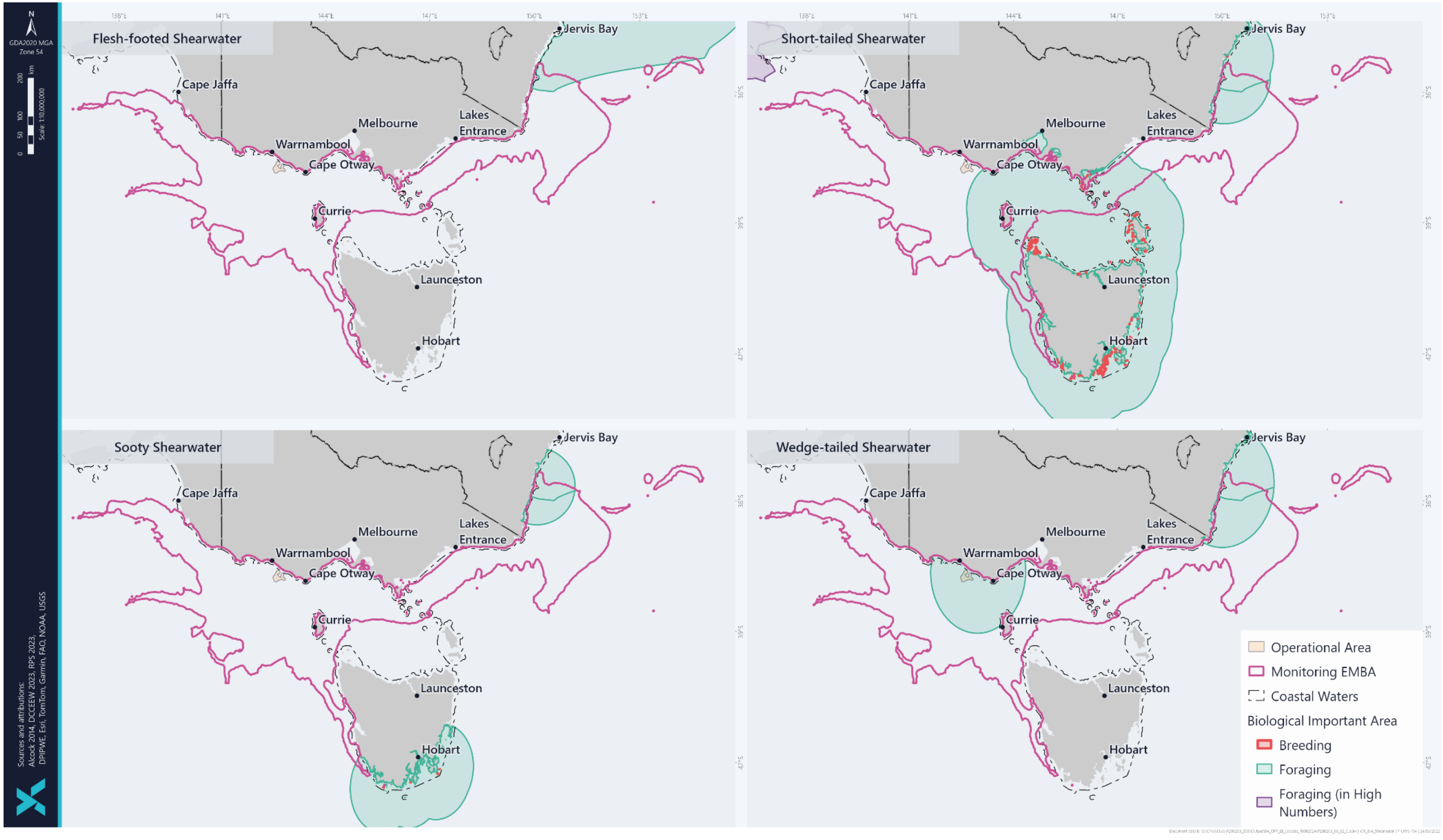


Figure 6-38: Shearwater species with BIAs within the monitoring EMBA

Terns

There is one species of tern that may occur within the operational area, with an additional 7 that may occur within the monitoring EMBA. None of these species have known BIAs that overlap with the operational area. Of the 7 species with potential presence in the monitoring EMBA, 4 are listed as threatened or migratory under the EPBC Act and are known or likely to occur or have either a BIA or habitat critical to their survival and are listed below. Those with BIAs are displayed in Figure 6-40.

- Greater crested tern – Foraging and Breeding BIA
- Little tern
- Caspian tern
- Australian fairy tern.

Many tern species are widespread and occupy beach, wetland, grassland and beach habitats. Terns rarely swim; they hunt for prey in flight, dipping to the water surface or plunge-diving for prey (Flegg, 2002) usually within sight of land, for fish, squid, jellyfish and sometimes crustaceans (DEWHA, 2007).

Terns breed in colonies on small offshore islands, including those of the Furneaux Group in the eastern Bass Strait, and the Lord Howe Island group. Nests are in the open in sand or coral scrapes or among low vegetation (DoE, 2023). The greater crested tern is not listed as threatened species under the EPBC Act; however, it is listed as migratory. During the breeding season this species can be found on islands and coastlines of tropical and subtropical areas, including Australia, where it breeds in dense colonies or in small groups. Outside of the breeding season it can be found at sea throughout this range (CoA, 2020).

Therefore, species of tern are likely to overfly and may forage within the operational area and monitoring EMBA.

Figure 6-39 Crested tern observed on back deck of IMR vessel, offshore Victoria, Gippsland region in 2023. Photo attributed to Claudia Hartmeier, Marine Fauna Observer.

Australasian Gannet

The Australasian gannet is confined to the temperate waters around Australia and New Zealand. Their diet is comprised mainly of pelagic fish, but also squid and garfish. Prey is caught mainly by plunge-diving, but it is also seen regularly attending trawlers (CoA, 2020). Foraging generally occurs over the continental shelf or inshore waters. The Australasian gannets breeding is highly seasonal (October–May), nesting on the ground in small but dense colonies (CoA, 2020). Breeding colonies occur off the coast of Victoria, Tasmania and New Zealand and include Black Pyramid Rock (Tasmania) and Lawrence Rocks (Victoria) (CoA, 2020). Foraging and aggregation BIAs for the Australasian gannet have been identified within the monitoring EMBA (Figure 6-40). Therefore, considering the proximity of known Australasian gannet breeding sites it is considered that they would be likely to overfly and forage within the operational area and monitoring EMBA.

Little Penguin

The little penguin is the smallest species of penguin in the world and are endemic, permanent residents on several inshore and offshore Australian and New Zealand islands (CoA, 2020). Bass Strait has the largest proportion (~60%) of the known breeding colonies in Australia; however, breeding populations are also found on the NSW coast. Individuals exhibit strong site fidelity, returning to the same breeding colony each year to breed in the winter and spring months (Gillanders et al., 2013). The little penguin is a generalist feeder, with large variability in diet amongst colonies (CoA, 2020). Prey may include small school fish, squid and krill. Prey is typically caught with rapid jabs of the beak and swallowed whole. Foraging and breeding BIAs for the little penguin have been identified within the monitoring EMBA (Figure 6-40). Therefore, considering the high occurrence of breeding sites within the region it is considered that the little penguin is likely to transit and forage within the operational area and monitoring EMBA.

Black-faced Cormorant

The black-faced cormorant is endemic to southern Australia (CoA, 2020); and is primarily found along the rocky coasts of Tasmania and Victoria. The species feeds in coastal waters on a variety of fish, typically catching prey by pursuit-diving. Breeding usually occurs on rocky islands, but also on stacks, slopes and sea cliffs in colonies of up to 2,500 individuals (CoA, 2020). Foraging and breeding BIAs for the black-faced cormorant have been identified within the monitoring EMBA (Figure 6-40). Therefore, considering the proximity of potential breeding grounds it is considered that the black-faced cormorant would be likely to overfly and forage within the operational area and monitoring EMBA.

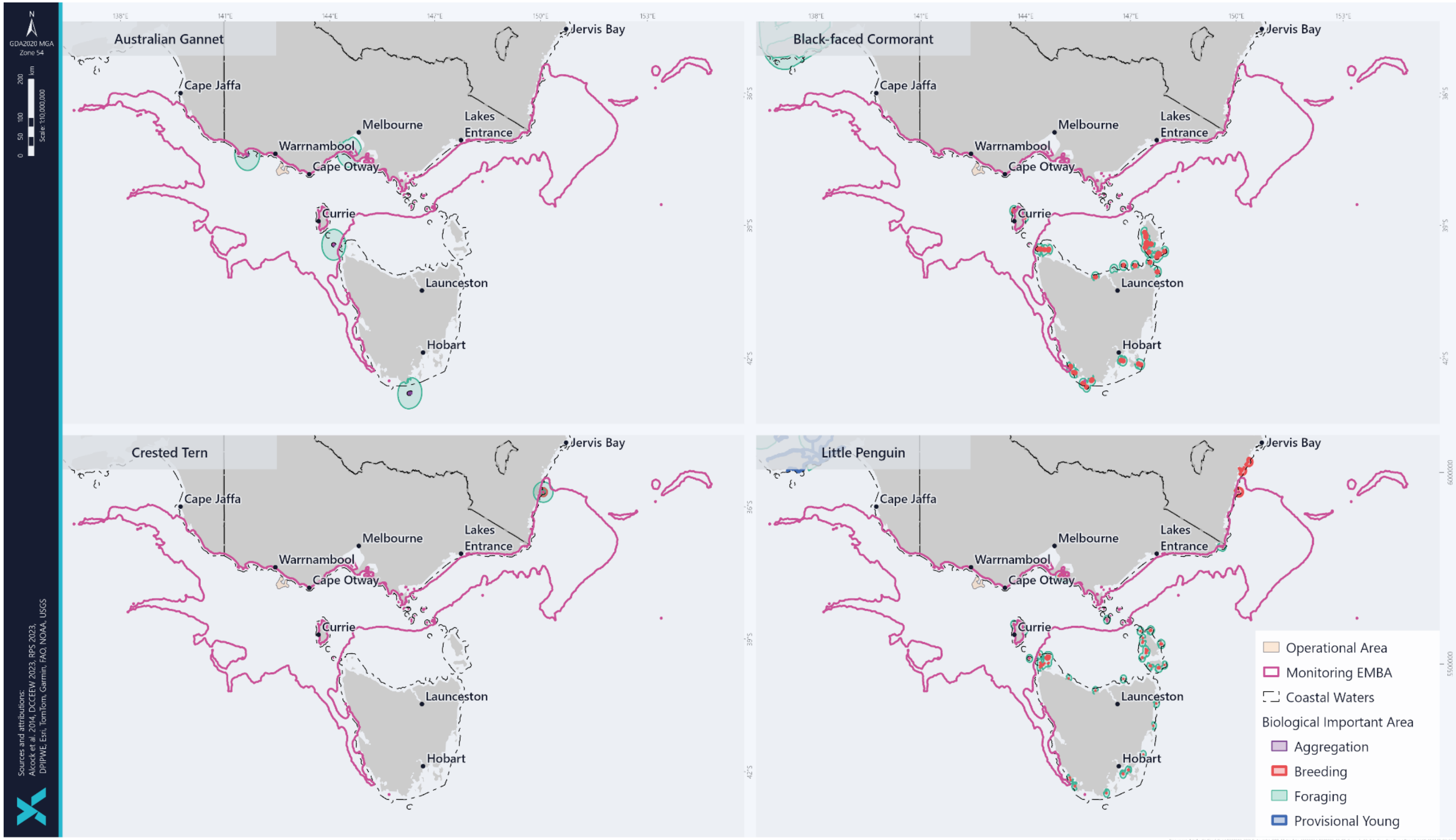


Figure 6-40: Gannet, Tern, Cormorant and Little Penguin BIAs within the monitoring EMBA

Fork-tailed Swift

The fork-tailed swift is a non-breeding visitor to Australia and occurs across all states and territories. The species primarily inhabits aerial environments but may be found in coastal areas, foothills and urban centres (DoE, 2024). The fork-tailed swift forages almost exclusively in the air, using aerial hunting techniques, flying between 1 to 300 m above the ground feeding on insects. The species migrate across long distances, departing from Siberia in August or September, passing through many countries before arriving in Australia in October (DoE, 2024). Within Australia, they move around a lot, within large flocks following low-pressure systems. They depart from Southern Australia from mid-April and return to their breeding grounds in May. The fork-tailed swift has a large habitat range, occurring from inland plains, foothills, coastal areas, cliffs, beaches, islands, and sometimes well out into the ocean (DoE, 2024). No biologically important behaviours or areas were identified within the operational area or monitoring EMBA, however, opportunistic foraging may occur.

Common Noddy

The common noddy is found mainly off the coast of Queensland and occasionally off the north-west and central WA coast, they have also been recorded on Norfolk, Lord Howe, Christmas, and Cocos-Keeling Islands (DoE, 2024). During breeding season, this species nests on islands, rocky islets, coral or sand shoals, or cliffs and forages in the surrounding waters. Breeding colonies are recorded on around 50 Australian islands, ranging from a few pairs to over 100,000 pairs. This species feed during the day foraging mainly on fish, but may also consume squid, molluscs, aquatic insects, and fruit. The common noddy is considered to forage further from the shore than other similar species (DoE, 2024). Migrating patterns of this species are unclear, but they are likely migratory, considering breeding islands are mostly or totally abandoned outside of breeding season (DoE, 2024). No biologically important behaviours or areas were identified to overlap the operational area or monitoring EMBA, however, opportunistic foraging may occur.

Fairy Prion (southern)

The fairy prion (southern) breeds on Macquarie Island and other subantarctic islands outside of Australia (NRE Tas, 2024). The species has a breeding population of 50 to 250 breeding pairs in Australia and the subantarctic islands. This species will dig burrows among the rocks or low vegetation for nesting. Their foraging activities involve plucking food from the ocean surface, usually feeding off small fish or krill. Some individuals have been recorded to migrate towards New Zealand and Southern Australia (DoE, 2024). No biologically important behaviours or areas were identified to overlap the operational area or monitoring EMBA, however, opportunistic foraging may occur.

6.5.7.2 Shorebirds

The group of birds generally referred to as waders, or shorebirds, fall under the Charadriiforms order which contains 15 families and subfamilies including plovers (Charadriidae) and sandpipers (Scolopacidae).

These birds typically inhabit shorelines, estuarine mudflats or marshes and are characterized by long legs and bills suited to feeding on invertebrates in soft sediments or shallow water (Tully et al., 2009). Many taxa are considered ground nesters, and may nest on rocky shorelines, or in uplands or polar tundra. Further, many species within these families migrate long distances between summer nesting sites and winter-feeding grounds (Tully et al., 2009).

Species that are listed as threatened or migratory under the EPBC Act and are known or likely to occur or have either a BIA, or habitat critical to their survival within the monitoring EMBA and are listed under their respective families below.

Charadriidae

Six species within the Charadriidae family are listed as threatened or migratory under the EPBC Act and are known or likely to occur or have either a BIA, or habitat critical to their survival within the monitoring EMBA. Species include the grey plover, greater sand plover, lesser sand plover, double-banded plover, Pacific golden plover and the eastern hooded plover. No known BIAs occur within the monitoring EMBA.

Scolopacidae

Twenty-nine species within the Charadriidae family are listed as threatened or migratory under the EPBC Act and are known or likely to occur or have either a BIA or habitat critical to their survival within the monitoring EMBA. Species include the terek sandpiper, wood sandpiper, broad-billed sandpiper, pectoral sandpiper, curlew sandpiper, sharp-tailed sandpiper, common sandpiper, marsh sandpiper, long-toed stint, red-necked stint, long-toed stint, black-tailed godwit, bar-tailed godwit, Nunivak bar-tailed godwit, Australian painted snipe, Latham's snipe, Swinhoe's snipe, pin-tailed snipe, wandering tattler, grey-tailed tattler, red knot, great knot, ruff (reeve), red-necked phalarope, ruddy turnstone, sanderling, common greenshank, little curlew, whimbrel. No known BIAs occur within the monitoring EMBA.

The curlew sandpiper is an EPBC listed critically endangered species that is a non-breeding visitor to Australia. The breeding range of this species is restricted to the Russian Arctic where it nests in June and July each year (TSSC, 2015a). Once the breeding season comes to an end individuals will make the migration to the southern hemisphere, including Australia. Individuals begin to reach the northern shores of Australia in late August and early September where they are resident until mid-January when the earliest departures back to breeding grounds will take place (TSSC, 2015a). In Australia the curlew sandpiper will occupy intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast. Individuals will forage within these habitats where they prey on invertebrates, including worms, molluscs, crustaceans and insects (TSSC, 2015a).

6.5.7.3 Parrots

There are 4 species of Parrots that may occur within the monitoring EMBA. Of those, 3 species are listed as threatened or migratory under the EPBC Act and are known or likely to occur or have a BIA or habitat critical to their survival within the monitoring EMBA and are listed below. No species of Parrot have known BIAs within the monitoring EMBA.

- Orange-bellied parrot
- Blue winged parrot
- Swift parrot.

Parrots are very social birds that are characterized by their strong, hooked bills, zygodactyl feet (two toes facing forward and two backward) and vibrant plumage. In, Australia parrots have adapted to diverse ecosystems, thriving in environments which range from arid landscapes to lush rainforests.

Although the orange-bellied parrot and swift parrot do not have defined BIAs within the monitoring EMBA both species participate in yearly migrations over the Bass Strait to mainland Australia for winter. Both species are EPBC listed critically endangered species that strictly breed in Tasmania over summer. Further details on the lifecycle characteristic of each species are provided below.

- The breeding range of the swift parrot is largely restricted to the east and south-east coast of Tasmania and closely mirrors the distribution of blue gum tree (TSSC, 2016d). Individuals will begin to make the migration over to mainland Australia in autumn where they will spend in the non-breeding season. Primary habitat is dry forests and woodlands of the box-ironbark region on the inland slopes of the Great Dividing Range in Victoria. The species can also be found in NSW where they occupy forests and woodlands throughout the coastal and western slopes regions (TSSC, 2016d).
- The breeding range of the orange-bellied parrot is restricted to the south-west of Tasmania, within 10 km of the Melaleuca Lagoon. Breeding habitat is characterised by a mosaic of Eucalypt forest, rainforest and fire dependent moorland and sedgeland plains, in the Tasmanian Wilderness World Heritage Area (DEWLP, 2016). This species is endemic to south-eastern Australia and migrates from breeding grounds in

Melaleuca to mainland Australia in April each year (DELWP, 2016). The migration route follows the west coast of Tasmania, with some individuals known to stop on King Island during the northward migration in autumn. Over winter individuals can be found along the coast of South Australia and Victoria where they are found in locations associated with coastal saltmarshes and adjacent pastures, close to free-standing water bodies (DELWP, 2016). The migration back to breeding grounds begins in late September and appears to be more rapid with no stopovers on King Island (NRE Tas, 2023).

- The wild population of the orange-bellied parrot got as low as 35 individuals in 2010 (NRE Tas, 2023) and is one of the most threatened birds in Australia.
- Most recent census data has shown an increase in the wild population. 2023 census data resulted in a recorded number of individuals to return from the southern migration in 15 years. It is estimate that a total of 139 individuals would have migrated north from the breeding grounds at the end of the 2022/23 breeding season of which 81 returned for the 2023/24 breeding season resulting in a 58% return rate (DPC 2023).

Distribution and migration routes of the orange-bellied parrot overlapped by the monitoring EMBA are displayed in Figure 6-41.

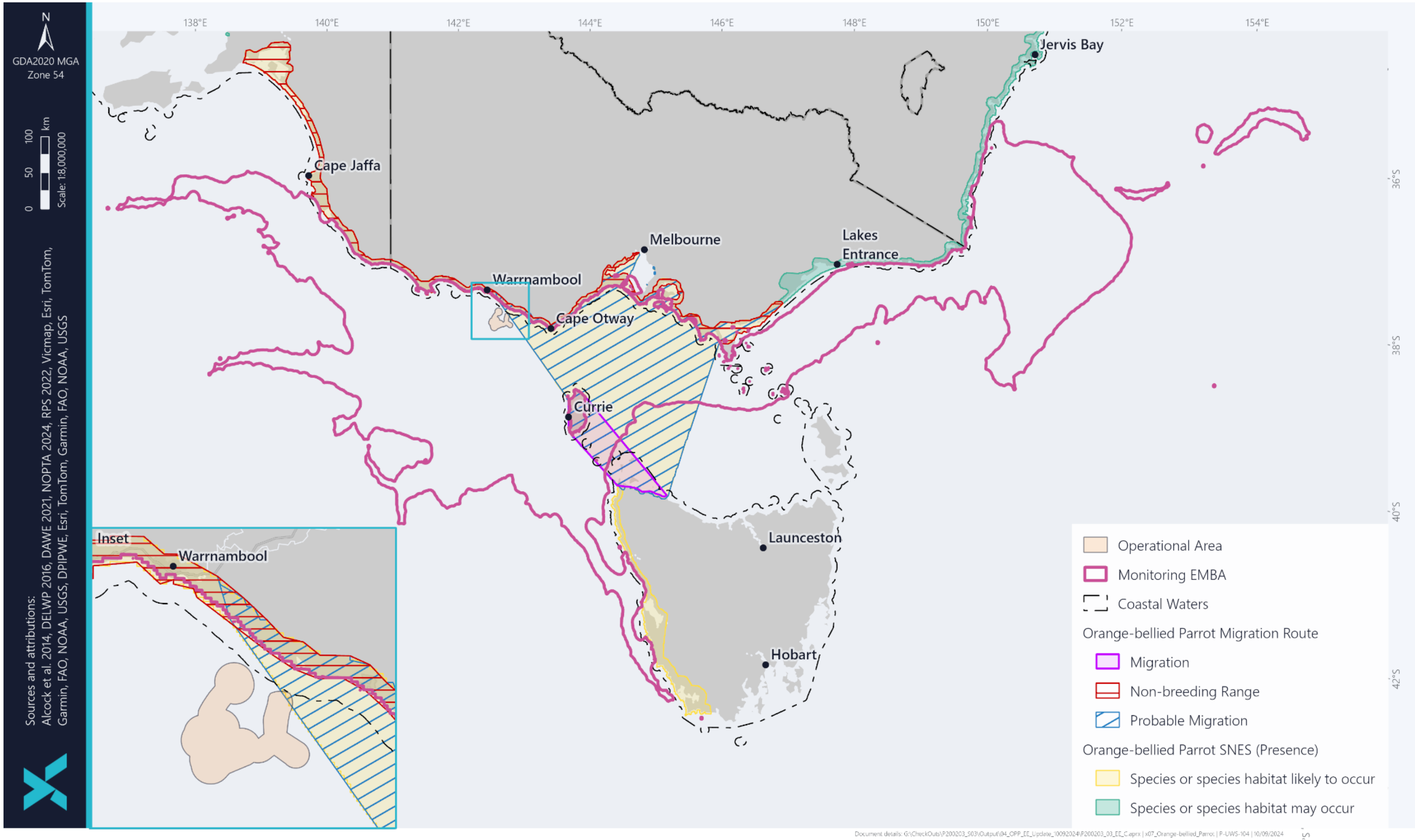


Figure 6-41: Distribution and migration routes of the Orange-bellied Parrot and overlap with the monitoring EMBA

6.5.7.4 Other Bird Species

Other birds listed as threatened or migratory under the EPBC Act that are known or likely to occur or have habitat within the monitoring EMBA are discussed below. These species are listed migratory (terrestrial) and predominately belong to the order Passeriformes, known as perching birds. None of these species have known BIAs within the monitoring EMBA.

The spectacled and black-faced monarch, rufous fantail and the satin flycatcher are typically found in rainforests, eucalypt woodlands and coastal scrub (such as mangroves), along the coast of eastern Australia and south-east Asia. In Australia, these species migrate between resident grounds in northern Australian to summer breeding grounds along the south-eastern coast of Australia (Evans, 2022; Southey, 2013; Birdlife Australia, 2017). Diets of these species are typically composed of insects which they forage for in the air or among the foliage.

The oriental cuckoo, white-throated needletail and the yellow and grey wagtails are non-breeding visitors to Australia. These species migrate between summer breeding grounds in the northern hemisphere and winter grounds in the southern hemisphere (DCCEEW, 2010). The yellow and grey wagtails are more commonly found in northern Australia during the winter season and considered a vagrant to south-eastern Australia. While the white-throated needletail is most commonly spread across eastern and south-eastern Australia. Species are found among a range of habitats like wooded forested areas, wetlands and marshes. The yellow and grey wagtails in particular have a strong association with water and may occur on tidal mudflats or along the edges of mangroves (DCCEEW, 2010).

6.5.8 Marine Mammals

PMST reports were generated for the operational area, ecological EMBA and monitoring EMBA to identify EPBC listed marine mammal species (or species habitat) that may occur within the EMBA (Appendix 1). Table 6-9 identifies the presence and protection status of all marine mammal species for each EMBA. There are 37 EPBC listed marine mammal species (or species habitat) that may occur within the monitoring EMBA. Of these, 17 occur within the operational area.

For the purpose of the OPP, species listed as threatened or migratory under the EPBC Act which are known or likely to occur or have either a BIA or habitat critical to the survival, within the monitoring EMBA are discussed further below.

BIAs were identified for 4 species of marine mammals (Australian sea-lion, pygmy blue whale, southern right whale, humpback whale) within the monitoring EMBA as displayed in Figure 6-44, Figure 6-47, Figure 6-51, Figure 6-52 and Figure 6-53. There is no habitat critical to the survival of marine mammal species defined within the East Coast Project operational area. One species, the southern right whale, has habitat critical to the survival of the species defined under the National Recovery Plan for the Southern Right Whale (DCCEEW, 2024l) adjacent to the operational area, and within the monitoring EMBA. Within the Plan, all reproductive BIAs across the species range are proposed as habitat critical to the survival of the species. In 2024, DCCEEW updated the BIA boundaries to define a reproductive BIA across the entire coastline of Victoria including embayments and major ports, as well as much of the coastline across the other south-eastern states (DCCEEW, 2024) (Figure 6-47).

Table 6-9: Marine mammal species or habitats which may occur within the operational area and ecological and monitoring EMBA

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Pinnipeds									
Arctocephalus forsteri	New Zealand Fur-seal			✓			MO	MO	BKO
Arctocephalus pusillus	Australian Fur-seal			✓			MO	BKO	BKO
Mirounga leonina	Southern Elephant Seal	V		✓	*Conservation Advice Mirounga leonina southern elephant seal (TSSC, 2016f)* *Sub-Antarctic Fur-seal and Southern Elephant Seal Recovery Plan (DEH, 2003)*		-	-	BMO
Neophoca cinerea	Australian Sea-lion	E		✓	*Recovery Plan for the Australian Sea Lion (Neophoca cinereal) (CoA, 2013a)* *Conservation Advice for the Neophoca cinerea (Australian sea lion) (TSSC, 2020c)*	*	MO	MO	KO*f
Whale and other cetaceans									
Balaenoptera acutorostrata	Minke Whale						MO	MO	MO
Balaenoptera bonaerensis	Antarctic Minke Whale		✓				-	LO	LO
Balaenoptera borealis	Sei Whale	V	✓		*Conservation Advice for Balaenoptera borealis (Sei Whale) (TSSC, 2015e)*		FLO	FKO	FKO
Balaenoptera edeni	Bryde's Whale		✓				-	MO	LO
Balaenoptera musculus	Blue Whale	E	✓		*Conservation Management Plan for the Blue Whale, 2015-2025 (DoE, 2015a)*	*	FKO*f, d	FKO*f, d	FKO*f, d
Balaenoptera physalus	Fin Whale	V	✓		*Conservation Advice for Balaenoptera physalus (Fin Whale) (TSSC, 2015f)*		FLO	FKO	FKO
Berardius arnuxii	Arnoux's Beaked Whale						-	MO	MO
Caperea marginata	Pygmy Right Whale		✓				FMO	FLO	FLO
Eubalaena australis	Southern Right Whale	E	✓		*National Recovery Plan for the Southern Right Wale Eubalaena australis (DCCEEW, 2024l)*	*	BKO*m	BKO*m, r	BKO*m, r
Globicephala macrorhynchus	Short-finned Pilot Whale						-	MO	MO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Globicephala melas	Long-finned Pilot Whale						-	MO	MO
Grampus griseus	Risso's Dolphin						MO	MO	MO
Hyperoodon planifrons	Southern Bottlenose Whale						-	-	MO
Kogia breviceps	Pygmy Sperm Whale						-	MO	MO
Kogia sima	Dwarf Sperm Whale						-	MO	MO
Lagenorhynchus obscurus	Dusky Dolphin		✓				MO	LO	LO
Lissodelphis peronii	Southern Right Whale Dolphin						-	MO	MO
Megaptera novaeangliae	Humpback Whale		✓		*Listing Advice for Megaptera novaeangliae (Humpback Whale) (TSSC, 2022)*	*	LO	KO	FKO*f
Mesoplodon bowdoini	Andrew's Beaked Whale						-	MO	MO
Mesoplodon densirostris	Blainville's Beaked Whale						-	MO	MO
Mesoplodon ginkgodens	Gingko-toothed Beaked Whale						-	-	MO
Mesoplodon grayi	Gray's Beaked Whale						-	MO	MO
Mesoplodon hectori	Hector's Beaked Whale						-	MO	MO
Mesoplodon layardii	Strap-toothed Beaked Whale						-	MO	MO
Mesoplodon mirus	True's Beaked Whale						-	MO	MO
Delphinus delphis	Common Dolphin						MO	MO	MO
Orcinus orca	Killer Whale		✓				LO	LO	LO
Physeter macrocephalus	Sperm Whale		✓				-	MO	FKO
Pseudorca crassidens	False Killer Whale						LO	LO	LO
Tasmacetus shepherdi	Shepherd's Beaked Whale						-	-	MO

Scientific Name	Common Name	Threatened Species	Migratory Species	Listed Marine Species	Conservation/ Recovery Plan	BIA	Operational area	Ecological EMBA	Monitoring EMBA
Tursiops aduncus	Indian Ocean Bottlenose Dolphin					*	LO	LO	LO*b
Tursiops truncatus s. str.	Bottlenose Dolphin						MO	MO	MO
Ziphius cavirostris	Cuvier's Beaked Whale						-	MO	MO

Threatened Species:
V *Vulnerable*
E *Endangered*
Biologically Important Area (Designation shown where relevant in each spatial extent column)
* *BIA Present*
f *Foraging*
d *Distribution*
b *Breeding*
r *Reproduction*
m *Migration*

Type of Presence:
MO *Species of species habitat may occur within area*
LO *Species or species habitat likely to occur within area*
KO *Species of species habitat known to occur within area*
FLO *Foraging, feeding or related behaviour likely to occur within area*
FKO *Foraging, feeding or related behaviour known to occur within area*
BMO *Breeding may occur within area*
BKO *Breeding known to occur within area*

6.5.8.1 Cetaceans

Blue Whale

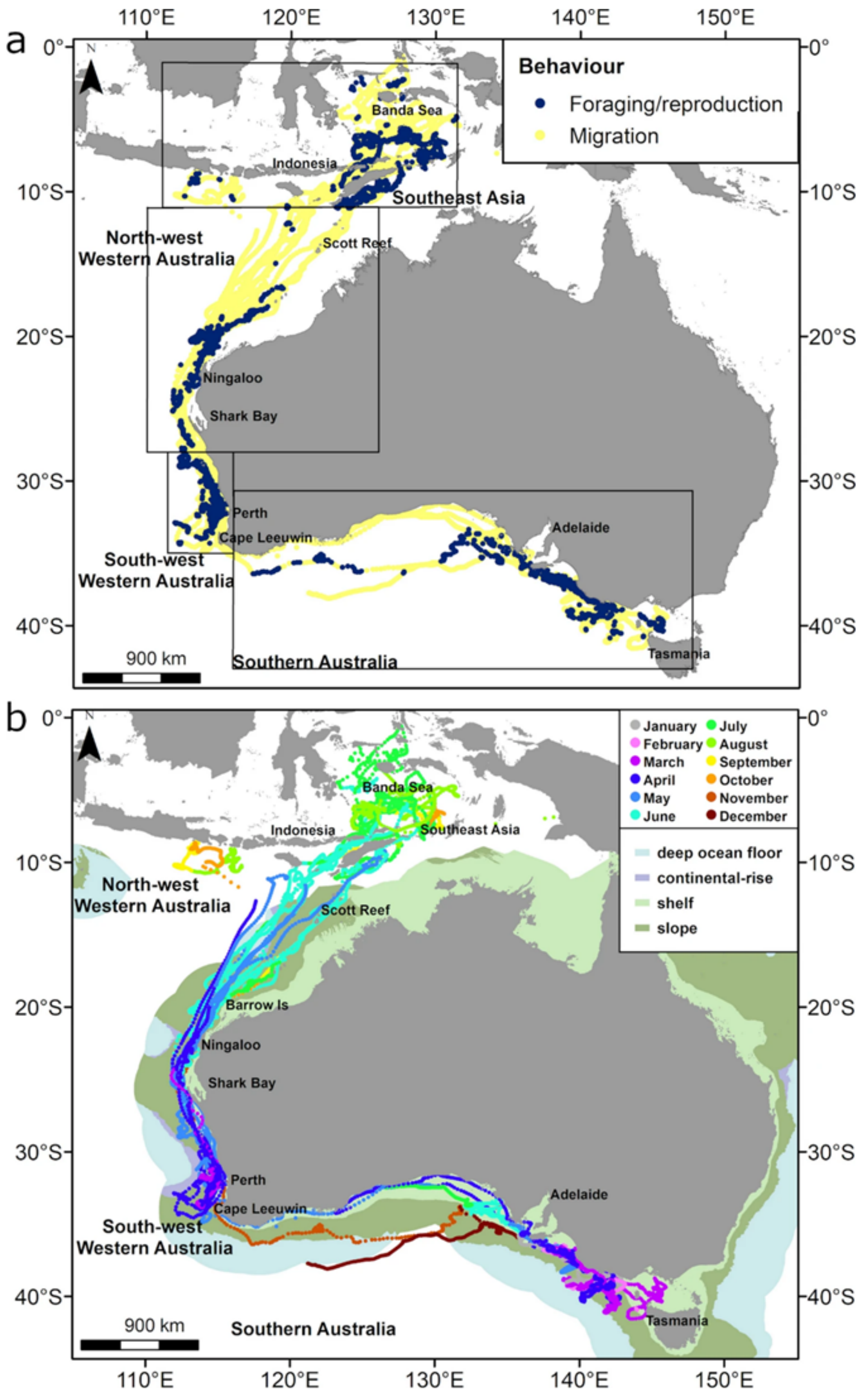
The blue whale is a large baleen whale with a broad spatial distribution. Within the Southern Hemisphere, including Australian waters, there are two subspecies that are known to occur: Antarctic blue whale and the pygmy blue whale (DoE, 2015a). The Antarctic blue whale appears to remain at higher latitudes and migrate, likely in oceanic waters east of Australia, to lower polar latitudes for feeding, breeding and calving during the Australian summer (Barlow et al., 2023). The pygmy blue whale has a more widespread distribution, found throughout the Indian Ocean usually at lower latitudes, with individuals migrating between Australian waters and Indonesia along the Western Australian coastline (DoE, 2023). The pygmy blue whale is mostly found north of 55°S, while Antarctic blue whales are mainly sighted south of 60°S. Blue whales sighted within the vicinity of the East Coast Project and associated monitoring EMBA are likely to be the pygmy blue whale subspecies which will be the focus of this description. However, there is potential for occurrence of the Antarctic blue whale considering its migration path.

Blue whales have the highest known prey requirements of any predator, consuming up to two tonnes of krill per day (DoE, 2015a). Therefore, feeding grounds typically occur in areas of high primary productivity that can support sufficient densities of krill, such as oceanographic upwelling or frontal systems. Australia has 3 seasonal feeding aggregations known to be utilised by the pygmy blue whale:

- The Great Southern Australian Coastal Upwelling System (GSACUS) including the Bonney Upwelling and other small upwelling centres off South Australia, Victoria and Tasmania (within the monitoring EMBA)
- The Perth Canyon and adjacent waters of the WA coastline (outside of the monitoring EMBA)
- South along the sub-tropical convergence zone within the Bass Strait between Victoria and Tasmania (within the monitoring EMBA) (Thums et al., 2022).

Möller et al., (2020) observations found that movements and behaviour corroborate previous suggestions that blue whales aggregate to feed in the wider GSACUS, between the Great Australian Bight to the Bass Strait from late spring to autumn each year. This timing coincides with the upwelling season which occurs yearly typically between November and March (Möller et al., 2020). Species concentration within the GSACUS occurred mostly over the continental shelf where krill are known to aggregate, with outlier observations occurring over the slope and deep sea (Möller et al., 2020).

A recently published study has supported these findings. Ferreira et al., (2024) analysed satellite tracking data for 38 Eastern Indian Ocean pygmy blue whales where movement models were applied to identify relationships between whale occurrence and the environment. This was used to predict foraging and migration habitat suitability in Australia and Southeast Asia. Where there was low move persistence behaviours such as foraging, or reproduction were assumed, where there was high move persistence migration was assumed. Results indicated that the depth of the water column was a top predictor of suitable habitat for most regions, however dynamic localised oceanic processes also influenced the probability of occurrence (Ferreira, et al. 2024). In southern Australia suitable habitat was represented as a semi-continuous area encompassing both shelf and slope habitats (43% of suitable habitat on the shelf and 48% on the slope) (Ferreira, et al. 2024). Suitable foraging habitat occurred on the slope and shelf break throughout Australia with activity occurring along the continental shelf between South West and Southern Australia (Figure 6-42) (Ferreira, et al. 2024). While the shelf off the Bonney Upwelling, Great Australian Bight and southern Western Australia and the slope off WA coast was identified as suitable migration habitat (Figure 6-42).



Source: Ferreira, et al. 2024

Figure 6-42: Predicted suitable habitat for foraging and migration in Eastern Indian Ocean pygmy blue whales from satellite tracking

Defined foraging BIAs overlapped by the operational area and associated monitoring EMBA are described below and displayed in Figure 6-44 and Figure 6-45.

- Foraging – Occurs throughout the majority of the Bass Strait and coastal waters of Tasmania
- Known foraging – Occurs within the Bonney Upwelling from Robe to the eastern edge of the Great Australian Bight and the north-west of Bass Strait, from Cape Otway to Port Phillip Heads and to the south of King Island

- Foraging (annual high use area) – Occurs between Cape Otway and Robe (include the Bonney Upwelling)
- Foraging (abundant food source) – Occurs in the eastern Great Australian Bight upwelling (Kangaroo Island Canyons)

Typically, blue whales migrate between breeding grounds (low latitudes) where mating and calving take place in the winter, to feeding grounds (high latitudes) where foraging occurs in the summer. The pygmy blue whale population shows three migratory stages around Australia, a “southbound migratory stage” where whales travel southwards from Indonesian waters down the WA coast, mostly over October to December but possibly into January of the following year, a protracted “southern Australian stage” (January to June) where animals spread across southern waters of the Indian Ocean and south of Australia, then a northbound migratory stage (April to August) where whales move north back to Indonesia again (Figure 6-43) (McCauley et al., 2018). These findings are supported by Möller et al., (2020) and Thums et al., (2022) who observed a high probability of transiting behaviour (i.e., migration periods) between April and June and November and December. Movements from the GSACUS occur initially in a westward direction before turning northwards along the WA coastline to breeding grounds outside of Australian waters (Möller et al., 2020).

The pygmy blue whale has a known distribution range which is broadly consistent with foraging areas and migratory paths of the species which extend through the South-east Marine Region, overlapping the operational area and monitoring EMBA (Figure 6-44).

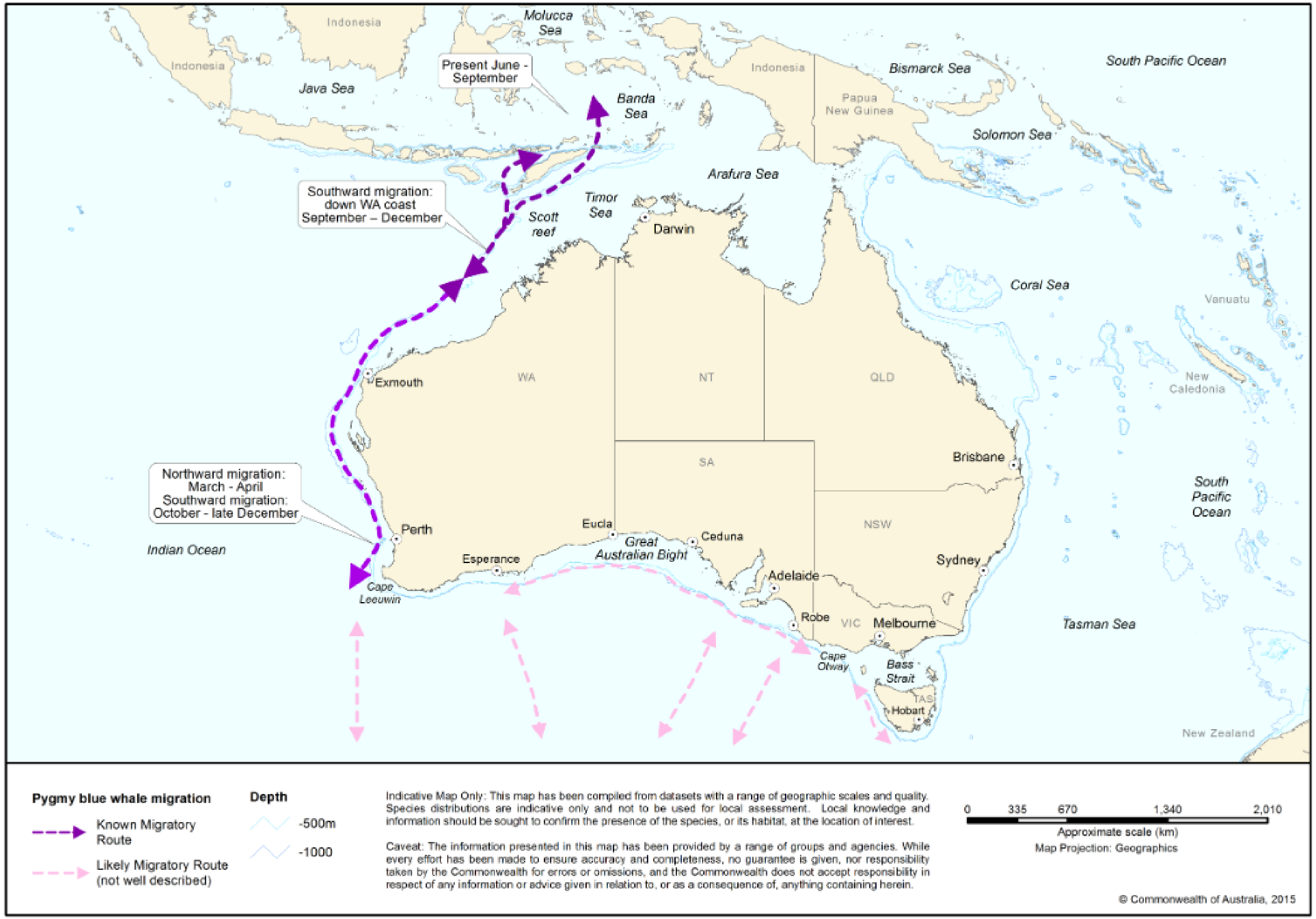


Figure 6-43: Pygmy Blue Whale migration routes around Australia

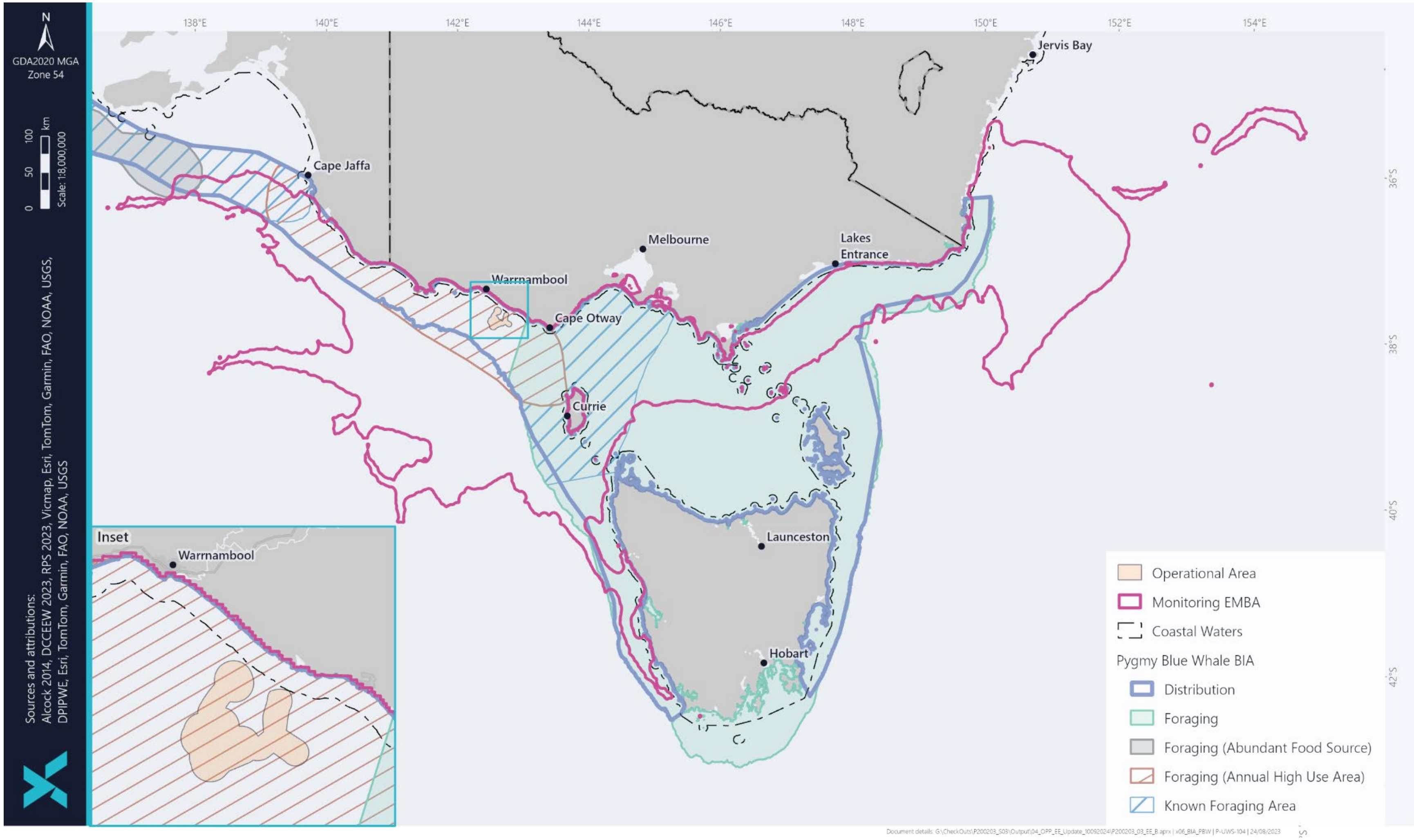


Figure 6-44: Pygmy Blue Whale BIAs within the monitoring EMBA

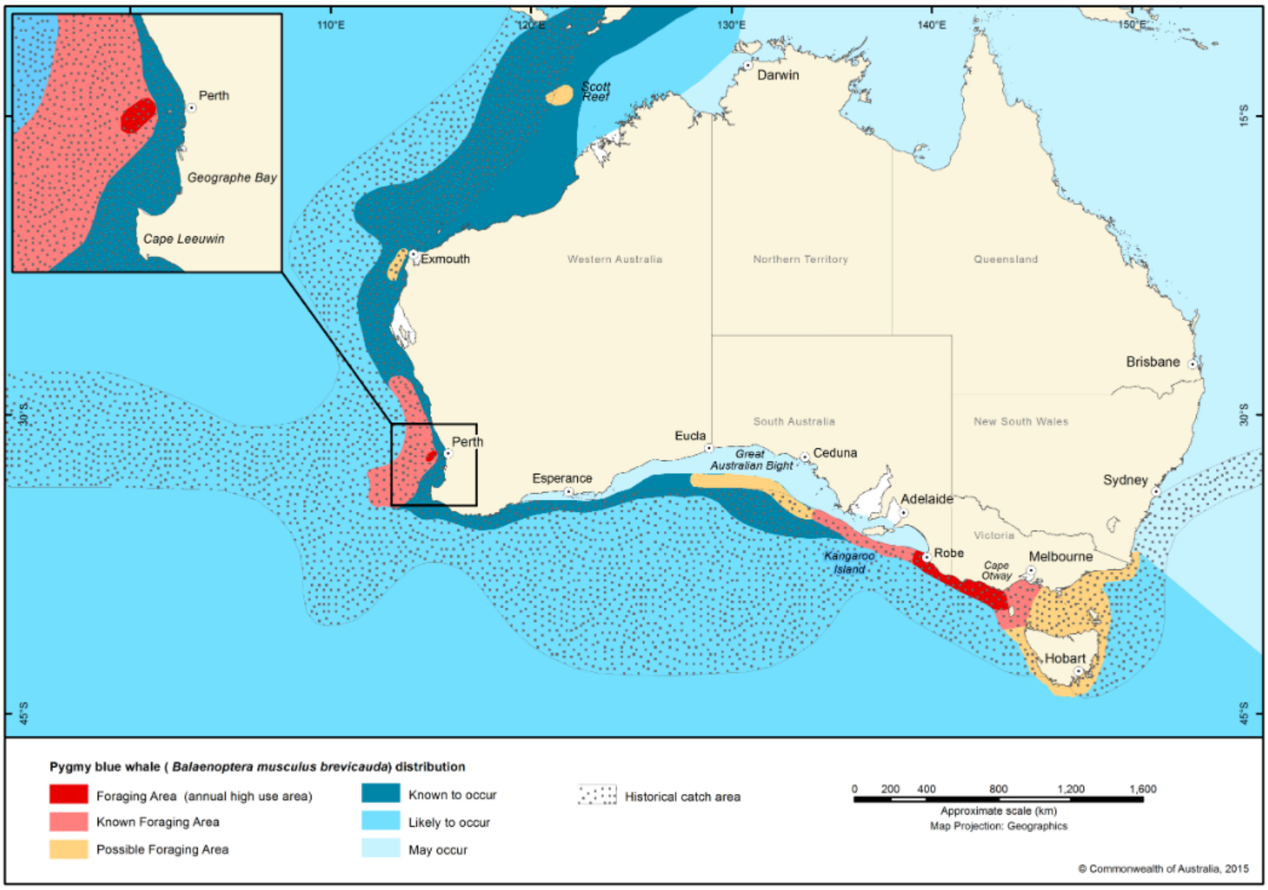


Figure 6-45: Pygmy Blue Whale distribution around Australia

Southern Right Whale

Southern right whales have a circumpolar distribution in the Southern Hemisphere occurring seasonally in all state coastal waters of Australia between April and November each year. There are two populations of the southern right whale within Australian waters (eastern and western). The western population is present west of Ceduna in South Australian (outside EMBA), and the eastern population is present from east of Ceduna to Queensland and Tasmania (DCCEEW, 2024l).

The seasonal presence of the southern right whale in Australia correlates with breeding behaviours. The peak abundance period occurs between May and October each year when the southern right whale will predominately occur in shallow (< 10 m) coastal waters within 1 km of the coast (Charlton, et al., 2019, Smith, et al., 2019 cited in DCCEEW, 2024l). Breeding behaviours (i.e., mating, calving and nursing) typically occur within reproductive areas which have been defined by the National Recovery Plan for the Southern Right Whale (DCCEEW, 2024l) as habitat critical to the survival of the species (Figure 6-47). The importance of the reproductive BIAs to the species is twofold.

Female southern right whales are known to show strong site fidelity to breeding locations, often returning to the same location to breed each cycle (peaking every 3 and 5 years) (Stamation et al. 2020) and it is believed that females transmit this preference to offspring within the first year of their life (Valenzuela, et al., 2009, Carroll, et al., 2015, Carroll, et al., 2016 cited in DCCEEW, 2024l). For example, one female whale was sighted to had calved at Logans Beach at least 7 times over a 17-year period, before shifting to calve at Head of Bight in South Australia for four consecutive calving events over 10 years (Stamation et al. 2020). Additionally, while partaking in breeding behaviours within Australian waters female southern right whales do not feed, resulting in a decline in energy stores. Considering their finite energy stores and the energetic costs of reproduction, environmental influences and/or disturbance have the potential to impose further demands on the whale’s limited energy stores and affect the body condition of lactating females and the reproductive viability of offspring (DCCEEW, 2024l).Therefore, habitat critical to survival for the southern right whale has been identified as all reproductive BIAs across the species range (Figure 6-46).

As highly mobile migratory species, the southern right whale travels thousands of kilometres between habitats used for essential life functions. Similar to breeding areas, the southern right whale is known to show strong site fidelity to foraging locations. The foraging ecology of the southern right whale is poorly understood, and observations of feeding whales are rare. Foraging and feeding is thought to occur in a latitudinal range between at least 30°S and 65°S, particularly in offshore areas associated with large-scale features such as the Sub-Tropical and Polar Fronts (Torres et al., 2013, Carman et al., 2019 cited in DCCEEW, 2024l). Feeding has not been observed in coastal Australian waters, although other parts of the Australian EEZ may be utilised for feeding (Torres et al., 2013 cited in DCCEEW, 2024l). A counter-clockwise migration between foraging and breeding areas has been suggested whereby movements from Australian coastal waters include directly southern and western migration pathways (DCCEEW, 2024l). Migration areas include the movement of whales along the coast (highlighting the importance of coastal habitat connectivity) and the movement from offshore areas, including foraging areas, to nearshore and coastal areas (DCCEEW, 2024l). A migration BIA has been identified within the monitoring EMBA (Figure 6-47).

The south-eastern population of southern right whales currently have one established calving ground located at Logans Beach, Warrnambool in south-west Victoria, located ~24 km north-west of the operational area (Watson et al., 2021). At least 93 calves were born at Logans Beach between 1980 and 2018 (Watson et al., 2021), however, there has been no increase in the average number of calves born annually at Logans Beach over the last three decades (Stamation et al., 2020). Southern right whales live long with late maturing and long calving intervals (Charlton, 2017), therefore a significant increase in the number of calves born at Logans Beach is not expected until 2028 (Stamation et al., 2020). The total number of southern right whale individuals identified in south-eastern Australia in a single whale-watching season increased from 3 in 1993 to 368 individuals in 2017 (Stamation et al., 2020). Between 1993 and 2017, a total of 37 individual female southern right whales with calves were identified. Of these, 20 were identified west of Warrnambool, with 14 individual breeding females sighted at Logans Beach (Stamation et al., 2020). A further 21 individual females were sighted east of Warrnambool: 5 in the Great Ocean Road area, 3 near Wilson’s Promontory, 10 off Flinders Island and the east coast of Tasmania, and 3 in New South Wales (Stamation et al., 2020).

Southern right whales have been observed during Cooper Energy offshore activities. Two individuals were observed from a moored semi-submersible MODU at the Casino-5 well location in the Otway in 2018. Sighting cues were body and blow. The sighting occurred in April, which may seem unusually early for southern right whale occurrence in the region, though is not unprecedented; the ALA reports 8 southern right whale sightings in the Otway in April between 1984 and 2019 (ALA, 2024). Whales observed during Cooper Energy activities are reported to the Australian Marine Mammal Centre.

First Nations people around Australia have long had a strong connection to whales, which has significance as totemic ancestors to some groups. Whales that travel through Sea Country are recognised by Gunditjmara First Nations people within the Gunditjmara Nyamat Mirring Plan 2023-2033 (GMTOAC, 2023). The southern right whale (Koontapool) migration which occurs along the Victorian coast provides known resting and feeding sites for the species, and safe havens for mothers with calves (DCCEEW, 2024l). First Nations people’s cultural heritage, including identified values and sensitivities are further described in Section 6.8.3.7.

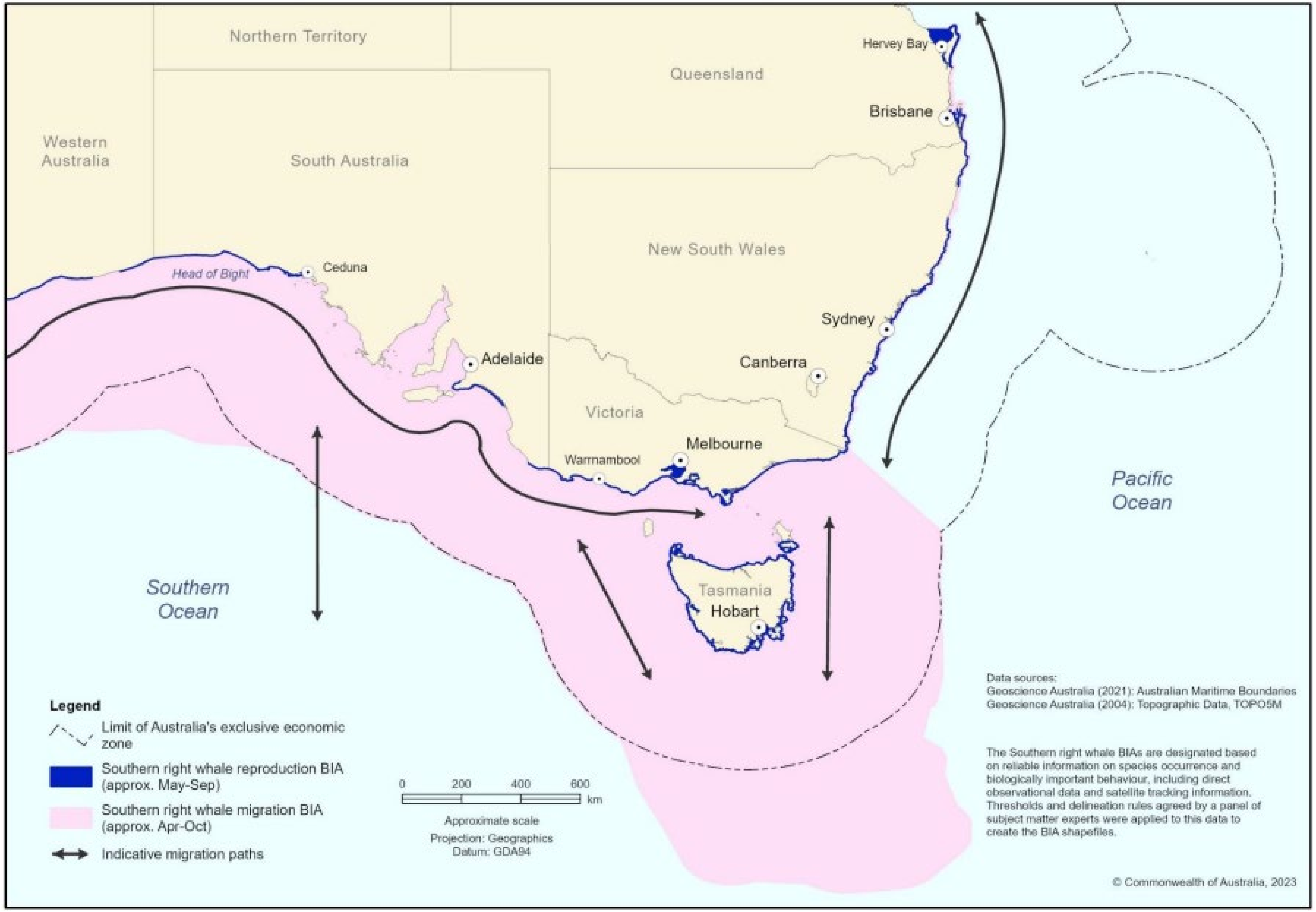


Figure 6-46: Southern right whale Biologically Important Areas and Habitat Critical to the Survival (reproduction BIA) in eastern Australia (DCCEEW, 2024l)

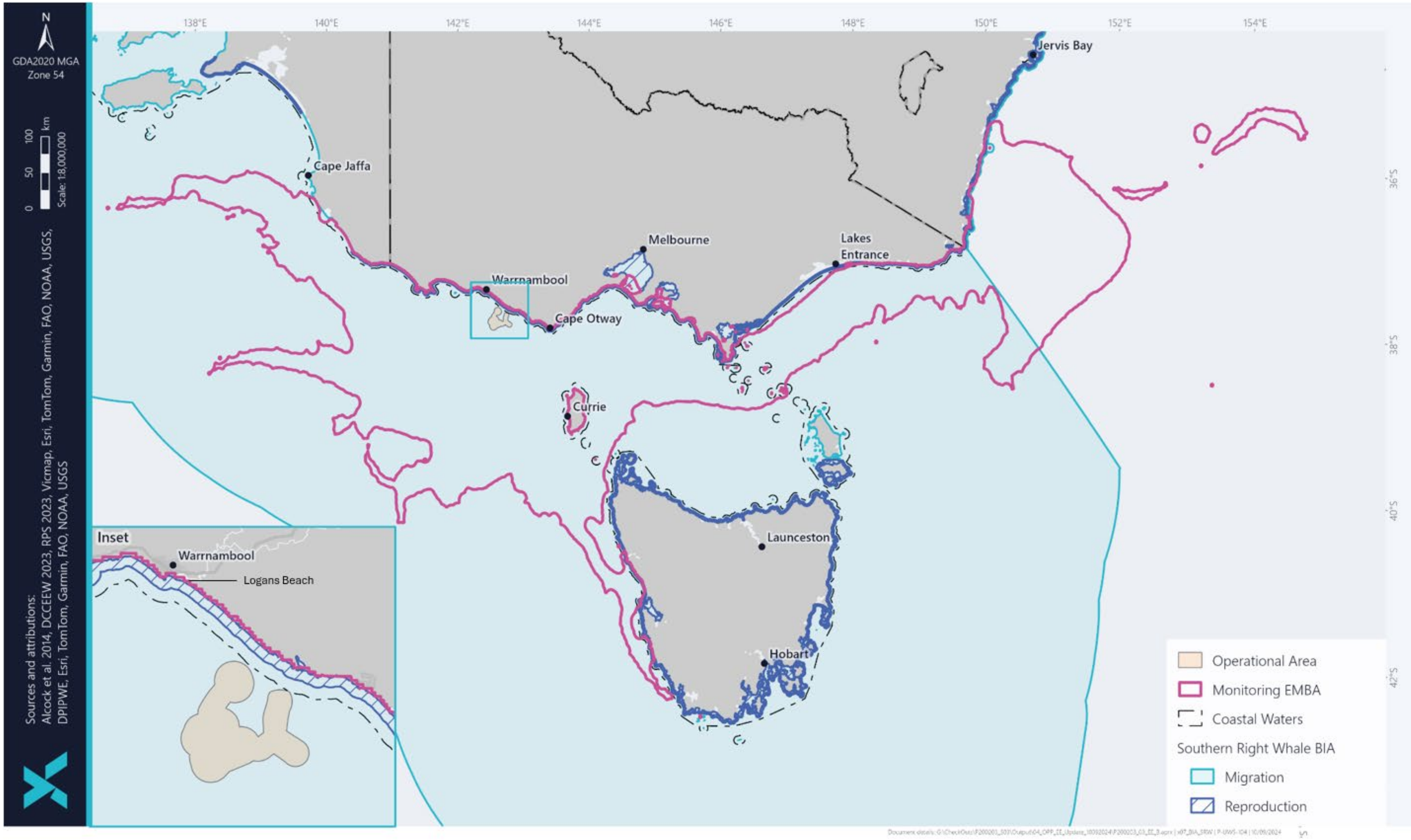


Figure 6-47: Southern Right Whale BIAs within the monitoring EMBA

Humpback Whale

Humpback whales have a near global distribution, migrating annually between high latitude feeding areas and low latitude breeding and calving grounds. Within Australian waters Humpback whales can be found migrating between May and November each year from breeding areas along the east and west coast of Australia and feeding areas in the Antarctic (DoE, 2023) (Figure 6-50).

There are two distinct populations of humpback whale in Australian waters. The east coast population, with the potential to occur within the monitoring EMBA, migrate along the continental shelf, within 50 km of the coast, to the east of the Bass Strait. The exact timing of the migration period varies between years in accordance with variations in water temperature, extent of sea ice, abundance of prey, and location of feeding grounds (DoE, 2023).

During 2023 Cooper Energy undertook vessel-based IMR activities in the Gippsland region. Over the course of this 33-day campaign there were approximately 435 whales sighted by marine mammal observers on board the vessel, with visual range being up to ~6.2km depending on weather conditions. Sightings were primarily of humpback whales undertaking their southerly migration, including mothers and calves. Behaviours observed include fast and slow travel, milling and surface active (e.g. fin slapping and breaching) (Figure 6-48). Figure 6-49 shows sightings distribution relative to the vessel.

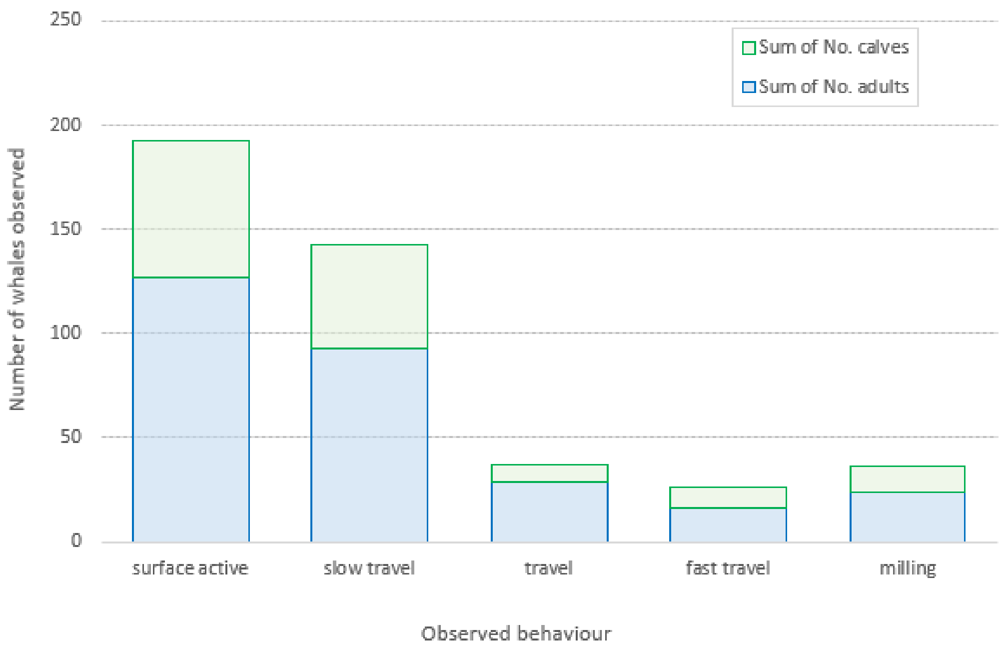


Figure 6-48: Whale observations (behaviours) within the Gippsland Region during Cooper Energy activities (Basker Manta Gummy (BMG) / Gippsland MMO Sightings Sheet, 2023)

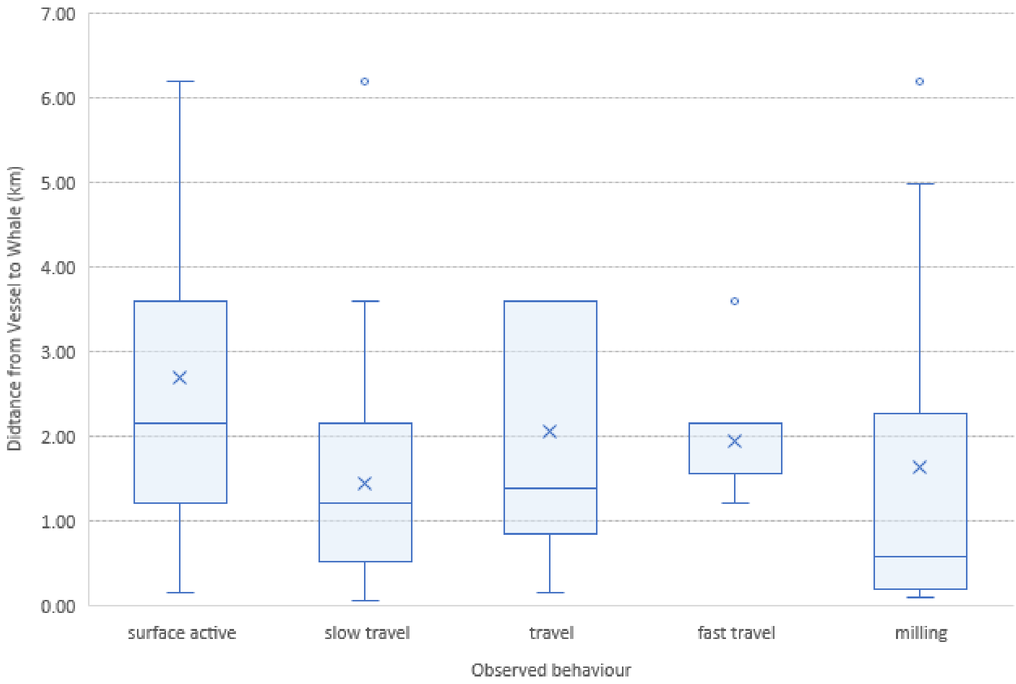


Figure 6-49: Whale observations during Cooper Energy activities – sightings distribution relative to observer vessel (BMG / Gippsland MMO Sightings Sheet, 2023)

Humpback whales feed primarily on krill in Antarctic waters south of 55°S, though opportunistic feeding during migration has been observed in Eden, NSW (DoE, 2023). A foraging BIA for the Humpback Whale occurs along the NSW-QLD border to Eden and is overlapped by the monitoring EMBA (Figure 6-50).

In 2022, the humpback whales EPBC threatened species status was removed due to significant population recovery (TSSC, 2022). The Humpback Whale remains a MNES under the EPBC Act as a listed Migratory Species, and as a Cetacean.

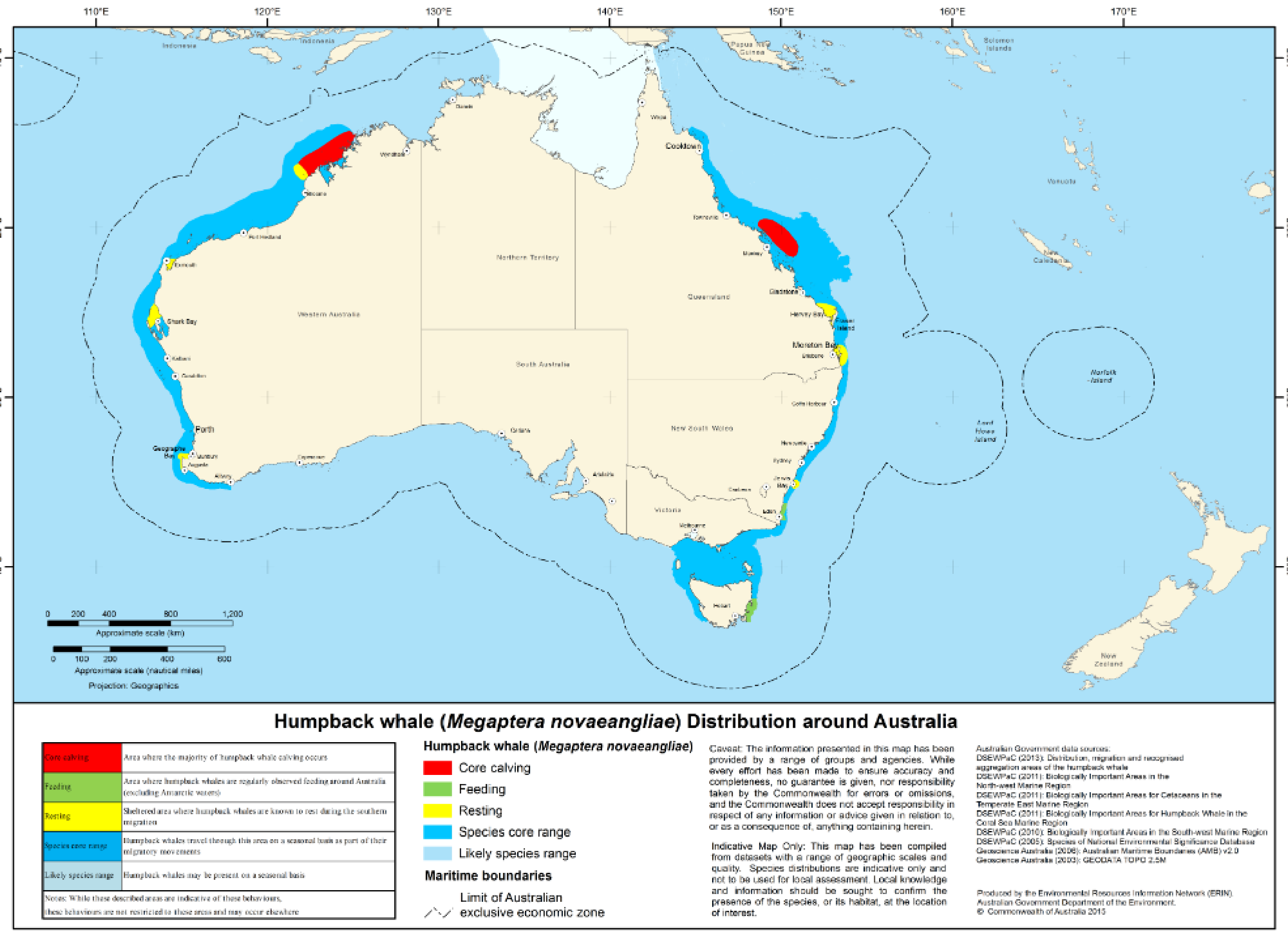


Figure 6-50: Humpback Whale distribution around Australia

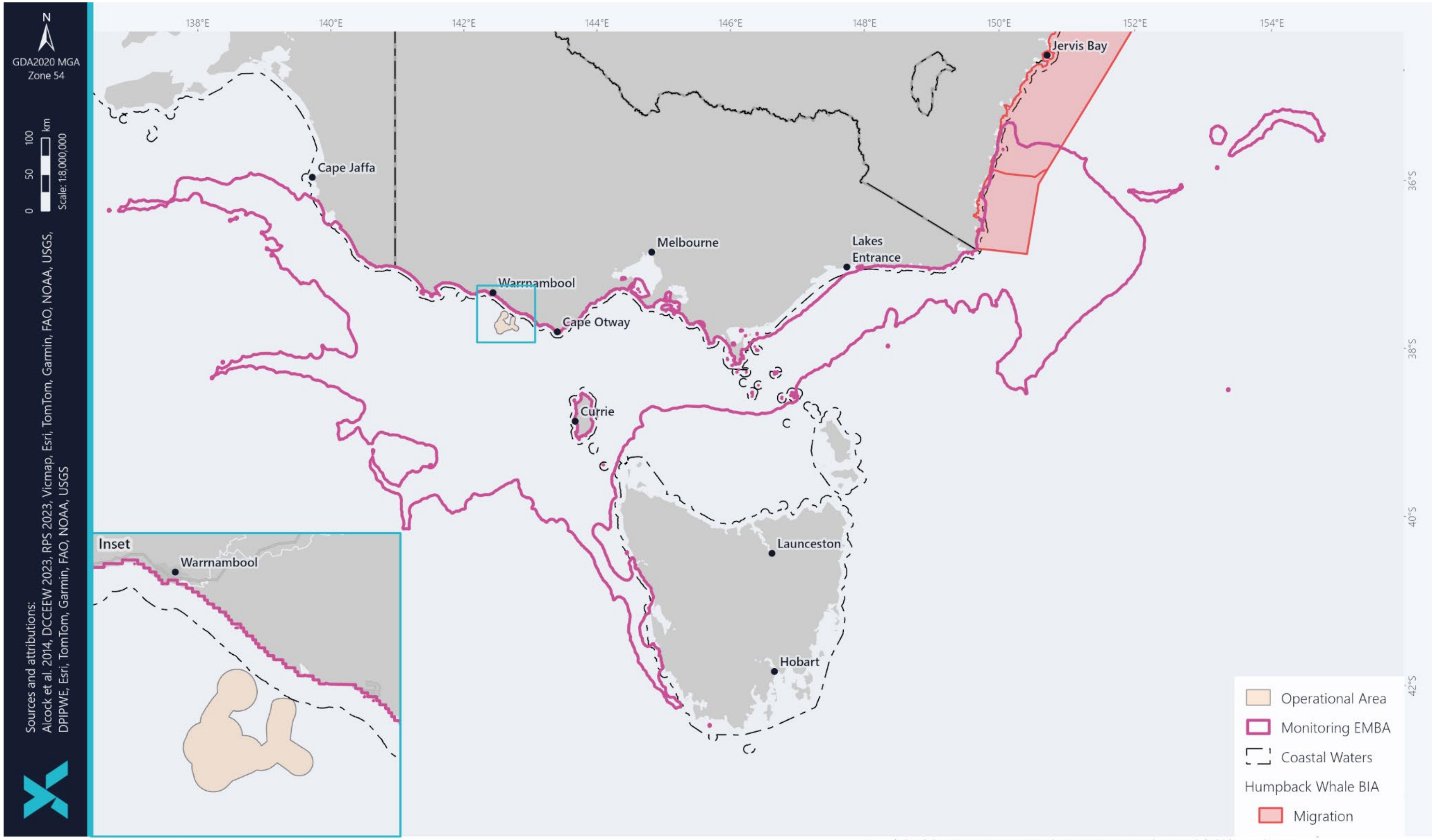


Figure 6-51: Humpback Whale BIAs within the monitoring EMBA

Sei Whale

Sei whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. They show well-defined migratory movements between polar, temperate and tropical waters. Migratory movements are strictly north-south with little longitudinal dispersion.

The sei whale has been infrequently recorded in Australian waters; however occasional sightings have been recorded off most states (DoE, 2023). Sei whales move between Australian waters and Antarctic feeding areas, sub-Antarctic feeding areas (e.g., Subtropical Front), and tropical and subtropical breeding areas. The species feeds intensively between the Antarctic and subtropical convergences on planktonic crustacea, in particular copepods and amphipods (DoE, 2023). However, sei whales have also been observed feeding on the continental shelf in the Bonney Upwelling region during November and May, suggesting the area may be used for opportunistic feeding (DoE, 2023).

The species is likely to forage in the vicinity of the East Coast Project and have a known foraging presence in the monitoring EMBA.

Fin Whale

Fin whales are considered a cosmopolitan species and occur from polar to tropical waters and are rarely in inshore waters. They show well-defined migratory movements between polar, temperate and tropical waters. Migratory movements are strictly north–south with little longitudinal dispersion.

The fin whale has been infrequently recorded in Australian waters; however occasional sightings have been recorded off most states (DoE, 2023). Fin whales migrate between Australian waters and Antarctic feeding areas, sub-Antarctic feeding areas and tropical and subtropical breeding areas. The species frequency feed on the surface of the water through lunge of skim methods, however they may also dive up to 230 m to feed depending on prey availability (DoE, 2023). Fin whales have been observed within proximity of the Bonney Upwelling along the continental shelf between November and May, suggesting the area may be used for opportunistic feeding (DoE, 2023).

The species is likely to forage in the vicinity of the East Coast Project and have a known foraging presence in the monitoring EMBA.

Bryde’s Whale

The Bryde’s whale can be found in tropical and warm temperate waters exceeding 16.3°C, but generally in the 20°C isotherm where they stay year-round (DoE, 2023). The species appears to have coastal and offshore forms which display different life cycle characteristics such as migration patterns and feeding preferences.

In Australia, the Bryde’s Whale has been recorded in all states except the Northern Territory. Typically, the coastal form is restricted to within 32 km from the coast, while the offshore form occupies waters over 80 km from the coast (DoE, 2023). The Bryde's whale is considered an opportunistic feeder, consuming any shoaling prey that is available and frequently exploit the activities of other predators. There is no evidence of large-scale movements of the inshore form of the species, however it appears that the offshore form may migrate seasonally, heading towards warmer tropical waters during the winter (DoE, 2023).

The waters of Bass Strait are not known feeding, resting or calving grounds for Bryde’s whales, although feeding may occur opportunistically where sufficient krill density is present.

Antarctic Minke Whale

Antarctic minke whales appear to primarily occupy offshore and pelagic habitats and can be found throughout the southern hemisphere within cold temperate to Antarctic waters (DoE, 2023). In Australia, the Antarctic minke whale has been recorded in all states except the Northern Territory. Little is known about their foraging or breeding locations in Australian waters. The species undergo extensive migration between the summer Antarctic feeding grounds and winter sub-tropical to tropical breeding grounds (DoE, 2023). The Antarctic minke whale feeds primarily on Antarctic krill and do not appear to feed much whilst in the breeding grounds of lower latitudes (DoE, 2023).

The species is unlikely to forage in the vicinity of the East Coast Project and do not have a known foraging presence in the monitoring EMBA.

Sperm Whale

The sperm whale inhabits a large geographical range from the polar regions to the equator, typically occurring offshore in deep waters (>600 m). In Australia, the sperm whale has been recorded in all states, with concentrations of individuals known to occur at the shelf edge off Albany WA and south-west of Kangaroo Island (DoE, 2023).

In the open ocean, there is a generalised movement of sperm whales southwards in summer, and corresponding movement northwards in winter, particularly for males (DoE, 2023). Male and female sperm whales exhibit different distributions. Females mostly inhabit tropical and subtropical waters while adult males are found at higher latitudes (apart from the breeding season) in ice-free deep waters or along the edges of continental shelves (Chambault et al., 2021). After accompanying the females from 4 to 21 years, young males may leave their female relatives to migrate towards higher latitudes. The diet of the sperm whale is primarily composed of oceanic cephalopods, however, may include demersal fishes, rays and sharks. Sperm whales are deep and prolonged divers and are able to forage throughout the entire water column, however, they seem to forage mainly on or near the bottom (DoE, 2023).

The species is considered to likely forage in the vicinity of the East Coast Project and have a known foraging presence in the monitoring EMBA. However, considering the deep offshore preference of the species (>600 m) (DoE, 2023) individuals are unlikely to occur in the operational area where water depths range from 50–90 m.

Killer Whale

The killer whale can be found throughout all oceans; however, they are found in highest concentrations in coastal waters and in cooler regions where productivity is high (DoE, 2023). In Australia, they are recorded in all states, with concentrations reported around Tasmania and frequent sightings in South Australia and Victoria. Individuals are most often seen in along the continental slope and on the shelf, particularly near seal colonies. Due to their cosmopolitan nature and ability to inhabit most marine environments the killer whale is difficult to characterise (DoE, 2023).

Killer whales make seasonal migrations; however, little is known about specific seasonal movement patterns as it is likely that movements are related to the movement of their prey. It is thought that some individuals migrate to Antarctica during the southern summer to prey on Antarctic minke whales and then migrate back to lower altitudes during the southern winter (DoE, 2023). The killer whale is an apex predator whose diet fluctuates seasonally and regionally. A 'resident' whale will eat mostly fish, while a 'transient' whale will feed on birds and marine mammals (DoE, 2023). Pack-hunting strategies have been reported in Australian waters for individuals preying on pods of whales or dolphins.

The species is unlikely to forage in the vicinity of the East Coast Project, although feeding may occur opportunistically in the monitoring EMBA.

Dusky Dolphin

The dusky dolphin can be throughout the southern hemisphere in temperate and sub-Antarctic regions, typically in association with cold currents. This species primarily occupies inshore habitats but may also be pelagic at times (DoE, 2023). In Australia, the dusky dolphin occurs along the southern coastline from WA to Tasmania. The seasonal reports of dusky dolphin sightings suggest a link with changes in oceanographic features in this region (DoE, 2023). For example, movement patterns may be linked to the position of the Subtropical Convergence and/or El Nino Southern Oscillation events (DoE, 2023). This species is generally considered a surface feeder that preys on schooling fish, cephalopods or other benthic prey.

The waters of Bass Strait are not known feeding, resting or calving grounds for the dusky dolphin, although feeding may occur opportunistically where sufficient prey is present.

Indian Ocean Bottlenose Dolphin

The Indian Ocean bottlenose dolphin is found in tropical and sub-tropical coastal and shallow offshore waters. In Australia, the species is distributed continuously and occurs mainly in riverine and shallow coastal waters (on the shelf or around oceanic islands) (DoE, 2023). They inhabit a variety of inshore (<20 m water depth) habitats including, inshore reefs, tidal and dredged channels, mangroves and river mouths. Movement patterns of the Indian Ocean bottlenose dolphin in Australia are variable, and include year-round residency in small areas, long-range movements and migration (DoE, 2023). This species is a generalist feeder, preying on bottom-dwelling and pelagic fish and cephalopods. Gestation lasts approximately 12 months and calving peaks occur in spring and summer or spring and autumn which coincide with the peak mating period in each location (DoE, 2023).

Breeding BIAs for the Indian Ocean bottlenose dolphin occurs throughout state waters of the East Marine Region, within the 20 m contour. Breeding BIAs are overlapped by the monitoring EMBA and displayed in Figure 6-52.

6.5.8.2 Pinnipeds

Australian Sea-lion

The Australian sea-lion is the only endemic, and least abundant, pinniped that breeds in Australia (DoE, 2023). They use a variety of shoreline types but prefer the more sheltered side of islands typically avoiding exposed rocky coasts. The breeding range of the Australian sea-lion extends from Houtman Abrolhos, WA to The Pages Island, SA where breeding colonies occur on islands or remote sections of coastline (DoE, 2023). However, the species is known to forage in Commonwealth waters adjacent to these states.

Australian sea-lion is considered to be a specialised benthic forager, i.e., feeding primarily on the sea floor (CoA, 2013a). The Australian sea-lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (CoA, 2013a). Foraging trips are relatively short compared to other sea lions, with maximum durations of 5.1, 6.2 and 6.7 days in juveniles, adult females and adult males, respectively with individual dives rarely exceed 8 minutes in duration (CoA, 2013a).

A foraging BIA for males occurs within the Great Australian Bight, Eyre Peninsula, Spencer Gulf, Investigator Passage, Gulf of St Vincent and Kangaroo Island. An additional foraging BIA for both males and females occurs at Kangaroo Island, Investigator Passage and the Gulf of St Vincent. Both foraging BIAs are overlapped by the monitoring EMBA and displayed in Figure 6-53.

Australian Fur-seal

Australian fur-seal populations are in a phase of slow recovery following near-extinction after commercial sealing during 18th and 19th centuries (Shaughnessy, 1999). Breeding colonies are occupied year-round. Peak numbers occur during the breeding season which occurs in summer months with pups born between October and December each year (DoE, 2024). All but one of the known 20 breeding colonies (total number quoted in McIntosh, 2018) occur on islands within Bass Strait, characterised by a shallow continental shelf region with a relatively uniform bathymetry (average depth 60 m). The largest breeding colonies are at Deen Maar and Seal Rocks in Victoria (McIntosh, 2018).

In practice, seals are frequently observed offshore and around vessels; hundreds of sightings of seals were recorded near vessels over the course of the BMG Closure Project – Phase 1 offshore Gippsland in 2024, Marine mammal observers for the project reported behaviours including foraging, milling and swimming.

Reports by Arnould and Kirkwood (2008 and 2011) tracked the foraging habits of female Australian fur-seals from four breeding sites in northern Bass Strait during the winters of 2001-2003. The studies found that all individuals foraged over the shallow continental shelf of Bass Strait and none of the foraging trips recorded any individuals venturing beyond the continental shelf-edge of Bass Strait. This data supports earlier studies that suggested the species is an exclusively benthic forager, although will opportunistically hunt throughout their transit to feeding grounds. Analysis of habitat use indicated that individuals selected areas with depths of 60–80 m with several areas regularly frequented and considered ‘hot spots’, while others with similar bathymetries were never entered by the individuals in this study. Furthermore, while there was substantial inter-individual variation, most seals displayed some degree of foraging site fidelity (Arnould and Kirkwood, 2008 and 2011). Hoskins et al., (2015) considered the role of intensive foraging zones for Australian fur-seal, finding that foraging intensity ‘hot spots’ occur in a mosaic throughout the Bass Basin (within the Bass strait), primarily to the south-west of the known colonies. Diving data also suggested that individuals were maximising their time within the benthic foraging zone.

The species is known to breed within the vicinity of the East Coast Project and likely to have a foraging presence in the monitoring EMBA. Australian fur-seal colonies and breeding habitat within the monitoring EMBA are displayed in Figure 6-54.

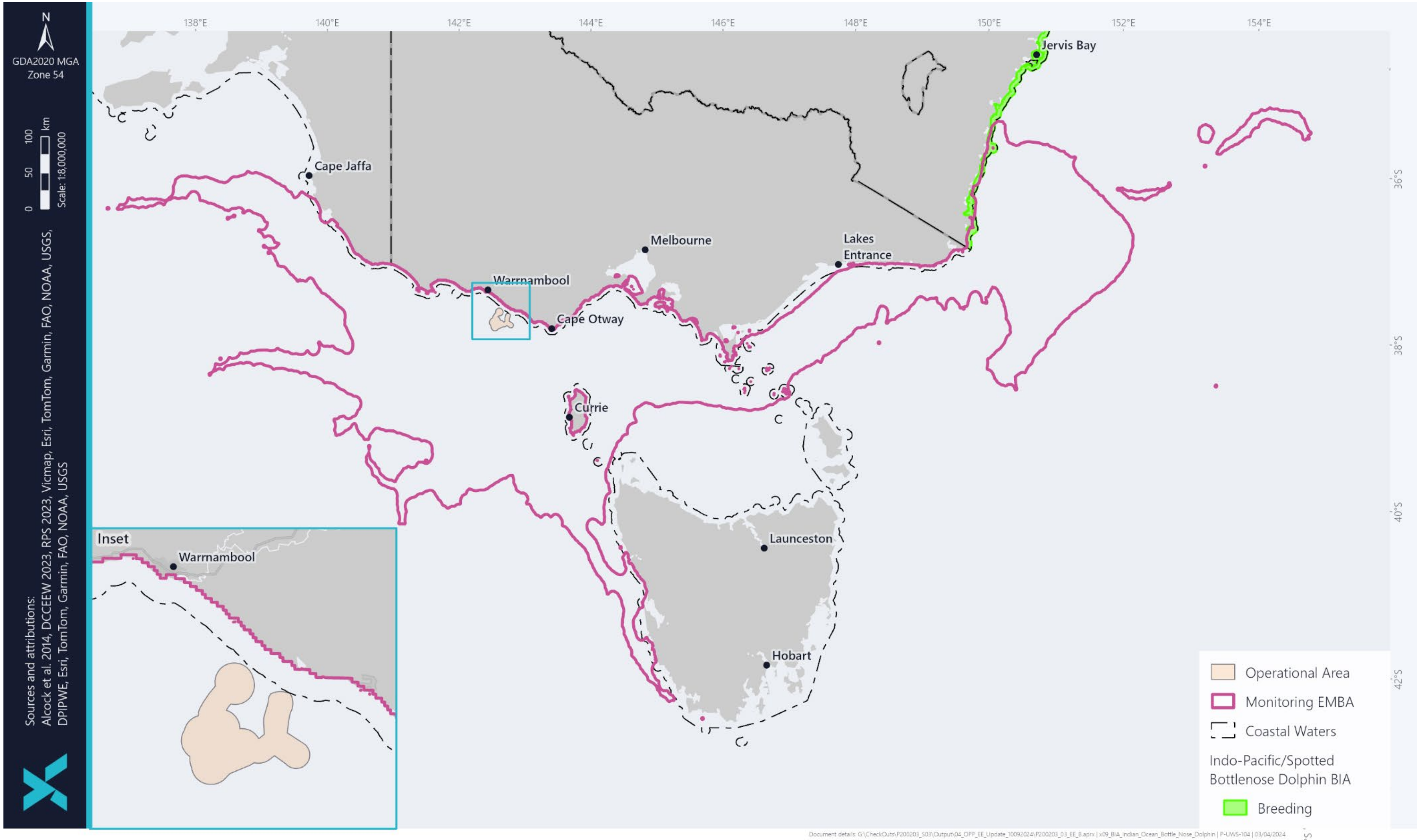


Figure 6-52: Indian Ocean Bottlenose Dolphin BIAs within the monitoring EMBA

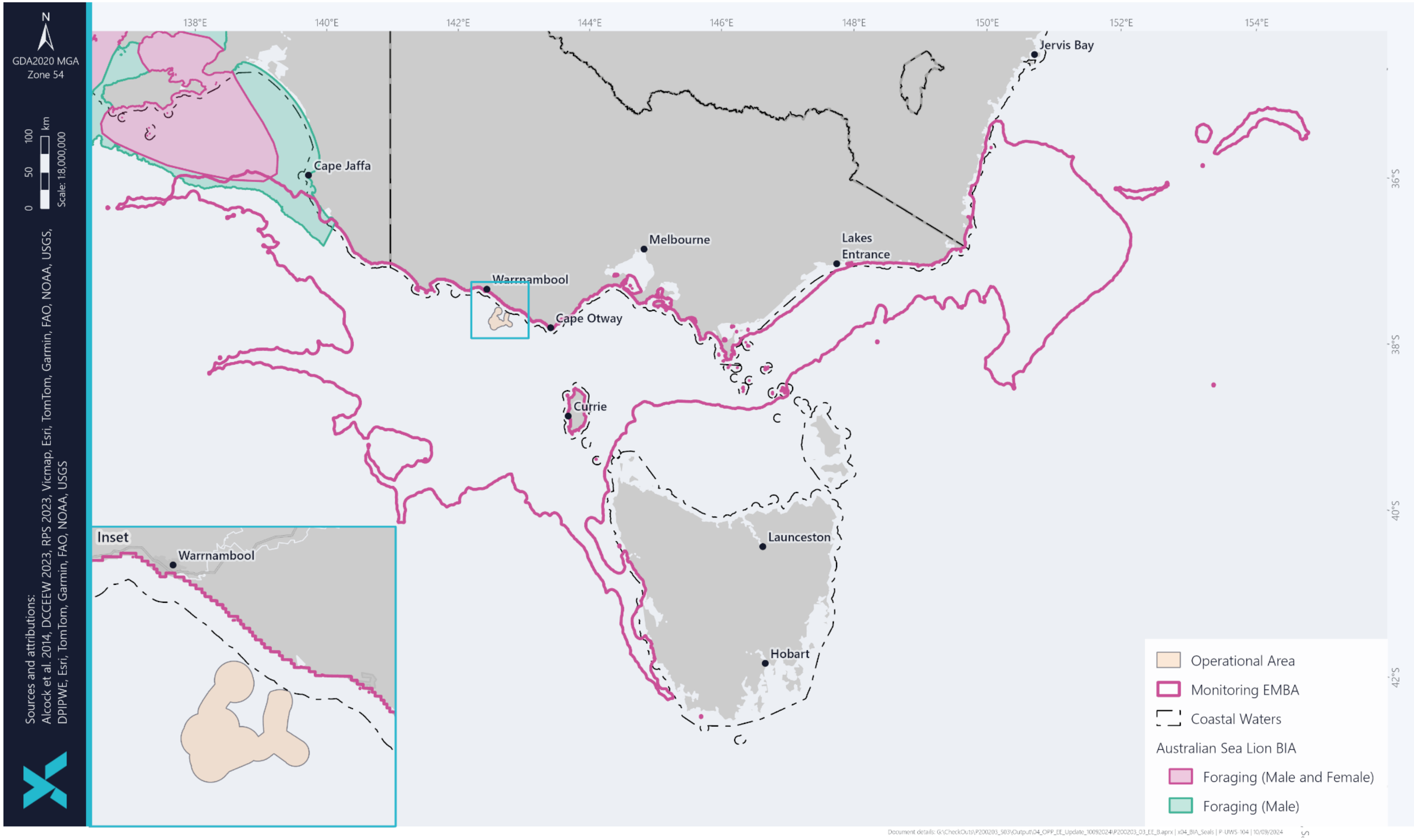


Figure 6-53: Australian Sea-Lion BIAs within the monitoring EMBA

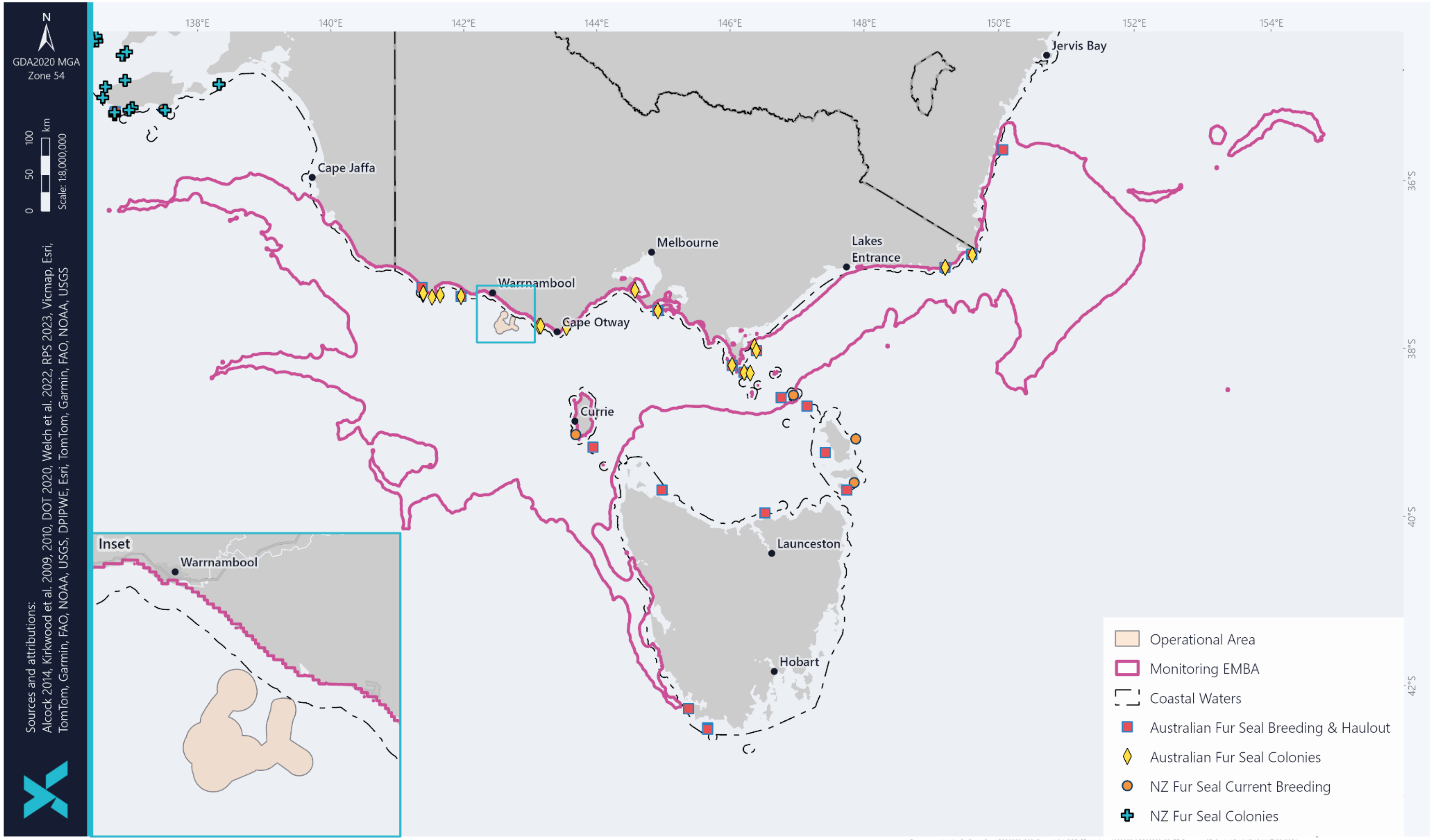


Figure 6-54: Australian fur-seal colonies and breeding sites within the monitoring EMBA

6.5.9 Seasonality of Key Sensitivities

Table 6-10 identifies when species described within this section of the OPP typically occur within the region. Some species may occur year, round which some may be transient, or have a seasonal occurrence. The arrival of some species to the region is linked to physical processes such as seasonal upwellings in the region, and may vary from year to year. This information is used to inform the impact and risk assessment, including the likelihood of a particular consequence eventuating.

Table 6-10: Seasonality of Key Sensitivities within the Otway Basin

Environmental Sensitivity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine Mammals												
Antarctic minke whale			Likely to occur in the austral summer									
Australian sea lion	Assumed present year-round – South-east marine region (SEMR) is a known range											
Australian fur seal (Koorn Moorn)	Present year-round – Islands of the Bass Strait are known colonies Breeding occurs during summer months (October-December)											
Pygmy blue whale		Foraging occurs linked to Bonney Upwelling – BIA										
Bryde's whale	Prefers water depths ranging from 200 m – 1000 m											
Dusky dolphin	Assumed present year-round – prefers inshore habitats but may also be pelagic at times											
Fin whale	Present during the Bonney Upwelling events											
Humpback whale				Nth Migration through SEMR						Sth Migration through SEMR		
Killer whale	Assumed present year-round – frequent sightings off Vic along the continental slope and shelf											
Pygmy right whale	Uncommon / few or no records available for Vic.											
Sei whale	Sighted during the Bonney Upwelling event											

Environmental Sensitivity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Southern right whale – migration				Species is regularly present on the Australian coast between early-April to early November								
Southern right whale – reproduction							Peak reproductive behaviours mid-July through to August					
Sperm whale	Prefer deep offshore environments >600 m											
Marine Reptiles												
Green turtle	Occurs in limited numbers in Vic and SA											
Leatherback turtle	Foraging in the SEMR is known to occur											
Loggerhead turtle	Uncommon in southern Australia											
Fish, Sharks and Rays												
Kooyang (Short finned eel)		Adult eels begin seasonal migration to the Coral Sea.					Larvae and glass eel forms enter Victorian estuaries to complete upstream migration.					
Australian grayling		Spawning from late Summer to Winter (freshwater)				Assumed present year-round – typically occurs in freshwater but can occur in coastal seas						
Eastern dwarf galaxias	Occurs in freshwater habitats											
Porbeagle	Assumed present year-round											
Shortfin mako shark	Assumed present year-round											
White shark	Assumed present year-round with distribution and foraging BIAs identified throughout the region											
Yarra pygmy perch	Occurs in freshwater habitats											
Blue warehou	Assumed present year-round											

Environmental Sensitivity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eastern school shark	Assumed present year-round											
Orange roughy	Assumed present year-round											
Southern dogfish	Assumed present year-round											
Seabirds and Shorebirds												
Antipodean albatross	Foraging known to occur all year											
Australasian gannet						Present year-round – foraging and aggregation BIAs				Breeding occurs Oct – May		
Black-browed albatross				Fledglings (Apr – May)		Present – foraging BIA			Breeding within SEMR on Macquarie Is.			
Black-faced cormorant	Assumed present year-round (endemic to southern Australia)											
Buller's albatross	Foraging BIA – however, records indicate the species is mainly present around Tas when in the SEMR (species endemic to NZ)											
Campbell albatross					Present in the non-breeding season – foraging BIA			Breeds on Campbell Island, south of NZ Aug - May				
Common diving petrel		Present year-round – foraging BIA					Breeding occurs Jul-Jan – breeding BIA					
Indian yellow-nosed albatross			Fledgling Mar-Apr			Non-breeding visitor – foraging BIA			Breeding occurs in South Africa – eggs laid in Sep-Oct			
Little penguin			Present year-round – foraging BIA						Breeding Sept – Feb			
Short-tailed shearwater (mutton bird)	Present Sep-May – foraging BIA					Migrates north for Winter				Breeding Oct – May		
Shy albatross	Assumed present year-round – foraging BIA. Breeding occurs in SEMR with eggs laid in Sept and fledglings in Apr											
Wandering albatross	Assumed present year-round – foraging BIA. Breeding occurs biennially on Macquarie Island with eggs laid in Dec and fledglings between mid-Nov and late-Feb											
Wedge-tailed shearwater	Present Aug-May – foraging and breeding BIA											

Environmental Sensitivity	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
White-faced storm petrel	Fledglings mid-Feb – mid-Mar Foraging BIA during breeding season			Migrates to tropical and subtropical locations in non-breeding season					Species arrive at breeding colonies late-Sept – early-Oct with egg laying occurring in early Summer. Foraging BIA during breeding season			
Other seabirds (With no BIAs identified)	Various species – assumed present											
Shorebirds	Various species – assumed present											
Legend												
	Peak occurrence / activity (reliable and predictable)											
	Low level of occurrence/ activity (may vary from year to year), or otherwise as described above											
	No occurrence											

6.5.10 Marine Pests

Estuarine and marine non-native species are typically introduced and spread through coastal waters by vessel movements and, to a lesser extent, the aquarium trade and aquaculture (Clark and Johnston, 2017). Over 250 introduced marine plants and animals have been recorded in Australian waters (DAFF, 2017). Marine pests are non-native plants or animals which can have a detrimental impact on native marine ecosystems. Not all non-native species become pests, but, when they do, they are classified as invasive. Invasive species often occur in high proportions on artificial substrates (Clark and Johnston, 2017).

The Australian Government National Introduced Marine Pest Information System (NIMPIS) provides information on marine pests in Australian Waters. No IMS have been identified to occur within the operational area of the East Coast Project. One location identified on NIMPIS is in the same region as the East Coast Project: Portland (Otway Region) and has a number of detected IMS which are listed below (DAWE, 2023):

- Asian Bag Mussel (*Arcuatula senhousia)* – likely to inhabit shores and shallow waters up to 20 m deep.
- European Fan Worm (*Sabella spallanzanii)* – likely to inhabit hard and soft surfaces in shallow water up to 30 m deep.
- Japanese Kelp (*Undaria pinnatifida)* – likely to inhabit shores and shallow waters up to 20 m deep.
- Fanworm (*Euchone limnicola)* – likely to inhabit the soft sediments of sub-tidal waters up to 24 m deep.
- White Bushy Bryozoan (*Amathia distans)* – likely to inhabit the hard substrates, including on other organisms, in sheltered subtidal waters.
- Bryozoan spp. (*Cryptosula pallasiana* and *Bugula neritina)* – likely to inhabit hard substrates and is characteristically shallow water species, have been found up to 77 m deep.
- Dead Man's Finger (*Codium fragile ssp fragile)* – likely to inhabit hard substrates but has the ability to tolerate various marine environments. The species appears to occur most frequently in the low subtidal zone up to 15 m deep.
- Solitary Ascidian (*Ascidiella aspersa)* – likely to inhabit hard sediments from intertidal to shallow subtidal water 50 m deep.
- East Asian Bivalve (*Theora lubrica)* – likely to inhabit muddy sediments from the low tide mark to 50 m deep.
- European Clam (*Varicorbula gibba)* – likely to inhabit the soft sediments of subtidal waters up to 146 m deep.
- Toxic Dinoflagellate spp. (*Alexandrium tamarense* and *Alexandrium minutum)* – likely to inhabit temperate to warm temperate coastal and estuarine waters between shore and 20 m depths.

6.6 Conservation Values and Sensitivities

6.6.1 World Heritage Areas

World Heritage Places are sites of outstanding universal value, defined by cultural and/or natural criteria. Australia is home to more listed natural World Heritage Sites than any other country and contains a total of 20 World Heritage Places altogether (DCCEEW, 2022c).

There are no known World Heritage Places located within the operational area or the monitoring EMBA. One site, the Tasmanian Wilderness, is described briefly below and displayed in Figure 6-55 due to its close proximity to the monitoring EMBA.

6.6.1.1 Tasmanian Wilderness

The Tasmanian Wilderness is one of the largest temperate wilderness areas in the world encompassing more than 1,580,000 hectares and covering almost a quarter of the island state of Tasmania (DCCEEW, 2023m). The place is a stronghold for several animals that are either extinct or threatened on mainland Australia and is recognised as an International Centre for Plant Diversity by the IUCN. Additionally, it is an important cultural landscape for Tasmanian Aboriginal people, who have lived there for at least 35,000 years (DCCEEW, 2023m). At its closest point the World Heritage Place is ~270 m from the monitoring EMBA.

6.6.2 National Heritage Areas

The National Heritage List has been established to list places of outstanding heritage significance to Australia. In Australia, National Heritage Places are categorised as natural, historic or Indigenous sites of significance.

There are no known National Heritage Places located within the operational area, however a total of 4 were identified within the monitoring EMBA:

- Great Ocean Road and Scenic Environs
- Point Nepean Defence Sites and Quarantine Station Area
- Western Tasmania Aboriginal Cultural Landscape
- Tasmanian Wilderness (as detailed in section 6.6.1.1).

Further, there is an additional National Heritage Place nomination which is currently under assessment, Summerland Peninsula.

Of those listed above, listed places with marine or shoreline features are described below and displayed in Figure 6-55.

6.6.2.1 Western Tasmania Aboriginal Cultural Landscape

The Western Tasmania Aboriginal Cultural Landscape holds evidence of people moving seasonally up and down the north-west coast of Tasmania. This way of life began approximately 1,900 years ago and lasted until colonisation in the 1830s. Dotted along the wind-swept coastline of the Western Tasmania Cultural Landscape are the remains of numerous hut depressions found in Aboriginal shell middens. These huts and middens are the remnants of specialised way of life based on the hunting of seals and land mammals, and the gathering of shellfish. The Western Tasmania Aboriginal Cultural Landscape was listed as a National Heritage Place in 2013 and is categorised as an Indigenous site of significance (DCCEEW, 2021a).

6.6.2.2 Great Ocean Road and Scenic Environments

The geomorphological features of the Port Campbell Limestone Coast are rare in their diversity, and it is the definitive place in Australia to observe limestone geomorphology and coastal erosion processes on rocky coasts. The Cretaceous coast of the Otway's displays geomorphological processes that are contributing to research into the origins of significant shore platforms that illustrate the environment prior to the breakup of Gondwana. Recreational tourism was among the purposes for the road's construction, and the cultural and natural tourism experiences it offers, including the iconic Twelve Apostles and the treacherous Shipwreck Coast, are greatly valued by the Australian community. The iconic Bells Beach is valued by Australia's surfing community for its place in Australian surfing. It was the world's first Surfing Recreation Reserve and remains the location of the world's longest running international surfing carnival and home to one the most prestigious trophies in surfing. The Great Ocean Road and Scenic Environments was listed as a National Heritage Place in 2011 and is categorised as a historic site of significance (DCCEEW, 2021b).

6.6.2.3 Point Nepean Defence Sites and Quarantine Station Area

Point Nepean is the site of the oldest, surviving, purpose-built, barracks-style, quarantine accommodation buildings in Australia, as well as fortifications demonstrating the primary importance of coastal defence to the Australian colonies. Point Nepean, and its surroundings, are a historic landscape, which features a range of values relating to both Victorian and national quarantine processes from the 1850s and to the history of coastal defence from the 1870s. The Point Nepean Defence Sites and Quarantine Station Area was listed as a National Heritage Place in 2006 and is categorised as a historic site of significance (DCCEEW, 2021c).

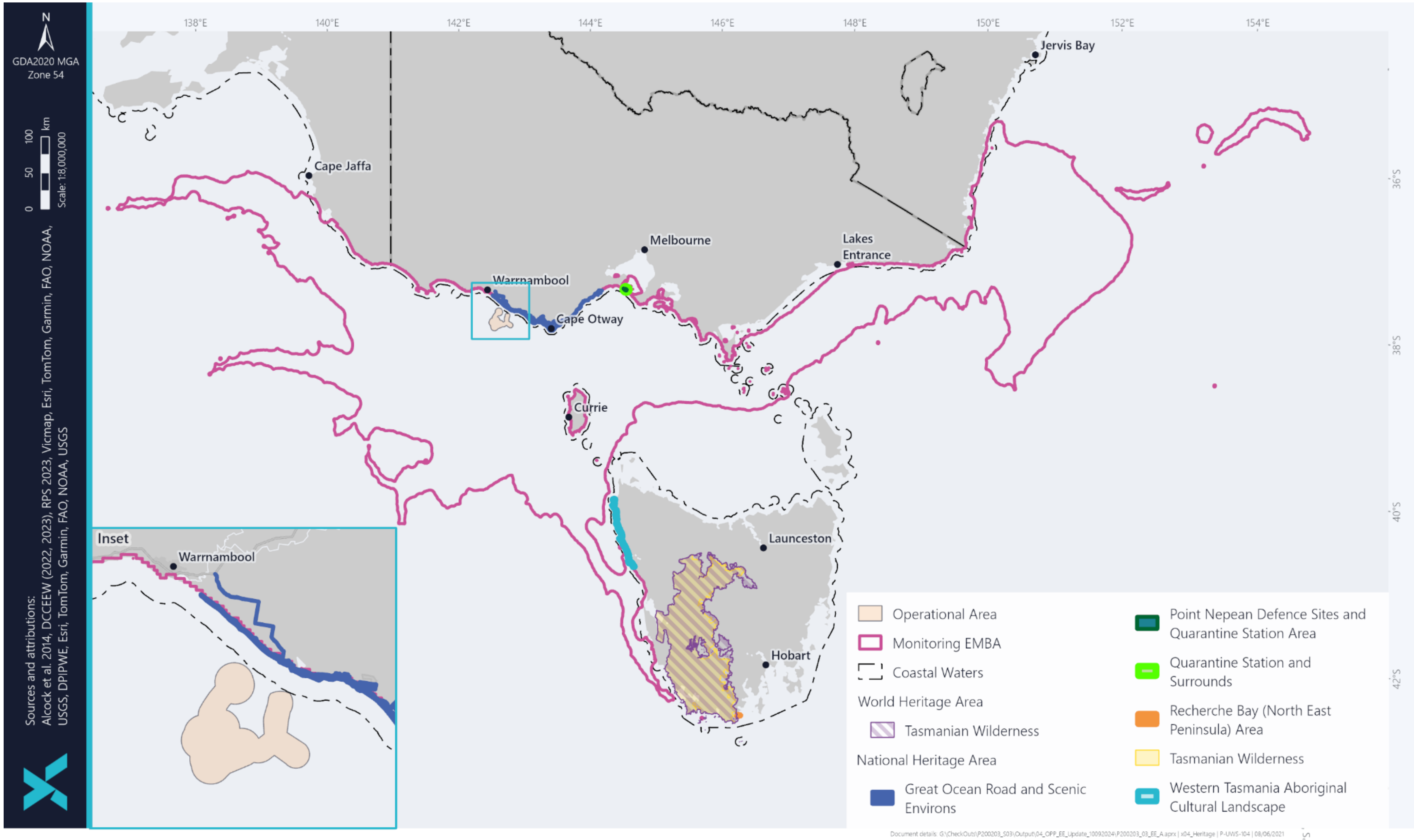


Figure 6-55: Listed World and National Heritage Places located within the monitoring EMBA

6.6.3 Australian Marine Parks

The East Coast Project is located within the South-east marine region while the associated monitoring EMBA overlaps both the South-east marine region and the Temperate-east marine region. Each marine region around Australia has a series of Australian Marine Parks (AMP) which are managed for the primary purpose of conserving the biodiversity found within them, while also allowing for sustainable use of natural resources. No AMPs are intersected by the operational area, however 7 are overlapped by the monitoring EMBA (Figure 6-56) all of which are managed under the South-east marine region and described in Table 6-11.

As identified by Parks Australia (2023) in the South-east Marine Parks Network State of Knowledge key pressures to each of the 7 parks listed below include:

- Resource extraction
- Climate change
- Underwater noise.

Table 6-11: Australian Marine Parks located within the monitoring EMBA

AMP	Zoning[8]	Major Conservation Values
Apollo **Depth: 47 – 101 m**	Multiple use (IV)	Apollo AMP covers representative areas of five bioregions and contains a variety of ecosystems such as sediment-based communities, deep (mesophotic) reefs, a 5 m high raised ridge feature. There is suspected to be deeper (rariphotic) reef habitat extending from the western park boundary to the northern park boundary. The AMP is an important foraging area for a variety of seabird species such as the shy albatross and short-tailed shearwater. Further, the commercially important southern rock lobster (*Jasus edwardsii*) is thought to migrate throughout the year between state waters and the parks reef systems. There is one known site of cultural heritage significance located in the AMP • MV City of Rayville shipwreck
Zeehan	Multiple use (IV), Special purpose (VI)	Zeehan AMP covers representative areas of four bioregions and displays low-profile platform reef across much of the shelf area. The eastern edge of the park is smooth and undulating before changing in the mid shelf to a more corrugated pavement characterised by 3-5 m high ledges with flat faces. The variety of seafloor features including the rocky limestone reefs, small canyons and coarse seafloor sediments support a diverse community of associated fauna (i.e. crustaceans, sponges, bryozoans).
Nelson **Depth: 2,557 – 5,612 m**	Special purpose (VI)	Nelson AMP covers representative areas of the West Tasmania Transition bioregion and contains complex undersea topography, including lower-slope and abyssal ecosystems. The AMP is likely located in a migration pathway for a variety of whale species such as the humpback, blue, fin and sei whales.
Franklin **Depth: 49 – 116 m**	Multiple use (IV)	Franklin AMP covers representative areas of four bioregions and is dominated by shelf unvegetated sediment habitat. The northern section of the AMP contains complex reef, likely formed by volcanic lava flows, which at its shallowest depths of 35 m support kelp forests (*Ecklonia radiata*). The southern end of the AMP contains limestone pavement outcrops, and is sponge dominated in areas of higher relief. Further, the AMP is an important foraging area for a variety of seabird species. Of

[8] *IUCN zoning categories as defined in Table 2-2*

AMP	Zoning[8]	Major Conservation Values
		particular interest is the northern half of the park which is a core foraging area for the endangered shy albatross.
Beagle **Depth: 46 – 77 m**	Multiple use (IV)	Beagle AMP covers representative areas of three bioregions and contains an extensive area of soft sediment with some areas of rocky reef which are likely to be a relict sand dune field prior to sea level rise. Deep (mesophotic) reefs are exposed to large currents leading to high biological productivity providing habitat for a diverse range of species from the little penguin to the white shark. Further, a high density and diversity of sponges provide food for other species by concentrating the nutrients swept past in the currents. The marine park was once dry land which made up part of a land bridge to Tasmania and continues to be culturally significant for First Nations communities. There are two known sites of cultural heritage significance located in the AMP: • SS Cambridge shipwreck • SS Queensland shipwreck
Murray **Depth: 24 – 5,729 m**	Multiple use (IV), Special purpose (VI)	Murray AMP covers representative areas of four bioregions and contains highly varied geomorphology throughout the park, potentially encompassing many shelf reef habitats. The northern edge consists predominately of Lacepede shelf, a large shelf area intersected by ancient channels of the Murray River that runs from NSW through Victoria and South Australia to the deep ocean. Further, the AMP is an important foraging area for a variety of seabirds and whales including EPBC listed species like they shy albatross and the pygmy blue whale The marine park has one of the first produced management plans for Sea Country which was developed by the Ngarrindjeri Nation in associated with the Australian Government marine team.
East Gippsland **Depth: 604 – 5,276 m**	Multiple use (IV)	East Gippsland AMP covers representative areas of the south-east transition bioregion and contains deep water habitats featuring large box canyons, ridges, margin slumps, and plateaus bordered by steep escarpments. There is a sufficient level of knowledge regarding the features of the park as 100% of the seafloor has been mapped. Rocky escarpments provide valuable habitat for benthic communities and mid bathyal seafloor habitats support a diverse array of mobile and sessile fauna which contribute valuable biomass to the seafloor. Further, the east Australian current interacts with the complex seafloor and results in the formation of large eddies mixing warm waters with cool nutrient-rich waters increasing marine biodiversity.
Boags* **Depth: 40 – 80 m**	Multiple use (VI)	Boags AMP covers ecosystems, habitats and communities associated with the Bass Strait Shelf Province and associated with the sea-floor features: plateau and mobile dune fields. Diverse soft sediment communities are dominated by crustaceans, polychaete worms and molluscs. Boags Marine Park also provides important foraging grounds for nearby breeding colonies of seabirds such as the short-tailed shearwater and shy albatross, and habitat for southern right and pygmy blue whales.
*Although the Boags AMP is identified by the PMST report to occur within the EMBA it is located ~3.85 km outside of the EMBA at its closest point.		

Source: Parks Australia, 2023; Australian Marine Parks, 2023

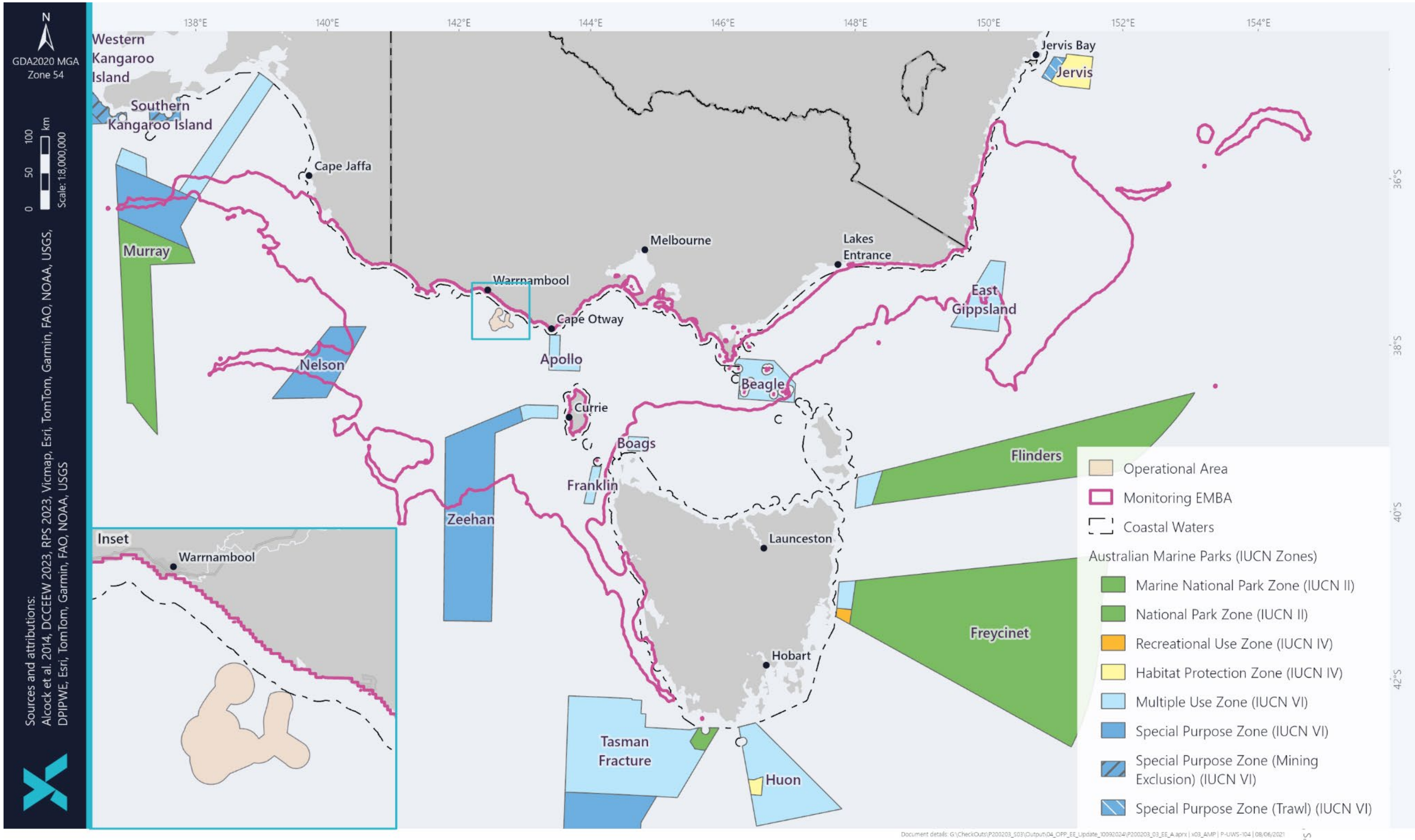


Figure 6-56: Australian Marine Parks located within the monitoring EMBA

6.6.4 Wetlands

6.6.4.1 Wetlands of International Importance

Internationally important wetlands are termed ‘Ramsar wetlands’ and are representative, rare of unique, or are important for conserving biological diversity. Australia currently has 67 listed Ramsar wetlands that cover more than 8.3 million hectares (DCCEEW, 2022b).

Several Ramsar wetlands occur along the coasts of Tasmania, Victoria, NSW and South Australia. Due to their coastal presence, no Ramsar wetlands will be intersected by the operational area. Those located within the monitoring EMBA are described below in Table 6-12 and displayed in Figure 6-57.

Table 6-12: Ramsar wetlands located within the monitoring EMBA

Ramsar Wetland	State	Major Conservation Values
Corner Inlet	Victoria	Corner Inlet protects 67,186 ha on the south-east coast of Victoria including a barrier islands, multiple beach ridges, lagoons and swamps, tidal creeks, tidal deltas, and tidal washovers. Coastal habitats protected by this site include mangroves, saltmarshes, sandy beaches and extensive intertidal mudflats. Additionally, the area contains the only extensive bed of the Broad-leafed Seagrass in Victoria. A high diversity of fauna species utilise the variety of floral communities associated with the site including EPBC listed species such as the orange-bellied parrot, the growling grass frog and a variety of migratory wader species. First Nations people traditionally used the site and many archaeological sites including scarred trees, burial sites, artefact scatters, shell middens and camps have been found. Additionally, the site has recreational and industrial uses. Source: DCCEEW, 2019a
Western Port	Victoria	Western Port protects a large bay of ~260 km of coastline and 59,950 ha in southern Victoria. Six major rivers flow into the northern and eastern shores of Western Port and several minor rivers and creeks drain into the western shores. A wide variety of habitats, from deep channels, seagrass flats, intertidal mudflats, extensive mangrove thickets and saltmarsh vegetation occur within the site. White mangrove communities within Western Port are the most well-developed and extensive in Victoria and are the largest communities situated this far south from the Equator. A high diversity of fauna species utilise the variety of floral communities associated with the site including EPBC listed species such as the orange-bellied parrot, swift parrot, fairy tern and the southern right whale. First Nations people traditionally used the site and a number of cultural heritage sites on the shores of Western Port have been identified. Additionally, the site has recreational and industrial uses. Source: DCCEEW, 2019b
Port Phillip Bay (Western Shoreline) and Bellarine Peninsula	Victoria	Port Phillip Bay (Western Shoreline) and Bellarine Peninsula protects 6 distinct district areas in the western portion of Port Phillip Bay, Victoria totalling 22,897 ha. The site is low-lying and a natural discharge point for the rivers draining southern central Victoria. A wide variety of habitats, from shallow marine waters, seasonal freshwater swamps, estuaries, saltmarshes, intertidal mudflats and seagrass beds. This site is the most important area in Victoria for migratory waders such as the fairy tern and the sharp-tailed sandpiper. Additionally, a high diversity of other fauna species utilise the variety of floral communities associated with the site including EPBC listed species such as the orange-bellied parrot and the little tern. First Nations people traditionally used the site and many sites including burial sites, artefact scatters and shell middens have been found. Additionally, the site has recreational and industrial uses.

Ramsar Wetland	State	Major Conservation Values
		Source: DCCEEW, 2019c
Lavinia	Tasmania	Lavinia protects 7,034 ha on the north-east coast of King Island, Tasmania. The boundary of the site forms the Lavinia State Reserve, with major wetlands in the reserve including the Sea Elephant River estuary area, Lake Martha Lavinia, Penny's Lagoon, and the Nook Swamps. The Lavinia State Reserve is one of the few largely unaltered areas of King Island, containing remaining native vegetation, such as Succulent Saline Herbland, Coastal Grass and Herbfield, Coastal Scrub and King Island *Eucalyptus globulus* Woodland. A high diversity of fauna species utilise the variety of floral communities associated with the site including EPBC listed species such as the orange-bellied parrot who is heavily dependent on the samphire plant for food during migration, which occurs in the saltmarsh. Prior to the last ice age King Island was connected to mainland Tasmania via the Bassian Plain which allowed for passage. There are artefacts of First Nations Australian occupation on King Island that date back to this time period. Additionally, the site has recreational, and conservation uses. Source: DCCEEW, 2019d
Glenelg Estuary and Discovery Bay Wetlands	Victoria	Glenelg Estuary and Discovery Bay Wetlands protects 22,289 ha on the western coast of Victoria. The site comprises three broad systems that support different wetland types: freshwater wetlands, the Glenelg Estuary and the beach and dune system. Further, the site contains several regional, and international, rare wetland types such as a humid dune slack system. The wide variety of habitats supported by this wetland system in turn support a variety of fauna species. A total of 14 native, diadromous, fish species utilise these systems and migrate through them throughout their lifecycle. The site also provides habitat for 95 species of waterbirds, some of which nest on the dunes. First Nations people traditionally used the site which has cultural value as it is part of their Koonang (sea) and Bocara Woorrowarook (river forest) Country. Specifically, the Gunditjmara have a living association with the site. Additionally, the site has recreational and industrial uses. Source: DCCEEW, 2019e
Piccaninnie Ponds Karst Wetland	South Australia	Piccaninnie Ponds Karst Wetlands protects 862 ha on the south-east coast of South Australia. The site is an exceptional example of karst spring wetlands with the deepest spring reaching more than 110 m. There are 4 distinct area of the wetlands; Piccaninnie Ponds, Western Wetland, Eastern Wetland and Pick Swamp. The karst springs support unique macrophyte and algal associations, with macrophyte growth extending to 15 m below the surface. The geomorphic and hydrological features of the site produce a complex and biologically diverse ecosystem which supports considerable biodiversity, including EPBC listed species such as the orange-bellied parrot, Australian bittern and Yarra pygmy perch. First Nations people traditionally used the site which has spiritual and cultural value. The Bunganditj peoples are the Traditional Owners of the land. Additionally, the site is a popular cave diving and snorkelling attraction for the public. Source: DCCEEW, 2019f
Gippsland Lakes*	Victoria	The Gippsland Lakes Wetlands protects 60,015 ha on the south-east coast of Victoria, ~300 km from Melbourne. The site contains an extensive system of estuarine, fresh and brackish coastal wetlands present including lagoons, marshes and tree-swamps. The site supports a broad range of ecosystem services and benefits including nationally and internationally threatened wetland species, waterbird breeding and fish spawning sites. Cultural and socio-economic values are equally diverse, noting the particular importance of the site in

Ramsar Wetland	State	Major Conservation Values
		a regional context in terms of recreational activities such as boating, recreational fishing and holiday tourism. Source: BMT, 2011
*Although the Gippsland Lakes Ramsar site is identified by the PMST report to occur within the EMBA it is located ~3 km outside of the EMBA at its closest point.		

6.6.4.2 Wetlands of National Importance

Nationally important wetlands are considered important for their role in maintaining ecological and hydrological conditions in wetland systems, providing important habitat for animals at a vulnerable stage in their life cycle, supporting 1% or more of the national population of any native plant or animal taxa and/or for their outstanding historical or cultural significance.

Many nationally important wetlands occur along the coasts of Tasmania, Victoria, NSW and South Australia. Due to their coastal presence, no nationally important wetlands will be intersected by the operational area. Those located within the monitoring EMBA can be found in Appendix 1 and are displayed in Figure 6-57.

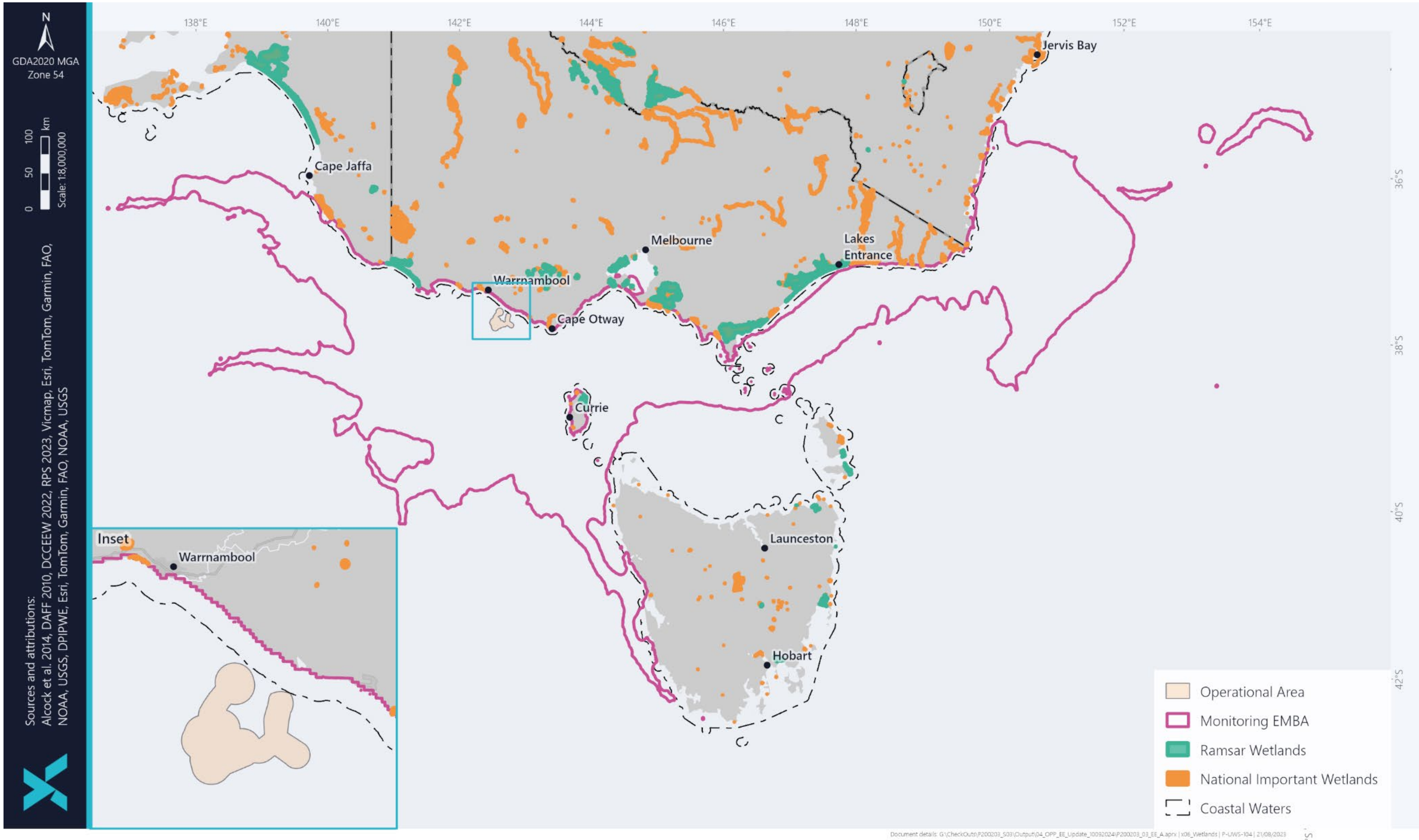


Figure 6-57: Wetlands of Importance located within the monitoring EMBA

6.6.5 State Parks and Reserves

6.6.5.1 Victoria

In Victoria, Parks Victoria, is the statutory authority that acts in accordance with the Parks Victoria Act 2018. The group is responsible for the management of over 4 million hectares of terrestrial, coastal and marine protected areas making up 18% of Victoria's landmass and 70% of Victoria's coastline (PV, 2023). Those of relevance to the activities described in this OPP include coastal and marine protected areas (Figure 6-58) which protect coastal, intertidal or subtidal land which are of conservation or scientific significance.

There are no state protected marine or coastal protected areas located within the operational area. Those located within the monitoring EMBA are described in Table 6-13.

Table 6-13: Victorian Marine and Coastal Protected Areas located within the monitoring EMBA

Map reference	Title	Classification	Values
1	Barwon Bluff	Marine Sanctuary	The Barwon Bluff Marine Sanctuary is located east of Torquay and protects 17 ha of diverse habitats including kelp forests, subtidal reef and rockpools. Important Aboriginal cultural landscape is associated with the Sea Country of the protected area in association with the Wadawurrung People. Surfing, diving and snorkelling are popular activities that occur within the protected area.
2	Bay of Islands Coastal Park	Conservation Park	The Bay of Islands Coastal Park is located along the Great Ocean Road west of Peterborough to Warrnambool. Main habitats within the park include beaches and dunes which are home to the threatened hooded plover. Further, in the months between May and October the southern right whale can be observed offshore. The Bay of Islands Coastal Park is recognised as part of an Aboriginal cultural landscape with evidence of activities in the form of shell middens, stone artefacts, and staircases cut into the coastal cliffs found in the park. Fishing, bush walking and wildlife viewing are popular activities that occur within the protected area.
3	Beware Reef	Marine Sanctuary	The Beware Marine Sanctuary is located east of Cape Conran and 3 km offshore. The sanctuary covers 1.5 km of partially exposed offshore reef making it a preferable resting place for the Australian fur-seal. The isolated reef showcases a unique mix of both warmer and cooler temperate species. Between June and August migrating whales can be seen utilized the protected area. Species may include the humpback whale or the southern right whale. The protected area contains the remains of numerous shipwrecks and is a popular diving location.
4	Bunurong	Marine National Park	Bunurong Marine National Park is located on the Bass Strait coastline between Inverloch and Wonthaggi and extends out several kilometres from shore. The park has intertidal sandstone rock platforms with pink coralline algae, barnacles, many molluscs and beaded algae (Neptune's Necklace). There are groups of Port Jackson sharks and southern rock lobsters in areas with kelp. The park is also home to 31

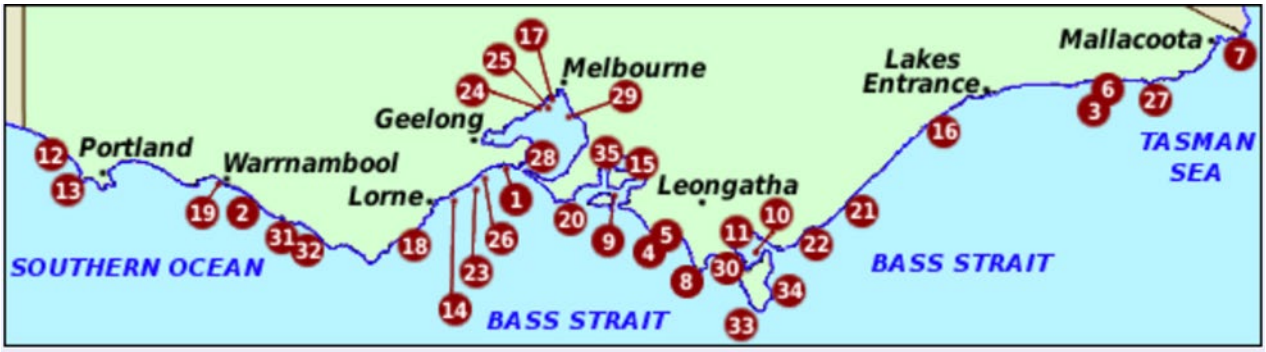
Map reference	Title	Classification	Values
			conservation listed sea birds and shorebirds, including the hooded plover. Snorkelling, surfing, and rock pooling activities are popular activities for visitors.
5	Yallock-Bulluk Marine and Coastal Park	Conservation Park	The park is located along the Bass Coast from San Remo to Inverloch. This area is the traditional land and hunting grounds of the Bunurong people. It is home to the Hooded Plover. There are walking and cycling trails within the park and camping areas nearby.
6	Cape Conran Coastal Park	Conservation Park	Cape Coran Park is located along Victoria's far-east Wilderness Coast. The park is home to the Lace Monitor, wombats, southern brown bandicoots, long-nosed potoroos, and birds such as the New Holland honeyeater and white-bellied sea eagle. Humpback whales and southern right whales migrate through the park during the winter months. The park is part of an Aboriginal cultural landscape. There are camping areas within the park as well as snorkelling, surfing, fishing, and walking activities.
7	Cape Howe	Marine National Park	Cape Howe Marine National Park is located on the eastern border of New South Wales near Gabo Island. The park is part of an Aboriginal cultural landscape. The park contains shallow and deep subtidal reefs with warm and cool water species like eastern blue groper, purple wrasse, blue-throated wrasse, and herring cale. southern right whales and humpback whales regularly occur in the park, as well as humpback whales which migrate through the park and occasionally killer whales. A grey nurse shark was observed in the park in 2021. SCUBA diving and coastal walking activities are popular in the park.
8	Cape Liptrap Coastal Park	Conservation Park	Cape Liptrap Coastal Park is located between Point Smythe and Waratah Bay. Several rare fauna species occur in the park, including the hooded plover, swamp antechinus and powerful owl. The area also provides a vegetated coastal corridor for migratory birds. The park has a camping area and is popular for fishing, swimming, rock pooling, and coastal walks.
9	Churchill Island	Marine National Park	Churchill Island Marine National Park is located south of Rhyll on the eastern shore of Phillip Island. The park is influenced by tidal activities that expose mudflats and seagrass beds that provide a foraging habitat for migratory waders with the park forming part of the Western Port Ramsar Site and the East Asian-Australasian Flyway. There are migratory birds in winter months and roosting areas in the saltmarsh and mangroves for seabirds and shorebirds in the park. The park is popular for bird watching, tidal watching, and coastal walks.
11	Corner Inlet Marine and Coastal Park	National Parks Act Schedule 4 park or reserve	Corner Inlet Marine and Coastal Park is located near Toora Beach. The park includes a wetland area listed under the Ramsar Convention. The wetland inhabits coastal

Map reference	Title	Classification	Values
			woodland, vast mangrove communities, saltmarsh areas, intertidal zones and broadleaf seagrass forests. The park is popular for walking, fishing, boating, picnics, and camping.
12	Discovery Bay Coastal Park	Conservation Park	Discovery Bay Coastal Park is in south-west Victoria between Portland and Nelson. The beaches of the park are home to the Hooded Plover. There are campgrounds located within the park and it is popular for swimming, snorkelling, bird watching, walking, horse riding, and picnics. Cultural heritage significance of Discovery Bay is discussed in Section 6.8.3.7.2.
13	Discovery Bay	Marine National Park	Discovery Bay Marine National Park is in south-west Victoria between Portland and Nelson. Southern right whales and humpback whales are regularly seen within the park during their migration in winter. Blue whales are also seen in the summer months. Australian fur-seals forage nearby. The hooded plover breeds on the beaches in the Autumn months. The park is popular for surfing, snorkelling, swimming, rock pooling, and coastal walks. Cultural heritage significance of Discovery Bay is discussed in Section 6.8.3.7.2.
14	Eagle Rock	Marine Sanctuary	Eagle Rock Marine Sanctuary is located in Aireys Inlet and extends offshore for 300 m. The shore rocks are home to octopuses, decorator crabs, chiton, and schools of tiny silver fish. Other species found in the park include Port Jackson sharks, sparsely spotted stingarees, and rusty catsharks. The park is popular for rock pooling, snorkelling, diving, surfing, and coastal walks.
18	Marengo Reefs	Marine Sanctuary	Marengo Reefs Marine Sanctuary near the township of Marengo which is just 3 km from Apollo Bay. The island is a known haul out area for Australian Fur-seals and is a Special Protection Area. southern right whales pass through this section of the coast during their migration. Popular activities include snorkelling, swimming, boating, and coastal walks.
19	Merri	Marine Sanctuary	Merri Marine Sanctuary is located near the Breakwater within the City of Warrnambool. There are two islands, Merri and Middle, that sit just offshore. A colony of little penguins live on Middle Island which is accessible during low tide. The pot-bellied seahorse is found on subtidal reefs in the sanctuary. The sanctuary is popular for snorkelling, diving, rock pooling, and coastal walks.
20	Mushroom Reef	Marine Sanctuary	Mushroom Reef Marine Sanctuary is located in Flinders, on the Mornington Peninsula. The sanctuary sits within an Aboriginal cultural landscape in the traditional Sea Country of the Bunurong People. Anemones, black and white sea star, saddled wrasse, magpie morwong, cowfish, weedy seadragons, crabs, elephant snail, chiton, sea hare, intertidal slug, dog

Map reference	Title	Classification	Values
			winkle, blue-ringed octopus, shore crab, bryozoan, and biscuit star are all found within the sanctuary. The sanctuary is popular for snorkelling, diving, coastal walks, rock pooling.
22	Nooramunga Marine and Coastal Park	National Parks Act Schedule 4 park or reserve	Nooramunga Marine and Coastal Park is located near McLoughlins Beach and is protected from the harsh surf of the Bass Strait by barrier islands resulting in quiet waters. The park is composed of a network of shallow marine waters, extensive tidal inlets, intertidal mudflats and a the only extensive broad-leaf seagrass meadows in Victoria. Common recreational activities include fishing, bird watching, swimming, and bush camping.
23	Point Addis	Marine National Park	Point Addis is located between Torquay and Anglesea. Many sea birds and mammals of conservation significance, including blue whales, southern right whales, filler whales, and Australian fur-seals, have been recorded in this park. Twenty-six conservation listed shore and sea birds have been sighted in the park. There are two historic shipwrecks within the park. The park is popular for rock pooling, snorkelling, diving, surfing, and coastal walks.
26	Point Danger	Marine Sanctuary	Point Danger Marine Sanctuary is located in Torquay. The sanctuary is recognised for its diverse sea slug fauna found on both intertidal and subtidal reefs with 96 species recorded, many of which are endemic. There are three species of albatross located in the sanctuary. The sanctuary is popular for snorkelling, SCUBA diving, rock pooling, scenic walks.
27	Point Hicks	Marine National Park	Point Hicks Marine National Park is ~450 km east of Melbourne and 25 km south of Cann River. The park contains a variety of marine ecological communities, including sandy beaches, intertidal and subtidal rocky reefs, subtidal soft sediments and pelagic communities. The park has high landscape and seascape values. The granite headland of Point Hicks contrasts strongly with the adjacent sandy shorelines. The most popular activity in the park is sightseeing and appreciating the seascape values.
28	Port Phillip Heads	Marine National Park	Port Phillip Heads Marine National Park is located in Queenscliff, east of Melbourne. The park is part of an Aboriginal cultural landscape in the traditional Sea Country of the Wadawurrung Peoples. Australasian gannets, blue devilfish, octopus, feather stars, cuttlefish, Australian fur-seals, whales, dolphins, little penguins and weedy sea dragons are all found within the sanctuary. The park is popular for diving, snorkelling, surfing, water sports, and bird watching.
30	Shallow Inlet Marine and Coastal Park	National Parks Act Schedule 4 park or reserve	Shallow Inlet Marine and Coastal Park is located between Waratah Bay and the majestic peaks of Wilsons Promontory.

Map reference	Title	Classification	Values
			It is characterised by sheltered waters with extensive areas of subtidal and intertidal sediments. The sheltered waters of Shallow Inlet provide a secluded and peaceful setting for a range of water-based activities such as fishing, boating and sailboarding.
31	The Arches	Marine Sanctuary	The Arches Marine Sanctuary is only accessible by boat and is located offshore from Port Campbell. The sanctuary is an important site for Port Jackson sharks. Birds such as the shy albatross, the short-tailed shearwater, and the black-faced cormorant use the sanctuary as a feeding ground. The sanctuary is popular for diving, beach walks, and trail walks.
32	Twelve Apostles	Marine National Park	The Twelve Apostles Marine National Park is located near Princetown. Port Jackson sharks and southern rock lobsters are found in the park, as well as birds such as magpie perch and blue throated wrasse. A large breeding colony of little penguins in found within the park, as well as the hooded plover. There is a shipwreck within the sanctuary but is known for rough waters. Popular activities in the park are trail walks, diving, beach walks, surfing, and fishing.
33	Wilsons Promontory	Marine National Park	Wilsons Promontory National Park is approximately three hours' drive from Melbourne. Southern right whales and humpback whales can be seen during their migration. The hooded plover can also be found within the park. Popular activities include trail walks, swimming, snorkelling, and camping. Cultural heritage significance of Wilsons Promontory is discussed in Section 6.8.3.7.2.
34	Wilsons Promontory Marine Park and Reserve	National Parks Act Schedule 4 park or reserve	Wilsons Promontory National Park is approximately three hours' drive from Melbourne. Southern right whales and humpback whales can be seen during their migration. The offshore islands are home to Australian fur-seals which breed on Kanowna Island. The park is vital for the recovery of white shark populations. The park is popular for SCUBA diving, kayaking, canoeing, and snorkelling. Cultural heritage significance of Wilsons Promontory is discussed in Section 6.8.3.7.2.

Source: Parks Victoria, 2023



Source: Travel Victoria, 2023

Figure 6-58: Victorian Coastal and Marine Protected Areas

6.6.5.2 Tasmania

In Tasmania, Tasmanian Parks and Wildlife Service (PWS) and Forestry Tasmania, manage 3,621,000 ha of reserved area across the terrestrial, coastal and marine environments (PWS Tas, 2022a). Those of relevance to the activities described in this OPP include coastal and marine protected areas (Figure 6-59 and Figure 6-60). These areas conserve the state's nature and cultural heritage while still allowing for sustainable use and economic opportunity for the Tasmanian community.

There are no state protected coastal or marine protected areas located within the operational area. Those located within the monitoring EMBA are described in Table 6-14.

Table 6-14: Tasmanian Marine and Coastal Protected Areas located within the monitoring EMBA

Council	Title	Classification	Values
Marine			
Flinders	Kent Group	National Park Marine Reserve	The Kent Group is located in the north-eastern Bass Strait and consists of a group of 5 isolated granitic islands and several islets. The islands themselves are protected as a National Park while the waters around the islands are protected by the Beagle AMP and Kent Group Marine Reserve. Values and sensitivities associated with the island include: • Rocky shorelines, with steep cliffs on the southern and western shorelines. • The convergence of 3 major ocean currents occurs at the Kent Group resulting in a unique diversity of marine life • Breeding habitat for the resident white-bellied sea eagle from June to January • Breeding habitat for short-tailed shearwater and the Pacific Gull who are present from September to May • Breeding habitat for the little penguin. Species is present year-round, breeds June to February and moults February to March • Over 20 recorded shipwrecks lay in the shallow waters surrounding the islands. *Source: EPA Tas, 2023*
Terrestrial			
Circular Head	Arthur-Pieman	Conservation Area	The Arthur Pieman Conservation Area is located along the coastline of north-west Tasmania from the Arthur River in the north to the Pieman River in the south. The Conservation Area protects a range of ecosystems including some of the largest dune fields and the most extensive peatlands in the state. Species of significance found within the Conservation Area include the orange-bellied parrot whose migration pathway

Council	Title	Classification	Values
			crosses over the reserve while the beaches are known habitat for the hooded plover. The region forms part of the homelands of four clans from the North West nation, peerapper, manegin, tarkinener and peternidic. Stories of these clans are embedded in the landscape and to this day provide a spiritual connection for Tasmanian Aboriginal people. The Conservation Area is rich in Aboriginal shell middens, hut depression sites, artefacts and rock engravings. Other popular activities conducted within the Conservation Area include fishing, camping and surfing. *Source: PWS Tas, 2022a*
King Island	Lavinia	State Reserve	The Lavinia State Reserve is located on the eastern coast of King Island, Tasmania and is largely unaltered. The State Reserve include the internationally protected Lavinia Ramsar wetland and protects multiple types of wetlands (swamp, freshwater and sedge/rush), swamp forest, lagoons and herbfields. Ecological communities on the site are considered traditional as they represent a transition between vegetation on mainland Tasmania and mainland Australia making it a regional biodiversity hotspot. Species of significance found within the State Reserve include the orange-bellied parrot which often stop in King Island on their migration across the Bass Strait. *Source: Ramsar, 2014*
Circular Head	Black Pyramid Rock	Nature Reserve	Black Pyramid Rock Nature Reserve is located south of King Island and west of Hunter Island within the Bass Strait. Values and sensitivities associated with the island include: • Geological features include tertiary basaltic volcanics including both lava and pyroclastic deposits and small areas of limestone. • Largest breeding ground for Australasian gannets in the Bass Strait and one of 8 sites nationally (breeding occurs between September and April). *Source: DPIWE, 2000*
King Island	Christmas island New Year Island Councillor Island Reid Rocks	Nature Reserve Game Reserve Nature Reserve Nature Reserve	Christmas Island Nature Reserve and New Year Island Game Reserve which are located off the north-west coast of King Island. Councillor Island Nature Reserve is located off the east coast of King Island. Values and sensitivities associated with the islands include: • Seabird rookery complex, small terns ○ Nesting colonies for the fairy tern and the little tern (Christmas Island) Reid Rocks Nature Reserve is located in western Bass Strait between King Island and the north-western coastline of Tasmania. Values and sensitivities associated with Reid Rocks Nature Reserve include: • Home to one of Tasmania's only Australian fur-seal breeding colonies • The vegetation of the reserves is dominated by succulent herbfield communities. *Source: DPIWE, 2000; Threatened Species Section, 2012*
Flinders	Curtis Island Cone Islet	Nature Reserve Conservation Area	Curtis Island is a granite island located in the northern Bass Strait. Curtis Island is one of 3 islands in the Curtis Group and is a protected Nature Reserve. Values and sensitivities associated with the Curtis Island include: • Rocky shorelines, with steep cliffs on the southern shorelines

Council	Title	Classification	Values

			• Little penguins are found in high numbers. Species is present year-round, breeds June to February and moults February to March
			• Haul out site for the Australian fur-seal which are present year-round
			• Breeding habitat for threatened seabird species:
			  o Short-tailed shearwater (present September to May)
			  o Pacific gull (present all year, breed September to January).
			Cone Islet is a small granite island part of the Curtis Group and is a protected Conservation Area. It is located to the south-east of Curtis Island.
			Source: EPA Tas, 2023

	Devils Tower	Nature Reserve	Devils Tower is a Nature Reserve located in the northern Bass Strait north of the Curtis Group. Values and sensitivities associated with the Devils Tower include:
			• Rocky shorelines, with steep cliffs on the southern and western shorelines
			• Haul out site for the Australian fur-seal which are present year-round
			• Breeding habitat for threatened seabird species:
			  o Short-tailed shearwater (present September to May)
			  o Smaller petrel species.
			Source: EPA Tas, 2023

	Rodondo Island
	East Moncoeur Island
	West Moncoeur Island
		Nature Reserve
		Conservation Area
		Nature Reserve
			The Rodondo Group is comprised of 3 islands; Rodondo Island and East and West Moncoeur Island. The islands are comprised entirely of rocky shorelines, with steep cliffs on most shorelines. Values and sensitivities associated with the islands of the Rodondo Group include:
			• Rocky shorelines, with steep cliffs on the western shorelines
			• Haul out site for the Australian fur-seal which are present year-round (Rodondo Island)
			• Breeding colony for the Australia fur-seal which are present year-round, pups are born November to December and moult January to March (West Moncoeur Island)
			• Little penguins are found in high numbers. Species is present year-round, breeds June to February and moults February to March
			• Breeding habitat for threatened seabird species:
			  o Short-tailed shearwater (present September to May)
			  o Pacific gull (present all year, breed September to January)
			  o Fairy prion.
			Source: EPA Tas, 2023

	Hogan Group	Conservation Area	The Hogan Group is located in the north-eastern Bass strait at the northern limit of Tasmanian territorial waters. Hogan Island is the largest of 7 islands that make up the group and is a protected Conservation Area. Values and sensitivities associated with the Hogan Group include:
			• Rocky shorelines, with steep cliffs on the western shorelines
			• Little penguins are found in high numbers. Species is present year-round, breeds June to February and moults February to March
			• Breeding habitat for threatened seabird species:
			  o Short-tailed shearwater (present September to May)
			  o Pacific gull (present all year, breed September to January).

Council	Title	Classification	Values
			Further, Boundary Islet (previously North East Islet) is grouped within the Hogan Group and is a protected Nature Reserve. It is located to the north-east of Hogan Island. Sensitivities associated with Boundary Islet include: • A haul-out site for the Australian fur-seal which are present year-round. *Source: DPIPWE, 2011; EPA Tas, 2023*
West Coast	Ocean Beach	Conservation Area	Ocean Beach Conservation Area is located on mainland Tasmania ~6 km west of Strahan on the western coast. The Conservation Area protects over 40 km of coastline and is considered Tasmania's longest beach. The area provides habitat for threatened beach-nesting birds, shearwaters, and the critically endangered orange-bellied parrot. *Source: Wildcare Tasmania, 2023*
Huon Valley	Southwest	National Park Conservation Area	The Southwest National Park is part of the Tasmanian Wilderness World Heritage Area and is Tasmania's largest National Park covering almost 10% of the state. The National Park is located along the south-western coast of mainland Tasmania. The park protects a wide range of habitats from rocky coastlines and beaches to mountain ranges and buttongrass plains. The extensive variety of habitat leads to a high species diversity. Species of significance supported by the park include the critically endangered orange-bellied parrot who breeds exclusively within the park each year, the short-tailed shearwater and the hooded plover. The south-west of Tasmania is rich in resources and considered an Aboriginal cultural landscape where midden sites, artefact scatters, hut depressions and rock shelters provide links to the people that have lived, hunted, gathered and walked this land. The South Coast Track is a difficult 86 km multi-day hike located within the park that is popular among experienced hikers. Other popular activities conducted within the National Park include fishing, kayaking and bush walking. *Source: PWS Tas, 2022a*

Source: PWS Tas, 2022b

Additional protected areas were identified within the monitoring EMBA, however limited data is available, therefore they are listed below.

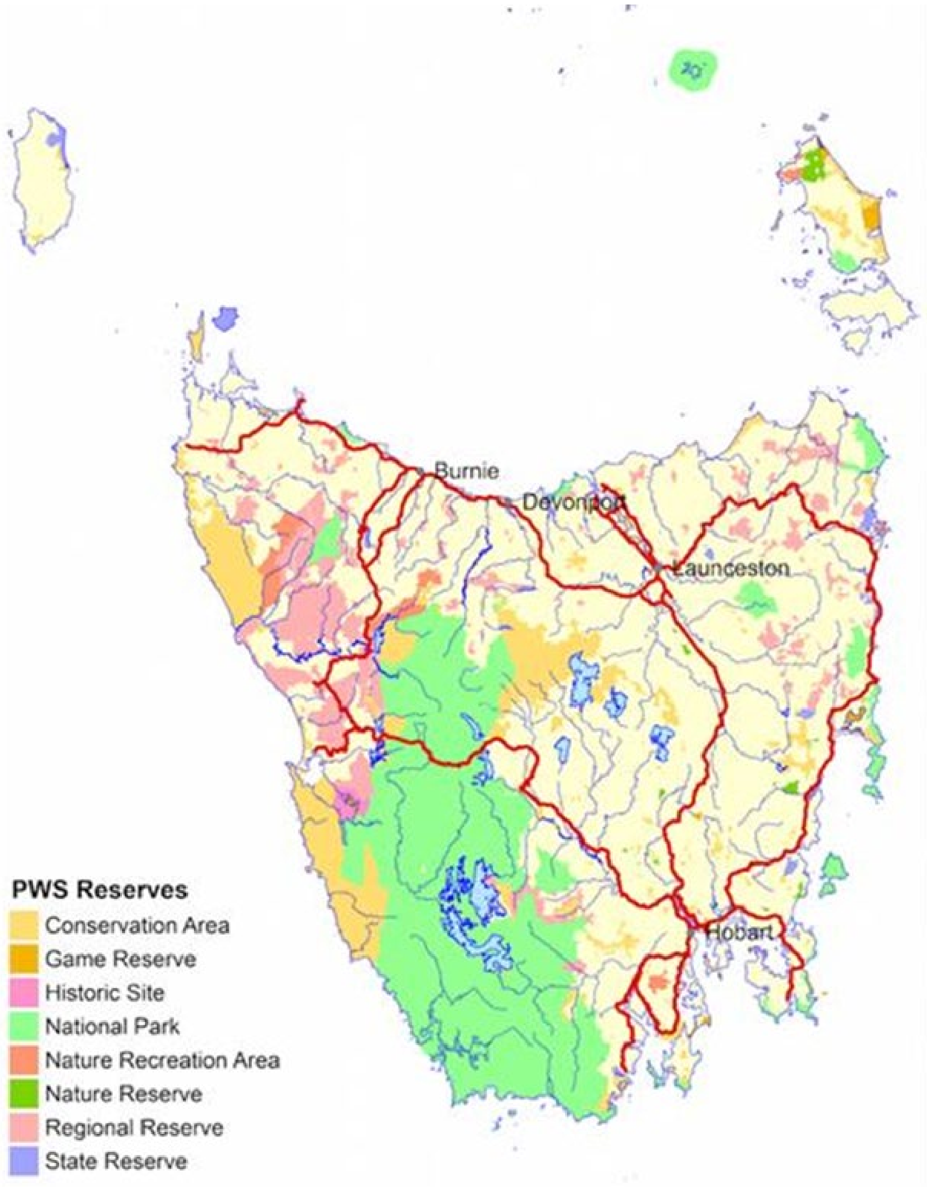
Mainland Tasmania (Figure 6-59)

- Four Mile Beach – Regional Reserve
- Sugarloaf Rock – Conservation Area
- Mount Heemskirk – Regional Reserve
- Trial Harbour – State Reserve.

King Island (Figure 6-60)

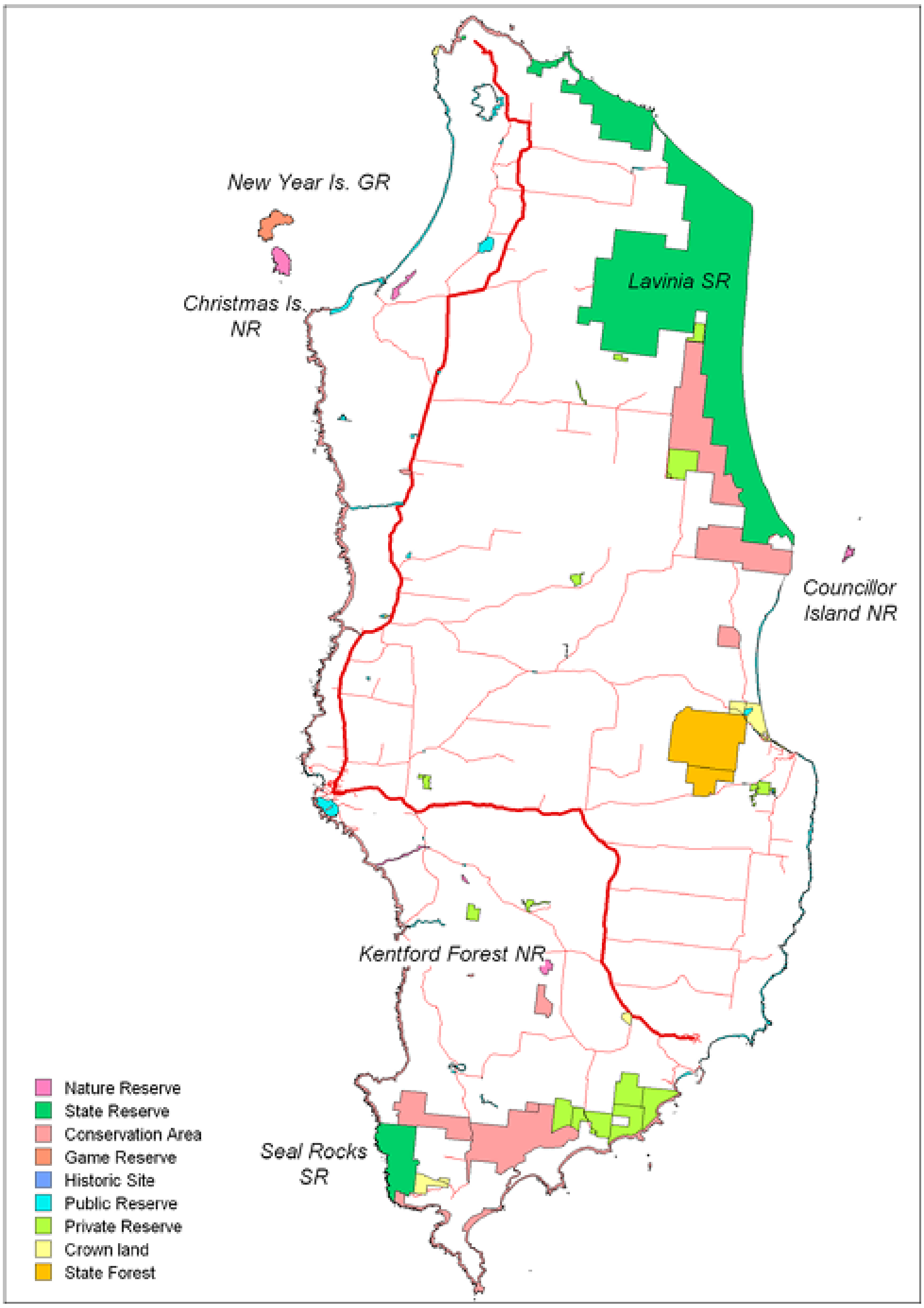
- Seal Rocks – Conservation Area and State Reserve
- Porky Beach – Conservation Area
- Cataraqui Point – Conservation Area
- Stokes Point – Conservation Area
- Badger Box Creek – Nature Reserve
- Cape Wickham – Conservation Area and State Reserve
- City of Melbourne Bay – Conservation Area
- Red Hut Point – Conservation Area

- Sea Elephant – Conservation Area
- Disappointment Bay – State Reserve.



Source: PWS Tas, 2022

Figure 6-59: Tasmanian Reserved Areas



Source: Threatened Species Section, 2012

Figure 6-60: Reserves on King Island

6.6.5.3 New South Wales

Protected areas in NSW are set aside for conservation and include a range of habitats and ecosystems, a diversity of flora and fauna species, significant geological features and landforms, as well as Aboriginal cultural heritage sites, heritage buildings and historic sites (NSW DPE, 2023). In NSW protected areas are managed by the NSW Nationals Parks and Wildlife Service (NPWS). Additionally, 30 protected areas are jointly managed between NPWS and Aboriginal peoples. Figure 6-61 displays protected reserves within the state of NSW.

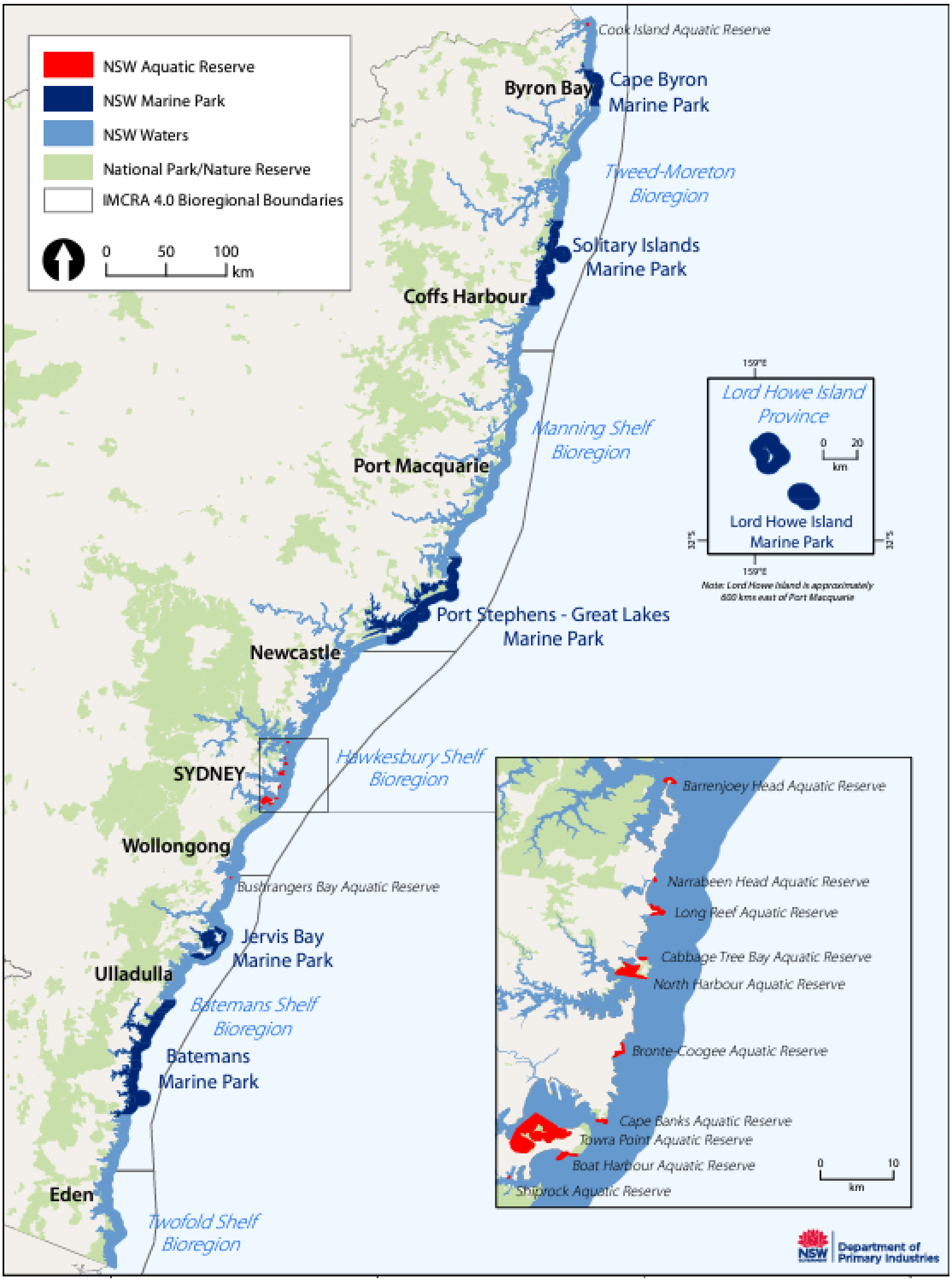
There are no state protected coastal or marine protected areas located within the operational area. Those with marine or shoreline features located within the monitoring EMBA are described in Table 6-15.

Table 6-15: NSW Marine and Coastal Protected Areas located within the monitoring EMBA

Title	Classification	Values
Marine		
Batemans Bay	Marine Park	Batemans Bay Marine Park is one of 6 Marine Parks within NSW state waters. The boundary of the Marine Park extends from the mean high water mark seaward 3 nm from Murramarang Beach near Bawley Point to the southern side of Wallaga Lake entrance at Murunna Point and includes the Tollgate Islands and Montague Island. It is a multiple use protected area that is sectioned into zones: • General Use Zone • Habitat Protection Zone • Sanctuary Zone. Each zone has specific strict management rules for activities such as recreational fishing and spearfishing permissions. Batemans Bay Marine Park is unique for its large expanses of rocky reef which support a diverse array of species. A large variety of habitats occur within the Marine Park such as rocky shores, offshore rocky reefs, kelp beds, seagrasses, mangroves, sponge gardens, sandy beaches, estuaries and open waters. The Marine Park contains important habitat for the critically endangered grey nurse shark and is a common location to see the humpback whale and southern right whale. One of the most culturally and spiritually significant Aboriginal sites within Batemans Marine Park is Barunguba, or Montague Island which features artefact scatters and mideens. Further, dreaming stories and song lines link the island to the mainland's Gulaga (Mount Dromedary) and Najanuga (Little Dromedary). Popular activities conducted in the Marine Park include swimming, boating, fishing and wildlife viewing.
Terrestrial		
Beowa	National Park	Beowa National Park, formally known as Ben Boyd National Park is located on the southern NSW coastline near Eden. The National Park is split by Twofold Bay into 2 sections and has a variety of landscape features such as rocky cliffs, red-rock platforms, lakes and beaches. The National Park is along the humpback whales migration path and is a popular whale watching spot in winter and spring. Further, the 32 km Light to Light walk traces the National parks coastline and has been deemed one of the best coastal walks in NSW. More than 50 Aboriginal sites have been recorded in Beowa National Park including middens, rock shelters, campsites and long-distance travel routes. Popular activities conducted in the National Park include swimming, surfing, fishing and camping.
Bournda	National Park	Bournda National Park is located on the NSW coastline, near Tathra and contains a mix of lagoons, lakes, creeks, beaches and coastal forests. The estuarine wetlands provide roosting and feeding areas for a large variety of bird species like the little tern and the hooded plover. Bournda has been a special place for the Dhurga and Yuin people for thousands of years. The terrain provided plentiful food supply and quarry for making tools. Further, there is evidence of European heritage dating back to the 1830s within the National Park. Anchor bolts can be seen at Kangarutha Point, which was established as a port with Kianinny Bay in 1859. Popular activities conducted in the National Park include swimming, surfing, fishing and camping.

Title	Classification	Values
Eurobodalla	National Park	The Eurobodalla National Park is located on the NSW coastline, stretching between Moruya Head to Mystery Bay and contains a range of aquatic environments. The National Park provides habitat for a variety of birds like the hooded plover and little tern and is an over-wintering area for migratory species. Eurobodalla National Park is the traditional Country of the Yuin People. The terrain provided a rich source of food, shelter, medicines and weapons and continues to be an important place for Aboriginal people today. The reserve contains the Bingi Dreaming track, a 14 km walk along the coast from Congo to Tuross Head. Other popular activities include camping, surfing and fishing.
Nadgee Nature Reserve	Nature Reserve	The Nadgee Nature Reserve is located on the NSW coastline, south of Eden. The reserve sits within Australia's Coastal Wilderness, which runs from the south coast of NSW to East Gippsland in Victoria. The reserve is largely undisturbed providing a combination of coastal health, forest and shoreline where flora and fauna flourish. A section of the reserve is associated with the Bidawal people and the Dtharwa and Monaroo people. Aboriginal people have a long spiritual and cultural association with the area around Nadgee and middens can be seen and along the shore of the park. The reserve contains a large section of the Nadgee wilderness walk which is a 55 km coastal walk from Merrica River, VIC to Mallacoota, NSW. Other popular activities include camping, wildlife viewing and swimming.
Barunguba Montague Island	Nature Reserve	The Barunguba Montague Island Nature Reserve is located 9 km off the south coast of NSW, near Narooma. The National Park is home year-round to a large colony of seals (both New Zealand and Australian fur-seals) who are a major tourism attraction for the island. The island is in the migration pathway of the humpback whale which can often be seen making its migration in spring and winter. The Yuin people have a long connection with the Island, travelling to the island for traditional ceremonies and food, and using it as a men's teaching place. There are many Aboriginal artefacts and middens on the island. In June 2018 Barunguba was declared an Aboriginal Place under the *National Parks and Wildlife Act 1974*. Access to the island is only available by NPWS-contracted commercial vessel tour operators for guided tour visitors or visitors with an overnight accommodation. Wildlife viewing is the most popular activity on the island.

Source: DPI,2023; NSW NPWS, 2023



Source: DPI, 2023

Figure 6-61: NSW Protected Ares

6.6.5.4 South Australia

In South Australia protected areas are managed National Parks and Wildlife Services South Australia. In South Australia protected areas:

- Conserve important ecosystems, habitats, flora and fauna, unique land formations, and culturally significant places

- Ensure clean air, soil and water
- Contribute to global efforts to conserve biodiversity against the impacts of climate change.
- Maintain connection to Country for Aboriginal people (DEW, 2023a).

Figure 6-62 displays protected reserves within the state of South Australia. There are no state protected coastal or marine protected areas located within the operational area. Those with marine or shoreline features located within the monitoring EMBA are described in Table 6-16

Table 6-16: South Australian Marine and Coastal Protected Areas located within the monitoring EMBA

Title	Classification	Values
Marine		
Lower South East	Marine Park	The Lower South East Marine Park is divided into 2 sections: the first adjacent to Canunda National Park and the second from MacDonnell Bay just west of French Point to the Victorian border. The Marine Park lies within the Limestone Coast and is considered a major tourism destination. The Marine Park features various habitats such as: • High energy sandy beaches and freshwater springs associated with the Piccaninnie Ponds Ramsar site • Various reef types (shore platforms, fringing and limestone) • South Australia's only giant kelp forest • Natural process such as the Bonney Upwelling that supplies nutrient-rich water to the area and is an important feeding ground for the endangered pygmy blue whale • Two sanctuary zones establish to help foster the population of the southern rock lobster, a species of commercial importance. The Buandig Aboriginal people have traditional associations with this region, including with the marine environment and associated marine life. Popular activities conducted in the Marine Park include boating, fishing diving and snorkelling.
Upper South East	Marine Park	The Upper South East Marine Park overlaps the Coorong and Otway Bioregions and is divided into 2 sections. The northern section runs from 11 km north of Tea Tree Crossing on the Coorong Ocean Beach to the Maria Creek outlet at Kingston SE. The second from Wright Bay to the northern most point of Stinky Bay. The Marine Park lies within the Limestone Coast and is considered a major tourism destination. The Marine Park features various habitats such as • High energy sandy beaches back by vast sand dunes • Fringing limestone and platform reefs • Dense seagrass beds and kelp forests which provide important nursey habitat for juvenile fish and invertebrate species • Natural process such as the Bonney Upwelling that helps drive the region's high biological productivity and is an important feeding ground for the endangered pygmy blue whale • Baudin Rocks is an important breeding and haul-out site for seal species including the vulnerable Australian sea lion. Two Aboriginal groups, the Ngarrindjeri and Buandig people, have traditional associations with areas of the marine park. Popular activities conducted in the Marine Park include boating, fishing diving and snorkelling. Annual fishing competitions occur at Robe and Kingston SE.
Terrestrial		
Piccaninnie Ponds	Conservation Park	Piccaninnie Ponds Conservation Park is located on the lower south-east coast of South Australia next to the Victorian border. The park features a Ramsar listed wetland (see section 6.6.4.2) and is valued for its underwater limestone chasms making it a renowned diving site.

Title	Classification	Values
		Popular activities conducted in the park include diving, snorkelling and bush walking.
Douglas Point	Conservation Park	Douglas Point Conservation Park is located on the lower south-east coast of South Australia just west of Port Macdonnell. The coastal park features areas of exposed limestone, sea cliffs, small sandy beaches and dense coastal vegetation. The Bunganditj Aboriginal people are the traditional owners of this area. Popular activities conducted in the park include bush walking, diving and fishing.
Canunda	National Park	Canunda National Park is located on the lower south-east coast of South Australia north-west of Millicent. The park features 40 km of coastline, limestone cliffs, sea stacks, offshore reefs, mobile sand dunes and stretches of beach. There is evidence throughout the park of the Boandik Peoples, who once regularly camped along the coast. Popular activities conducted in the park include four-wheel driving, snorkelling and fishing.
Little Dip	Conservation Park	Little Dip Conservation Park is located on the lower south-east coast of South Australia just south of Robe. The park features a rugged coastline, dunes and a number of small lakes and is key habitat for threatened species such as the hooded plover. The park was traditionally home to the Bunganditj and Meintangk indigenous groups. Shell middens can still be seen in the park today. Popular activities conducted in the park include bush walking, surfing and fishing.

Source: DEW, 2023b; DEW, 2023c

Additional protected areas were identified within the monitoring EMBA, however limited data is available, therefore they are listed below.

- Nene Valley – Conservation Park
- Unnamed (No.HA1404) – Heritage Agreement
- Unnamed (No.HA26) – Heritage Agreement
- Unnamed (No.HA1457) – Heritage Agreement.

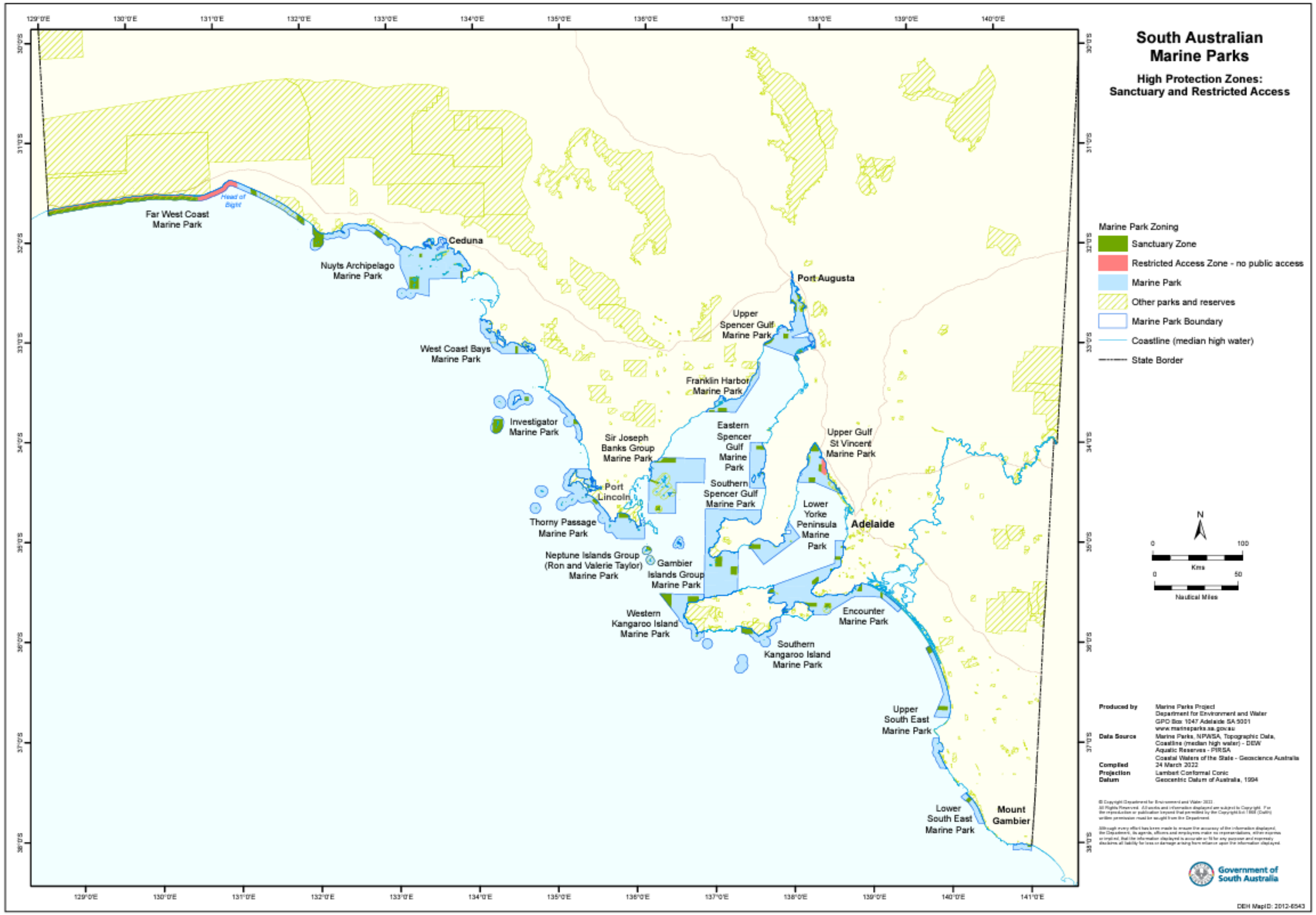


Figure 6-62: South Australia Protected Areas

6.6.6 Key Ecological Features

Key Ecological Features (KEFs) are elements of the Commonwealth marine environment that are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity.

Several KEFs are located within the South-east marine region and the Temperate east marine region, however none are intersected by the operational area. Those within the monitoring EMBA are described in Table 6-17 and spatially delineated KEFs are displayed in Figure 6-63.

Table 6-17: Key Ecological Features located within the monitoring EMBA

Key Ecological Feature	Marine Region	Major Conservation Values
Bonney Coast Upwelling	South-east	**An area of high productivity and aggregations of marine life** The Bonney Coast Upwelling is a predictable, seasonal upwelling bringing cold nutrient rich water to the sea surface and supporting regionally high productivity and high species diversity in an area where such sites are relatively rare and mostly of smaller scale. It is one of 12 widely recognised and well-known areas worldwide where blue whales are known to feed in relatively high numbers. The area is significant as one of the largest and most predictable upwellings in south-eastern Australia. This is not the only upwelling in southeast Australia driven by the prevailing south-easterly winds, but it is the most prominent. In addition to whales, many endangered and listed species frequent the area, possibly also relying on the abundance of krill that provide a food source to many seabirds and fish. The high productivity of the Bonney Upwelling is also capitalised on by other higher predator species such as little penguins and Australian fur-seals feeding on baitfish.
West Tasmania Canyons	South-east	**An area of high productivity and aggregations of marine life** The West Tasmania Canyons are located on the edge of the continental shelf offshore of the north-west corner of Tasmania and as far south as Macquarie Harbour. These canyons can influence currents, act as sinks for rich organic sediments and debris, and can trap waters or create upwellings that result in productivity and biodiversity hotspots. For example, plumes of sediment and nutrient-rich water can be seen at or near the heads of canyons. Sponges are concentrated near the canyon heads, with the greatest diversity between 200 m and 350 m depth. Sponges are associated with abundance of fishes and the canyons support a diversity of sponges comparable to that of seamounts.
Upwelling East of Eden	South-east	**An area of high productivity and aggregations of marine life** Dynamic eddies of the East Australian Current cause episodic productivity events when they interact with the continental shelf and headlands. The episodic mixing and nutrient enrichment events drive phytoplankton blooms which are the basis of productive food chains including zooplankton, copepods, krill and small pelagic fish. It is important to note that the upwelling east of Eden displays seasonal and annual variation. The upwelling supports regionally high primary productivity that in turn supports increased biodiversity, including top order predators, marine mammals, sharks and seabirds. For example, this area is one of two feeding areas for blue whales and humpback whales, known to arrive when significant krill aggregations form.
Big Horseshoe Canyon	South-east	**An area of high productivity and aggregations of marine life** The Big Horseshoe Canyon is located south of the coast of eastern Victoria and is the easternmost arm of the Bass Canyon systems. Steep, rocky slopes provide hard substrate habitat for attached large megafauna. Sponges and other habitat forming species provide structural refuges for benthic fishes, including the commercially important species like the pink ling. Further, it is the only known temperate location of the stalked crinoid *Metacrinus cyaneu*.

Key Ecological Feature	Marine Region	Major Conservation Values
Shelf rocky reefs	Temperate-east	**Unique sea-floor feature with ecological properties of regional significance** The shelf rocky reefs of the temperate east marine region occur along the continental shelf south of the Great Barrier Reef. The KEF supports a variety of benthic communities from algae-dominated sea-floor communities to those dominated by attached invertebrates (including large sponges, moss animals and soft corals). These invertebrates create complex habitats that support a multitude of animals including crabs, snails, worms and starfish. The habitats also contain a diverse assemblage of temperate and tropical species, whose distributions are strongly regulated by the East Australian Current. Note: The temperate-east shelf rocky reef KEF is not spatially delineated within the NCVA.
Canyons on the eastern continental slope	Temperate-east	**Unique seafloor feature with enhanced ecological functioning and integrity and biodiversity, which apply to both its benthic and pelagic habitats** The Canyons on the eastern continental slope have a powerful influence on the diversity and abundance of species, driven by the combined effects of steep and rugged topography, ocean currents, sea-floor types and nutrient availability. They significantly contribute to the overall habitat diversity of the sea floor, by providing hard surfaces in depth zones where soft sediment habitats are dominant. Large benthic animals such as sponges and feather stars are abundant, with particularly high diversity found in the upper slope regions (150–700 m). Canyons also create localised changes in productivity in the water column above them, providing feeding opportunities for a range of species, many of which are commercially important or threatened.

Source: DCCEEW, 2023s

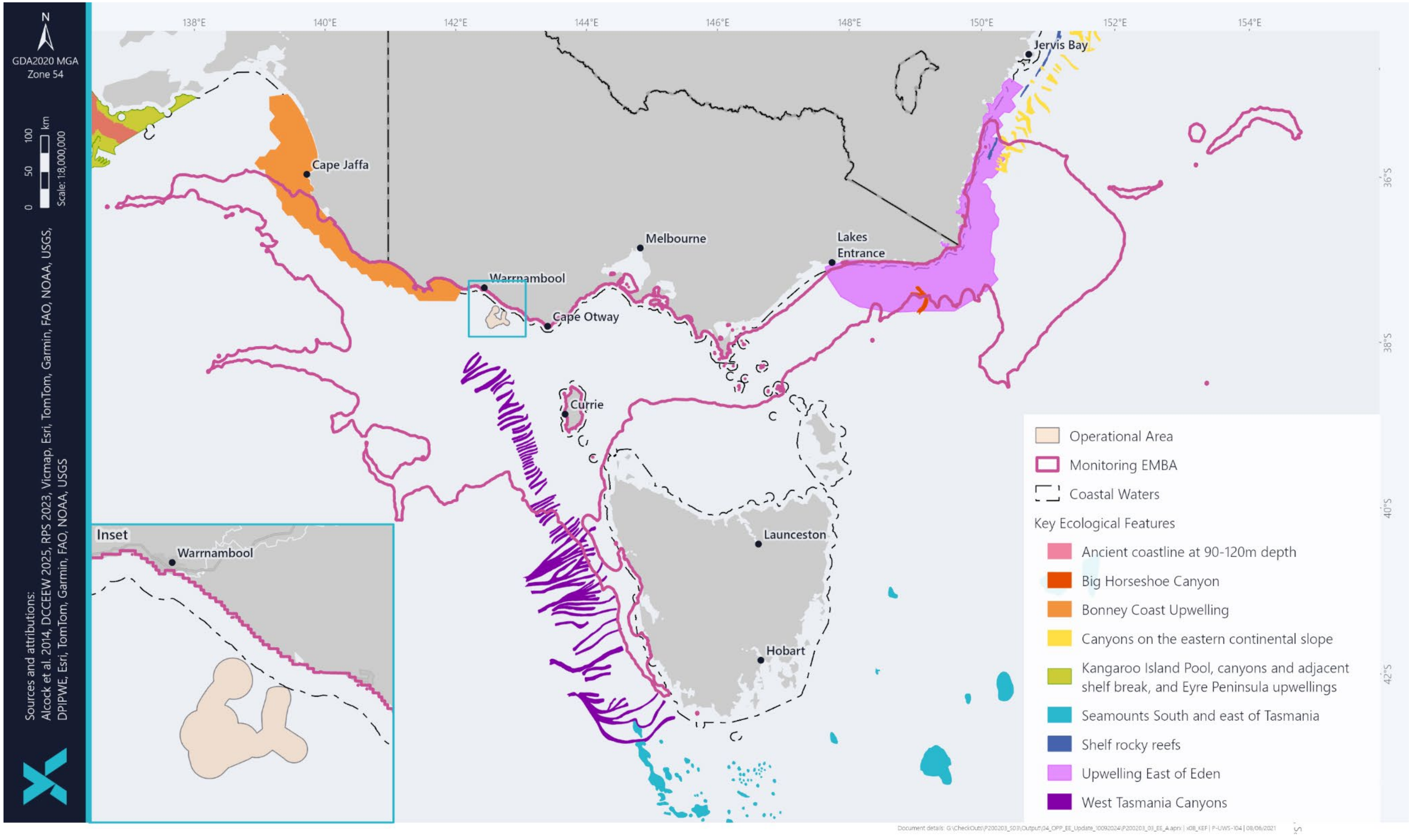


Figure 6-63: Key Ecological Features located within the monitoring EMBA

6.6.7 Threatened Ecological Communities

Ecological communities are groups of native plants, animals and other organisms that naturally occur and interact in a unique habitat. These communities often provide wildlife corridors and / or habitat refuges for many plant and animal species, including threatened species and other Australian plants and animals that are in decline. An ecological community become threatened when it is at risk of extinction. In Australia Threatened Ecological Communities (TECs) can be listed as critically endangered, endangered or vulnerable.

Several TECs are located along the coastline and within the nearshore waters of Victoria, Tasmania, NSW and South Australia. No TECs are intersected by the operational area, however a total of 13 TECs were identified within the monitoring EMBA:

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community
- Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland ecological community
- Giant Kelp Marine Forests of South East Australia
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain
- Illawarra and south coast lowland forest and woodland ecological community
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia
- Lowland Grassy Woodland in the South East Corner Bioregion
- Natural Damp Grassland of the Victorian Coastal Plains
- Natural Temperate Grassland of the Victorian Volcanic Plain
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains
- Subtropical and Temperate Coastal Saltmarsh
- Tasmanian Forests and Woodlands dominated by black gum or Brookers gum (*Eucalyptus ovata / E. brookeriana*)
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland

Of the TECs listed above, those with marine or shoreline features are described in Table 6-18 and displayed in Figure 6-64.

Table 6-18: Threatened Ecological Communities located within the monitoring EMBA

Threatened Ecological Community	State	EPBC Listing Status	Major Conservation Values
Giant Kelp Marine Forests of South East Australia	Victoria, South Australia, Tasmania	Endangered	Kelp forests are shallow coastal ecological communities of cold-water regions that extends between the ocean floor and ocean surface exhibiting a 'forest-like' structure (DSEWPaC, 2012b). The TEC occurs on rocky substrate along the east and south coastlines of Tasmania; some patches may also occur in the coastal waters of western and northern Tasmania, south-eastern South Australia, and Victoria (TSSC, 2012a). The TEC is characterised by a closed to semi-closed surface or subsurface canopy of *Macrocystis pyrifera* that hosts a diverse range of organisms occupying its benthic, pelagic and upper-canopy layers (TSSC, 2012a). *M. pyrifera* is the only species of kelp to provide this three-dimensional structure from the sea floor to the sea surface (TSSC, 2012a). The high primary and secondary productivity of the giant kelp forests create and provide a number of ecosystem

Threatened Ecological Community	State	EPBC Listing Status	Major Conservation Values
			services to the local environment including settlement habitat for juvenile life stages of commercially important fisheries, improvements in local water quality conditions and coastal protection via buffering strong wave conditions from reaching the shore (TSSC, 2012a).
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Victoria, NSW	Critically Endangered	The TEC is a complex of rainforest and coastal vine thickets on the east coast of Australia influenced by its proximity to the sea (typically occurring with 2 km) (DoE, 2015b; TSSC, 2008). The littoral rainforests and coastal vine thickets of Eastern Australia occur from Princess Charlotte Bay, Cape York Peninsula to the Gippsland Lakes in Victoria as well as on offshore islands on the east coast. The TEC occurs as a series of naturally disjunct and localised stands, on a range of landforms which have been influenced by coastal processes including dunes and flats, headlands and sea-cliffs (TSSC, 2008). The unique habitat and provides important stepping stones along the eastern Australian coast for various migratory and marine birds like the Gould's petrel (TSSC, 2008).
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Victoria	Endangered	The TEC is a collection of native plants, animals and micro-organisms associated with the dynamic salt-wedge estuary systems that occur within the temperate climate, microtidal regime (<2 m), high wave energy coastline of western and central Victoria (DoEE, 2018a). There are currently 25 estuaries with this listing which are defined by the border between South Australia and Victoria and the most southerly point of Wilsons Promontory (DoEE, 2018a). A sufficient hydrological regime is essential to the survival of the TEC to ensure salinity stratification; salt-wedge dynamics; connectivity; and ecological function between the estuary, river and ocean (and floodplain wetland components where applicable). These estuaries are influenced by seasonal longshore sand drift and characterised by intermittent mouths (sometimes open and sometimes closed) (DoEE, 2018a). The ecological community associated with this TEC is characterised by estuarine taxa, with associated components of coastal, estuarine, brackish and freshwater taxa that may reside in the estuary for periods of time and/or utilise the estuary for specific purposes (e.g., reproduction, feeding, refuge, migration) (DoEE, 2018a).
Subtropical and Temperate Coastal Saltmarsh	Victoria, Tasmania, NSW, SA	Vulnerable	The TEC spans 6 states and occurs on islands within its geographic range. It occurs within a relatively narrow margin along the southern and eastern Australian coast, within the subtropical and temperate climatic zones (DSEWPaC, 2013c). The physical environment for the ecological community is coastal areas under regular or intermittent tidal influence where it is typically restricted to the upper intertidal environment. The TEC consists mainly of salt-tolerant vegetation (halophytes) including grasses, herbs, sedges, rushes and shrubs (DSEWPaC, 2013c). A wide range of infaunal and epifaunal invertebrates and temporary inhabitants such as prawns, fish and birds (and can often constitute important nursery habitat for fish and prawn species) (DSEWPaC, 2013c). Many species of non-vascular plants are also found in saltmarsh, including

Threatened Ecological Community	State	EPBC Listing Status	Major Conservation Values
			epiphytic algae, diatoms and cyanobacterial mats (DSEWPaC, 2013c). The dominant marine residents are benthic invertebrates, including molluscs and crabs that rely on the sediments, vascular plants, and algae.
Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland	NSW	Endangered	The TEC occurs in coastal catchments of sub-tropical, sub-humid and temperate climatic zones from Curtis Island, north of Gladstone, in QLD to Bermagui in southern NSW. Typically, the TEC is found within 30 km of the coast at elevations of <20 m above sea-level where groundwater is saline or brackish (DoEE, 2018b). Associated habitats include coastal flats, floodplains, drainage lines, lake margins, wetlands and estuarine fringes where soils are at least occasionally saturated, water-logged or inundated (DoEE, 2018b). The TEC is often found in association with other vegetation types such as coastal saltmarsh, mangroves, freshwater wetlands, littoral rainforests or swamp sclerophyll forests in a 'mosaic' of coastal floodplain communities (DoEE, 2018b).

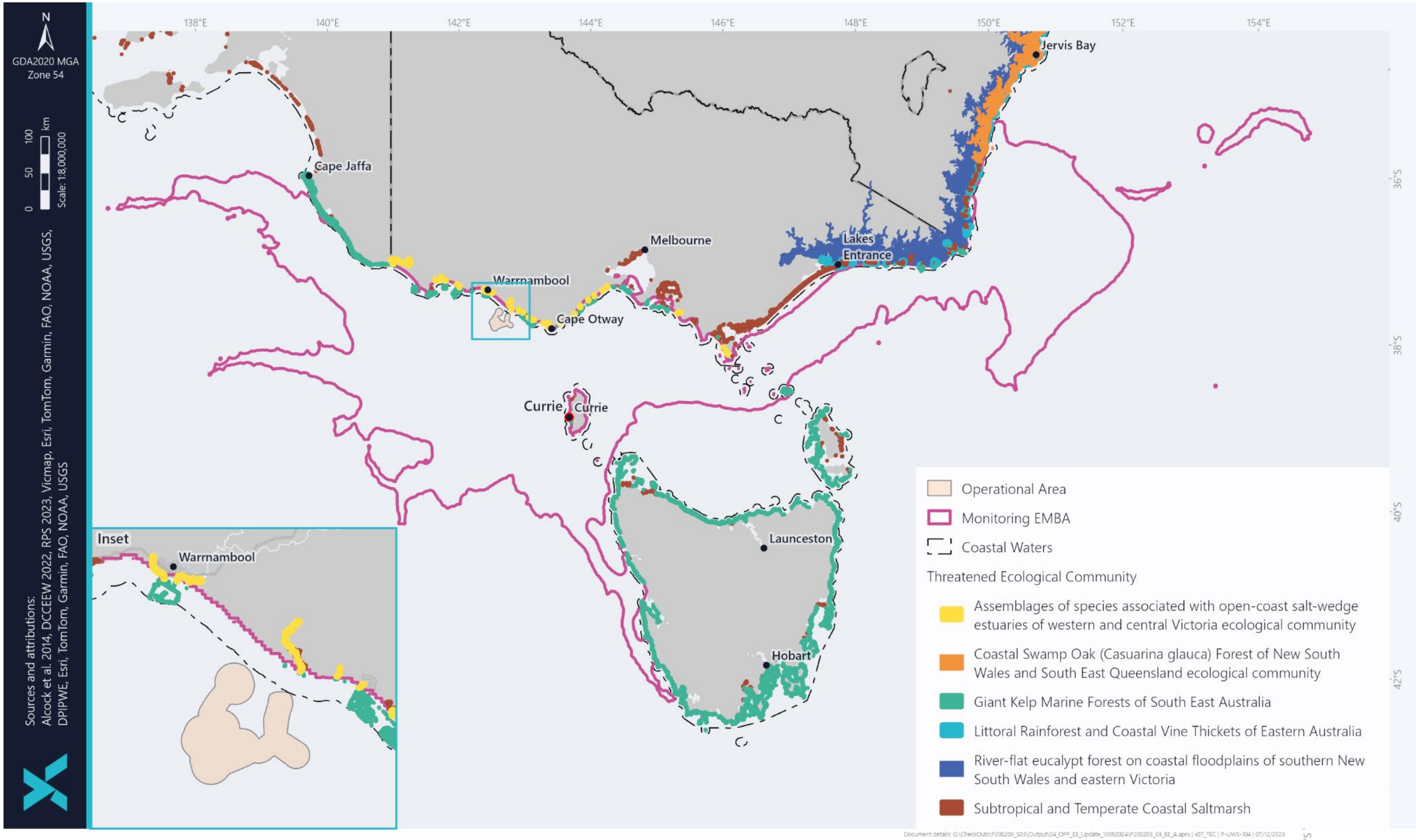


Figure 6-64: Threatened Ecological Communities located within the monitoring EMBA

6.7 Socio-Economic Environment

6.7.1 Coastal Settlements

Over 80% of the population in Australia live within 50 km of the coast (Hugo et al., 2013). Coastal hubs of Western Victoria are connected via the great Ocean Road with is a historical and popular tourist route. Key coastal hubs within and adjacent to the Otway Region are described below and displayed in Figure 6-65.

6.7.1.1 Portland

Portland is located within the Glenelg Shire on the southwest coast of Victoria. The 2021 Australian census estimated a total population of 10,450 with a median age of 47 (ABS, 2021). Of the total population 52.3% are in the workforce with 199 people employed by the Agriculture, Forestry and Fishing industry (ABS, 2021).

Portland is Victoria's western-most commercial port and is a deep-water port with breakwaters sheltering a marina and boat ramp. Commercial fishing in Portland includes a number of local and visiting boats, including trawling, targeting abalone, sharks, lobsters and giant crab. Two shops in Portland sell trawl fish and lobster fresh off the boats while squid and abalone are processed locally at a factory (Portland Tourist Association, 2022).

The southern right whales and blue whales can often be seen off the coast of Portland, typically over the winter months. The seasonal Bonney coast upwelling which occurs just off the coast of Portland is a known foraging location for the blue whale. Further, between September and March, Portland is home to the Australian gannet and cape gannet.

6.7.1.2 Warrnambool

Warrnambool is located within the Warrnambool Shire on the southwest coast of Victoria. The 2021 Australian census estimated a total population of 35,406 with a median age of 40 (ABS, 2021). Of the total population 69.8% are in the workforce with 237 people employed by the Agriculture, Forestry and Fishing industry (ABS, 2021).

Historically the Port of Warrnambool was an important port for cargo shipments and whaling. A breakwater was constructed in 1890 in an attempt to provide shelter from the waves and currents of the Bass Strait (Warrnambool City Council, 2023). Today the major function of the port is to provide safe haven and service to the commercial fishing industry, and recreational fishing and boating interests. Warrnambool also hosts an established tourism industry with holiday parks and attractions, as well as a competitive, community-focussed surf-life-saving club. The most sheltered section of the port waters inside the breakwater are used for exercising horses, while the Warrnambool racecourse hosts large meets through the year.

Offshore Warrnambool is within the designated biologically important area for the southern right whale and has long been associated with the species. Specifically, Logans Beach which is a known calving ground for the species and has an exclusion zone between 1 June and 31 October each year prohibiting vessels in the area. There is substantial local interest and tourism based on the seasonal occurrence and sightings of southern right whales in the winter months; there is an established 'winter whale trail' which identifies where whales can be observed and other notable location, spanning from Portland to Warrnambool (Glenelg Shire Council, 2024)

6.7.1.3 Port Campbell

Port Campbell is located with the Corangamite Shire and is the nearest town to East Coast Project. The 2021 Australian census estimated a total population of 440 with a median age of 42 (ABS, 2021). Of the total population 61.6% are in the workforce with 45 people employed by the Agriculture, Forestry and Fishing industry (ABS, 2021).

Port Campbell has both harbour and fish processing facilities but is not suitable for use by large vessels. The Port Campbell Jetty is a popular location for recreational fishing. The town is a popular tourist destination with an associated National Park (Port Campbell National Park) and proximity to the Great Ocean Roads most popular stops (i.e., Twelve Apostles, London Bridge).

The NCVA identifies offshore Port Campbell within the reproduction BIA for the southern right whale (NCVA, 2024). The whales aggregate along the coastline between Port Campbell and Portland and perform behaviours such as mating, calving and nursing (DCCEEW, 2022a).

6.7.1.4 King Island

King Island is located in the Bass Strait between Victoria and Tasmania. The 2021 Australian census estimated a total population of 1,617 with a median age of 45 (ABS, 2021). Of the total population 63.8% are in the workforce with 189 people employed by the Agriculture, Forestry and Fishing industry (ABS, 2021).

King Island is a major trading centre for some of Australia's highest value wild-catch fisheries primarily targeting southern rock lobsters (*Jasus edwardsii*), greenlip abalone (*Haliotis laevigata*), blacklip abalone (*Haliotis rubra*) and giant crabs (*Pseudocarcinus gigas*) (Norwood, 2014). Large quantities of bull kelp (*Durvillaea potatorum*) washed up on the coasts of King Island is also commercially harvested for sale domestically and for export (Norwood, 2014). King Island's fishing industry employs 2.5% of the workforce (ABS, 2021).

Offshore waters surround King Island are known foraging areas for pygmy blue whales based on the overlap with known foraging area BIA and a migratory BIA for the southern right whale (DCCEEW, 2022).

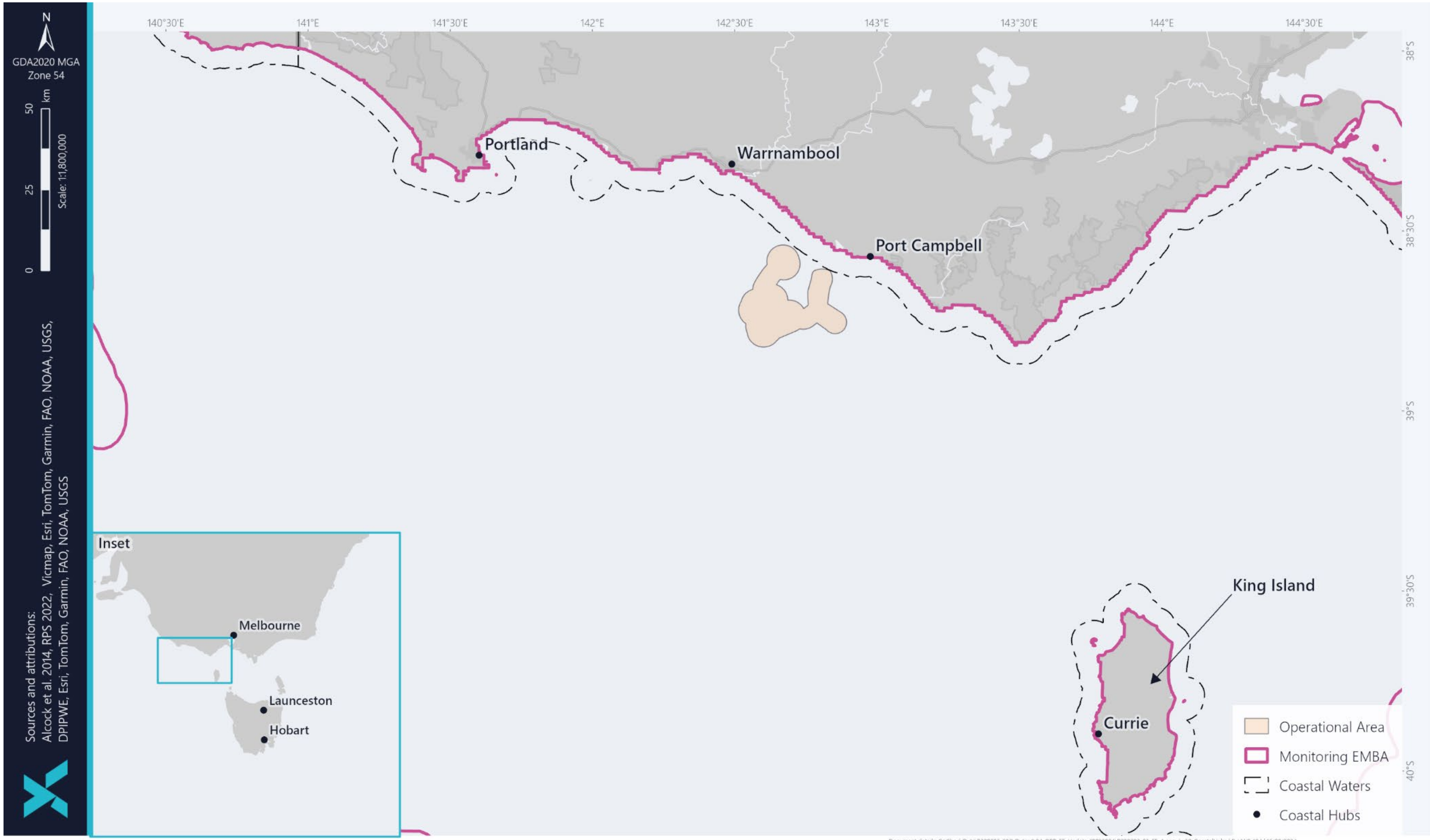


Figure 6-65: Coastal hubs within and adjacent to the Otway Region

6.7.2 Commercial Fisheries

6.7.2.1 Commercial Fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA), with the fisheries typically operating within 3 nm to 200 nm offshore (i.e., to the extent of the Australian Fishing Zone).

Commonwealth-managed commercial fisheries with potential to occur within the operational area and/or associated monitoring EMBA are detailed in Table 6-19. Overlap with reported fishing activity for each relevant Commonwealth fishery is displayed in Figure 6-66 to Figure 6-76.

6.7.2.2 State Fisheries -Victoria

Victorian fisheries are managed by an independent statutory authority, Victorian Fisheries Authority (VFA). The VFA work closely with stakeholder to ensure sustainable fishing, clear resource access and increased economic, social and cultural value.

Victorian state-managed commercial fisheries with potential to occur within the operational area and/or associated monitoring EMBA are detailed in Table 6-20. Where data is available overlap with reported fishing activity for each relevant Victorian fishery is displayed in Figure 6-77 to Figure 6-83. Note that where data is confidential fishing activity figures have not been provided.

6.7.2.3 State Fisheries – Tasmania

Tasmanian fisheries are managed by the state government under the jurisdiction of the Department of Natural Resources and Environment in accordance with the *Living Marine Resources Management Act 1995*.

Tasmanian state-managed commercial fisheries with potential to occur within the operational area and/or associated monitoring EMBA are detailed in Table 6-21. Where data is available overlap with reported fishing activity for each relevant Tasmanian fishery is displayed in Figure 6-85 and Figure 6-86. Note that where data is confidential fishing activity figures have not been provided.

6.7.2.4 State Fisheries – New South Wales

NSW fisheries are managed by the state government under the jurisdiction of the Department of Primary Industries in accordance with the *Fisheries Management Act 1994*.

NSW state-managed commercial fisheries with potential to occur within the operational area and/or associated monitoring EMBA are detailed in Table 6-22. Where data is available overlap with reported fishing activity for each relevant NSW fishery is displayed in Figure 6-88 to Figure 6-94. Note that where data is confidential fishing activity figures have not been provided.

6.7.2.5 State Fisheries – South Australia

South Australian fisheries are managed by the state government under the jurisdiction of the Department of Primary Industries and Regions (PIRSA) in accordance with the *Fisheries Management Act 2007*.

South Australian state-managed commercial fisheries with potential to occur within the operational area and/or associated monitoring EMBA are detailed in Table 6-23. Where data is available overlap with reported fishing activity for each relevant South Australian fishery is displayed in Figure 6-95 to Figure 6-98. Note that where data is confidential fishing activity figures have not been provided.

Table 6-19: Commercial Fisheries with Management Areas overlapped by the monitoring EMBA – Commonwealth

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and Vessels	Comments	Operational Area Presence	Monitoring EMBA Presence
Bass Strait Central Zone Scallop Fishery	Scallops (*Pecten fumatus*)	Typically: July to 31 December each year	Commonwealth waters between Victoria and Tasmania	Towed dredge fishing method. Fishery managed via seasonal/area closures and total allowable catch (TAC) controls together with quota statutory fishing rights (35 permits for the 2021 and 2022 season) and individual transferrable quotas. 10 vessels were active in the 2022 season	Scallop spawning occurs from winter to spring (June to November). The timing is dependent on environmental conditions such as wind and water temperature (Sause et al., 1987). Fishery can operate down to 120m water depth but prefers water depth of 70-80 m. Value of Fishery: $1.4 million for 2022 season.	Unlikely Between the 2016-2022 seasons all recorded fishing intensity was concentrated to the east of Flinders Island and King Island, outside of the operational area. (Figure 6-66)	Likely
Eastern Tuna and Billfish Fishery	Albacore tuna (*Thunnus alulunga*), bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), broadbill swordfish (*Xiphias gladius*), striped marlin (*Kaijikia audux*)	12-month fishing season: Commences 1 January each year	Commonwealth waters from Cape York (Queensland) to the Victoria – South Australia border	Pelagic longline, minor line (such as handline, troll, rod and reel). Currently there are a total of 79 longline boat Statutory Fishing Rights, and 83 minor line Statutory Fishing Rights. Vessels operating on 2021 and 2022 season – 34 and 36 longline and 8 and 6 minor-line.	Spawning occurs through most of the year in water temperatures greater than 26°C (Wild Fisheries Research Program, 2012). Value of Fishery: $34.7 million for 2022 season.	Unlikely Between the 2016-2022 seasons the majority of recorded fishing intensity was concentrated off the coast of NSW and QLD and the southern coast of Tasmania. There was no recorded activity off the western coast of Victoria. (Figure 6-67)	Likely
Western Tuna and Billfish Fishery	Bigeye tuna (*Thunnus obesus*), yellowfin tuna (*Thunnus albacares*), broadbill swordfish (*Xiphias gladius*) and striped marlin (*Tetrapturus audux*)	12-month fishing season: Commences 1 February each year	Commonwealth waters west from the tip of Cape York in Queensland, around Western Australia, to the border between Victoria and South Australia. Fishing occurs in both the Australian Fishing Zone and adjacent high seas.	Longline and minor line (including handline, troll, rod and reel) As of 2022 season there were 93 boat statutory fishing rights. Two longline vessels and 3 minor line vessels were active during the 2022 season.	The species caught in the fishery are also caught by many other countries. Australia's catch of tuna and billfish is a very small part of the total catch internationally Value of Fishery: Confidential	None The management area of the fishery does not overlap with the operational area. (Figure 6-68)	Unlikely In the 2022 season there was no recorded catch within South Australian waters.
Skipjack (eastern) Fishery NOT ACTIVE	Skipjack tuna (*Katsuwonus pelamis*)	12-month fishing season: previously would commence 1 February each year	Extends from the border of Victoria and South Australia to Cape York, Queensland.	N/A	There has been no fishing effort within the Skipjack fishery since the 2008-09 season, due to availability of target species and prices received for the product	None	None
Small Pelagic Fishery	Jack mackerel (*Trachurus declivis, T. symmetricus, T. murphyi),* blue mackerel (*Scomber australasicus*), redbait (*Emmelichthys nitidus*) and Australian sardine (*Sardinops sagax*)	12-month fishing season: Commences 1 May each year	Commonwealth waters from southern Queensland to southern Western Australia	Midwater trawl and purse seine methods are permitted. There were 4 purse seine and 2 midwater trawl vessels active in the 2021 and 2022 season.	The fishery is divided into two sub areas, east and west of latitude 146°30' due to evidence of separate stocks both east and west of Tasmania for jack mackerel, blue mackerel and redbait Value of Fishery: Confidential due to small number of fishers	Unlikely Between the 2016-2022 seasons the majority of recorded fishing intensity was concentrated along the southern NSW coastline. There was no recorded activity off the western coast of Victoria. (Figure 6-69)	Likely
Southern and Eastern Scalefish and Shark Fishery – Commonwealth Gillnet and Shark Hook Sector	Elephantfish (*Callorhinchus milii*), gummy shark (*Mustelus antarcticus*), sawsharks (*Pristiophorus cirratus, P.nudipinnis*) and school shark (*Galeorhinus galeus*)	12-month fishing season: Commences 1 May each year	Extends from the NSW and Victorian border west to the South Australian and Western Australian border	Demersal gillnet, demersal longline, auto-longline Vessels operating in the 2021 and 2022 season – 29 and 30 gillnet and 55 and 57 shark hook.	Since 2007 – after the closure to trawling of most SESSF waters deeper than 700 m – effort has become increasingly concentrated on the shelf (to 200 m) rather than on the slope Most fishing in the using nets occurs in Bass Strait, while most fishing using hooks occurs off South Australia	Potential In the 2022 season the shark Gillnet sub-sector the majority of recorded fishing intensity for the gillnet sector occurred around the Furneaux Islands and along the eastern Victorian coastline. However, there was recorded activity along the entire Victorian coastline. Between the 2016-2022 seasons high fishing intensity occurred along the eastern coast of Victoria and around the Furneaux Islands, however low to moderate activity was recorded along the	Likely

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and Vessels	Comments	Operational Area Presence	Monitoring EMBA Presence
					Value of Fishery: $21.06 million for 2021 season. No value is provided for 2022 season.	western Victorian coastline within the operational area. (Figure 6-70) Between the 2016-2022 seasons the Shark Hook sub-sector recorded fishing intensity was concentrated along the south coast of SA and south of the Furneaux Islands. (Figure 6-71)	
Southern and Eastern Scalefish and Shark Fishery – Commonwealth Scalefish Hook Sector	Blue grenadier (*Macruronus novaezelandiae*), tiger flathead (*Neoplatycephalus richardsoni*), orange roughy (*Hoplostethus atlanticus*), pink ling (*Genypterus blacodes*), blue-eye trevalla (*Hyperoglyphe antarctica)* and eastern school whiting (*Sillago flindersi*)	12-month fishing season: Commences 1 May each year	Extends from the south-eastern Australia to the border between South Australia and Western Australia	Multi-gear fishery Vessels operating in the 2021 and 2022 season – 32 and 31 trawl, 19 and 18 danish-seine and 21 and 12 scalefish hook.	Since 2007 – after the closure to trawling of most SESSF waters deeper than 700 m – effort has become increasingly concentrated on the shelf (to 200 m) rather than on the slope Sector is reported with the Commonwealth Trawl Sector as it shares many target species Value of Fishery: $80 million for 2021 season. No value is provided for 2022 season.	Potential Between the 2016-2022 seasons recorded fishing intensity was concentrated along the continental shelf, particularly where the shelf wraps around Tasmania. (Figure 6-72)	Likely
Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector	Blue grenadier (*Macruronus novaezelandiae*), tiger flathead (*Neoplatycephalus richardsoni*), orange roughy (*Hoplostethus atlanticus*), pink ling (*Genypterus blacodes*), blue-eye trevalla (*Hyperoglyphe antarctica)* and eastern school whiting (*Sillago flindersi*)	12-month fishing season: Commences 1 May each year	Extends south from Barrenjoey Point in northern NSW to east of Kangaroo Island off South Australia	Multi-gear fishery Vessels operating in the 2021 and 2022 season – 32 and 31 trawl, 19 and 18 danish-seine and 21 and 12 scalefish hook	Since 2007 – after the closure to trawling of most SESSF waters deeper than 700 m – effort has become increasingly concentrated on the shelf (to 200 m) rather than on the slope Sector is reported with the Scalefish Hook Sector as it shares many target species Value of Fishery: $80 million for 2021 season. No value is provided for 2022 season.	Potential Between the 2016-2022 seasons recorded fishing intensity was concentrated along the continental shelf. With high intensity occurring along the shelf offshore southern NSW, wrapping around Tasmania and along the eastern and western Victorian shelf. (Figure 6-73 and Figure 6-74)	Likely
Southern Blue Fin Tuna Fishery	Southern bluefin tuna (*Thunnus maccoyii*)	12-month fishing season: Commences 1 December each year	Spans the Australian Fishing Zone	Pelagic longline, purse seine, and minor line (such as troll and poling) fishing gear is used in this fishery Vessels operating on 2021 and 2022 season – 20 and 22 longline and 7 and 8 purse seine.	Majority of catch occurs by purse seine in the Great Australian Bight Value of Fishery: $35.45 million for 2022 season.	Unlikely Between the 2016-2022 seasons recorded fishing intensity was concentrated in two locations. Off the coast of South Australia and off the southern coast of NSW. The only recorded activity within the Bass Strait was located along the southern coast of Tasmania. (Figure 6-75)	Likely
Southern Squid Jig Fishery	Gould's squid (*Nototodarus gouldi*)	12-month fishing season: Commences 1 January each year	Commonwealth waters of NSW, Victoria, Tasmania and South Australia, and in a small area of oceanic waters off southern Queensland	Single method: jigging Vessels operating in the 2021 and 2022 season – 8 and 6 * Squid are also caught in the Commonwealth Trawl Sector and GAB Trawl Sector of the Southern and Eastern Scalefish and Shark Fishery.	Vessels typically operate at night in continental shelf waters between 60–120 m water depth. Value of Fishery: $1.86 million for 2022 season.	Potential In the 2022 season recorded fishing intensity was concentrated within the Bass Strait. Between 2016-2022 seasons high fishing intensity occurred off the western Victoria coastline (outside of the operational area), north of King Island and on the east coast of Tasmania. However low activity was recorded within the operational area. (Figure 6-76)	Likely

Source: AFMA, 2023; ABARES, 2023

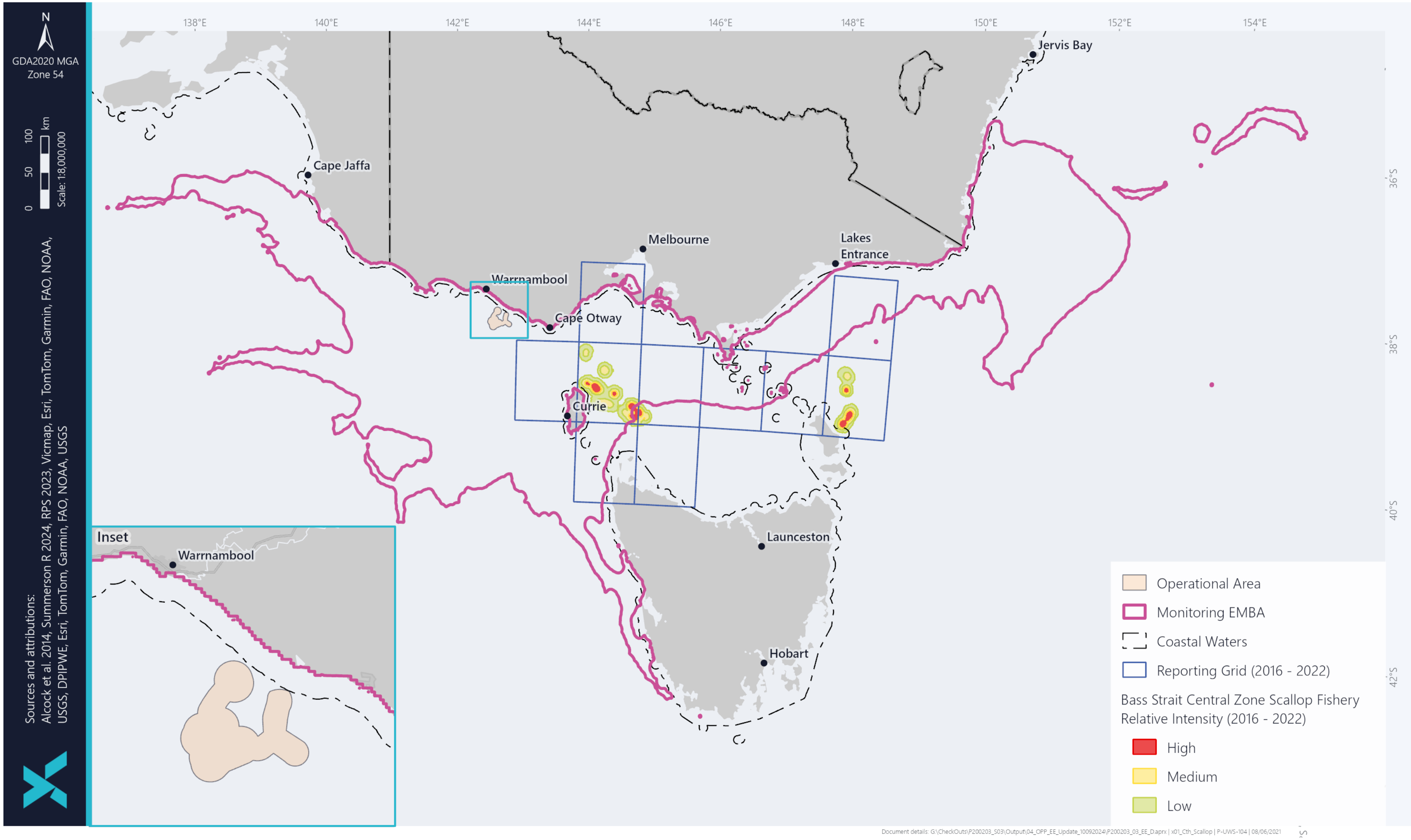


Figure 6-66: Bass Strait Central Zone Scallop Fishery and overlap with monitoring EMBA

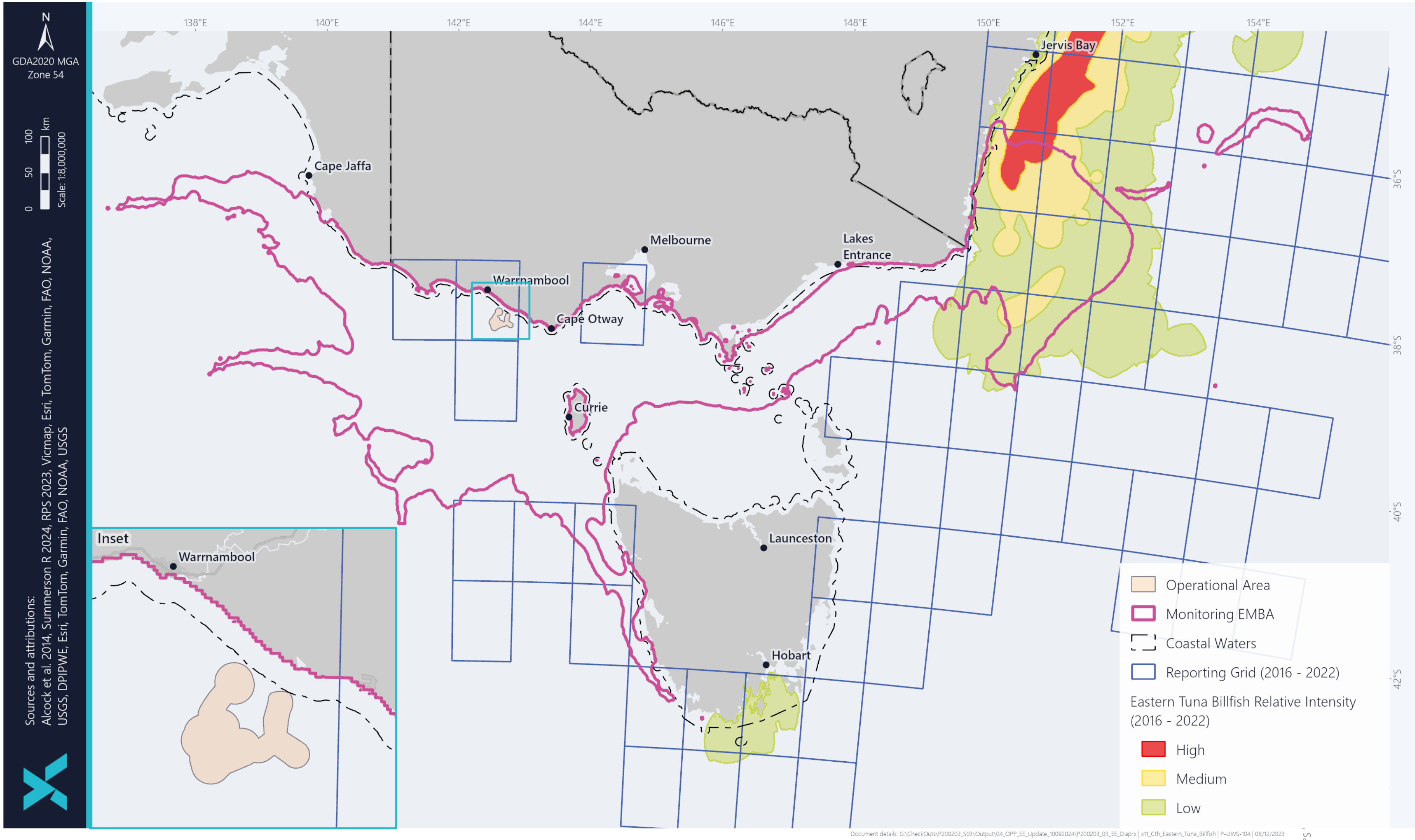


Figure 6-67: Eastern Tuna and Billfish fishery and overlap with monitoring EMBA

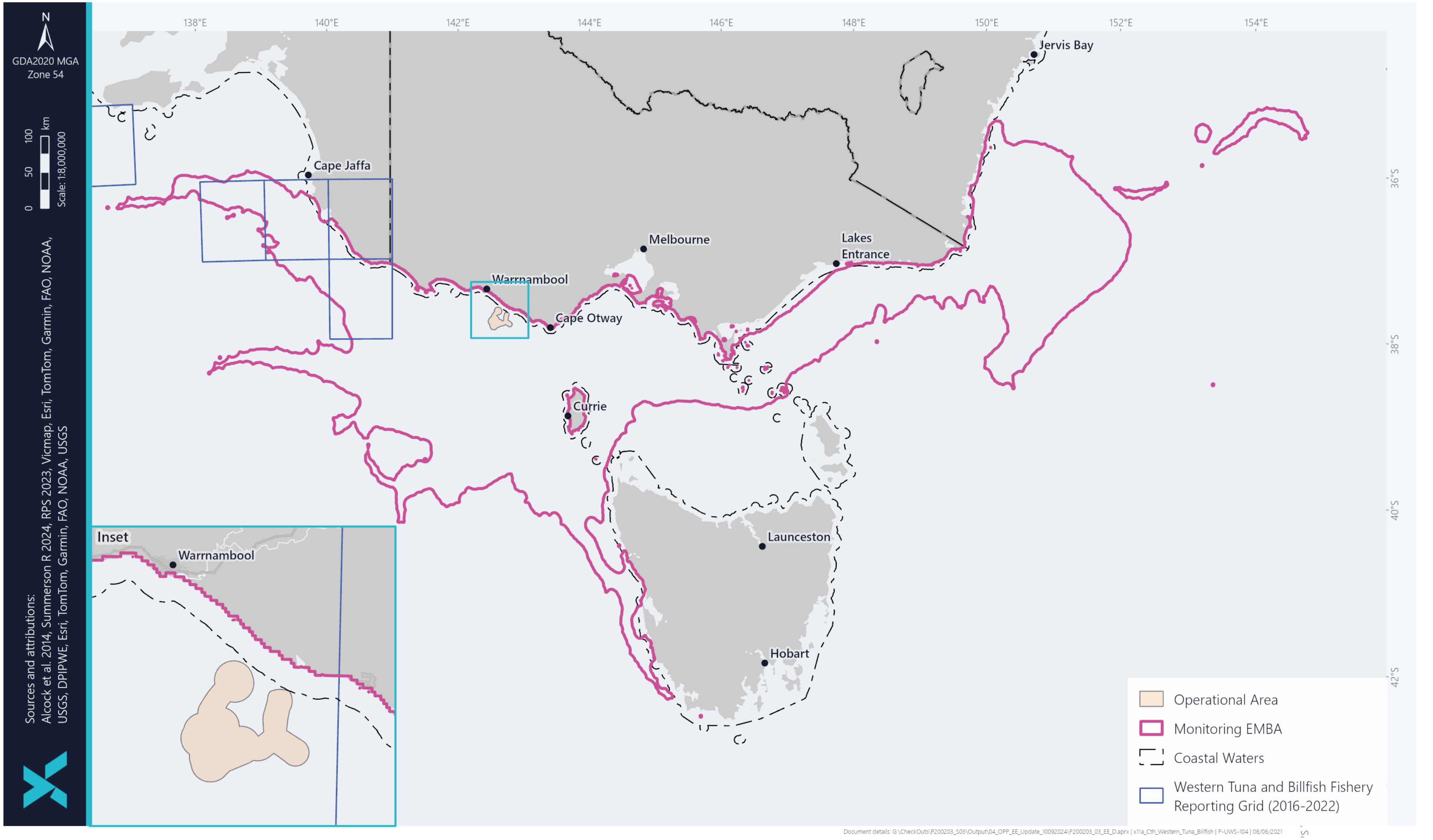


Figure 6-68: Western Tuna and Billfish Fishery and overlap with the monitoring EMBA

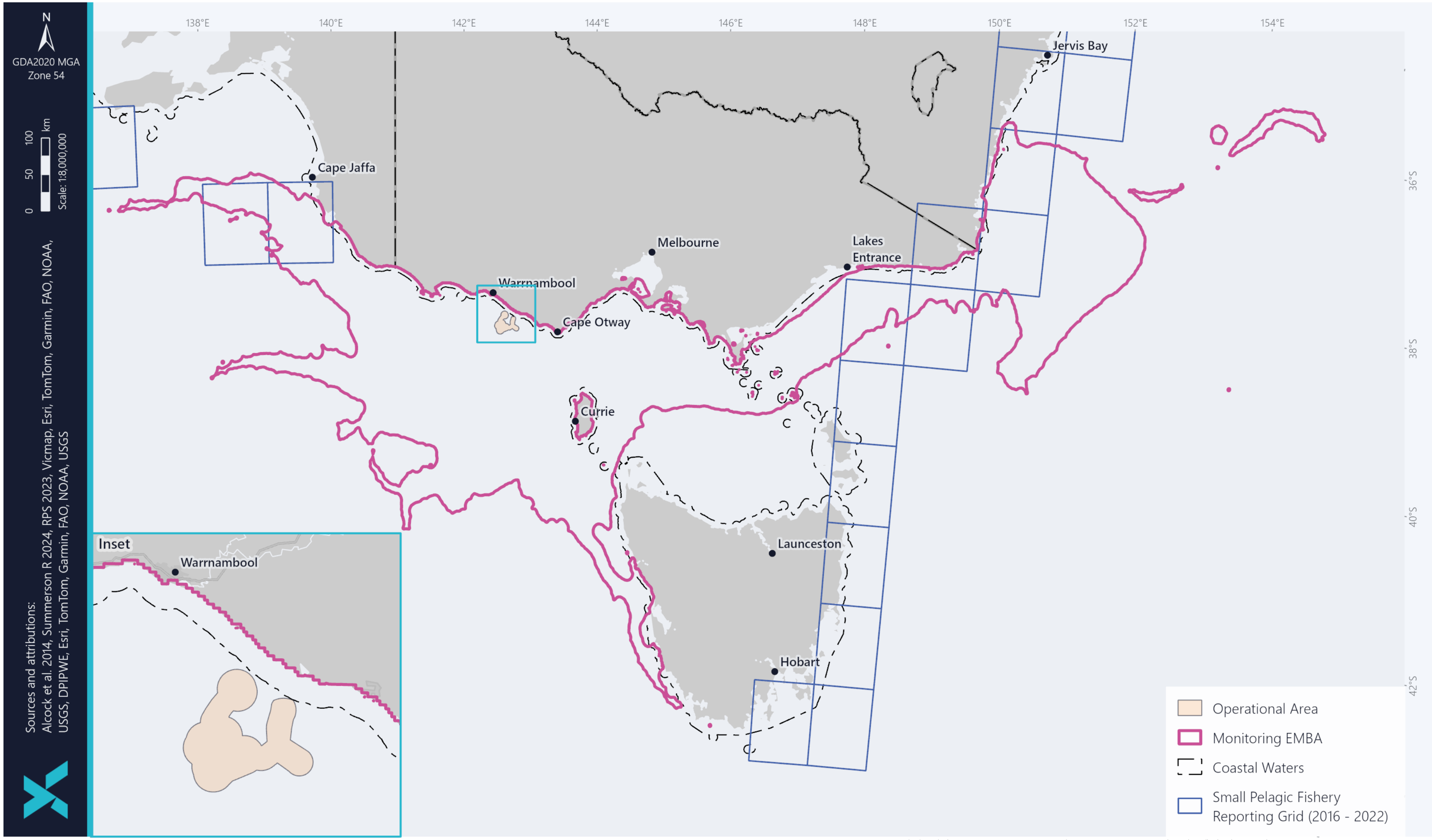


Figure 6-69: Small Pelagic Fishery and overlap with monitoring EMBA

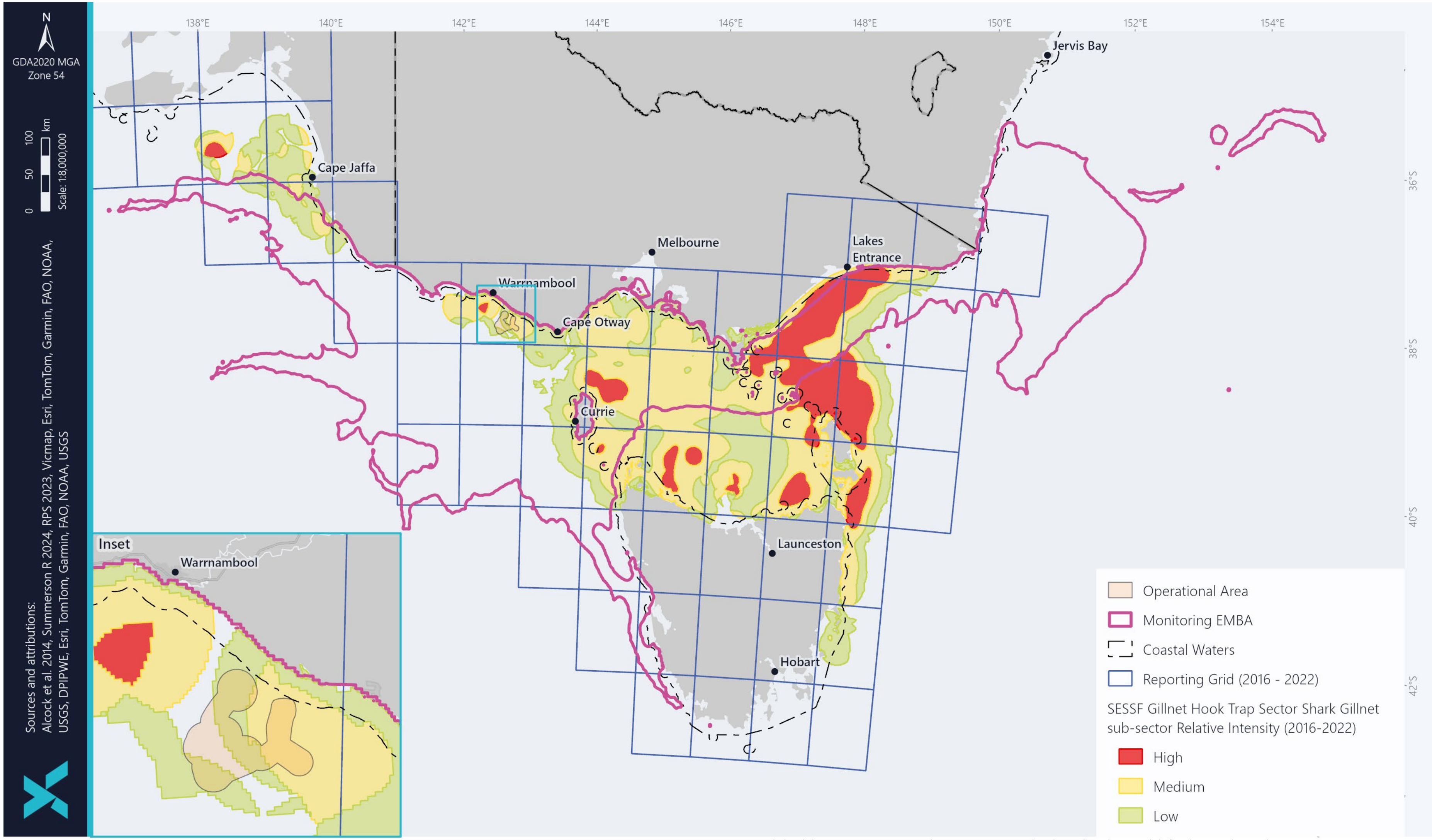


Figure 6-70: SESSF – Shark Gillnet sub-sector and overlap with the monitoring EMBA

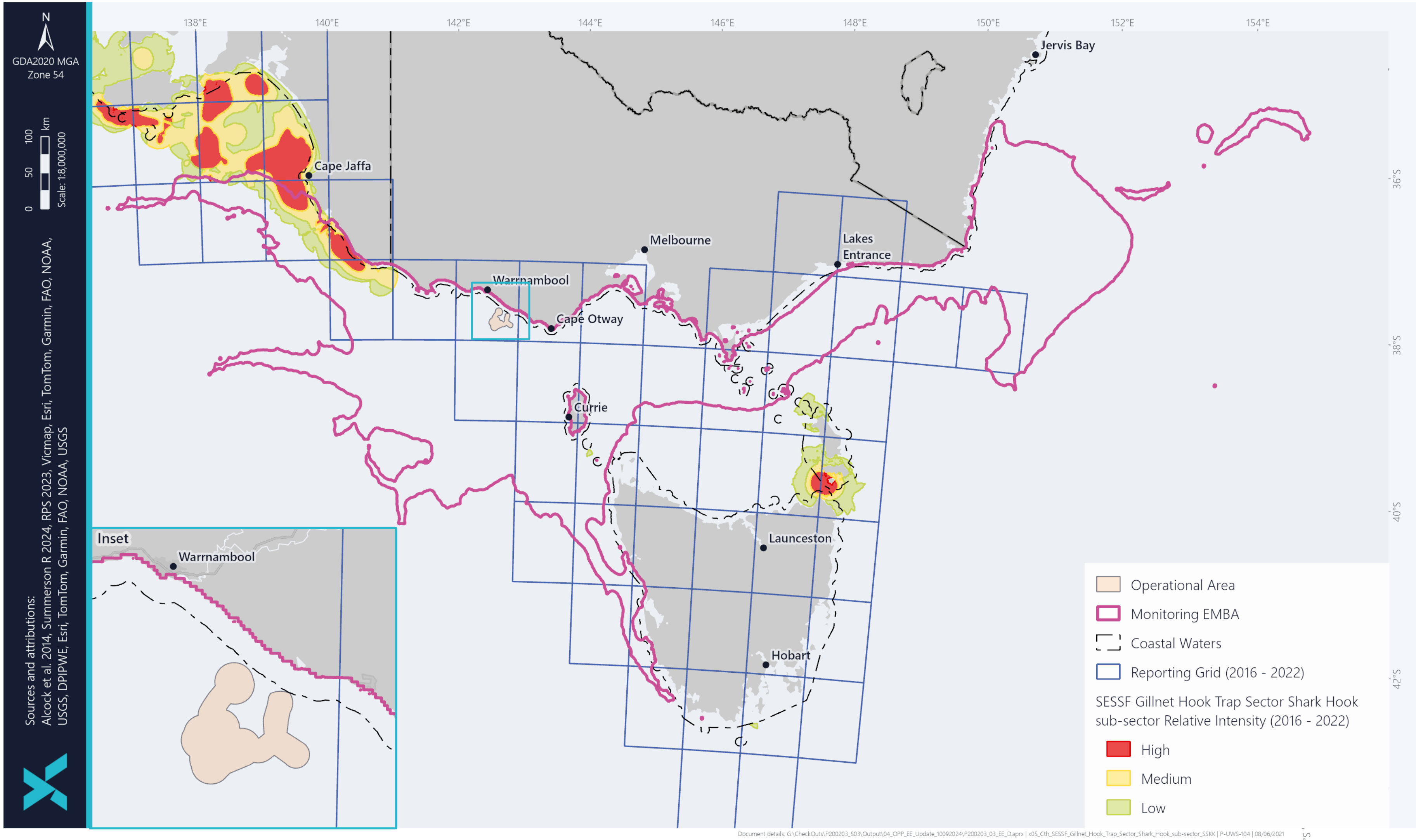


Figure 6-71: SESSF – Shark Hook sub-sector and overlap with the monitoring EMBA

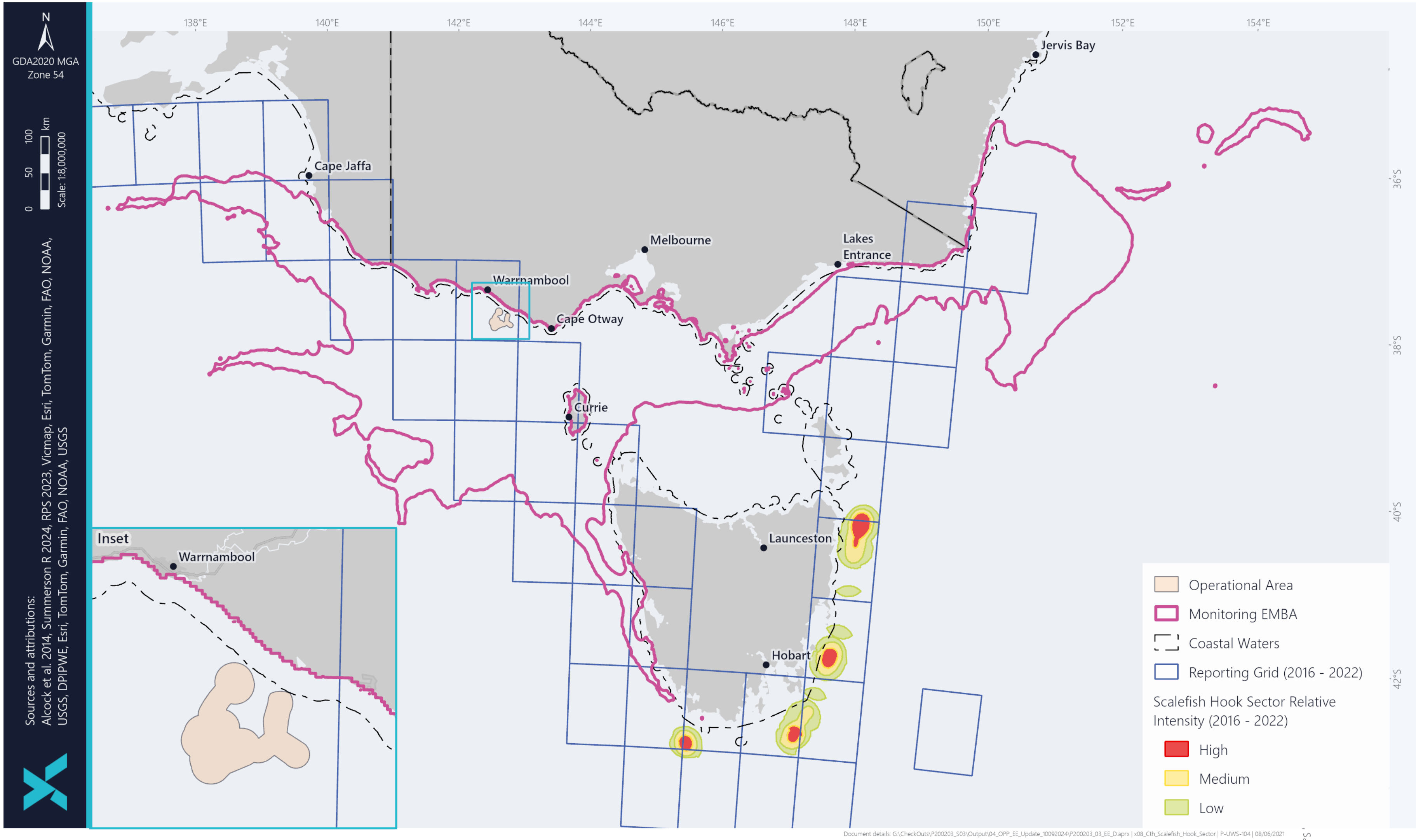


Figure 6-72: SESSF – Scalefish Hook Sector and overlap with the monitoring EMBA

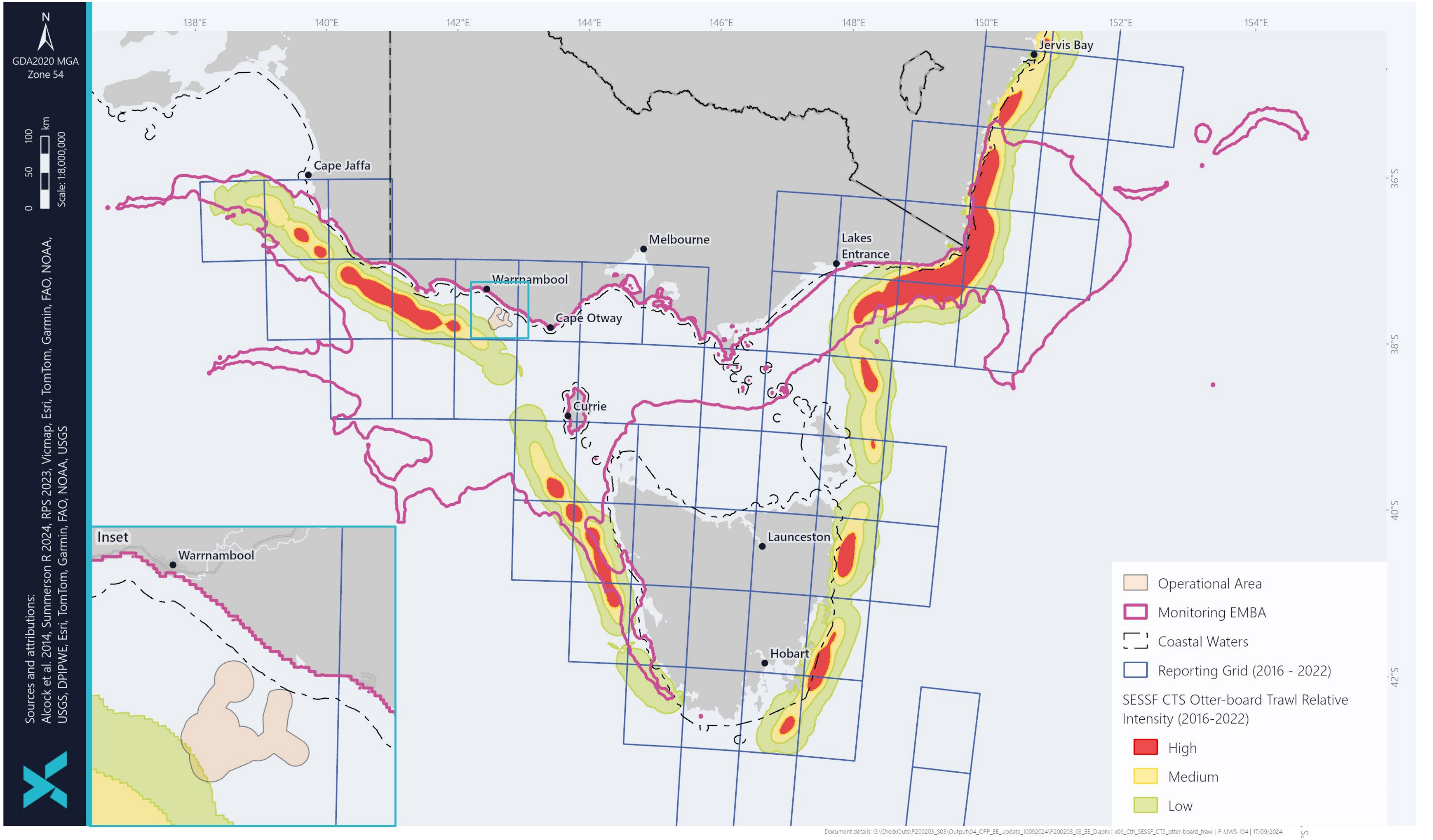


Figure 6-73: SESSF – CTS – Otter-board Trawl and overlap with the monitoring EMBA

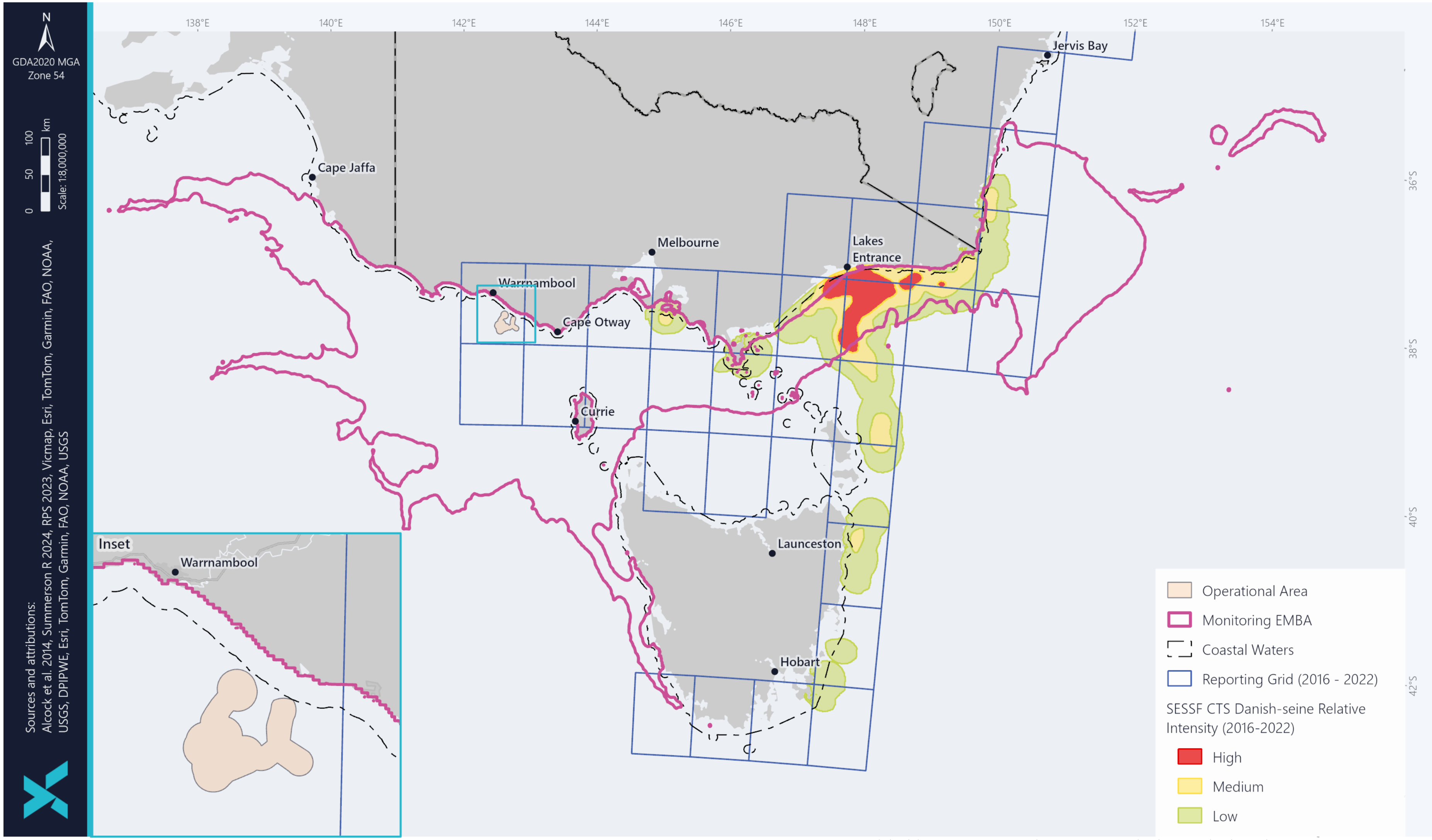


Figure 6-74: SESSF – CTS – Danish-seine and overlap with the monitoring EMBA

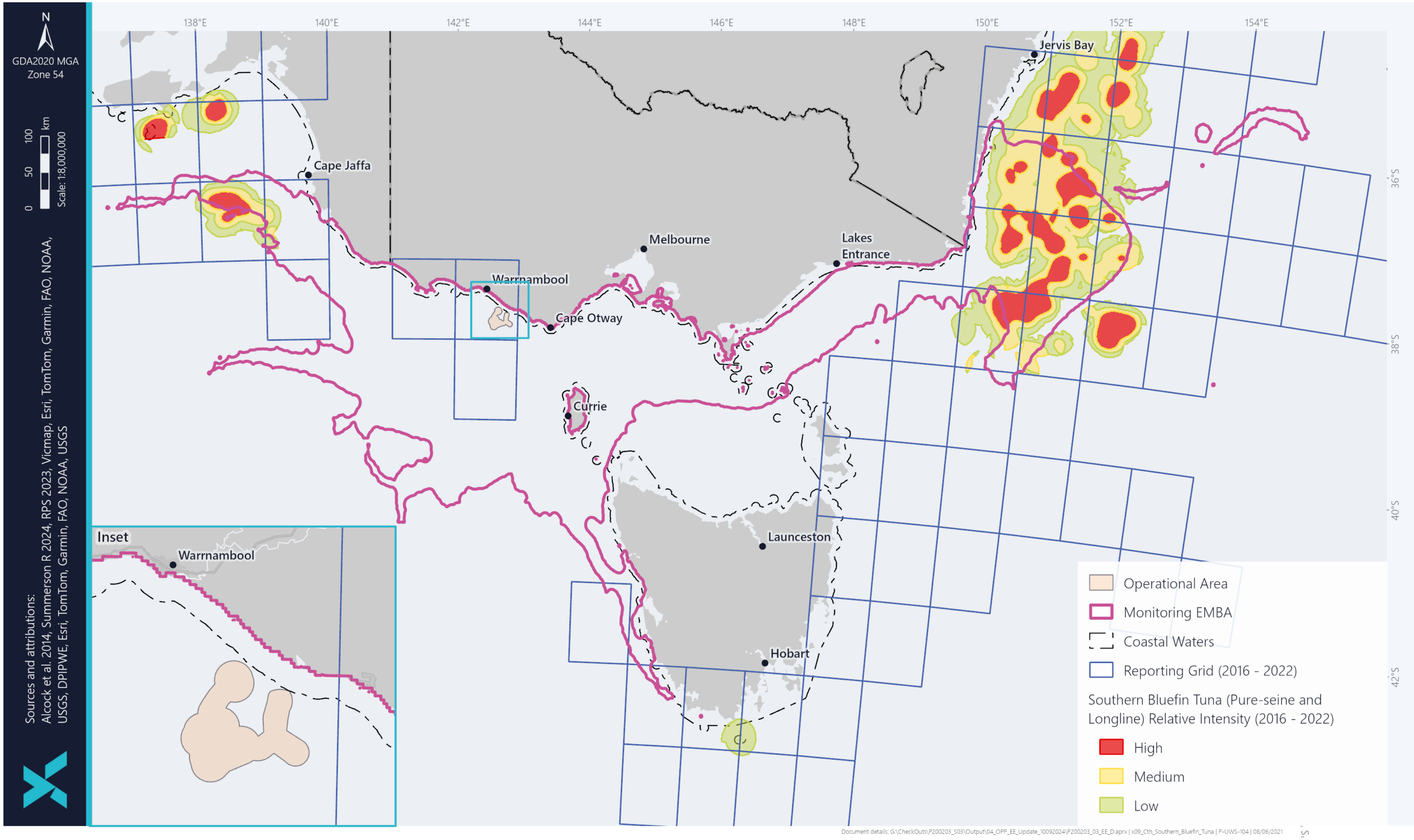


Figure 6-75: Southern Bluefin Tuna Fishery and overlap with the monitoring EMBA

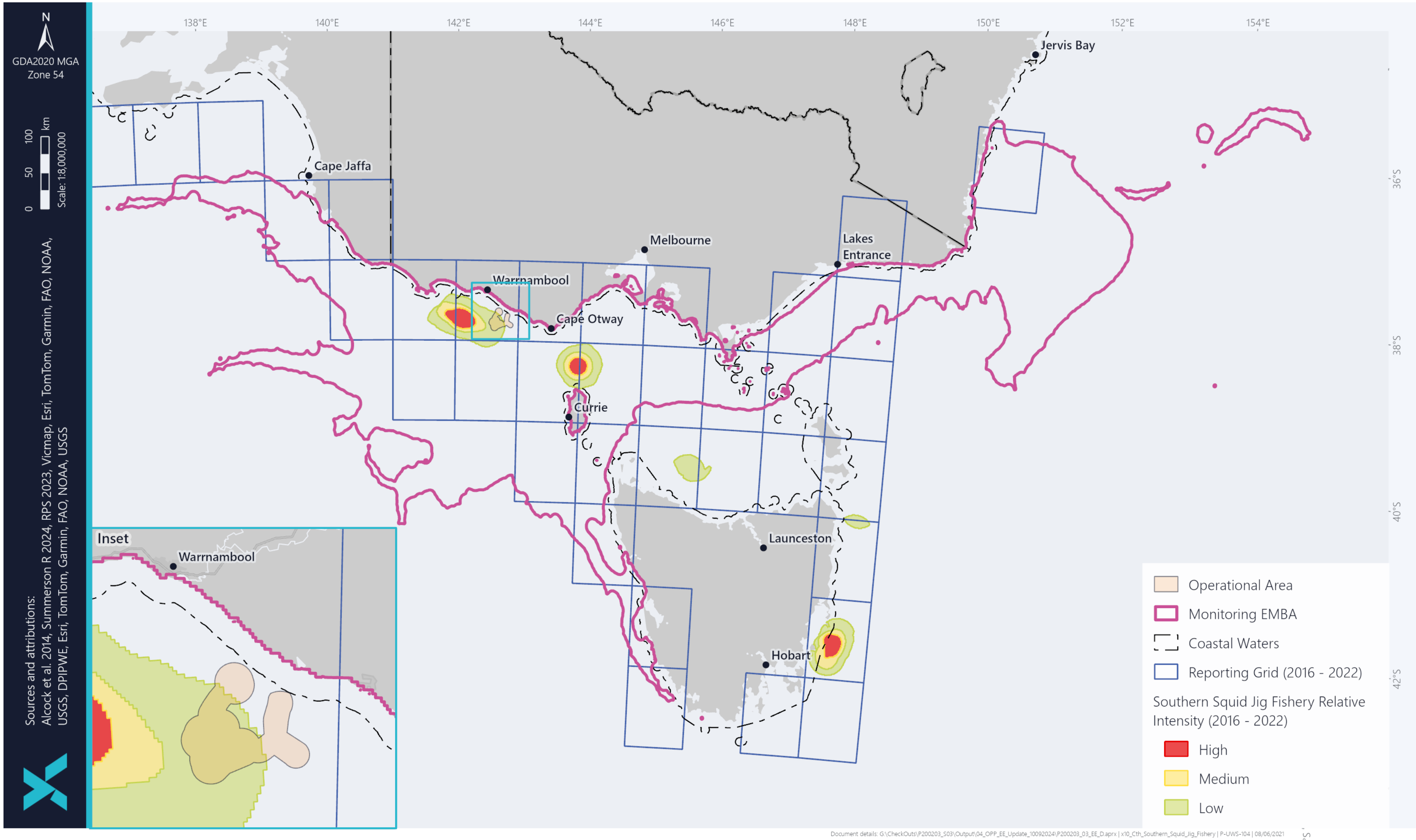


Figure 6-76: Southern Squid Jig Fishery and overlap with the monitoring EMBA

Table 6-20: Commercial Fisheries with Management Areas overlapped by the monitoring EMBA – Victorian

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and licenses	Comments	Operational Area Presence	Monitoring EMBA Presence
Victorian Abalone Fishery	Blacklip abalone (*Haliotis rubra*) and greenlip abalone (*Haliotis laevigata*)	12-month fishing season: Commences 1 April each year	The Victorian Abalone Fishery is divided into 3 management zones: western, central and eastern	Hand collected by divers 10 vessels were active in the 2021 season	Abalone is a mollusc (shellfish) that lives on rocky reefs from the shore out into the sea to depths of 30 m. 71 fishery access licences in the Victorian Abalone Fishery, which is subdivided into three management zones (14 in the Western Zone, 34 in the central zone and 23 in the Eastern Zone).	Unlikely Water depths of the East Coast Project operational area range from approximately 55 to 85 m, outside of the species depth range. No figure provided due to data confidentiality.	Likely
Victorian Rock Lobster Fishery	Southern rock lobster (*Jasus edwardsii*)	Female open season: Nov 16 – May 31 Male open season: Nov 16 – 16 Sept	The Victorian Rock Lobster Fishery is divided into management zones: western (Portland, Warrnambool and Apollo Bay) and eastern (Queenscliff, San Remo and Lakes Entrance)	Baited pots Western zone: 35 active vessels in the 2022 season Eastern zone: 12 active vessels in the 2022 season	In the 2022-23 season the Western Zone produced an average annual catch of 7.1t per vessel over 63 days fished. TACC for the western zone 2023/24 season has been set at 242 t. In the 2022-23 season the Eastern Zone produced an average annual catch of 1.3t per vessel over 76 days fished. TACC for the eastern zone 2023/24 season has been set at 21 t.	Potential Water depths of the East Coast Project operational area range from approximately 55 to 85 m. The median pot depth for the 2022-23 season was <30 m. Between 2013-2023 a moderate number of days fished have occurred across the entire operational area. (Figure 6-77)	Likely
Victorian Giant Crab Fishery	Giant crab (*Pseudocarcinus gigas*)	Female open season: Nov 16 -May 29 Male open season: Nov 16 – 16 Sept	The Victorian Giant Crab Fishery is divided into management zones: western (Portland, Warrnambool and Apollo Bay) and eastern (Queenscliff, San Remo and Lakes Entrance)	Baited pots; can only have one entrance and one chamber Maximum number of licenses: 30	In the Western zone, giant crabs can only be taken using commercial rock lobster pots by Western Zone rock lobster fishers. The total landed catch during 2022-23 season was 6.7 t (1 July to 30 June). TACC for the 2023/24 season has been set at 7.5 t.	Potential Same likelihood as the Victorian Rock Lobster Fishery as they are the only ones allowed to target Giant Crabs in the Western Zone. Between 2013-2023 a low number of days fished have occurred across the eastern extent of the operational area. (Figure 6-78)	Likely
Victorian Scallop Fishery	Scallop (*Pecten fumatus*)	12-month fishing season: Commences 1 April	The Victorian Scallop Fishery extends 20 nm south of the Victorian coastline. Excluding bays and inlets along the coast where commercial fishing for scallops is prohibited	Scallop dredge Maximum number of licenses: 91 and approximately 10-15 vessels	Scallops mature after one year but do not spawn until the second year. Adult scallops normally spawn between late winter and early spring TACC for the 2023/24 season has been set at 135 t	Unlikely Between 2013 – 2023 reported days fished has been concentrated along the eastern Victorian coastline. (Figure 6-79)	Likely
Victorian Octopus Fishery	Pale octopus (*Octopus pallidus*), Maori octopus (*Macroctopus maorum*) and gloomy octopus (*Octopus tetricus*)	Year-round	The Victorian Octopus Fishery is divided into 3 management zones: western, central and eastern *Central and western zones are managed through exploratory and temporary permits	Baited pots Eastern zone: 11 licenses Western and central zones: permit only, number unknown	Fishery commenced on 1 August 2020. Octopus Fishery Access Licenses authorise commercial take of octopus from the eastern octopus zone. This is where the majority of commercial octopus fishing in Victoria has occurred to date	Potential Highest catch and effort expected in the central and eastern zones, however potential for interaction with exploratory and temporary permit holders in the western zone. (Figure 6-80)	Likely
Victorian Multi-species Fishery	Pale octopus (*Octopus pallidus*)	Year-round	The fishery operates in Victorian state waters.	Multi-gear	This fishery is comprised of 3 sub-sectors: Ocean fishery, Commercial Permit fishery and Octopus fishery (central and western).	Potential Between 2013 – 2023a low number (between 5-300) of days fished have occurred within the north eastern extent of the operational area. (Figure 6-81)	Likely
Victorian Pipi Fishery	Pipi (*Donax deltoides*)	Year-round	The fishery covers the entire Victorian coastline, with the exception of Port	Hand collection	The species is found in the surf zone of high-energy sandy beaches.	Unlikely	Likely

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and licenses	Comments	Operational Area Presence	Monitoring EMBA Presence
			Phillip Bay and Marine National Parks where shellfish cannot be harvested in the intertidal region	There are 11 classes of Fishery Access Licenses that authorize Pipi harvest	Victorian Pipi Fishery commenced on 1 April 2020.	Pipi are harvested on the beach and the East Coast Project is located in offshore commonwealth waters. (Figure 6-82)	
Victorian Sea Urchin Fishery	White sea urchin (*Heliocidaris erythrogramma*), black, long-spined sea urchin (*Centrostephanus rodgersii*)	12-month fishing season: Commences 1 July each year	The Victorian Sea Urchin Fishery is managed spatially on the basis of four separate management zones: The Eastern Zone (EZ), Port Phillip Bay Zone (PPBZ), Central Zone (CZ) and Western Zone (WZ)	Hand collection	Allocated quota has only been established for the EZ and PPBZ	Unlikely Water depths of the East Coast Project operational area range from approximately 55 to 85 m, outside of recreational diving limits. No figure provided due to data confidentiality.	Likely
Victorian Wrasse Fishery	Blue-throat wrasse (*Notolabrus tetricus*), saddled (or purple) wrasse (*Notolabrus fucicola*), rosy wrasse (*Pseudolabrus psittaculus*), senator wrasse (*Pictilabrus laticlavius*) and southern Maori wrasse (*Ophthalmolepis lineolatus*)	Year-round	The fishery extends along the entire length of the Victorian coastline and out to 20 nm, excluding marine reserves Fishery is split into 3 management zones; western, central and eastern	Hook and line 22 Wrasse Fishery access license are currently issued	All species of wrasse are near-shore and are highly territorial with limited home ranges.	Potential Between 2013 – 2023 reported days fished has been concentrated along the western and central Victorian coastline with a low number (between 5-50) of days fished occurring within the north eastern extent of the operational area. (Figure 6-83)	Likely

Source: VFA, 2022b; VFA, 2023; VFA, 2024; personal communication, 27 October 2022

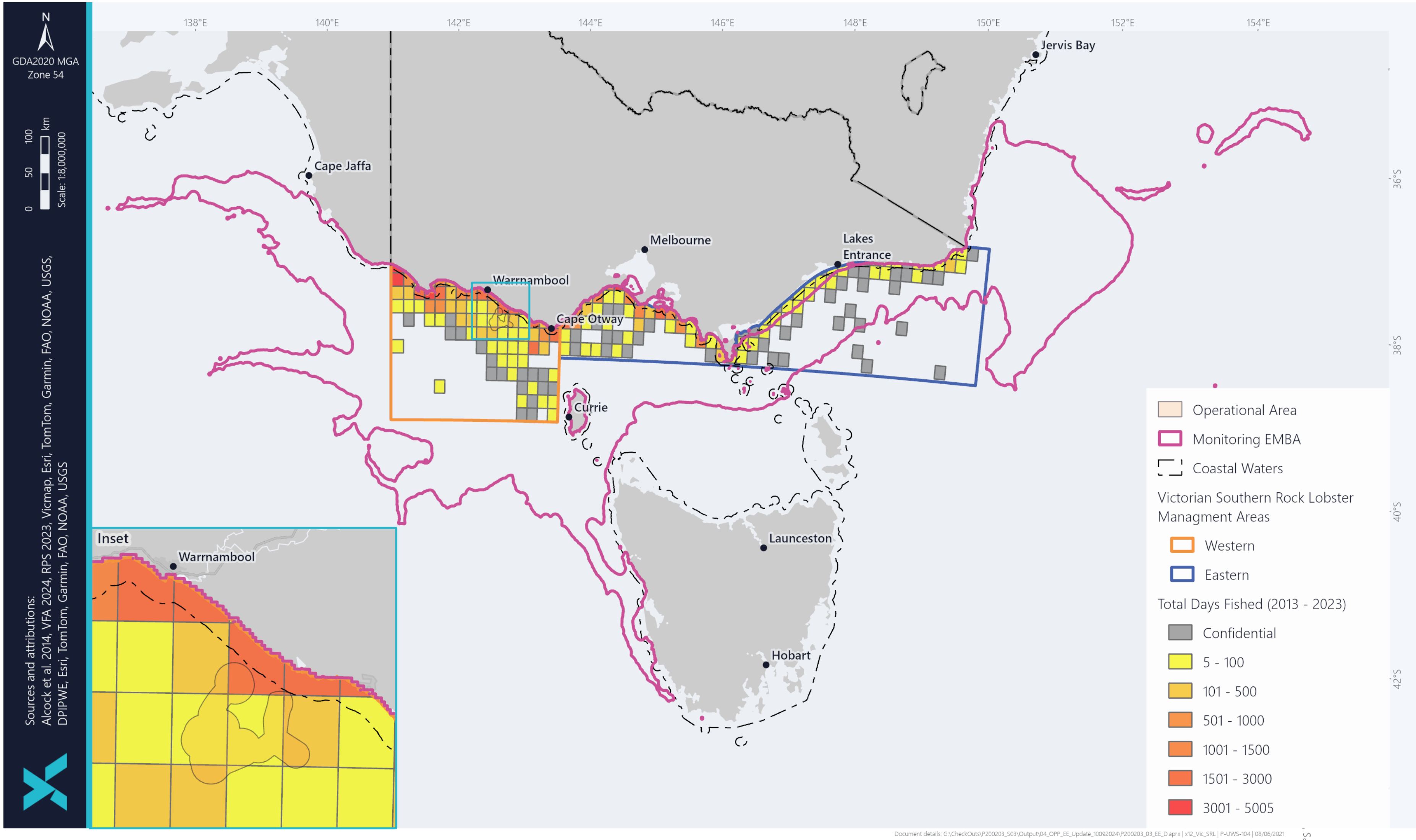


Figure 6-77: Victorian Rock Lobster Fishery and overlap with the monitoring EMBA

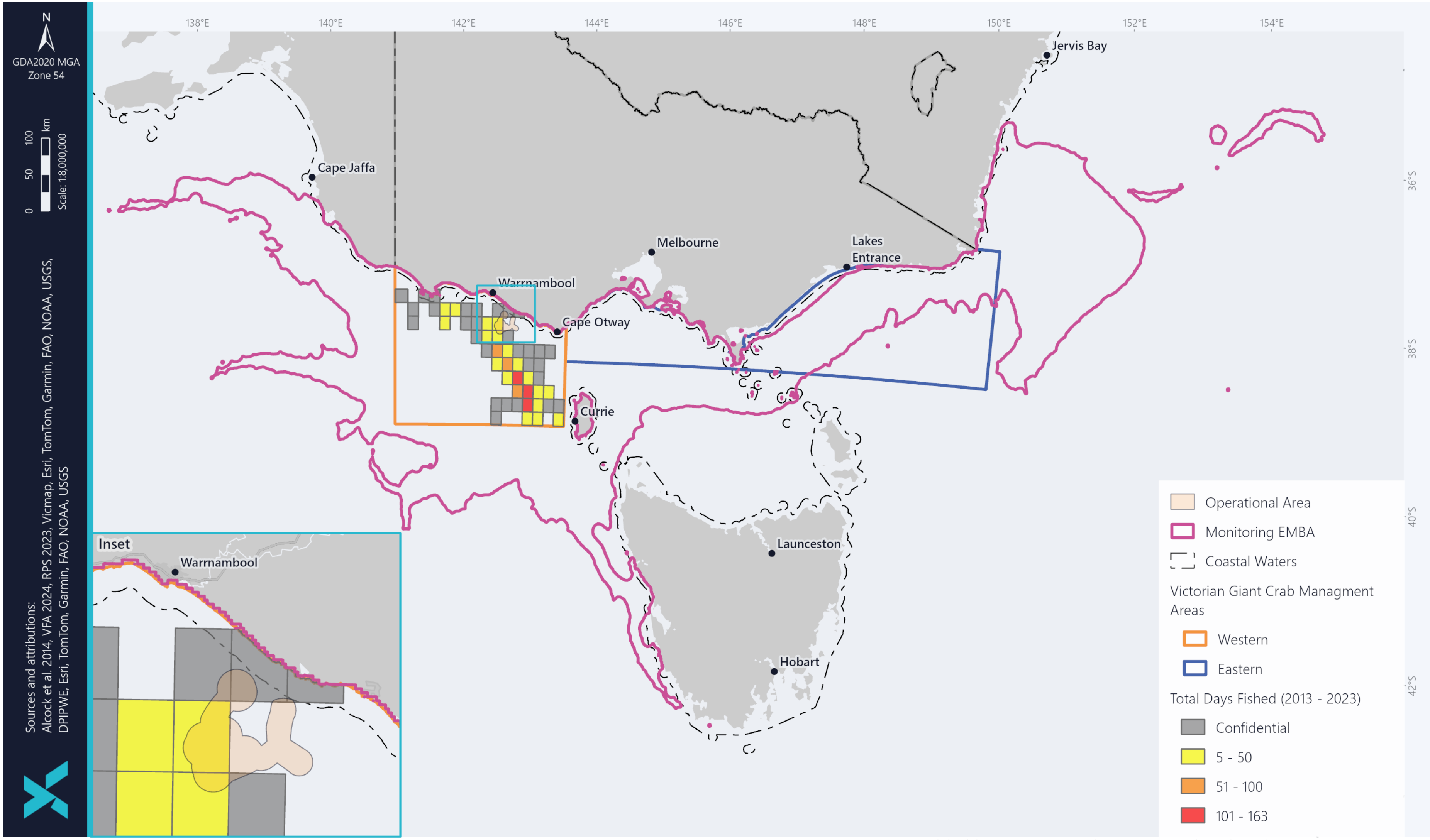


Figure 6-78: Victorian Giant Crab Fishery and overlap with the monitoring EMBA

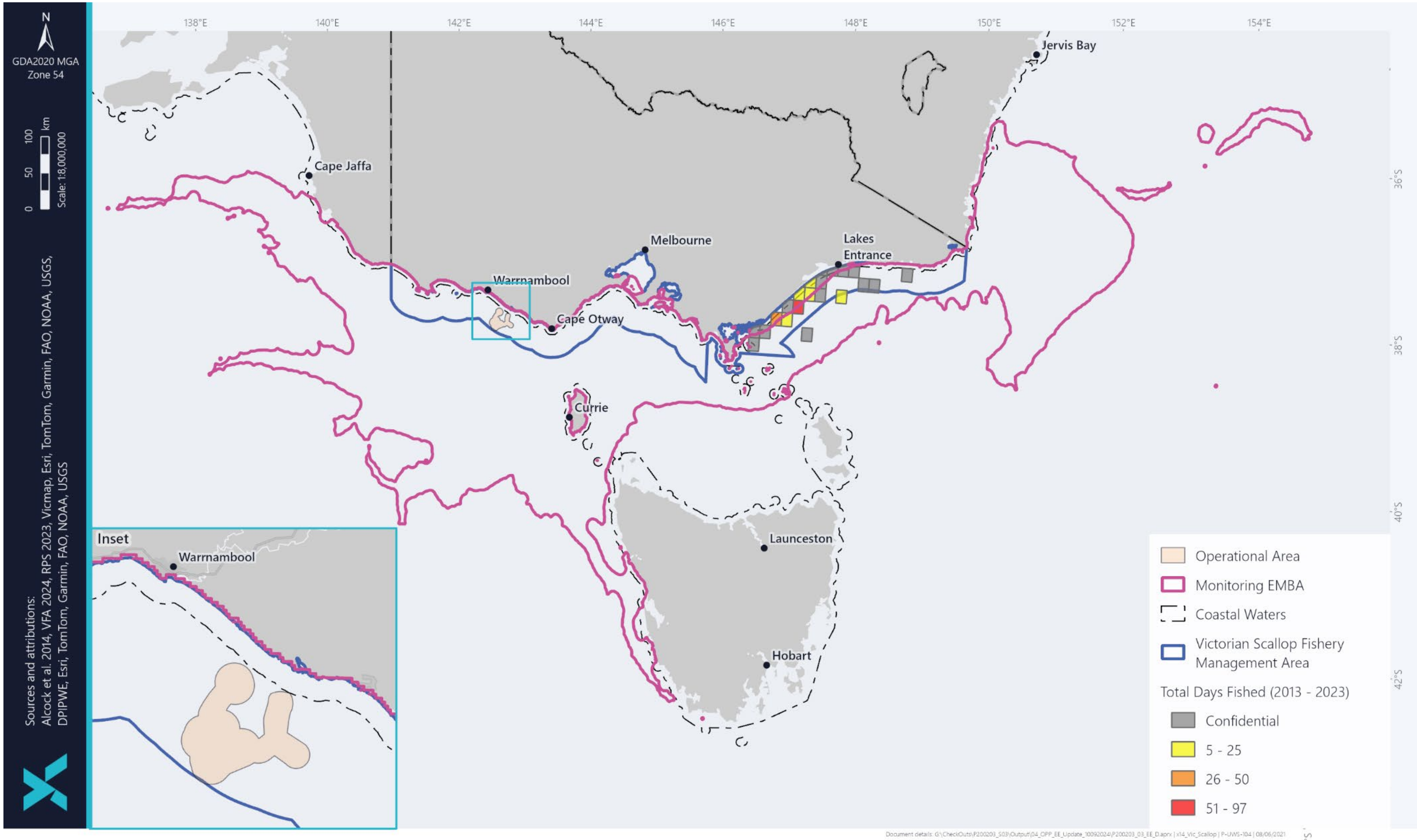


Figure 6-79: Victorian Scallop Fishery and overlap with the monitoring EMBA

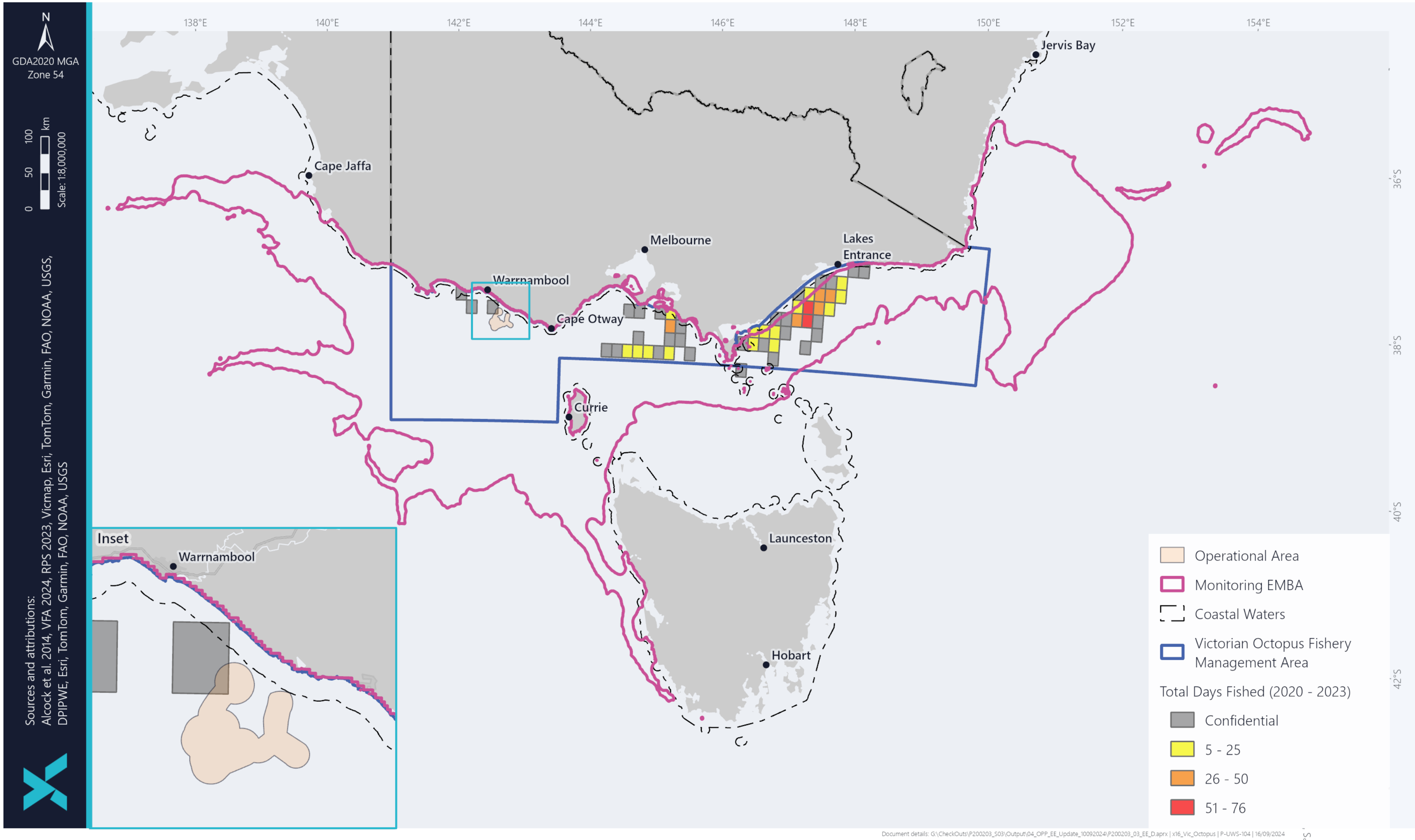


Figure 6-80: Victorian Octopus Fishery and overlap with the monitoring EMBA

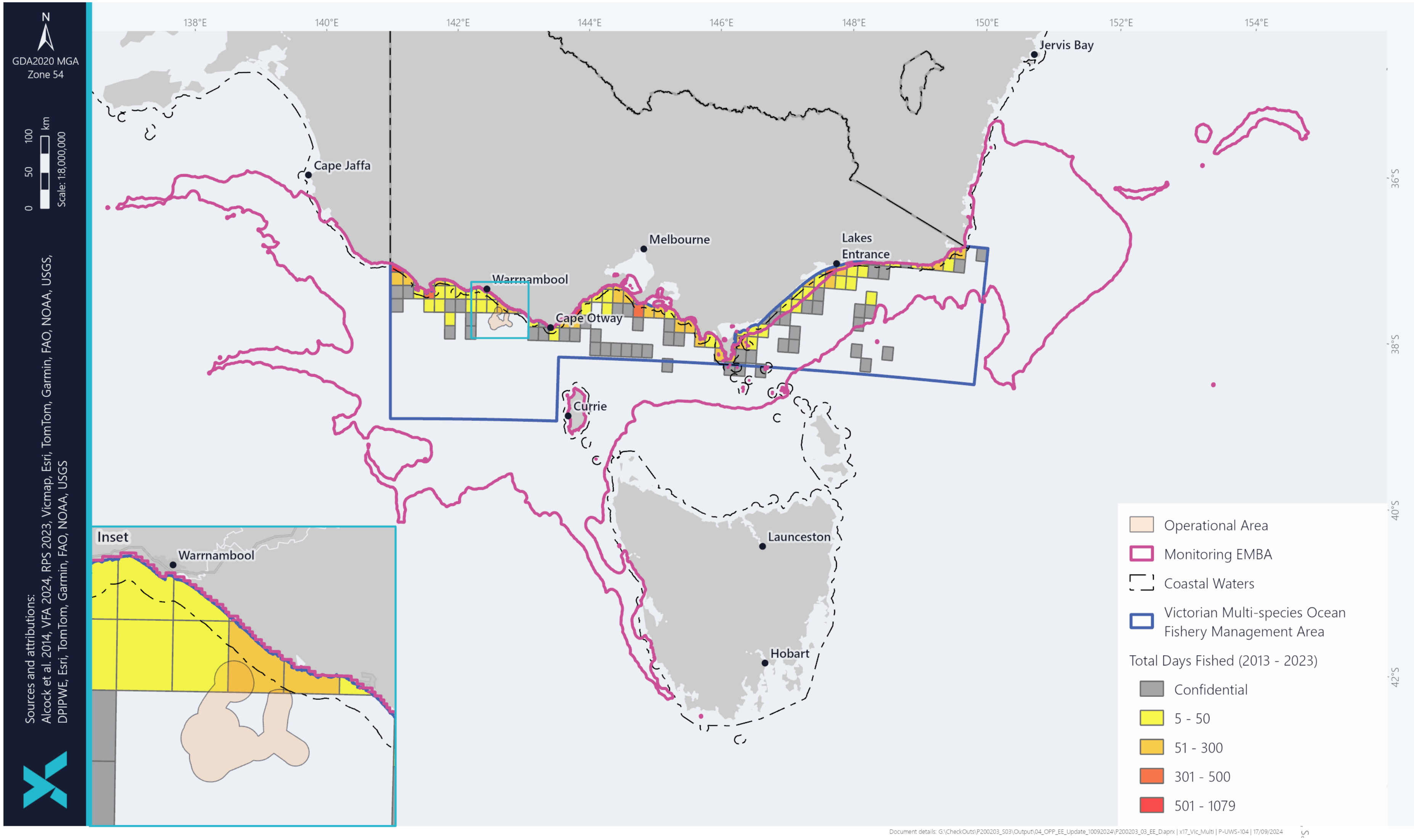


Figure 6-81: Victorian Multi-species Ocean Fishery and overlap with the monitoring EMBA

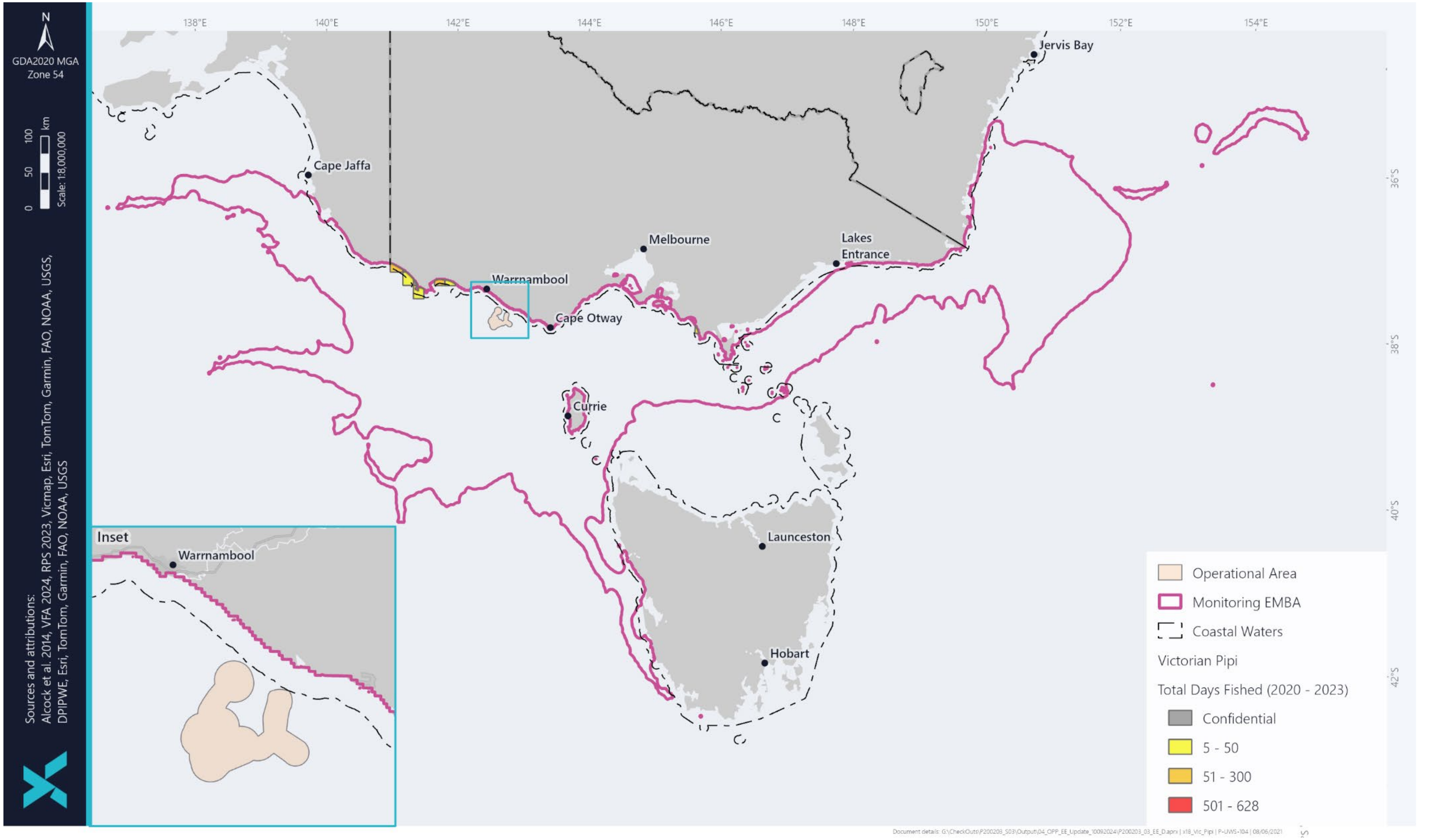


Figure 6-82: Victorian Pipi Fishery and overlap with the monitoring EMBA

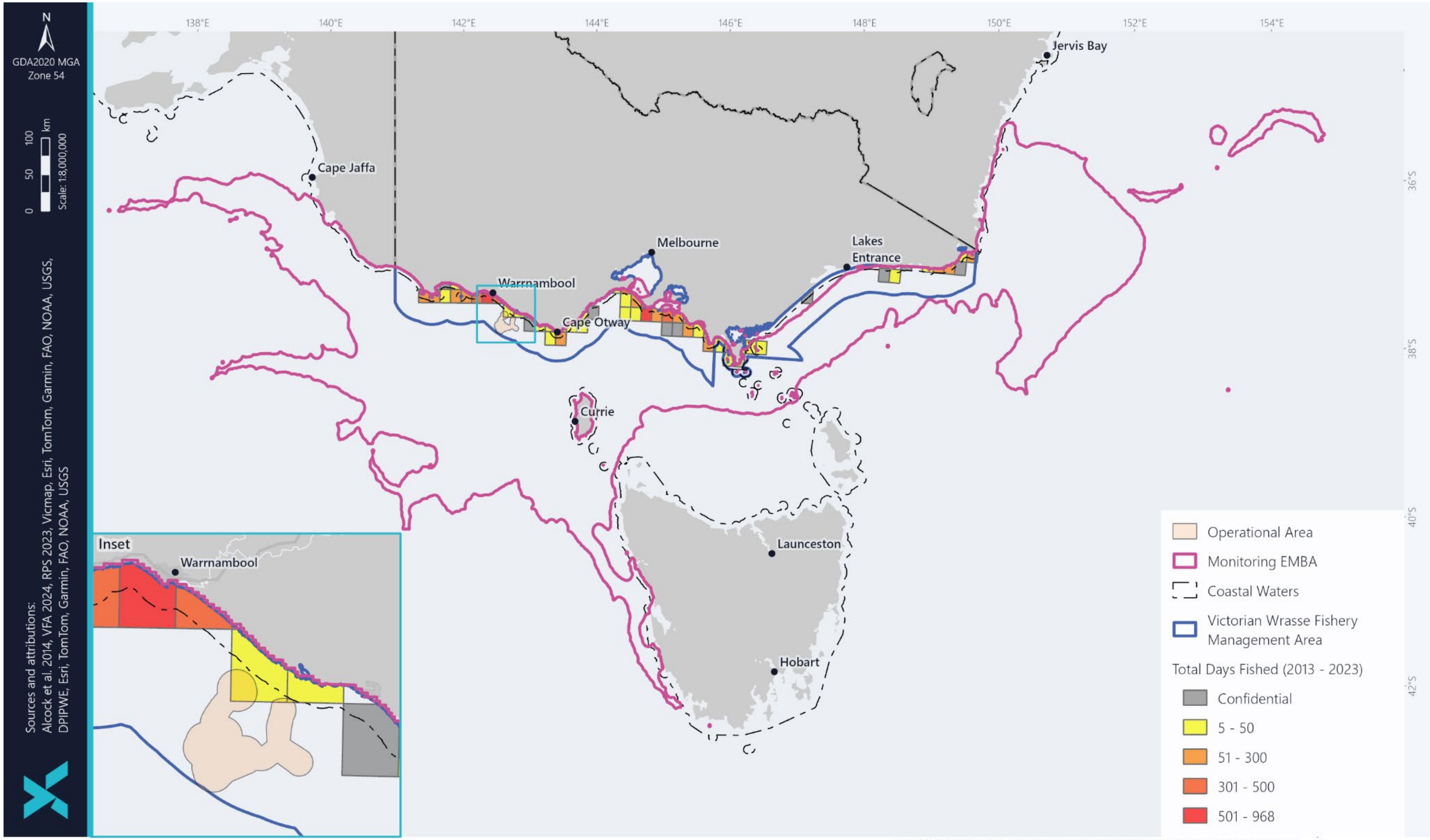


Figure 6-83: Victorian Wrasse Fishery and overlap with the monitoring EMBA

Table 6-21: Commercial Fisheries with Management Areas overlapped by the monitoring EMBA – Tasmania

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and licenses	Comments	Operational Area Presence	Monitoring EMBA Presence
Abalone Fishery	Blacklip abalone (*Haliotis rubra*) and greenlip abalone (*Haliotis laevigata*)	Commences 1 January each year. Fishery closes once total allowable catch for each species is met.	There are 4 management zones in Tasmanian State Waters: • Northern (overlaps monitoring EMBA) • Bass Strait (overlaps monitoring EMBA) • Western (overlaps monitoring EMBA) • Eastern	Hand collected by divers 121 fishing licenses (Abalone Dive) *Source: McAllister and Mundy, 2023*	Predominantly occur within the littoral zone from depths of 5-30 m, though they can also be found down to 40 m. Blacklip abalone are distributed around Tasmania. Greenlip abalone are found along the north coast and around the Bass Strait islands (Bradshaw, 2018). Important food source for Tasmanian Aboriginals. Total allowable catch for the 2024 season was set at 756 kg.	None	Likely (Figure 6-84)
Commercial Dive Fishery	Shortspined sea urchin (*Heliocidaris erythrogramma*), wavy periwinkles (*Lunella undulata*) and longspined sea urchin (*Centrostephanus rodgersii*)	Year-round Periwinkle: peak Aug-Nov Shortspined sea urchin: peak Aug- Jan Longspined sea urchin: peak Dec-July	There are 5 management zones in Tasmanian State Waters: • Northern (overlaps monitoring EMBA) • North-Eastern • Central-Eastern • South-Eastern • Western (overlaps monitoring EMBA)	Hand collected by divers Limited (53) transferrable licenses *Source: DNRET, 2023b*	Harvest occurs when the roe quality peaks just before spawning. There are no commercial limits to the longspined sea urchin, however there are for native shortspined sea urchins and periwinkles. Total allowable catch for the 2023/24 season of periwinkles and shortspined sea urchins are 54 t and 175 t, respectively. *Source: DNRET, 2023b*	None	Likely (Figure 6-84)
Giant Crab Fishery	Giant crab (*Pseudocarcinus gigas*)	Males – OPEN all year round. Females – OPEN from 15 November in a year to 31 May the following year inclusive.	Operates in State and Commonwealth waters surrounding Tasmania in waters south of 39° 12', and out to 200 nm from the coastline	Baited pots/traps	Total allowable catch for the 2023/24 season is set at 20.7 t. As of August 2024, 9.7 t have been caught. The fishery is linked to the Tasmanian Rock Lobster Fishery through the requirement to hold a rock lobster license as well as a giant crab license to target giant crab. With an annual harvest of 20.7 t the high landed value of this fishery is ~2 million.	None	Likely (Figure 6-85)
Marine Plant Fishery	Bull kelp (*Nereocystis luetkeana*) and wakame (*Undaria pinnatifida*)	Year-round	The Marine Plant Fishery is split into 6 zones: • King Island Area (overlapped by monitoring EMBA) • North west Area (overlapped by monitoring EMBA) • Granville Area (overlapped by monitoring EMBA) • Unzoned Area (overlapped by monitoring EMBA) • Restricted Undaria Area • Undaria Area	Handed harvested onshore (Undaria sp. are an exception and may be hand collected through diving) The North-West region is limited to eight licenses at any one time	To protect Tasmanian marine ecosystems, no marine plants may be harvested directly from the water, except in east coast waters under the *Undaria* fishery. No further licenses are to be granted in King Island and Granville Harbour.	None	Likely No figure provided due to data confidentiality.
Rock Lobster Fishery	Southern rock lobster (*Jasus edwardsii*)	Female – CLOSED from Wednesday, 1 May 2024 for all State waters. Male – CLOSED from Sunday, 1 September 2024 all waters south of St Helens Pt around to Sandy Cape (41° 29'). Male – CLOSED from Tuesday, 1 October 2024 all other State waters.	Operates in State and Commonwealth waters surrounding Tasmania in waters south of 39° 12', and out to 200 nm from the coastline. There are 2 zones in the Tasmanian Rock Lobster fishery. Mainland Tasmania is divided at Henty River on the west and Cape Pillar on the east to create the zones. • Northern zone • Southern zone *Both zones are overlapped by the monitoring EMBA	Baited pots Licenses are limited to 312	The majority of the commercial catch comes from the western half of the state. Total allowable catch for the 2023/24 season is set at 1050.7 t.	None	Likely (Figure 6-86)
Scalefish Fishery	Banded morwong (*Cheilodactylus spectabilis*), southern calmari (*Sepioteuthis australis*),	Year-round	The fishery is managed as one area – with the exception of Banded Morwong, Southern Calamari, Octopus and Rock Lobster. Scalefish license holders can only operate in coastal state waters.	Multi-gear As of 2024 there were 649 fishing licenses (vessel) renewed for the year.	The fishery is predominately made up of small owner operators. There are many different licenses associated with the fishery: • 10 gear type licenses	None	Likely (Figure 6-87)

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and licenses	Comments	Operational Area Presence	Monitoring EMBA Presence
	southern garfish (*Hyporhamphus melanochir*), wrasse (*Notolabrus* sp.), tiger flathead (*Neoplatycephalus richardsoni*), southern school whiting (*Sillago flindersi*) east Australian salmon (*Arripis trutta*), barracouta (*Thyrsites atun*), bastard trumpeter (*Latridopsis forsteri*), blue warehou (*Seriolella brama*) and Gould's squid (*Nototodarus gouldi*)				• 3 species licenses • 3 license types *Source: DNRET, 2023c*		
Scallop Fishery	Commercial scallop (*Pecten fumatus)*	OPEN – 5 July 2024 CLOSED – 31 December 2024.	Extends to 200 nm from the Tasmanian coast, except for Bass Strait, where its jurisdiction covers 3-20 nm offshore	Dredging	A scallop dredge can't be deployed in waters less than 20 m deep, Total allowable catch for the 2024 season was set at 4,000.3t. As of August 2024 985.8 t has been caught. The monitoring EMBA overlaps the north west 2024 open area.	None	Likely No figure provided due to data confidentiality.

Source: DNRET, 2023a ; DNRET, 2024

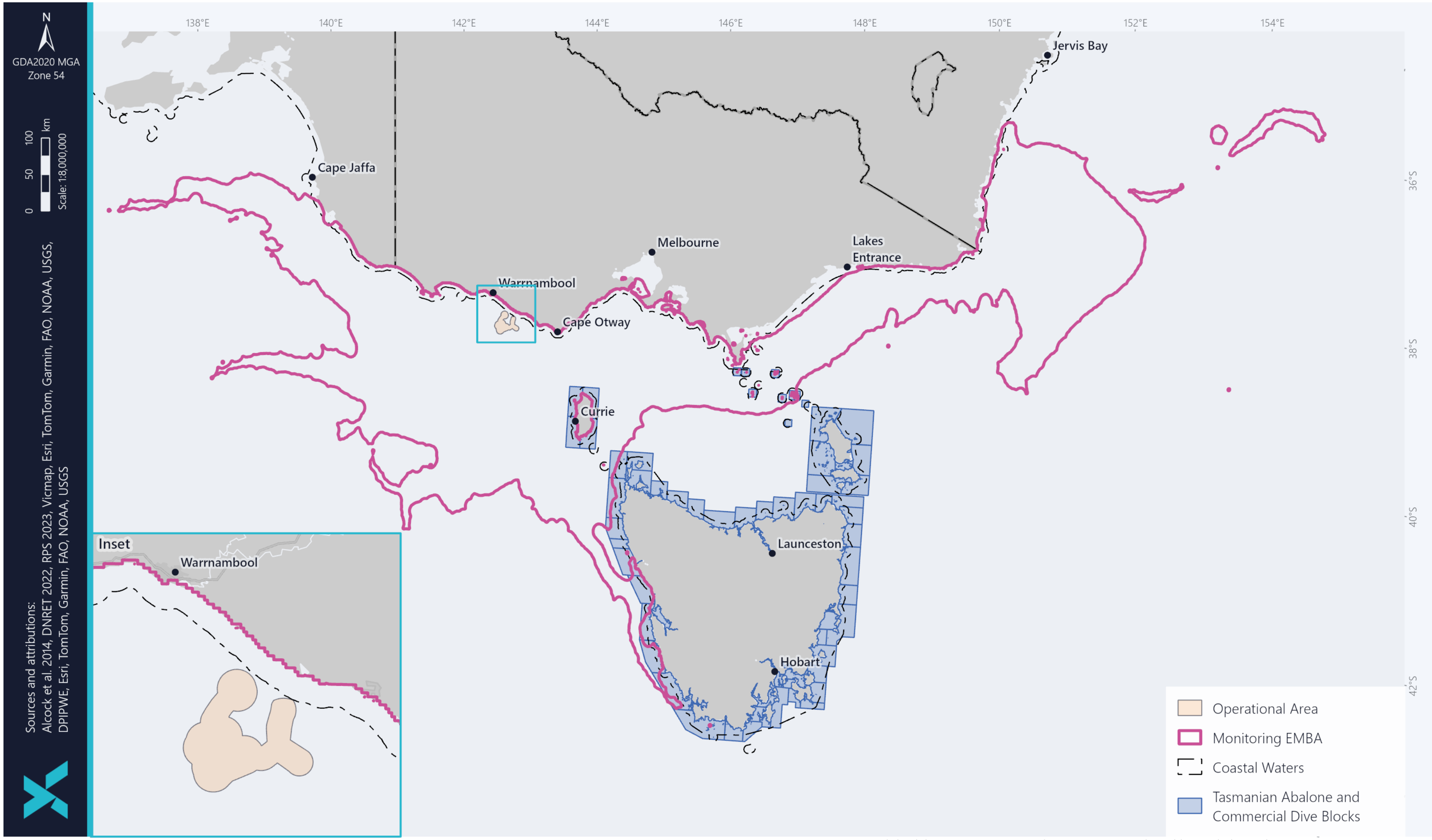


Figure 6-84: Commercial dive blocks for the Tasmanian Abalone and Commercial Dive Fishery and overlap with the monitoring EMBA

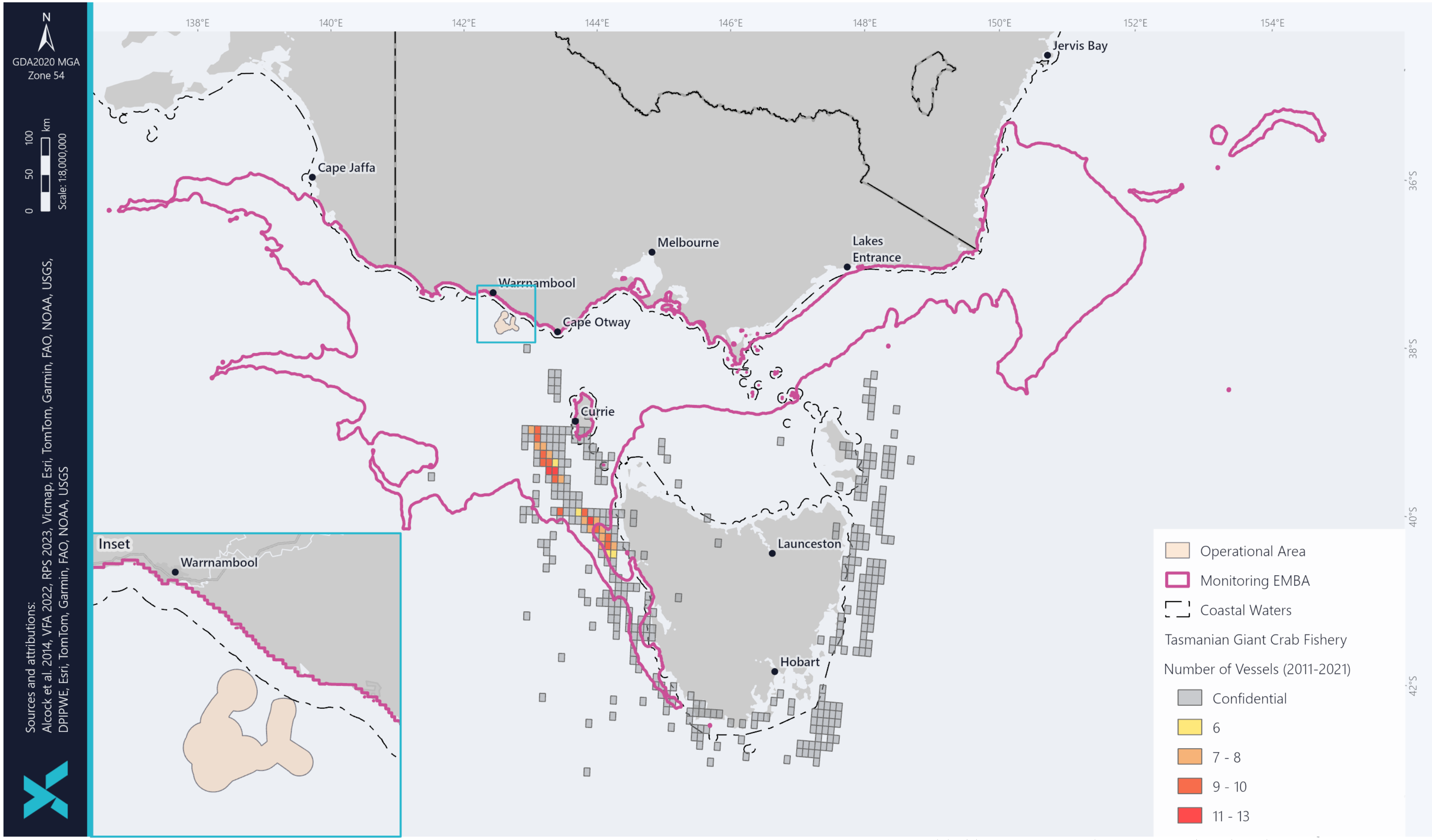


Figure 6-85: Tasmanian Giant Crab Fishery and overlap with the monitoring EMBA

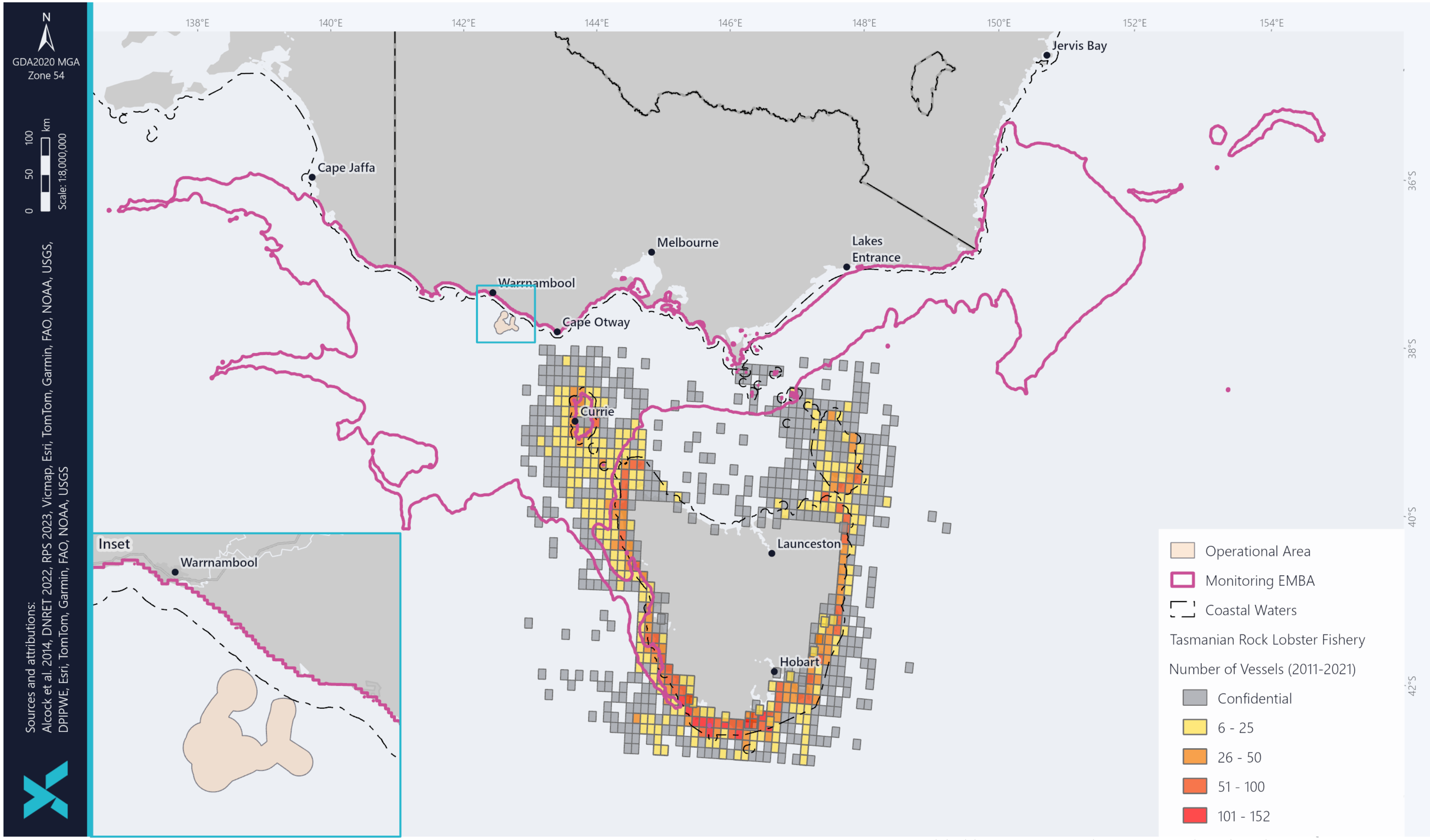


Figure 6-86: Tasmanian Rock Lobster Fishery and overlap with the monitoring EMBA

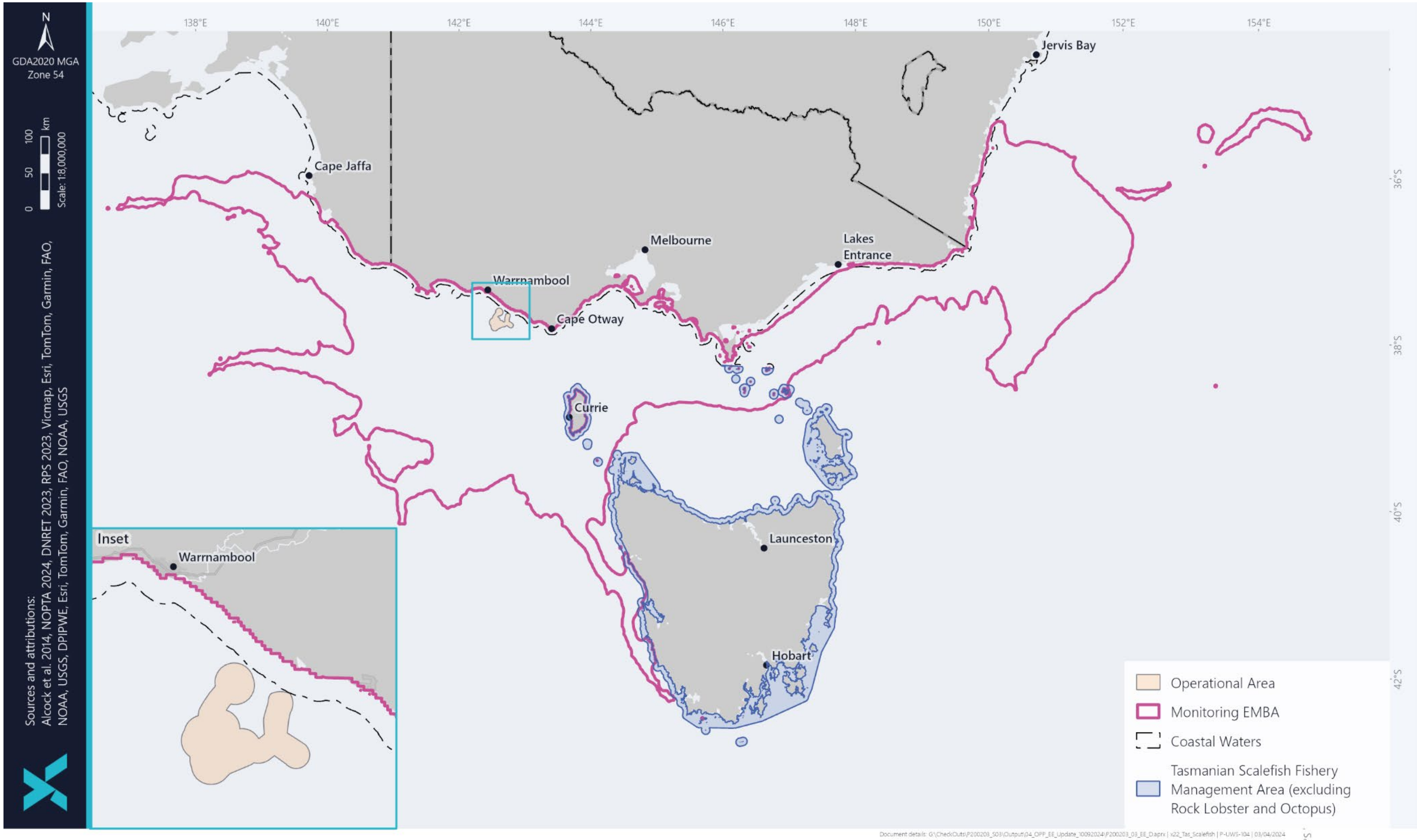


Figure 6-87: Tasmanian Scalefish Fishery Management Area and overlap with the monitoring EMBA

Table 6-22: Commercial Fisheries with Management Areas overlapped by the monitoring EMBA – NSW

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and licenses	Comments	Operational Area Presence	Monitoring EMBA Presence
Abalone Fishery	Blacklip abalone (*Haliotis rubra*)	Year-round	Operates along the coastline in NSW state waters	Hand collected by divers There are 35 shareholders with the minimum number of shares to have an endorsement that authorizes the taking of abalone	Most commercial abalone fishing takes place on the south coast of NSW, primarily from Jervis Bay to the Victorian border, with most abalone found close to the shore. A total allowable commercial catch for the 2023/24 season was set at 100 t. In 2019/20, the Abalone fishery produced $3.6 million in gross value of production (at beach price) from a catch of 83 t. *Source: TAFC, 2023a*	None	Likely (Figure 6-88)
Estuary General Fishery	Multi species The species that make up the top percentages of landings are listed below: • Sea mullet (*Mugil cephalus*) 40% • Luderick (*Girella tricuspidata*) 8% • Yellowfin bream (*Acanthopagrus australis*) 8% • School prawn (*Metapenaeus macleaya*) 5%, • Blue swimmer crab (*Portunus pelagicus*) 4%	Year-round	Operates in 76 of the NSW's estuarine systems It is a shared management fishery that is divided geographically into 7 regions from the Far North Coast to the Far South Coast of NSW. The monitoring EMBA overlaps portions of Region 6 and 7.	Multi-gear Approximately 600 fishing businesses	There are 63 classes of share available in the fishery, comprised of 9 classes of share for each of the 7 regions. Endorsements specify the methods that may be used and the waters in which fishing may be conducted. • Handline and hauling crew endorsement • Meshing endorsement • Prawning endorsement • Trapping endorsement • Eel trapping endorsement • Mud crab trapping endorsement • Hand gathering endorsement • Category one hauling endorsement • Category two hauling endorsement.	None	Likely No figure provided due to data confidentiality.
Lobster Fishery	Eastern rock lobster (*Sagmariasus verreauxi*)	2023/24 Season: 1 August 2023 – 31 July 2024	Extends from the Queensland border to the Victorian border and includes all waters under jurisdiction of NSW to around 80 miles from the coast.	Traps There are 96 shareholders in the fishery and 68 authorized fishers	A total commercial catch of 200 t was set for the 2023/24 season. The Fishery is considered sustainable. Gross value of production for 2021/22 was estimated at ~$11.23 million. *Source: TAFC, 2023b*	None	Likely (Figure 6-89)
Ocean Hauling Fishery	Multi species The species that make up the top percentages of landings are listed below: • Pilchards (*Sardinops sagax*) 34% • Sea mullet (*Mugil cephalus*) 30% • Australian salmon (*Arripis trutta*) 17% • Blue mackerel (*Scomber australasicus*) 8% • Yellowtail scad (*Trachurus novaezelandiae*) 5%	Year-round	Extends from beaches to sea within 3 nm of the NSW coast. It is a shared management fishery that is divided geographically into 7 regions from the Far North Coast to the Far South Coast of NSW. The monitoring EMBA overlaps portions of Region 6 and 7.	Commercial hauling and purse seine nets from beaches and in ocean waters There were 69 active businesses in the 2019/20 season	The 5 ocean hauling endorsement types in NSW ocean waters are listed below. Endorsements specify the methods that may be used and the waters in which fishing may be conducted. • General ocean hauling endorsement • Hauling net (general purpose) endorsement • Garfish net (hauling) endorsement • Pilchard, anchovy and bait net (hauling) endorsement • Purse-seine net endorsement In 2019/20, the Ocean Hauling fishery produced $10 million in gross value of production (at beach price) from a catch of 3,886 t.	None	Likely (Figure 6-90)
Ocean Trap & Line Fishery	Multi species Listed species form the majority of the catch: Snapper (*Chrysophrys auratus*), yellowtail kingfish (*Seriola lalandi*), leatherjackets, bonito	Year-round	Operates along the entire NSW coast and in the continental shelf and slope waters.	Mutli-method There were 211 active businesses in the 2019/20 season	The 6 types of Ocean Trap and Line endorsements in NSW ocean waters are listed below. Endorsements specify the methods that may be used and the waters in which fishing may be conducted. • Line fishing western zone endorsement	None	Likely (Figure 6-91)

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and licenses	Comments	Operational Area Presence	Monitoring EMBA Presence
	(*Sarda australis*) and silver trevally (*Pseudocaranz georgianus*) A variety of shark species are also targeted by the fishery.				• Line fishing eastern zone endorsement • Demersal fish trap endorsement • School and gummy shark endorsement • Spanner crab northern zone endorsement • Spanner crab southern zone endorsement. In 2019/20, the Ocean Trap & Line fishery produced $13 million in gross value of production (at beach price) from a catch of 1,352 t.		
S37 Permit Fishery	Various	Year-round	Various	Various	A Section 37 permit (miscellaneous permit) is required for any activity that involves taking or possessing fish or marine vegetation that would otherwise be unlawful under the *Fisheries Management Act 1994*. This includes activities such as: • Science or Research Collection • Aquarium Collection • Possessing Pacific Oysters Collecting Marine Vegetation for Commercial Purposes.	None	Likely (Figure 6-92)
Sea Urchin & Turban Shell Fishery	Black urchin (*Centrostephanus rodgersii)* red urchin (*Heliocidaris erythrogramma*), purple urchin (*Heliocidaris tuberculate*) and various turban shell species	Year-round	Operates along the entire NSW coast and is split into 5 regions: • Tweed Heads to Newcastle • Newcastle to Currarong • Currarong to Brush Island • Brush Island to Montague Island Montague Island to Cape Howe	Hand collected by divers There are currently 37 fishing businesses	Commercial harvest of the turban shell is mainly restricted to NSW waters. In 2019/20, the Sea Urchin & Turban Shell fishery produced $0.5 million in gross value of production (at beach price) from a catch of 126 t. Regional catch limits are in place.	None	Likely (Figure 6-93)
Southern Fish Trawl Fishery	N/A	N/A	N/A	N/A	In 2019 the Southern Fish Trawl Fishery was integrated into the Commonwealth Southern and Eastern Scalefish and Shark Fishery (SESSF) due to the substantial overlap between the two fisheries. *Source: DPI, 2018*	None	None
Ocean Trawl Fishery	Multi species Major species taken include: stout and red spot whiting (*Sillago robusta* and *S.flindersi*), eastern king, school and royal red prawns (*Melicertus plebejus* and *M.macleayi*), tiger flathead (*Platycephalus richardsoni*), silver trevally (*Pseudocaranz georgianus*), various species of sharks and rays, squid, octopus and bugs	Year-round	Operates along the entire NSW coast and in the continental shelf and slope waters.	Otter trawl net There were 96 active businesses in the 2019/20 season	There are two sectors to the NSW Ocean Trawl Fishery: the prawn trawl sector and the fish trawl sector. In 2019/20, the Ocean Trawl fishery produced $26.2 million in gross value of production (at beach price) from a catch of 2,672 t.	None	Likely (Figure 6-94)

Source: DPI 2023; Source: BDO Australia, 2022

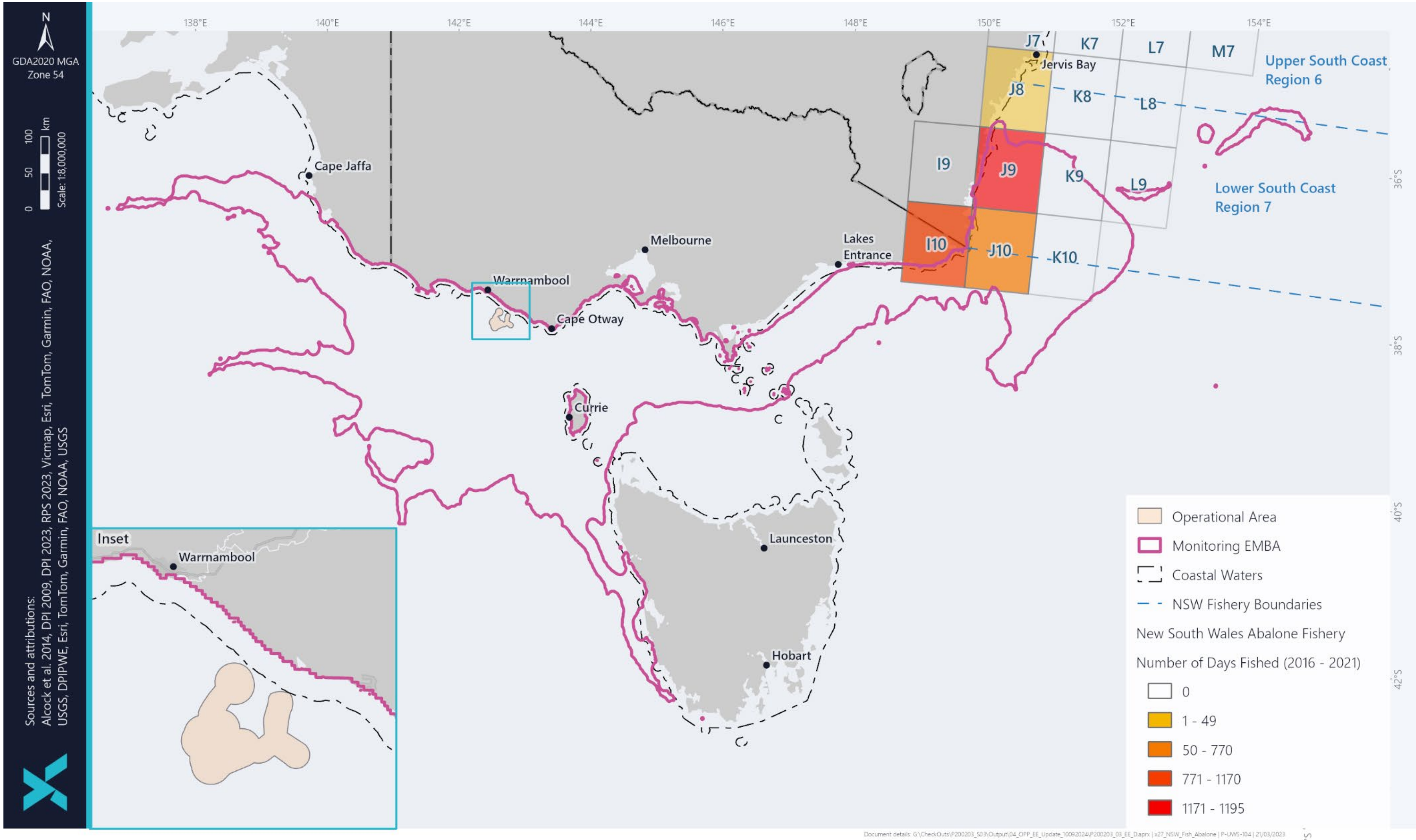


Figure 6-88: NSW Abalone Fishery and overlap with the monitoring EMBA

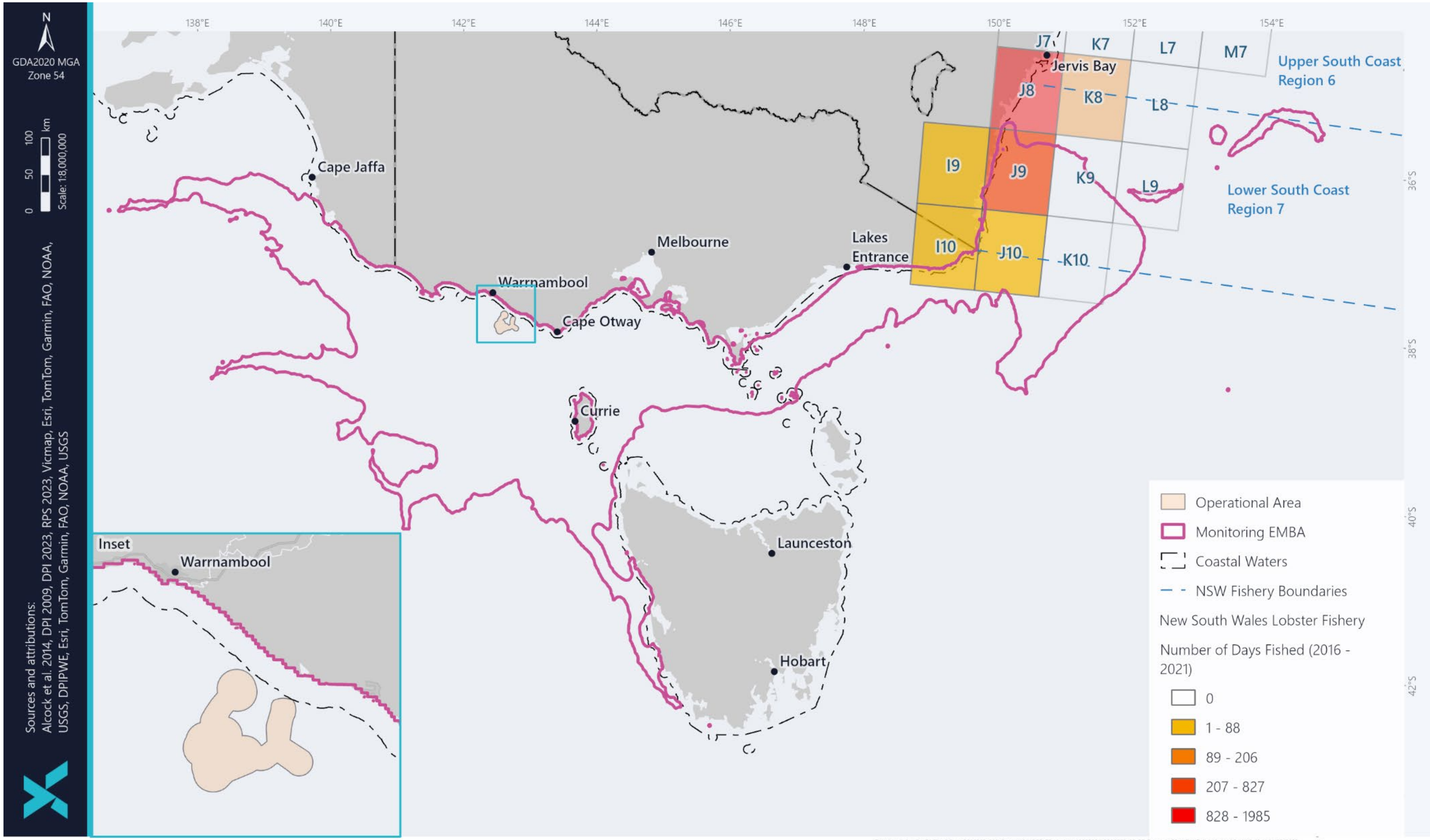


Figure 6-89: NSW Lobster Fishery and overlap with the monitoring EMBA

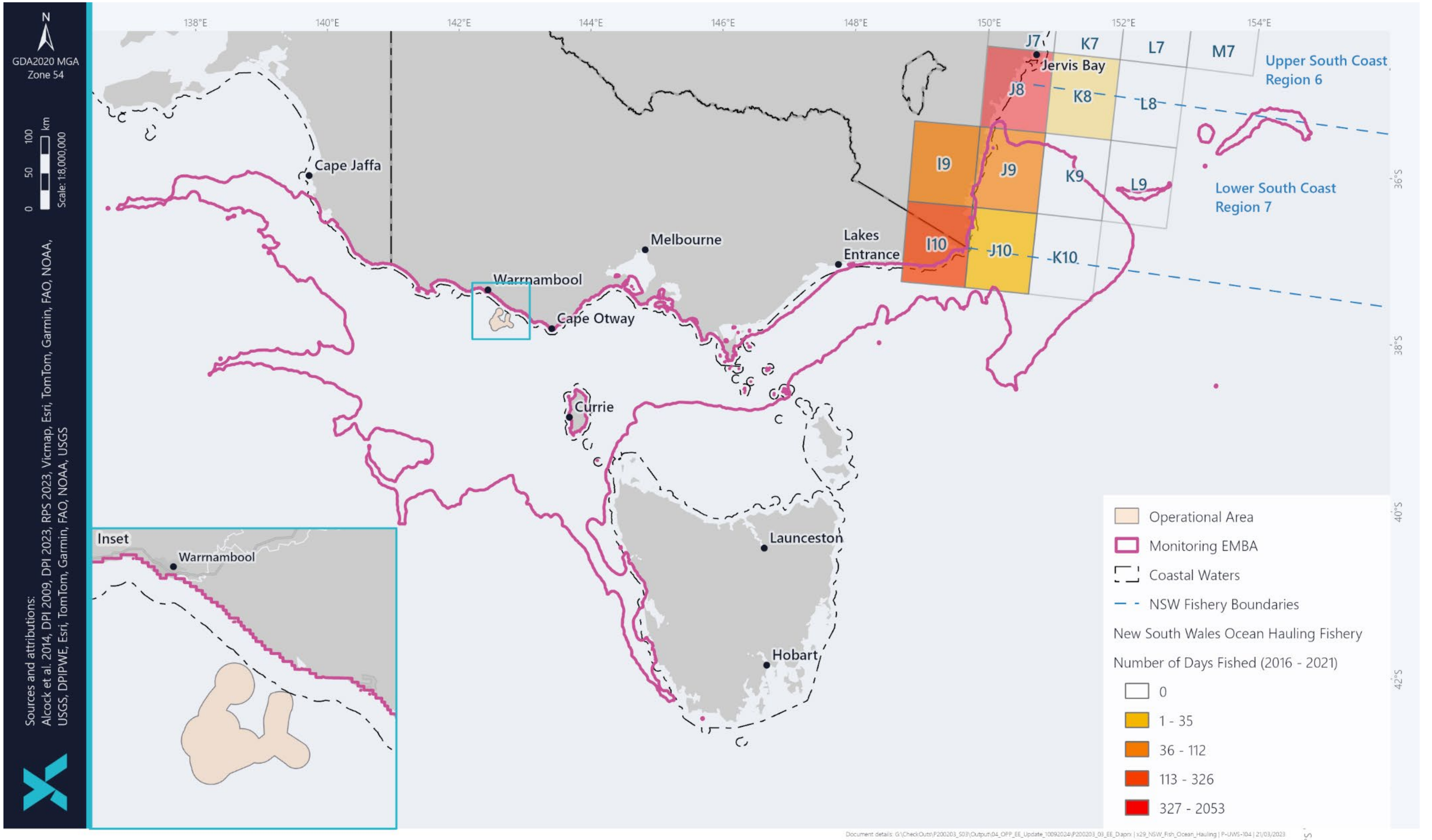


Figure 6-90: NSW Ocean Hauling Fishery and overlap with the monitoring EMBA

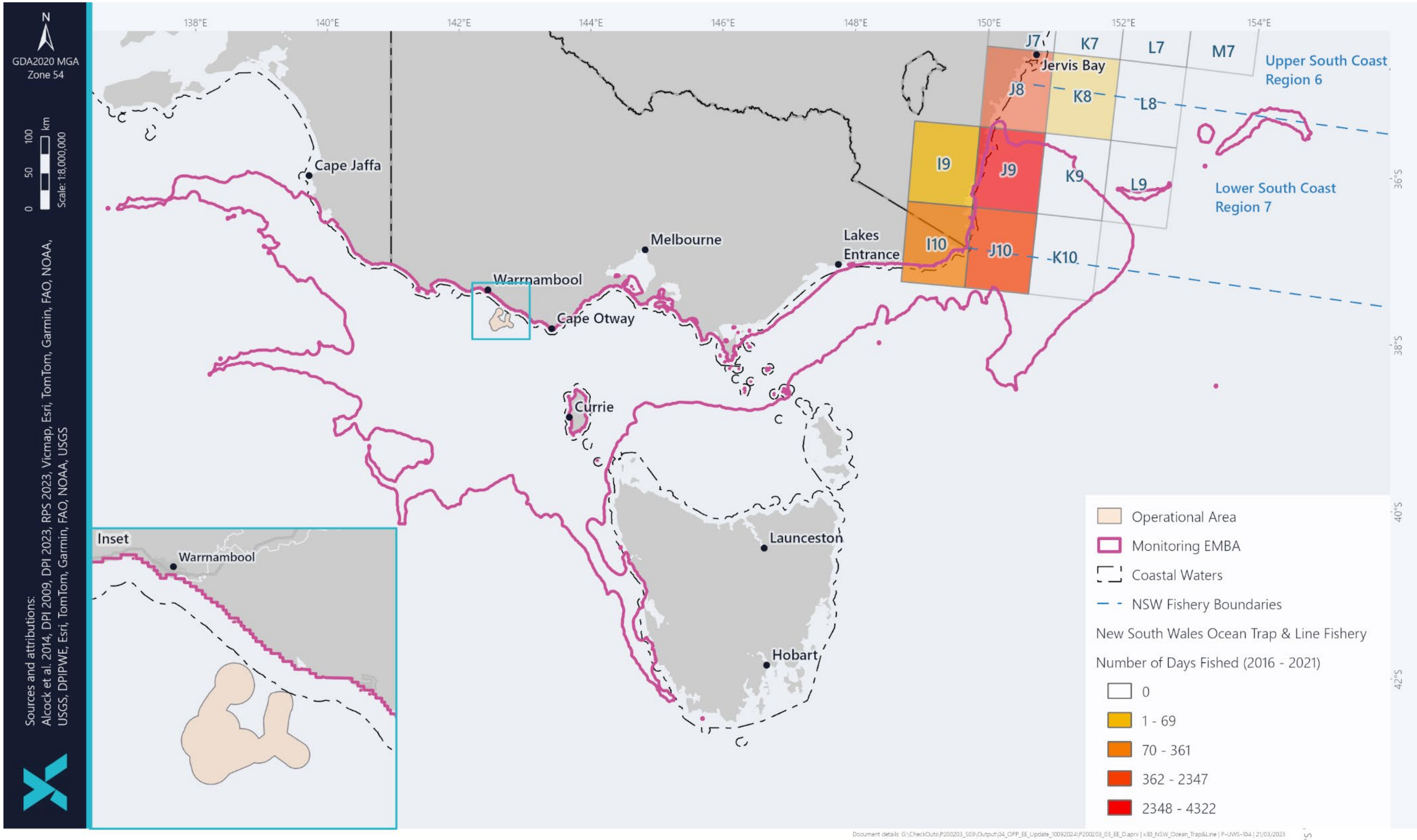


Figure 6-91: NSW Ocean Trap & Line Fishery and overlap with the monitoring EMBA

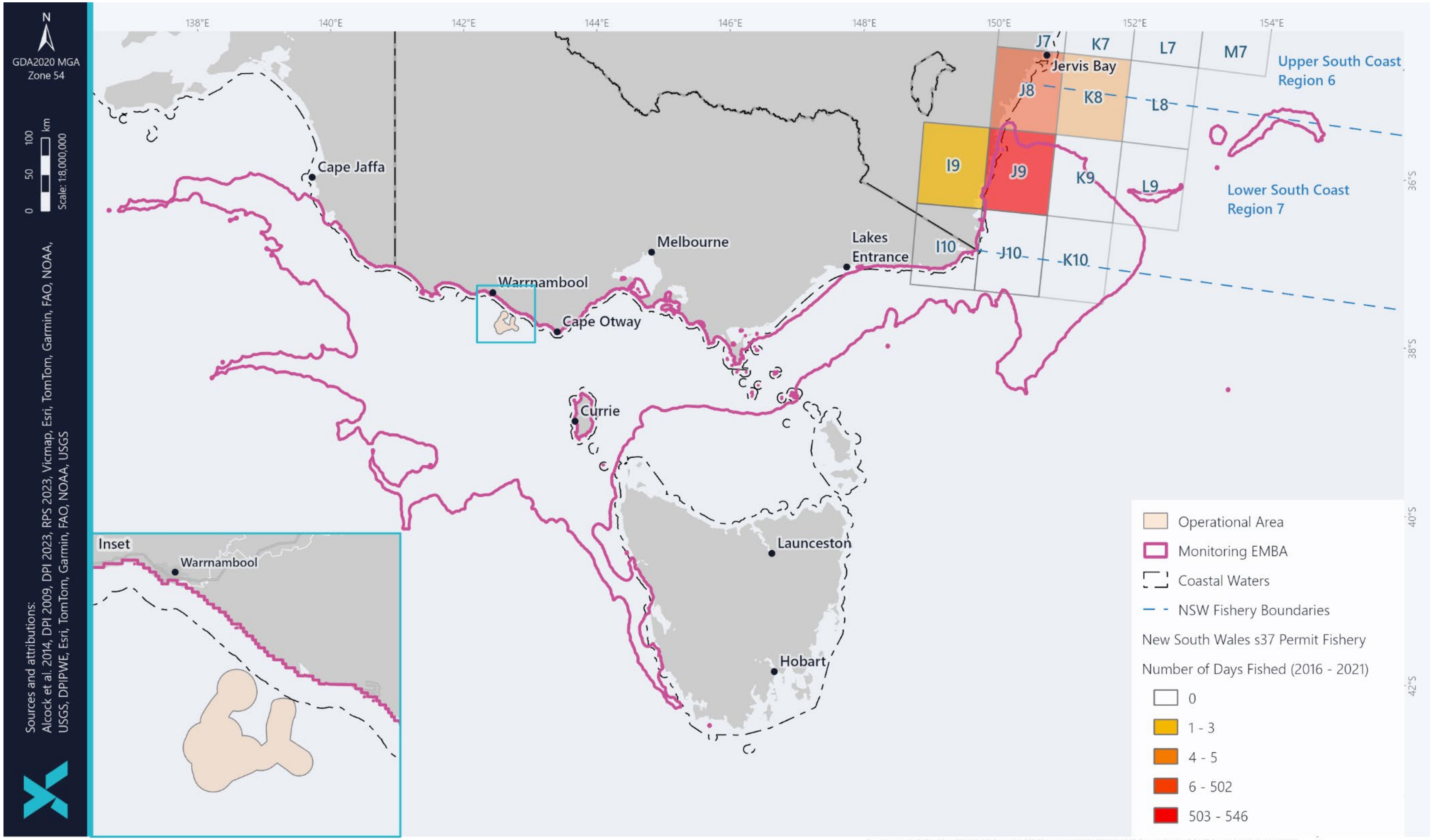


Figure 6-92: NSW S37 Permit and overlap with the monitoring EMBA

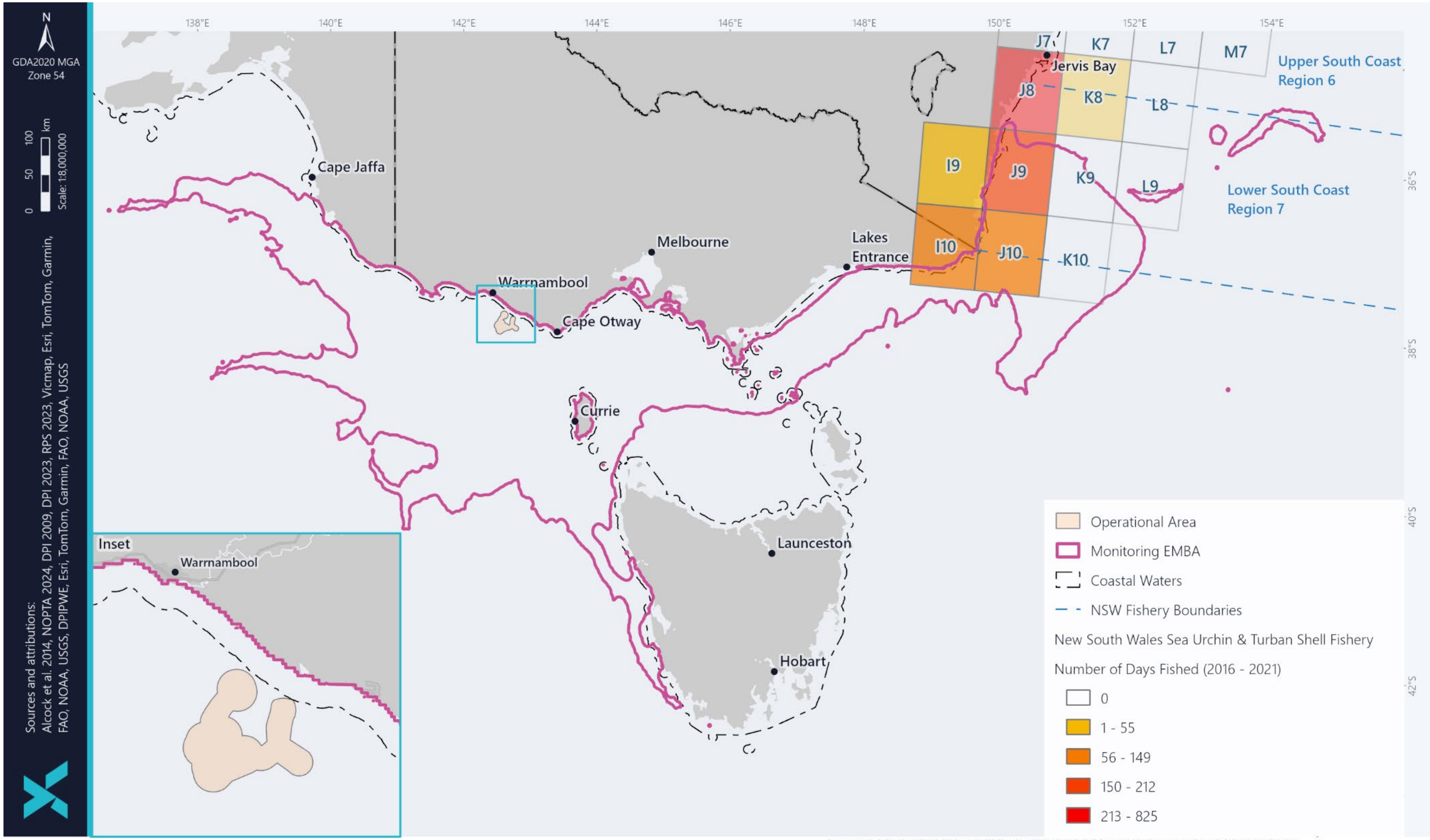


Figure 6-93: NSW Sea Urchin and Turban Shell Fishery and overlap with the monitoring EMBA

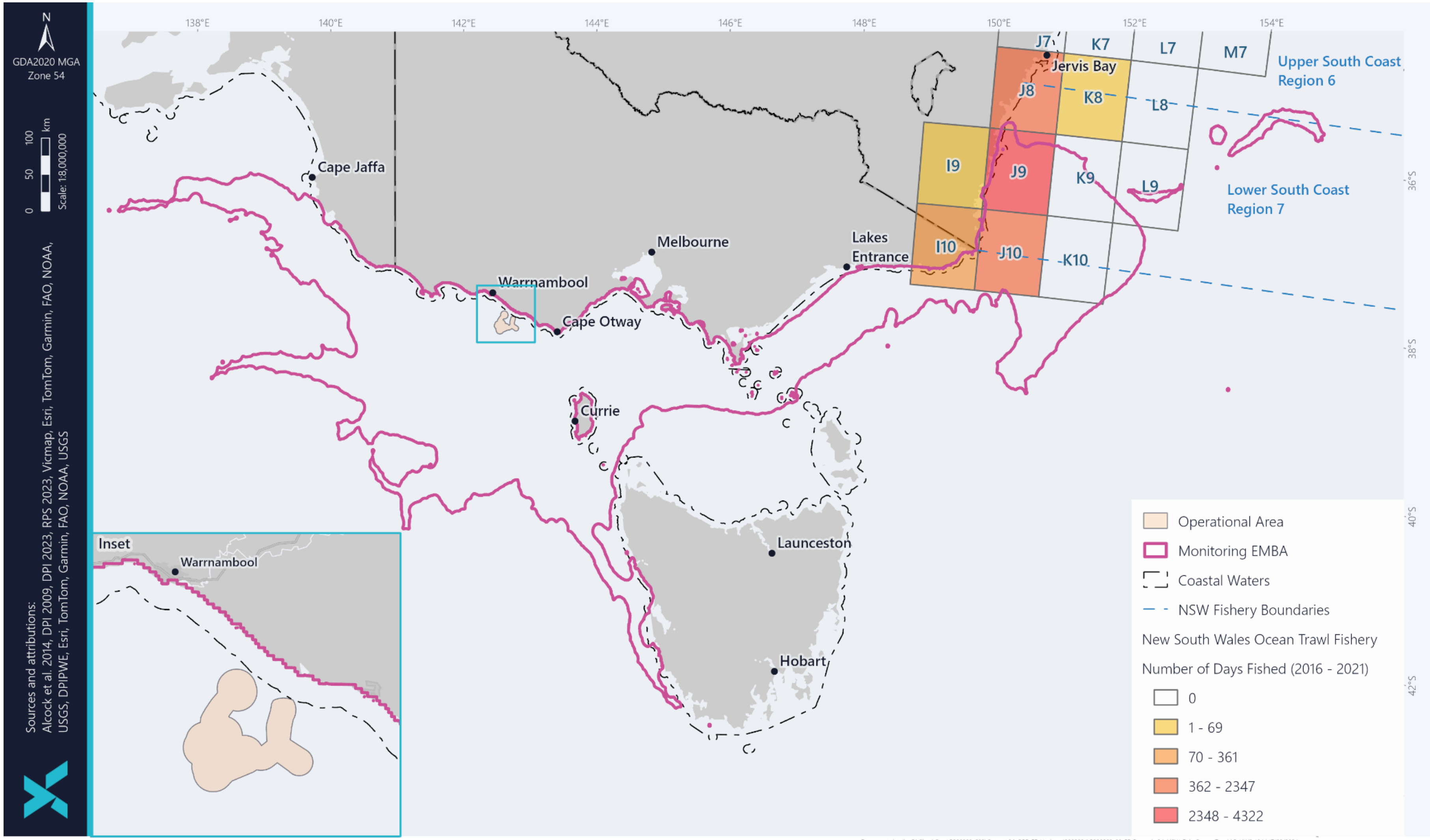


Figure 6-94: NSW Ocean Trawl Fishery and overlap with the monitoring EMBA

Table 6-23: Commercial Fisheries with Management Areas overlapped by the monitoring EMBA – South Australia

Commercial Fishery	Target Species	Season	Management Area	Fishing Methods and licenses	Comments	Operational Area Presence	Monitoring EMBA Presence
Abalone Fishery	Blacklip abalone (*Haliotis rubra*) and greenlip abalone (*Haliotis laevigata*)	Year-round	There are 3 management zones in South Australian State Waters: • Western • Central • Southern (overlaps with the monitoring EMBA)	Hand collected by divers. 32 active licenses during the 2022/23 season	Important food source for First Nations Peoples. Southern Zone: • Total allowable catch for blacklip abalone in the 2022/23 season was set at 132 t for the southern zone. Greenlip abalone has no set total allowable catch in the southern zone. • Blacklip abalone stock is assessed as sustainable. Greenlip abalone is assessed as undefined. *Source: Burnell and Hogg, 2023*	None	Likely No figure provided due to data confidentiality.
Charter Boat Fishery	Snapper (*Chrysophrys auratus*), King George whiting (*Sillaginodes punctatus*), southern bluefin tuna (*Thunnus maccoyii*) and nannygai (redfish, red snapper, swallowtail) (*Centroberyx gerrardi*)	Year-round	Operates throughout the coastal marine waters off South Australia	In 2022/23 there were 49 active licenses	Charter boat fishing is considered a commercial platform for recreational fishing, therefore all catch is regarded as recreational catch The majority of charter boat fishing activities occur around reef, seagrass meadows, unvegetated soft bottom, sheltered beaches and tidal flats.	None	Likely (Figure 6-95)
Scalefish Fishery	Over 60 species are taken under this license Main species include: King George whiting (*Sillaginodes punctatus*), southern garfish (*Hyporhamohus melanochir*) and southern calamari (*Sepioteuthis australis*)	Year-round	Operates in all coastal waters, including bays and estuaries of South Australia between the Western Australian and Victorian border	Multi-gear In 2022/23 there were 205 active licenses	The fishery provides for the commercial harvest of most commercially available aquatic resources, with the exception of southern rock lobster, prawns, abalone and freshwater fish species. The majority of catches of these primary species comes from Spencer Gulf and Gulf St Vincent (outside of the EMBA). *Source: PIRSA, 2013*	None	Likely (Figure 6-96)
Miscellaneous Fishery	Includes species that are not in management arrangements of existing commercial fisheries (ex. Australian salmon, sea urchins, scallop, oysters) Main species: Giant crab (*Pseudocarcinus gigas*)	Year-round (dependent on target species)	Operates throughout the coastal marine waters off South Australia. Giant Crab Fishery has 2 management zone: • Southern zone • Northern zone	Multi-gear (dependent on target species) Commercial access to the Giant Crab is limited to 245 license holders *Source: PIRSA, 2018*	Miscellaneous dive fishing activities are currently used to harvest sea urchins, scallops, turbo, specimen shells and native oysters. The giant crab is managed under a separate plan to other species covered by the Miscellaneous Fishery. Total allowable commercial catch for the 2022 season was set at 22.1 t.	None	Likely (Figure 6-97) *data only provided for the Giant Crab
Rock Lobster Fishery	Southern rock lobster (*Jasus edwardsii*)	Starting 2024: Southern Zone 1 September to 31 May Northern Zone: Year-round *Source: PIRSA, 2023c*	There are 2 management zones: • Northern zone • Southern zone (overlaps with monitoring EMBA) Zones extend from the low water mark out to edge of the Australian Fishing Zone 200 nm from shore	Pots In 2022/23 there were 180 commercial licenses within the southern zone	Commercial license holders are permitted to land and sell giant crabs and octopus taken as by-product in rock lobster pots. Densities of rock lobsters on the limestone reefs of the Southern Zone are generally higher than those of the granite reefs of the Northern Zone. Total allowable catch was 1,320 t in the 2022/23 season within the southern zone. *Source: PIRSA, 2020*	None	Likely (Figure 6-98)
Sardine Fishery	Australian sardine (*Sardinops sagax*) The take of Australian anchovy (*Engraulis australis*), maray (*Etrumeus teres*), blue sprat (*Spratelloides robustus*) and sandy sprat (*Hyperlophus vittatus*) are also permitted	Year-round	Operates in South Australian waters out to the 200 nm Australian Exclusive Economic Zone	Sardine net In 2022/23 there were 14 licenses	The Sardine Fishery is a component of the Marine Scalefish Fishery. Sardines are primarily used as feed for southern bluefin tuna, which are farmed by the aquaculture industry near Port Lincoln, South Australia. *Source: PIRSA, 2023b*	None	Likely No figure provided due to data confidentiality.

Source: PIRSA, 2023a; BDO Australia, 2024

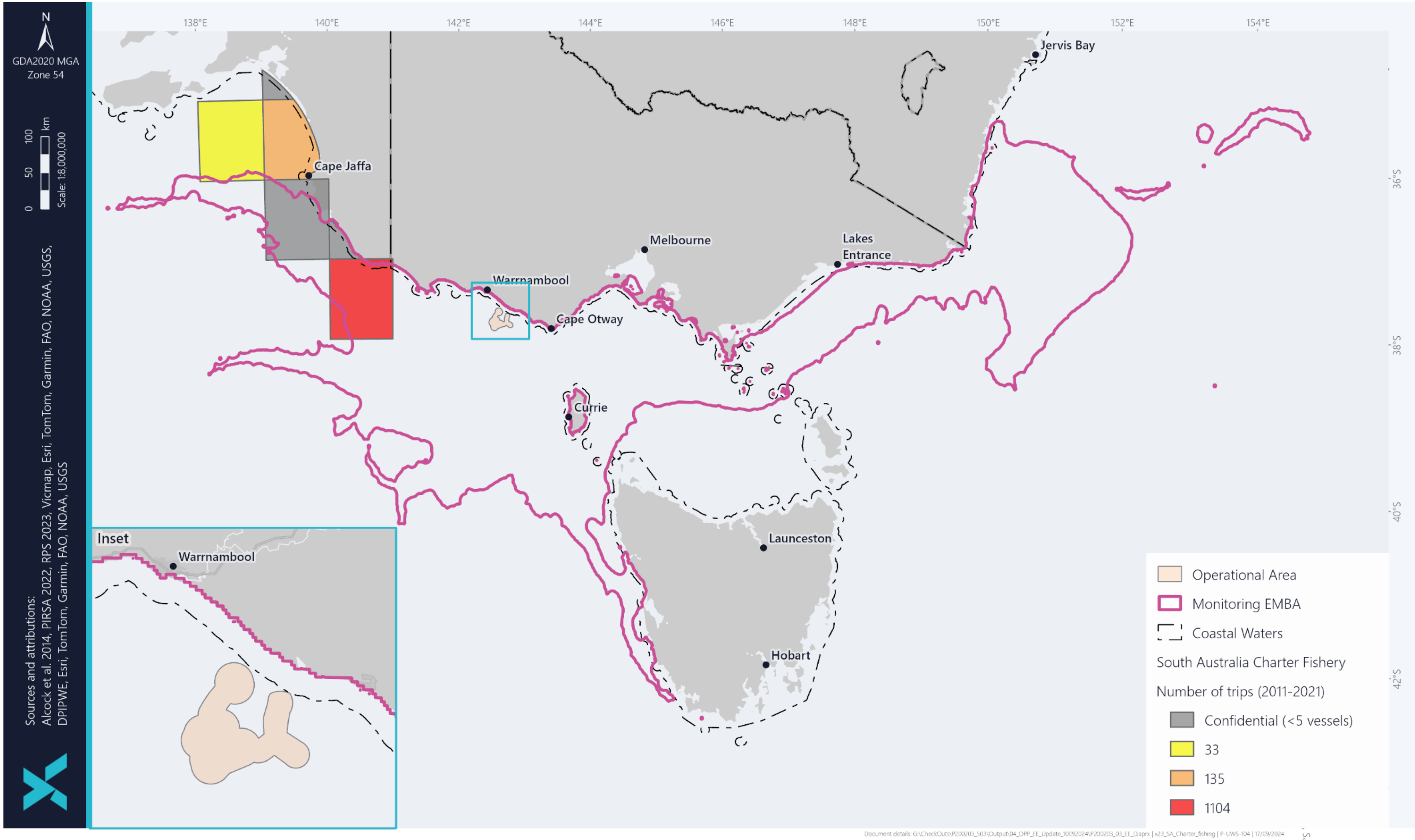


Figure 6-95: South Australian Charter Boat Fishery and overlap with the monitoring EMBA

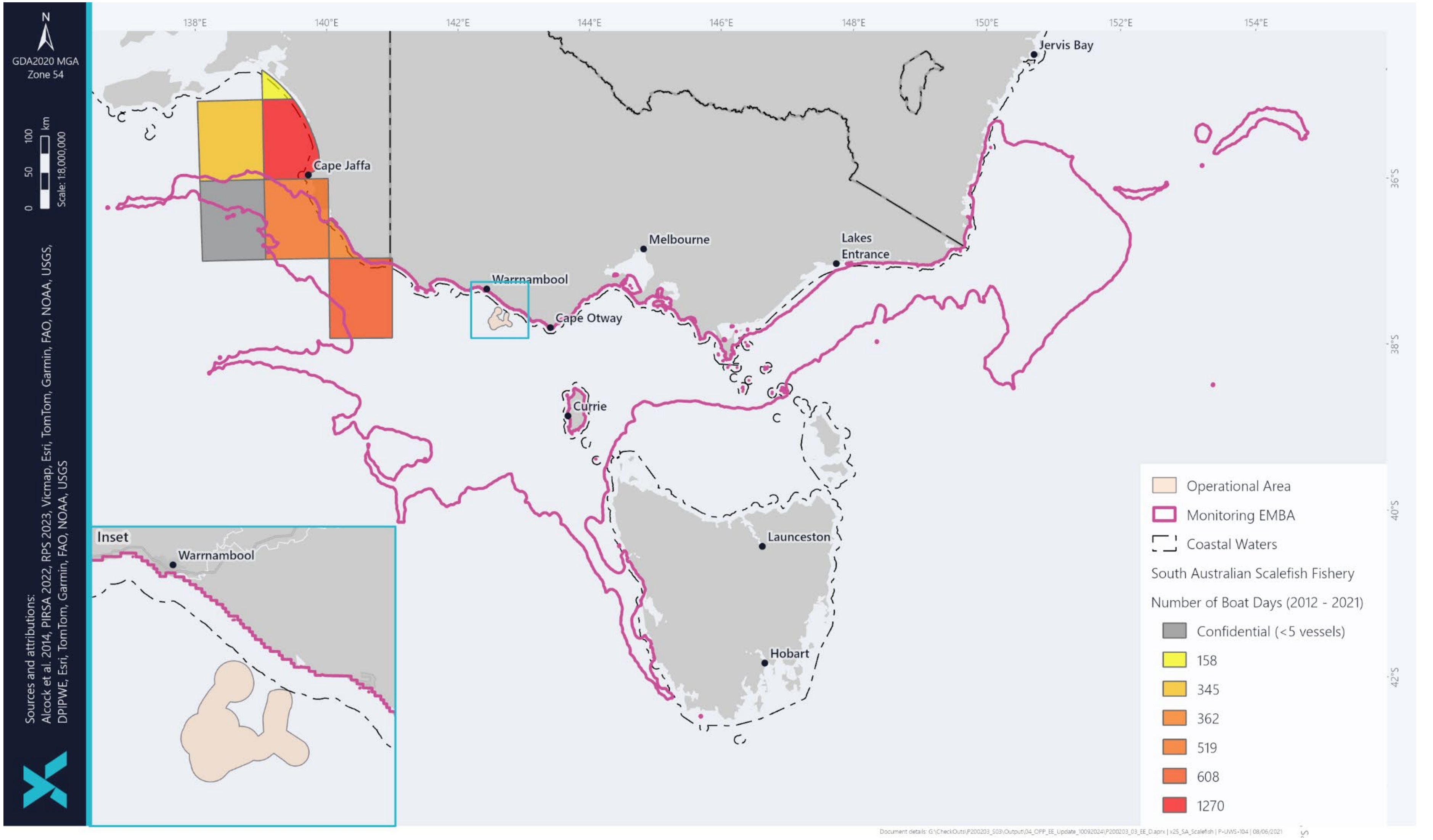


Figure 6-96: South Australian Marine Scalefish Fishery and overlap with the monitoring EMBA

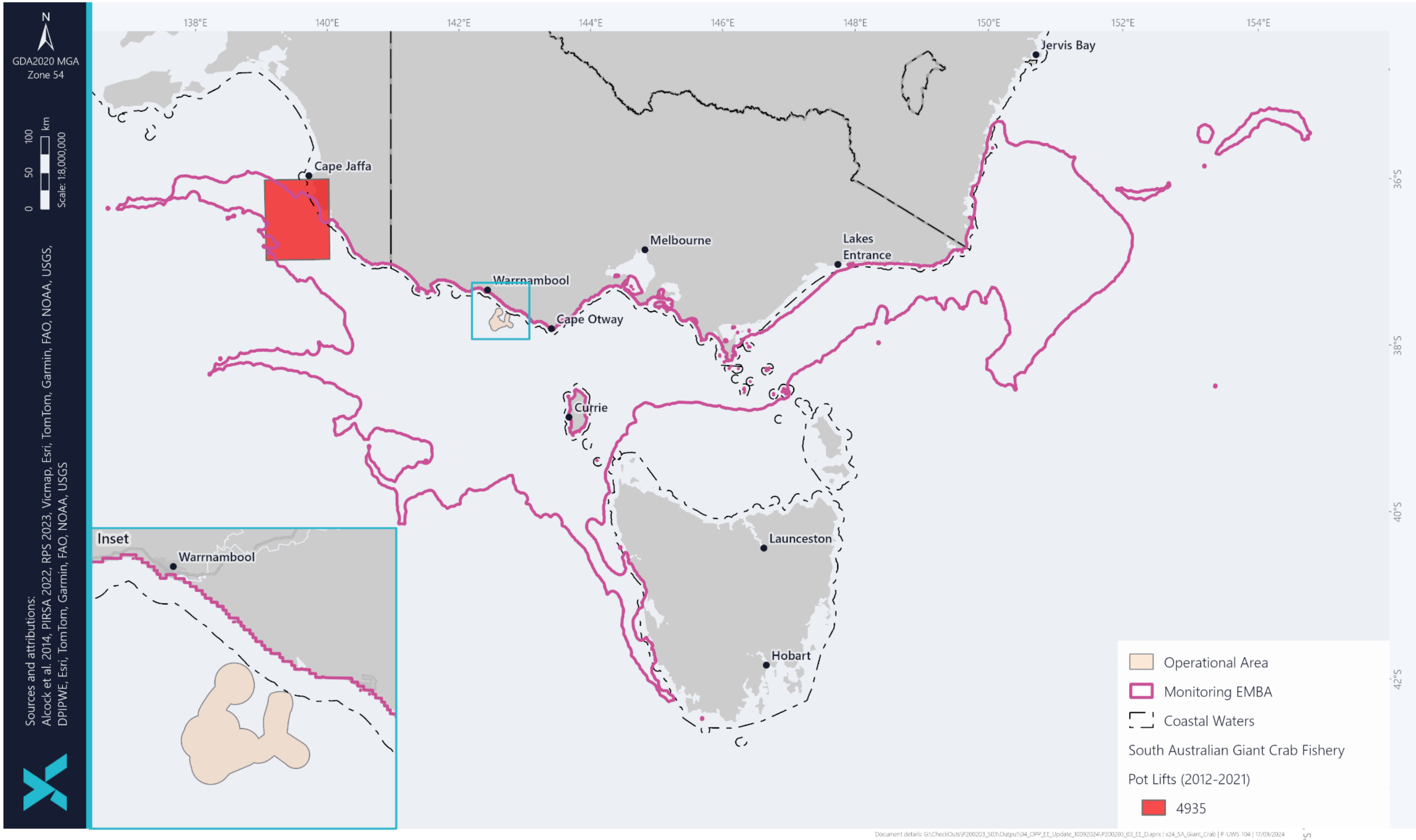


Figure 6-97: South Australian Giant Crab and overlap with the monitoring EMBA

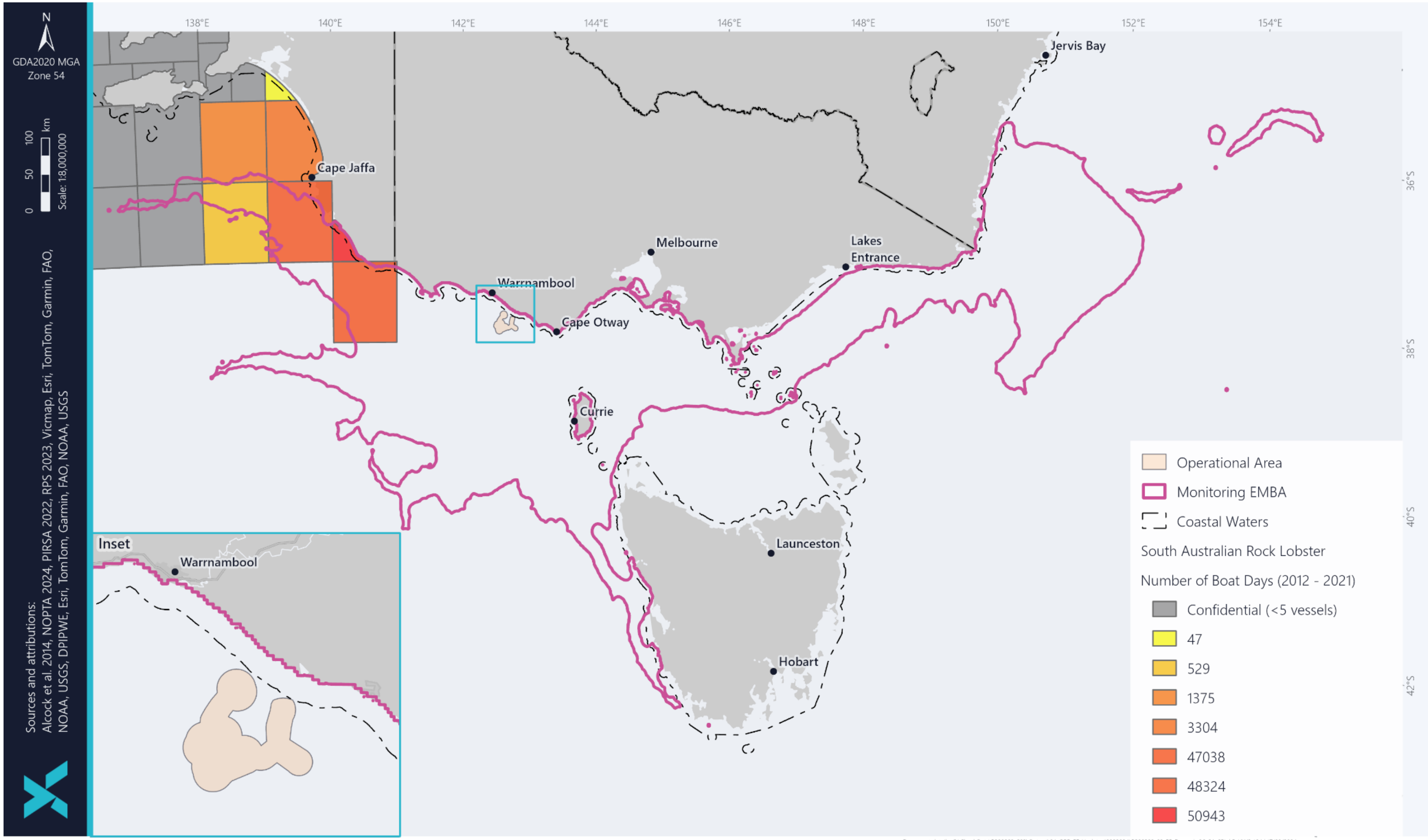


Figure 6-98: South Australian Rock Lobster and overlap with the monitoring EMBA

6.7.3 Other Offshore Industry

6.7.3.1 Shipping

The South-east Marine Region is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes. Commercial vessels use the route when transiting from international ports to ports on the east, south and west coasts of Australia; there are also regular passenger and cargo services between mainland Australia and Tasmania (NOO, 2004). Agricultural products and woodchips are transported from the Port of Portland to receiving ports in the Gulf of St Vincent, South Australia, and through Bass Strait to Melbourne and Sydney (NOO, 2004). Bass Strait is also transited by commercial vessels that may not call into ports on the south coast. There are also numerous smaller shipping routes in the area, such as those that service King Island.

The Australian Maritime Safety Authority (AMSA) indicates that the northern portion of shipping transects, ~75 km south of Warrnambool, are intersected by the southern portion of the operational area where moderate levels of vessel traffic may occur. This shipping transect is used by over 1,000 vessels per year which are travelling between major Australian and foreign ports. Additionally, the northern portion of the operational area is likely to be utilised by commercial fishing vessels frequently.

A total of 522 vessels intersected with the operational area in 2022 resulting in an average of 1.4 vessels per day utilising the area. Figure 6-99 provides an overview of the shipping traffic in the area. The East Coast Project is located at the northern extremity of areas with high traffic volumes. Figure 6-100 provides a snapshot of vessel activity in the region on a given day, including vessels of multiple different class and size.

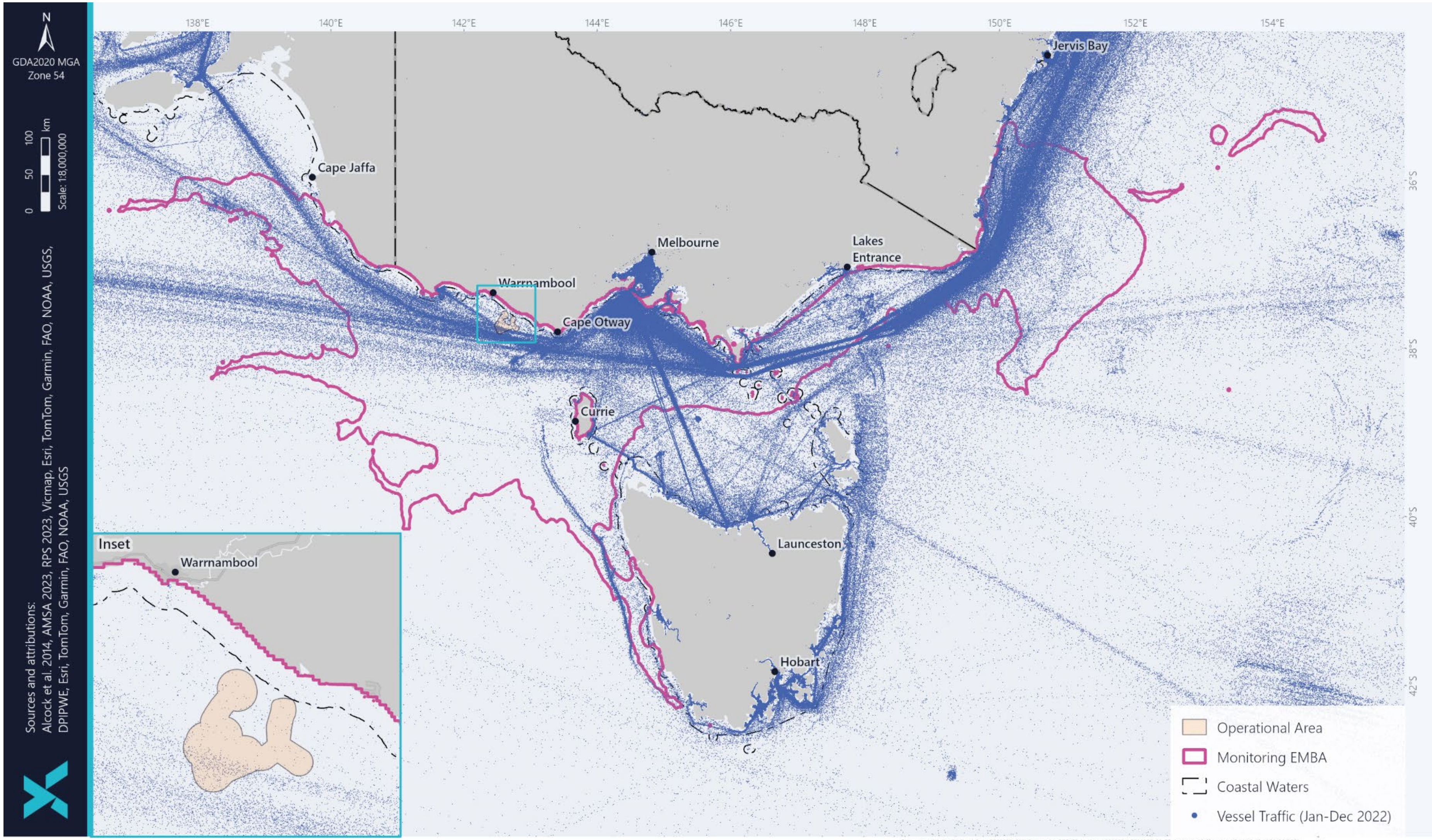


Figure 6-99: Vessel traffic within the operational area and monitoring EMBA over 1-month period

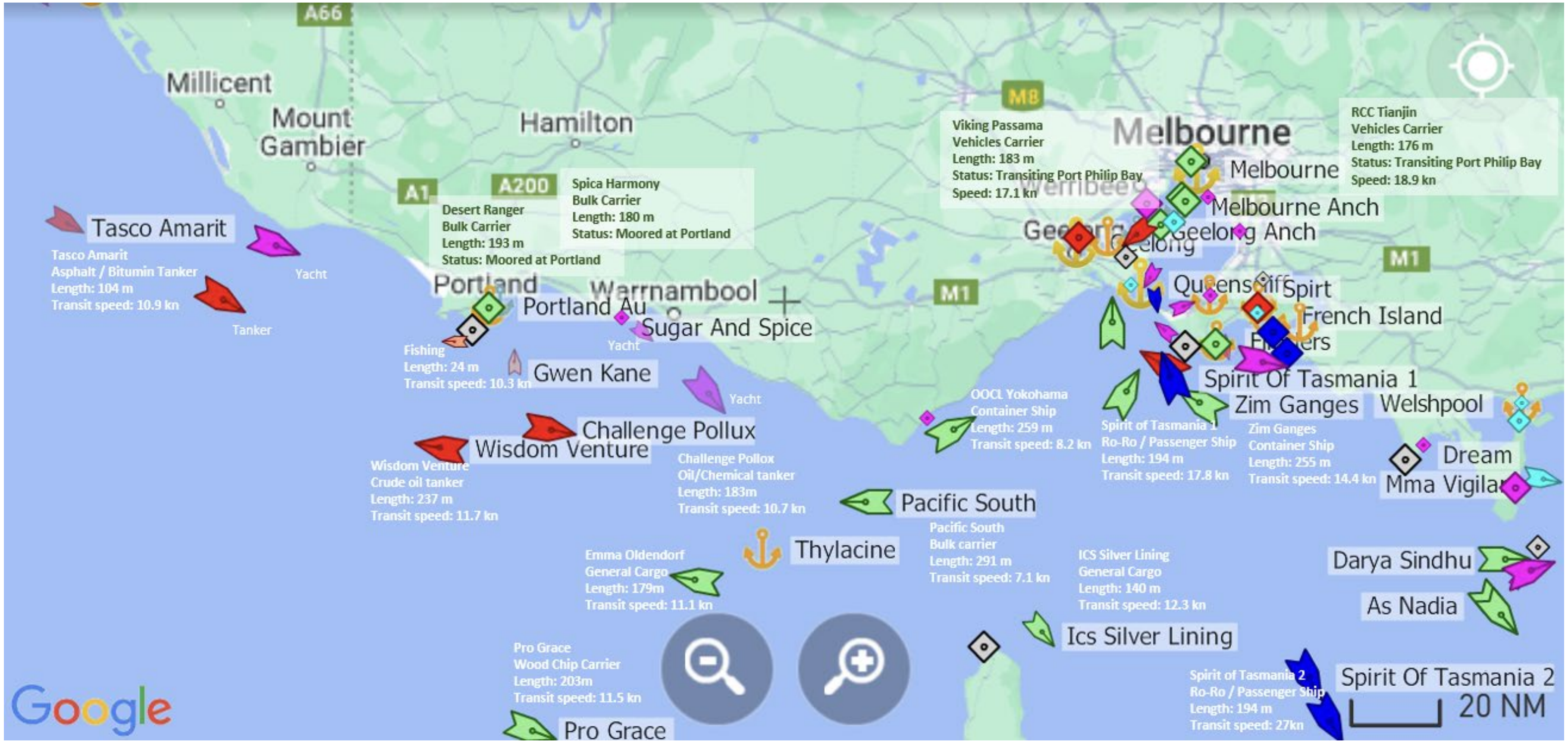


Figure 6-100: Vessel traffic within the Otway Region and Central Bass Strait 19/01/2024

**Image created from Marine Traffic app. Vessel positions received from coastal AIS receivers on 19/01/2024, approximate time 1600. Note, not all vessels report position via AIS.*

6.7.3.2 Petroleum Exploration and Production

Victoria's petroleum (oil and gas) exploration and production is concentrated in the offshore Commonwealth waters of the Otway and Gippsland basins as displayed in Figure 6-101.

The Otway Basin is an established gas producing region. Existing and historical offshore production in the Otway Basin includes the following oil and gas developments:

- CHN Development – Cooper Energy – previously described in Section 1.2
- Otway Gas Field Development – Operated by Beach Energy
  - The development consists of 6 wells, 4 of which are producing, tied back to a remotely operated platform (Thylacine), offshore and onshore pipelines and a gas processing plant (Otway Gas Plant) located 6.4 km north-east of Port Campbell.
- Minerva Gas Development – operated by Woodside
  - The development consists of two subsea wells in shallow waters (60 m depth), 10 km from the coast, these were tied back to shore, producing gas back to the Minerva Gas Plant gas plant (4.5 km inland) via a single pipeline. Production from the offshore wells ceased in 2019 and Woodside are in the process of decommissioning the offshore facilities.

Over the past few decades, numerous exploration and development wells have been drilled and seismic surveys have been undertaken in the Otway Basin. The most recent being the Beach Energy Artisan-1 exploration well (Vic/P43) in 2021 and Schlumberger Otway Basin 2D Marine Seismic Survey in 2020. At the time of writing, the following EPs are under development or assessment, and which propose to undertake activities in the Otway Region in the next 5-years:

- Otway Basin 3D Multi-client Marine Seismic Survey
- Regia MSS
- Beach Energy Otway Drilling Campaign
- Woodside Energy Minerva Facility Decommissioning
- Conoco Phillips Exploration Drilling

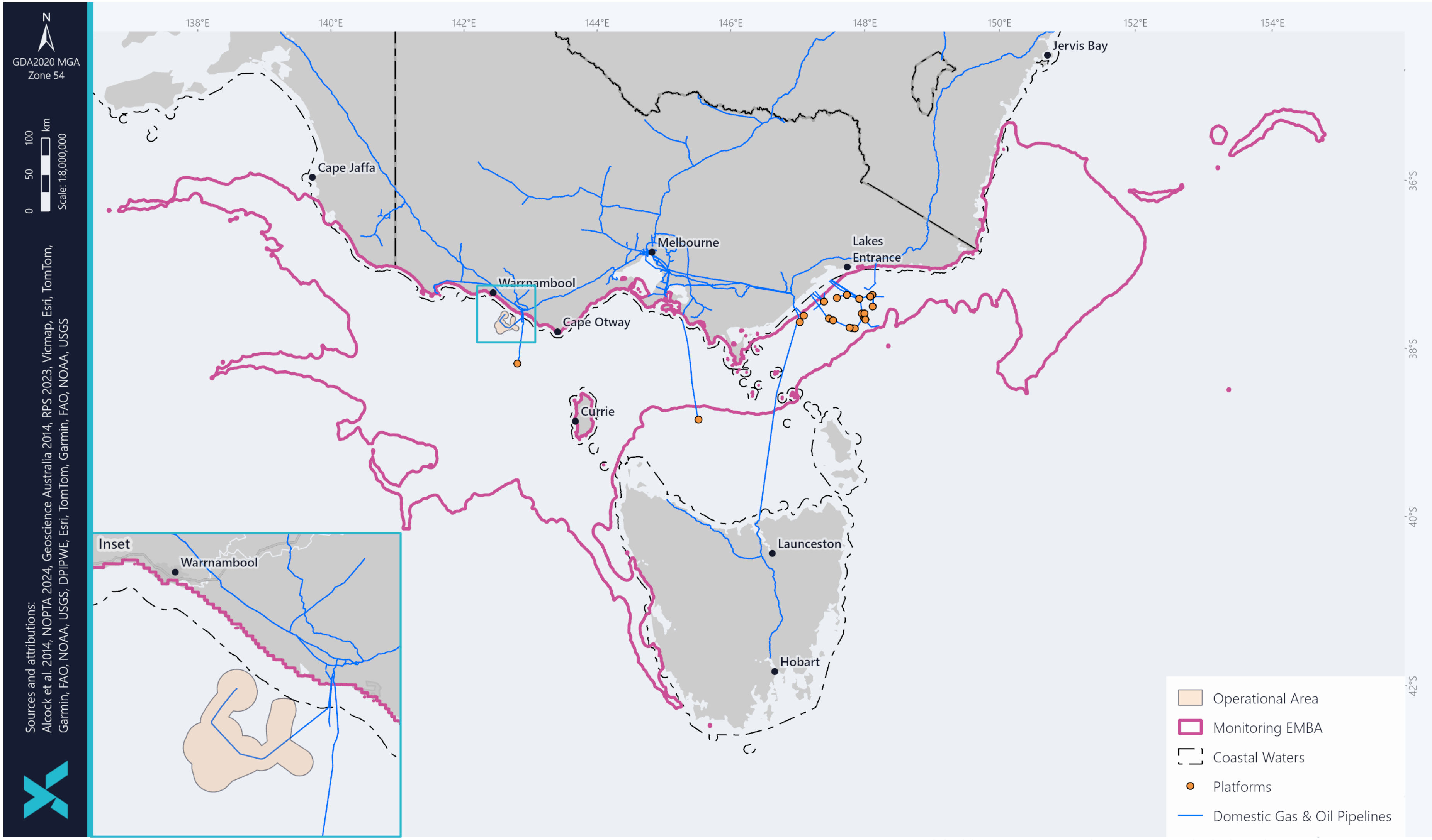


Figure 6-101: Existing Petroleum Infrastructure south-east Australia

6.7.3.3 Other Offshore Infrastructure

Offshore Renewable Energies

Australia released the Offshore Electricity Infrastructure Act 2021 which provided legislation on the development of offshore renewable energy projects. This Act was followed by the release of the Offshore Electricity Infrastructure Regulations 2022 and the announcement of 6 proposed areas in Australian Commonwealth waters where projects may occur. Since this announcement 3 of the proposed areas have been declared, all of which are located outside of the operational area:

- Southern Ocean, Victoria
- Gippsland, Victoria
- Hunter, NSW.

The Southern Ocean declared area is the closest to the East Coast Project, located ~5 km from the operational area. The Southern Ocean was declared in March 2024, with feasibility license applications closing July 2024. The declared area comprises an area 1,030 km^2 and is expected to support 2.9 GW.

Although none of the declared areas intersect with the operational area, one proposed offshore wind farm (OWF) (Barwon OWF) does overlap. This project is in the feasibility stages of development and has not yet been awarded a license. Other proposed projects located within the monitoring EMBA are displayed in Figure 6-102.

Subsea Cables

Submarine cables are underwater infrastructure which transfer communications or electricity from one area of Australia to another, and to other countries. The submarine communications cables carry the bulk of Australia's international voice and data traffic. In the South-east Marine Region there are a total of 6 subsea cables, which are listed below:

- Bass Strait-1, Bass Strait-2 – submarine transmission lines between mainland Australia and Tasmania (both Telstra fibre optic cables)
- Basslink – a subsea interconnector which joins the Tasmanian and national electricity grid
- INDIGO Central – a subsea interconnector, completed in 2019 offering direct, low latency connectivity from Sydney to Perth
- East Coast cable and Hawaiki Nui have a landing in Melbourne and are expected to be installed by 2024 and 2025, respectively
  - The East Coast Cable will connect two existing cable systems (the North West Cable System and the Australia-Singapore Cable)
  - Hawaiki Nui will connect Australia, New Zealand, American Samoa, Hawaii and the west coast of the United States

No subsea cables intersect with the operational area. Those within the monitoring EMBA are displayed in Figure 6-103.

Under the *Telecommunications and Other Legislation Amendment (Protection of Submarine Cables and Other Measures) Act 2005*, the Australian Communications and Media Authority (ACMA) can propose cable protection zones over these assets if they are considered to be of national significance (DEWHA, 2009b). Currently, 2 protection zones have been declared in Sydney, outside of the monitoring EMBA. No protection zones have been declared within the Otway region.

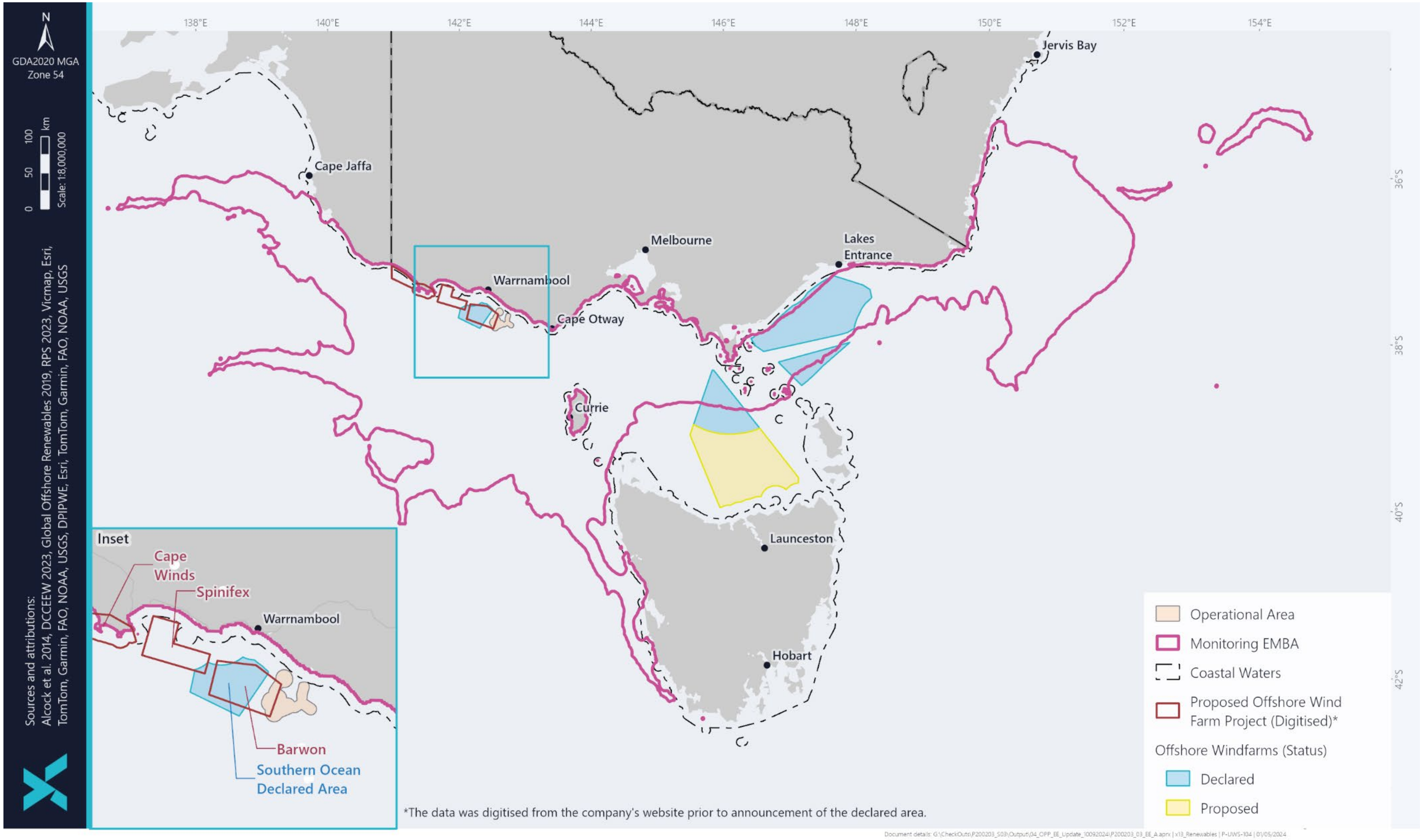


Figure 6-102: Offshore Renewable Energy declared areas and proposed projects within the monitoring EMBA

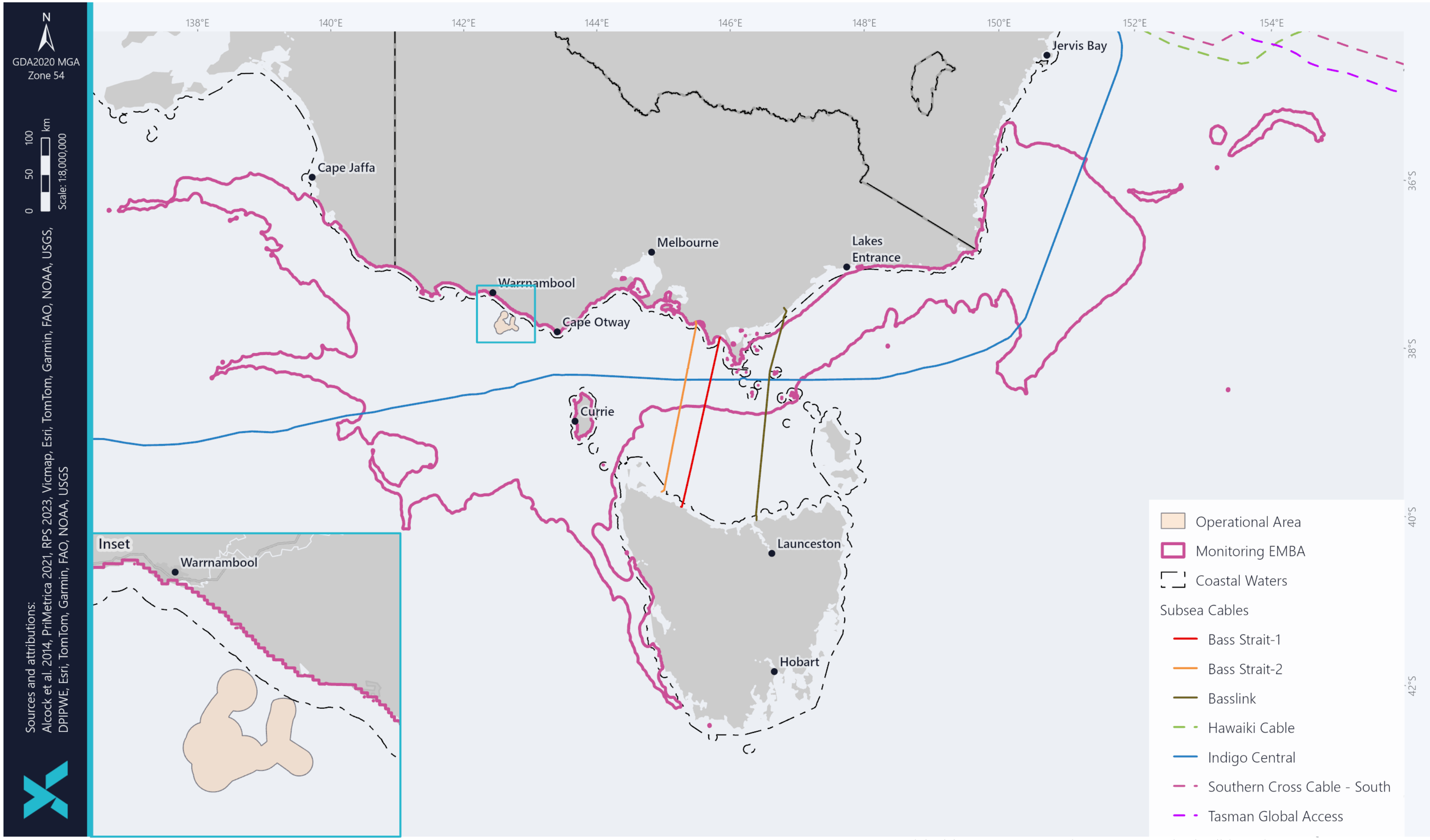


Figure 6-103: Subsea cables located within the monitoring EMBA

6.7.3.4 Defence

The Department of Defence continues to use offshore areas for training operations including live firing, bombing practice from aircraft, air-to-air and air-to-sea or ground firing, anti-aircraft firing, firing from shore batteries or ships, remote controlled craft firing, and rocket and guided weapons firing.

Additionally, in World War II mine fields were laid in Australian waters. Unexploded ordinance (UXO) is a by-product of past training activities undertaken by the ADF. Post-war minefields were swept to remove mines and to make marine waters safe for maritime activities, however there is still potential for interaction with UXO in certain sections of Australian waters. The Department of Defence's (DoD) interactive UXO in Australia map (DoD, 2021) was used to determine locations that are at risk of hosting UXO within the vicinity of the operational area. Locations outside of the operational areas were not assessed as loss of well control (LOWC) impacts are not expected to affect UXO.

No training facilities, sea dumping sites, or sites with potential UXO interaction areas are overlapped by the operational area, although a number are located within the monitoring EMBA, particularly around Melbourne, as displayed in Figure 6-104.

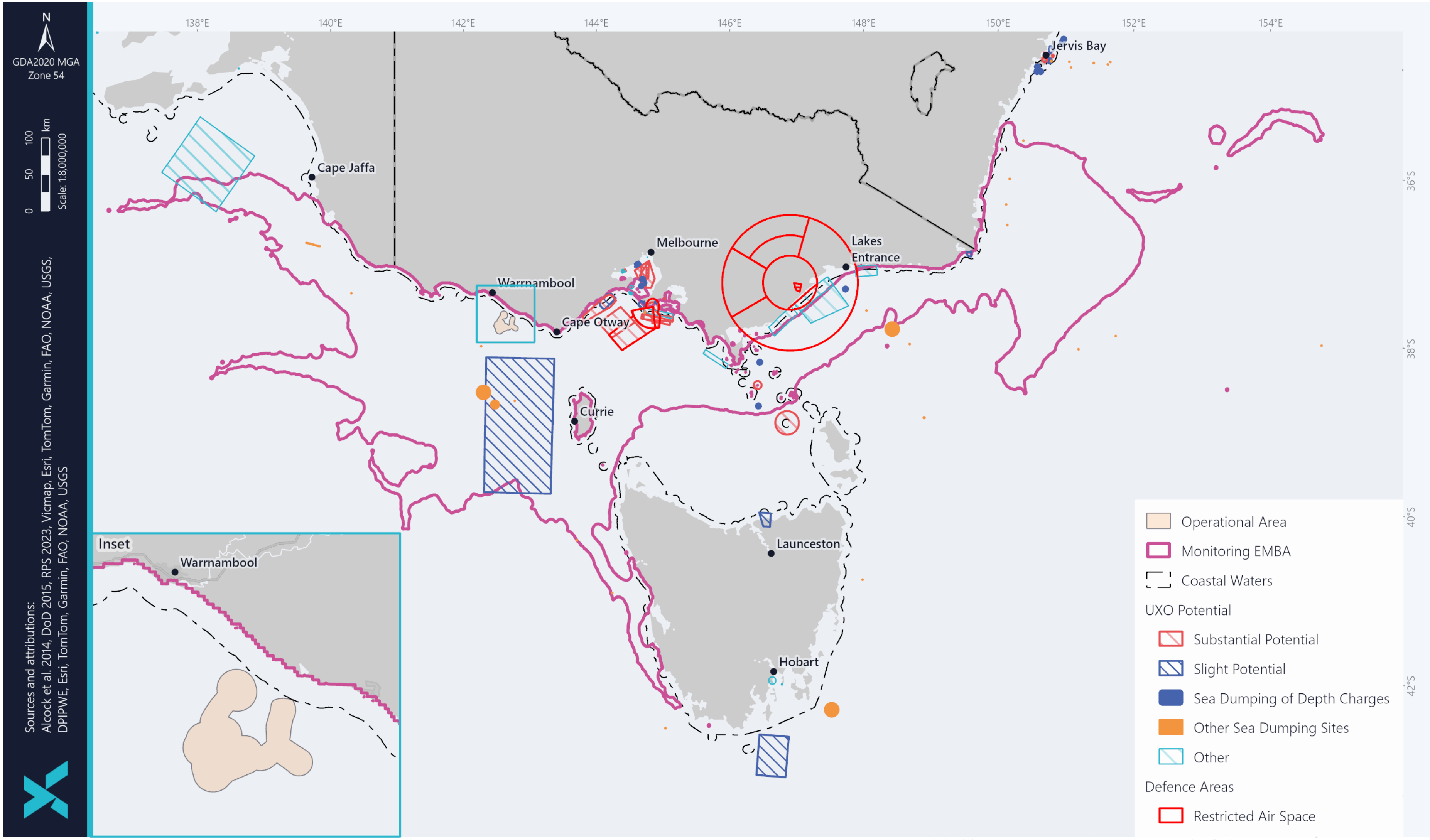


Figure 6-104: DoD activities and potential UXO located within the monitoring EMBA

6.7.4 Recreation and Tourism

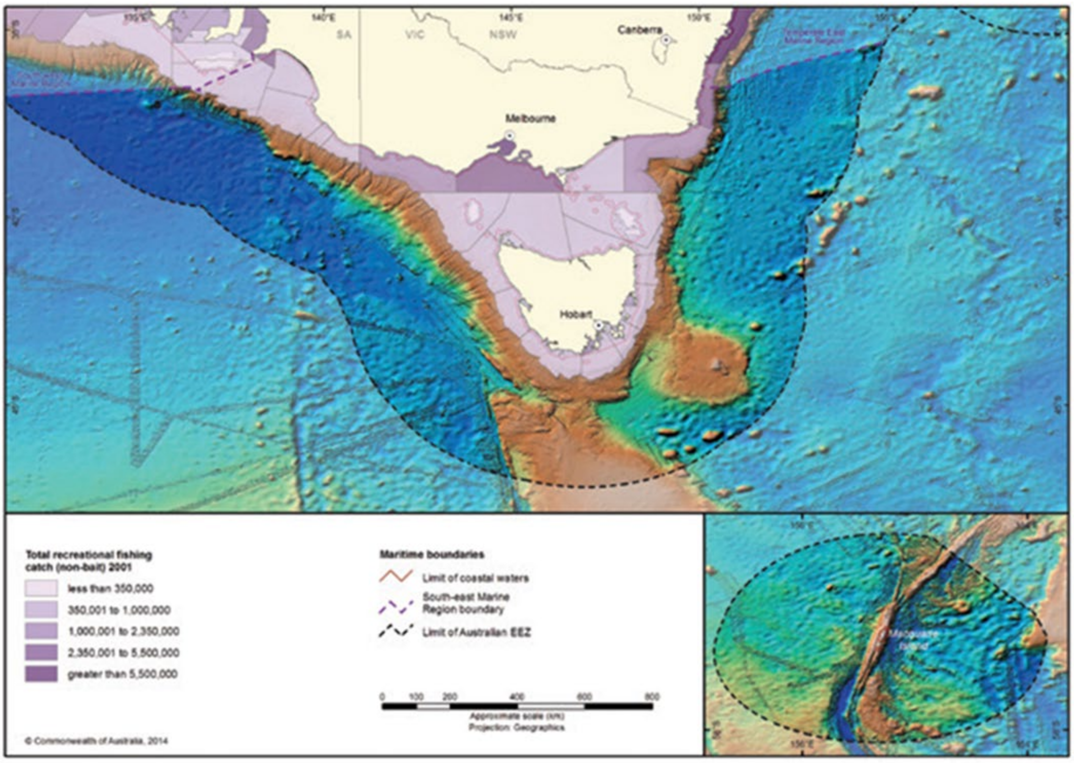
Recreational and tourism activities are extremely valuable foundations for the local and regional economy. In 2022-23 tourism in Victoria was estimated to be worth $28.2 billion to the economy in Gross State Product and generated approximately 257,500 jobs (Tourism Research Australia, 2024). The latest data from Tourism Research Australia shows that total tourism expenditure in Victoria was $35.0 billion in the year ending March 2023, an increase of 113% compared to the year ending March 2022. Total tourism spend has fully recovered and was back above the pre-pandemic level (+17%) (Business Victoria, 2023).

The Victorian coast and marine region provide a diverse range of land-based and near-shore tourism opportunities, including scuba diving, fishing, whale and wildlife watching, sailing, snorkelling and kayaking. The East Coast Project is located along an area of the coastline parallel to the Great Ocean Road, one of the most famous drives in the world which facilitates most tourist visits to the region. Numerous self-guided tours (e.g., Great South West Walk), picnic facilities and coastal lookouts are provided along the coast, with camping sites, caravan parks, guesthouses, motels and hotels encouraging tourism stays in the area.

Surfing in particular is a popular sport on the Victorian coastline that draws international attention. Popular surfing locations along the western Victorian coastline include Gibson Steps and Johanna Beach approximately 22 and 42 km, respectively (PV, 2023a). Whale watching is another popular past time that locals and tourists alike can enjoy along the western Victorian coastline. As discussed in Section 6.7.1 the ‘winter whale trail’ spans from Portland to Warrnambool and list’s locations where the southern right whale can be observed from the coast between May and October each year (Glenelg Shire Council, 2024).

6.7.4.1 Recreational Fishing

Recreational fishing in Australia is a multi-billion-dollar industry and includes rock, beach, boat and estuary fishing, using rod and line. Most recreational fishing typically occurs in nearshore coastal waters (shore or inshore vessels), and within bays and estuaries; offshore (>5 km) fishing only accounts for approximately 4% of recreational fishing activity in Australia. Charter fishing vessels are likely to account for most offshore fishing activity. The variation in recreational fishing intensity along the coast is illustrated in Figure 6-105. Common recreational fish species include tiger flathead, bream, snapper, Australian salmon, and lobster; and offshore catches can include mackerel, tuna, groper and shark.



Source: CoA, 2015a

Figure 6-105: Recreational Fishing Catch in South-eastern Marine Region, 2001

6.8 Cultural Environment

6.8.1 Underwater Cultural Heritage

In Australia, sunken aircraft, wrecks (>75 years old) and other underwater cultural heritage is protected within waters inside or outside Australian waters under the *Underwater Cultural Heritage Act 2018 (Cth)* and in Victorian waters under the *Heritage Act 1995 (Vic).*

The western Victorian coastline is known as the ‘Shipwreck Coast’ due to the number of wrecks present with most wrecked during the late nineteenth century. The strong waves, rocky reefs and cliffs of the region contributed to the loss of these ships. The wrecks represent significant archaeological, educational and recreational (i.e., diving) opportunities for tourism and local enjoyment.

The Australasian Underwater Cultural Heritage Database contains historical and environmental records of shipwrecks, aircraft, artefacts and other underwater sites. A search of this database resulted in the identification of one known site of underwater cultural heritage located within the operational area (DCCEEW, 2023n).

One shipwreck <75 years old, Alfred (ID 11052), was identified to be located near the border of the operational area:

- Latitude: -38.680000
- Longitude: 142.790000.

The search resulted in the identification of a handful of submerged aircrafts and a large number of historic (>75 years) and non-historic (<75 years) shipwrecks, within the monitoring EMBA which are displayed in Figure 6-106.

However, coordinates of heritage listed within the Australasian Underwater Cultural Heritage Database are not necessarily the known coordinates. Where records are incomplete, general coordinates are assigned which may give a nominal location within the region (e.g., where the ship was last observed or understood to be sailing through or to). As in the case of the Alfred, the actual location of the heritage may be some distance from the location attributed on the heritage database.

For conservation, management or public safety reasons certain shipwrecks within Australia have additional protection zones than that established under the *Underwater Cultural Heritage Act 2018 (Cth).* Those within the monitoring EMBA include:

- SS Glenelg (1900) – 500 m radius
- SS Federal (1901) – 800 m radius
- Clonmel (1841) – 50 m radius
- SS Alert (1893) – 500 m radius (DCCEEW, 2021d).

No underwater cultural heritage artifacts have been recorded in any seabed surveys completed within or proximal to the East Coast Project operational area.

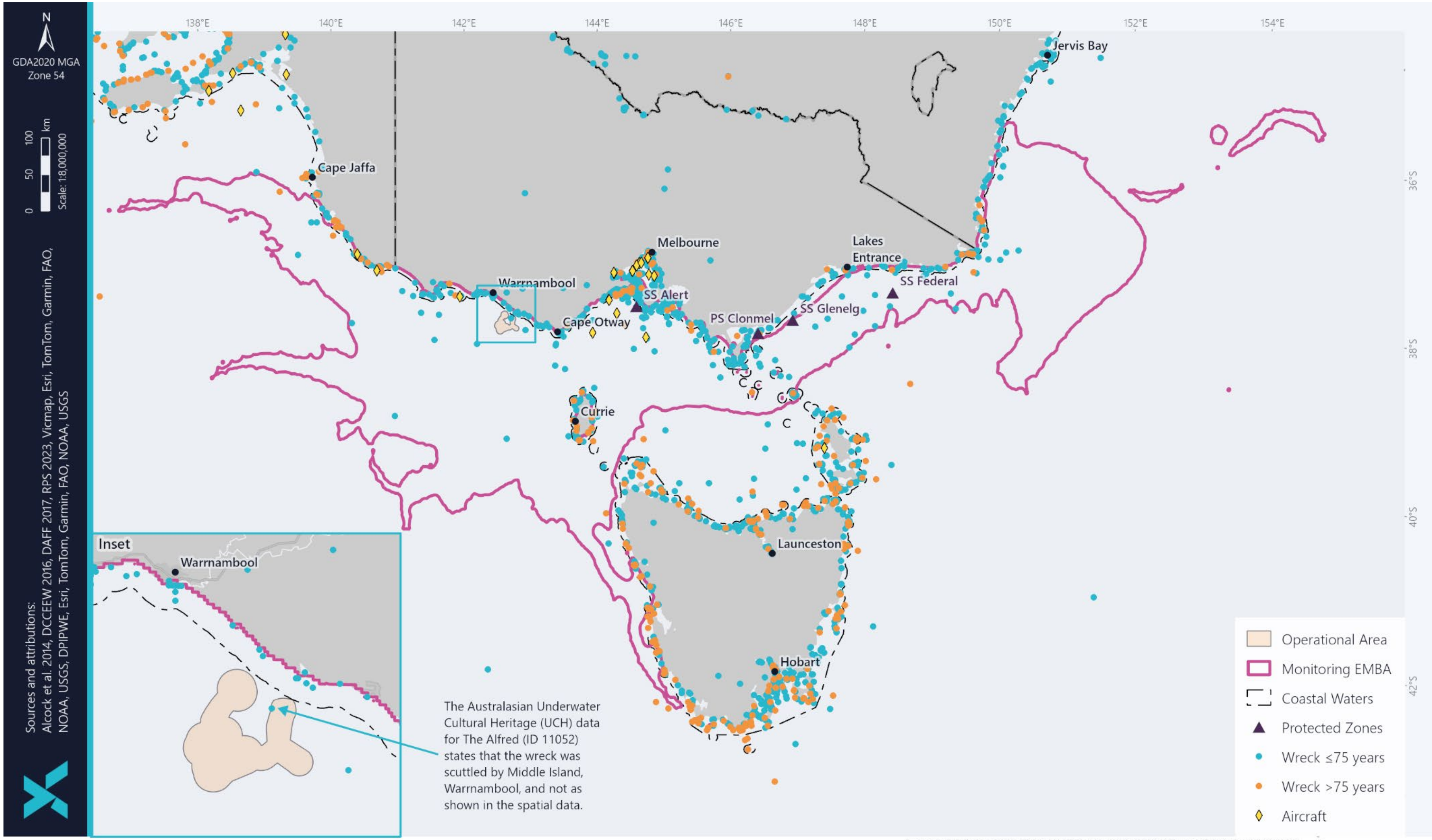


Figure 6-106: Sites of Underwater Cultural Significance within the monitoring EMBA

6.8.2 Commonwealth Heritage Places

Commonwealth heritage places are owned or controlled by the Australian Government that are of Indigenous, historic or natural heritage. Places may also be connected to defence, maritime safety, communications, customs or other government activities that reflect Australia's development as a nation.

Several Commonwealth Heritage Places are located along the coastline and nearshore waters of Victoria, Tasmania, NSW and South Australia. There are no known Commonwealth Heritage Places located within the operational area, however a total of 12 were identified within the monitoring EMBA:

- Cape Northumberland Lighthouse
- Cape Sorell Lighthouse
- Cape Wickham Lighthouse
- Fort Queenscliff
- Gabo Island Lighthouse
- HMAS Cerberus Central Area Group
- HMAS Cerberus Marine and Coastal Area
- Montague Island Lighthouse
- Sorrento Post Office
- Swan Island and Naval Waters
- Swan Island Defence Precinct
- Wilsons Promontory Lighthouse

Of those listed above, listed places with marine or shoreline features are described below and displayed in Figure 6-107.

6.8.2.1 HMAS Cerberus Marine and Coastal Area

The Sandy Point/ HMAS Cerberus area is a large sandy foreland extending east from Somers on the western shore of Western Port which is a Ramsar wetland (described in Section 6.6.4.1). The area has a diverse range of marine and coastal habitats, including tidal channels, fast tidal currents, tidal mudflats, seagrasses, mangroves, saltmarshes and sand beaches (DCCEEW, 2023o). This diversity in coastal habitat results in high marine invertebrate diversity and the extensive intertidal mudflats provide essential habitat to a number of listed migratory and resident shorebirds species. EPBC listed seabirds such as the Shy Albatross and the Southern Giant Petrel also utilise the area (DCCEEW, 2023o).

It is possible that cultural values, both Indigenous and non-Indigenous, of national estate significance may exist in this place, however none have currently been identified within publicly available literature.

6.8.2.2 Swan Island and Naval Waters

Swan Island is located off the Bellarine Peninsular close to the Port Phillip Bay heads and separated from Queenscliffe by a narrow artificial channel. Swan Island and Naval Waters is an integral part of Swan Bay, an internationally significant wetland which is important as wader and waterfowl habitat. The area provides habitat for 46 water bird species: of which 26 species are listed under the Japan-Australia and China-Australia migratory bird agreements; and 8 species are listed under the Bonn Convention on Migratory Species (DCCEEW, 2023o).

Swan Island itself is the largest emergent sand accumulation feature in Port Phillip Bay and has been built principally by wave actions rather than by aeolian forces. Swan Island has played a major role in determining the pattern of sedimentation in Swan Bay and contributes to the preservation of geomorphological evidence of changing Quaternary sea levels (DEECCW, 2023o). The eastern and northern shores of the eastern arm of Swan Island are of regional significance as an example of active coastal depositional and erosional processes. The patterns of erosion and accretion on these shores provide a good indicator of sand movements into Port Phillip Bay (DCCEEW, 2023o).

A number of historic shipwrecks are known to have occurred within the vicinity of Swan Island, 6 of which are known within the Naval Waters. The area also contains a highly significant historic cultural landscape, as the Swan Island Defence Precinct, a network of defensive fortifications, was built for Victoria's protection by the Colonial government in 1879 (DCCEEW, 2023o).

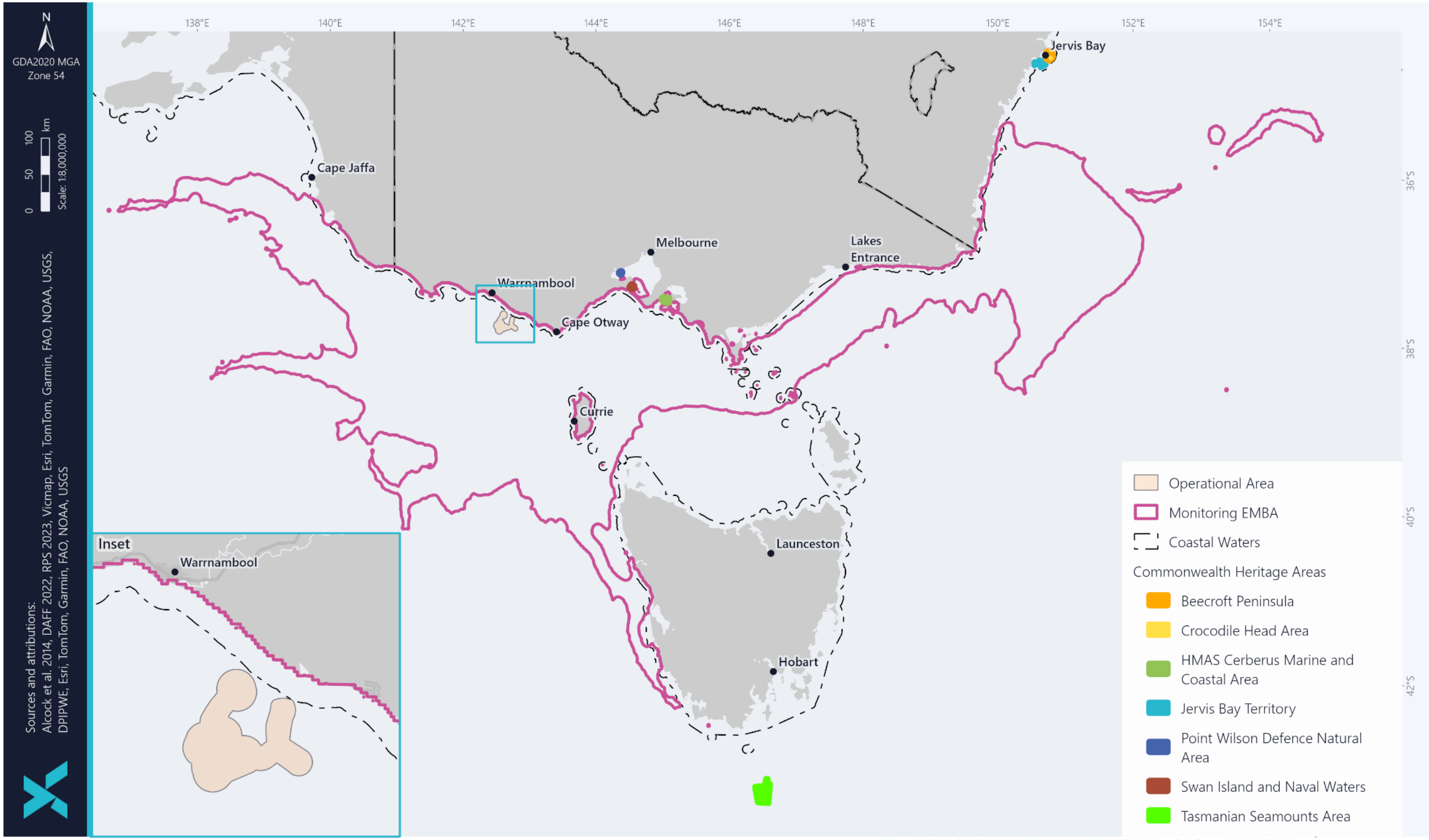


Figure 6-107: Listed Commonwealth Heritage Places located within the EMBA

6.8.3 First Nations People Cultural Heritage

First Nations people cultural heritage refers to the knowledge and lore, practices and people, objects and places that are valued, culturally meaningful and connected to identity and Country (Victorian Aboriginal Heritage Council, 2023).

To determine relevant First Nations cultural heritage within the monitoring EMBA, the following sub-sections provide details on:

- Knowledge and lore:
  - History of Sea Country (Section 6.8.3.1),
  - Modern First Nations coastal uses and interests (Section 6.8.3.2),
- Practices and people:
  - Relevant First Nations groups (Section 6.8.3.3)
  - Native Title (Section 6.8.3.4)
  - Indigenous Land Use Agreements (Section 6.8.3.5)
  - Indigenous Protected Areas
- Objects and places that are valued, culturally meaningful and connected to identity and Country
  - Values and sensitivities (Section 6.8.3.7)

6.8.3.1 History of Sea Country

Sea Country is not distinguishable from land-based Country to First Nations Peoples. It includes parts of open ocean, beaches, land and freshwater on the coast and encompasses all living things, beliefs, values, creation spirits and cultural obligations connected to an area (The University of Adelaide, 2023). Water is of particular cultural significance to First Nations Peoples as an integral part of songs, ceremonies, hunting and collecting, and other activities that bind people to Country and each other, including fishing (Smyth, Egan and Kennett, 2018). Cooper Energy offshore activities overlap elements of Sea Country. These include the coast, open ocean and living things; these things are ecologically and spiritually connected to First Nations culture.

Indigenous groups hold strong connections to the south-east marine region, as occupation of coastal areas dates back over at least 40,000 years (DoE, 2015a). The coastal area of south-east Australia was amongst the most densely populated regions of pre-colonial Australia; these areas provided an abundance of marine and other resources that were not available away from the coast and oceans (NOO, 2002). First Nations Peoples relationship with offshore involved travel to islands in bark rafts and canoes, and the use and management of marine species (e.g., migratory short-finned eels and bull kelp) (NOO, 2002). During recent ice age periods (the last ending approximately 14,000 years ago), sea levels were significantly lower, and the coastline was a significant distance seaward of its present location, enabling occupation and travel across land that is now submerged.

It is likely that the palaeo shelf was exposed and incised by fluvial systems over glacial maximum periods from the time of Australia's First Nations Peoples (~60,000 years ago to present day) (De Decker, et. al., 2020). Areas now submerged within the Bass Strait would have provided for First Nations People of that time, and there are some landscape features now partially submerged which continue to have a place in culture and stories told today.

The Tyrendarra lava flow is a particular landscape and seabed feature which is linked to First Nations stories and deep continued connection with Country. The lava flow extends from Mt Eccles to ~15km offshore, just east of Portland. The Budj Bim aquaculture system was established within the lava flow. Evaluation of high-quality 3D seismic imagery has indicated there is no geological evidence of recent (500,000 years or less) volcanic or hydrothermal flow events within the sedimentary record within Cooper Energy's operated offshore acreage. Several crater complexes and lava flows are present within the greater onshore region, however, are unlikely to extend into the Cooper Energy acreage.

6.8.3.2 Modern Indigenous Coastal Uses and Interests

First Nations people hold strong connections to the south-east marine region. The Victorian coast is of significance with respect to First Nations cultural heritage. This includes areas where there may be no physical evidence of past cultural activities but includes places of spiritual or ceremonial significance, places where traditional resource use occurs or trade and travel routes (Aboriginal Victoria, 2008).

Contemporary First Nations interests in the region are diverse and First Nations communities of the South-east Marine Region continue to strengthen First Nations cultural and spiritual connection to the ocean, and to use ocean resources for food, traditional purposes and income (CoA, 2015a). The Eastern Maar Country Plan describes the country's first peoples as continuing to utilise coastal resources – collecting tucker such as abalone and crayfish.

6.8.3.3 Relevant First Nations Groups

The coastal areas of the Otway Basin, Bass Strait and Gippsland Basin are associated with a number of First Nations groups (Figure 6-108). The Victorian Aboriginal Heritage Council's Registered Aboriginal Parties (RAP) map was used to determine the formally recognised First Nations people of the Victorian coastline (VAHC, 2023). First Nations groups with connection to land and Sea Country in the monitoring EMBA include:

- Gunditjmara people are the formally recognised First Nations people of the western coast of Victoria (Otway) from the SA border to Portland/Port Fairy.
  - the GMTOAC conveyed Gunditjmara's responsibility for protecting and healing Country in the event of an emergency response.
- Eastern Maar people are the formally recognised traditional owners of the western/central coastline of Victoria (Otway) from Portland/Port Fairy to Lorne.
- Wadawurrung people are the formally recognised traditional owners of the central coastline of Victoria (Bass Strait) from Lorne to Geelong
- Bunurong people are the formally recognised traditional owners of the central coastline of Victoria (Bass Strait) from Melbourne to Inverloch
- Gunaikurnai people are the formally recognised traditional owners of the eastern coastline of Victoria (Gippsland Basin) from Port Welshpool to Lakes Entrance.
  - the Gunaikurnai Land and Waters Aboriginal Corporation (GLaWAC), has shared knowledge of some sites and types of artefacts known in the Orbost area. A strong desire to be involved in protecting Country was expressed, whether this be during operations (possibly supporting marine mammal observation programs), or during emergency events in providing local cultural advice to the response agency and potentially being able to support oiled wildlife response (under direction of DEECA).

The NSW Aboriginal Land Council's Local Aboriginal Land Council map and the National Native Title Tribunal website were used to identify First Nations people of the NSW and South Australian coastline. The First Nations groups with connection to land and Sea Country in the monitoring EMBA include:

- Yuin people are the traditional custodians of the lands and waters from the south coast of New South Wales. The South Coast People have submitted a Native Title Determination Application relating to the lands and waters from Hacking River to Towamba River Figure 6-109).
- First Nations of the South East people are the traditional custodians of the lands and waters in south east south Australia. The First Nations of the South West people have submitted a Native Title Determination Application extending from the Victorian border to the Kingston District Council – Coorong District Council boundary (Figure 6-110).

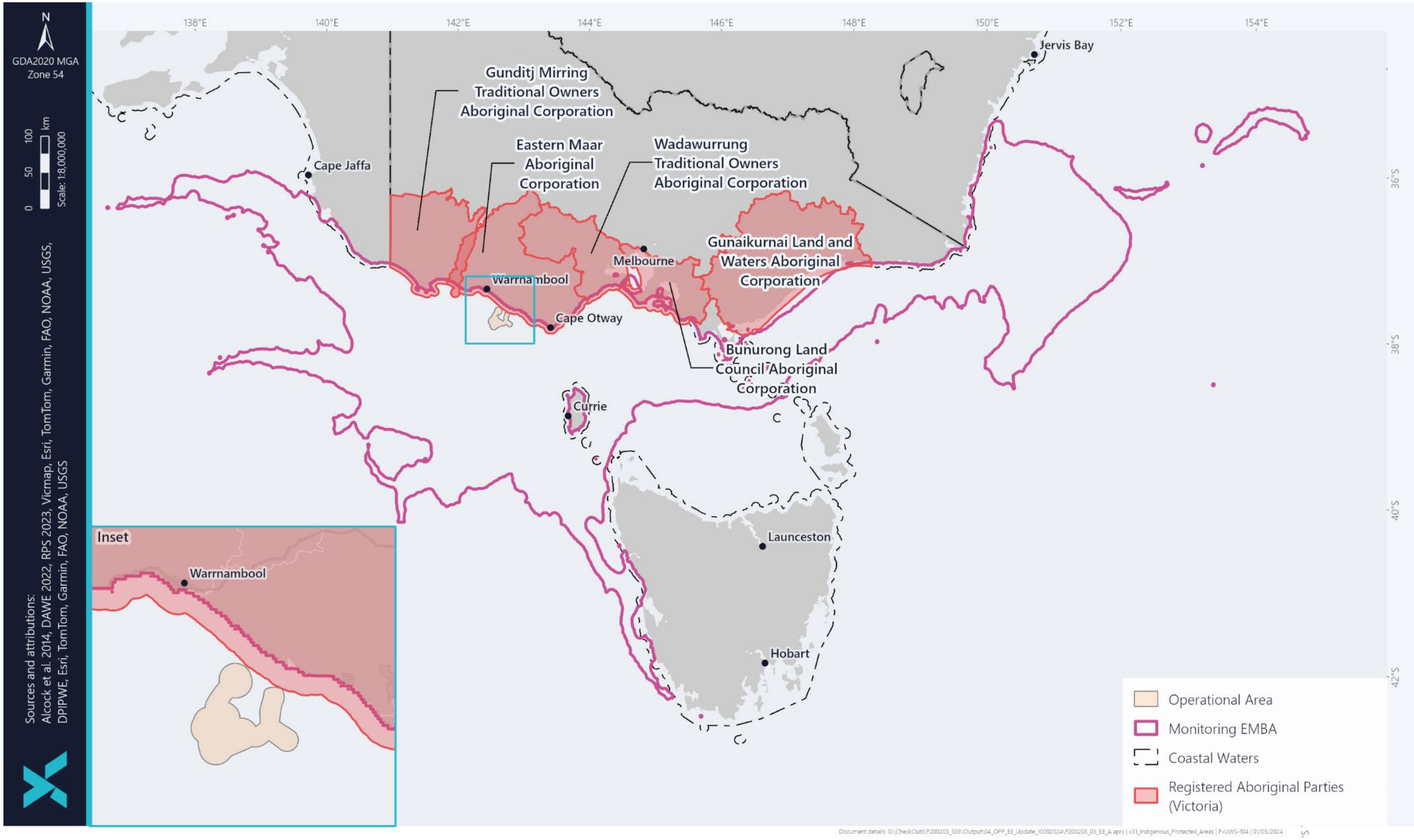


Figure 6-108: Registered Aboriginal Parties relevant to the Victorian coastline

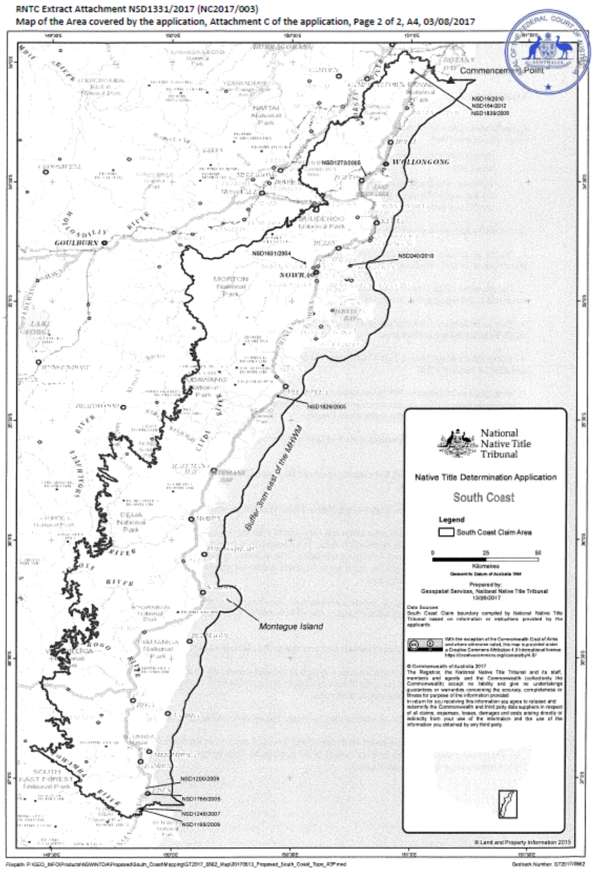


Figure 6-109: Native Title Determination Application - South Coast People

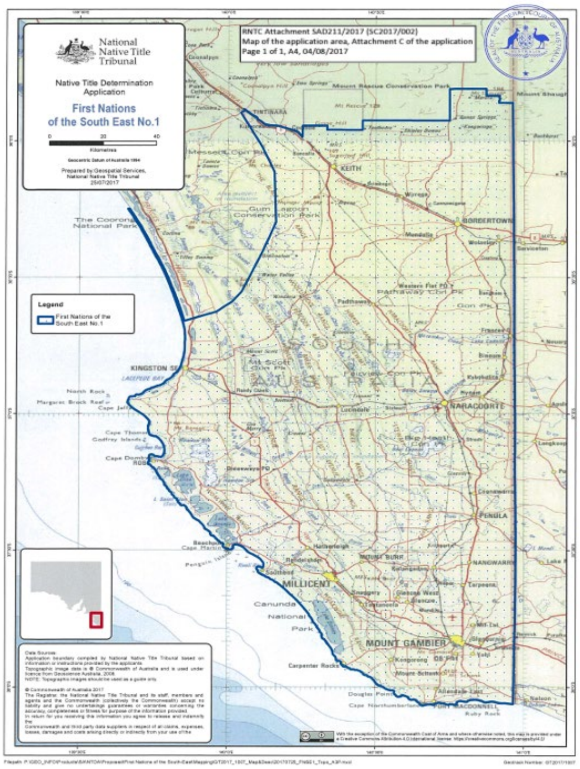


Figure 6-110: First Nations of the South East No.1 Native Title Determination Application

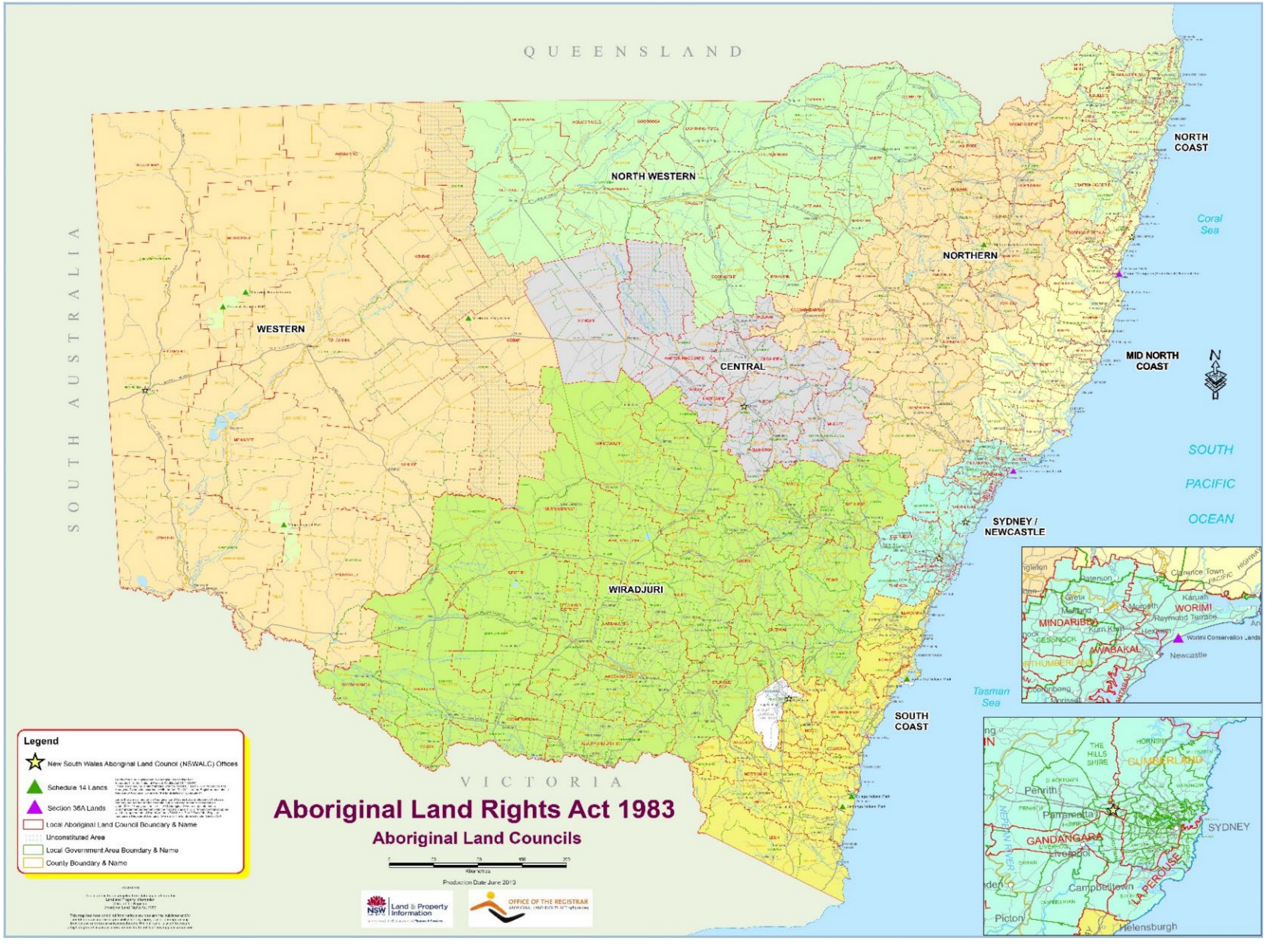


Figure 6-111: New South Wales Local Aboriginal Land Councils

6.8.3.4 Native Title

Native Title is the recognition of First Nations people's rights to their traditional lands and waters, recognised by law (*Native Title Act 1993*). First Nations groups can make a native title claim that claims they hold native title rights and interests in an area according to their traditional laws and customs. Only once a native title is granted, or determined, that First Nations group/s will have recognised rights to the area which are specific to each determination. No native title determinations or claims overlap the operational area. Native Title Vision (NNTT, 2023a) was used to identify native title determinations along the coastline and nearshore waters of Victoria, Tasmania, NSW and SA. Those that are overlapped by the monitoring EMBA will be discussed below and are displayed in Figure 6-112.

There is no overlap with native title determinations in either NSW or SA. Further, there have been no native title determinations made in Tasmania.

Victoria

- VCD2023/001 – Eastern Maar People. Eastern Maar Aboriginal Corporation Registered Native Title Body Corporate (RNTBC)
- VCD2011/001 – Gunditjmara & Eastern Maar. GMTOAC RNTBC, Eastern Maar Aboriginal Corporation RNTBC
- VCD2010/001 - Gunai/Kurnai People. Gunaikurnai Land & Waters Aboriginal Corporation RNTBC
- VCD2007/001 – Gunditjmara – Part A. Gunditj Mirring Traditional Owners Aboriginal Corporation RNTBC.

6.8.3.5 Indigenous Land Use Agreements

Indigenous Land Use Agreements (ILUAs) are voluntary agreements regarding the management of portions of land agreed upon by native title parties and others. Native Title Vision (NNTT, 2023a) was used to identify ILUAs along the coastline and nearshore waters of Victoria, Tasmania, NSW and SA that are overlapped by the monitoring EMBA will be discussed below.

There is no overlap with ILUAs in SA and no agreements have been made in Tasmania.

Victoria

- VIA1999/001 – BHPP – Minerva. ILUA between BHP Petroleum Pty Ltd and the Framlingham Aboriginal Trust and the Kirrae Whurrong Native Title Group for petroleum infrastructure (pipeline) installation.
- VI2005/006 – Gournditch Mara and Essential Petroleum Resources Ltd. ILUA between Essential Petroleum Resources and the Gunditjmara Native Title Group for hydrocarbon extraction.
- VI2006/004 – Gunditj Mirring people and the State of Victoria ILUA between GMTOAC and the State of Victoria to grant to Gunditj Mirring Crown land of the Lake Condah Area by private treaty.
- VI2010/001 – Gunditj Mirring Non-Extinguishment Principle. ILUA between the State of Victoria and Gunditj Mirring Traditional Owners Aboriginal Corporation RNTBC.
- VI2010/003 – Gunaikurnai Settlement. ILUA between the State of Victoria and the Gunaikurnai Land & Waters Aboriginal Corporation RNTBC.
- VI2013/008 – Gunaikurnai and Icon Energy. ILUA between Icon Energy and the Gunaikurnai Land & Waters Aboriginal Corporation RNTBC for petroleum exploration.
- VI2015/002 – Gunditjmara – SEAGAS Port Campbell VIC to Torrens Island SA Pipeline. ILUA between South East Australia Gas Pty Ltd, Eastern Maar Aboriginal Corporation and GMTOAC for hydrocarbon exploration and extraction.

Source: NNTT, 2023b

Figure 6-113 displays ILUAs within the State of Victoria.

New South Wales

- NI2001/003 – Twofold Bay. ILUA between the Twofold Bay native title group and the Minister of Transport on behalf of the Waterways Authority for infrastructure development.

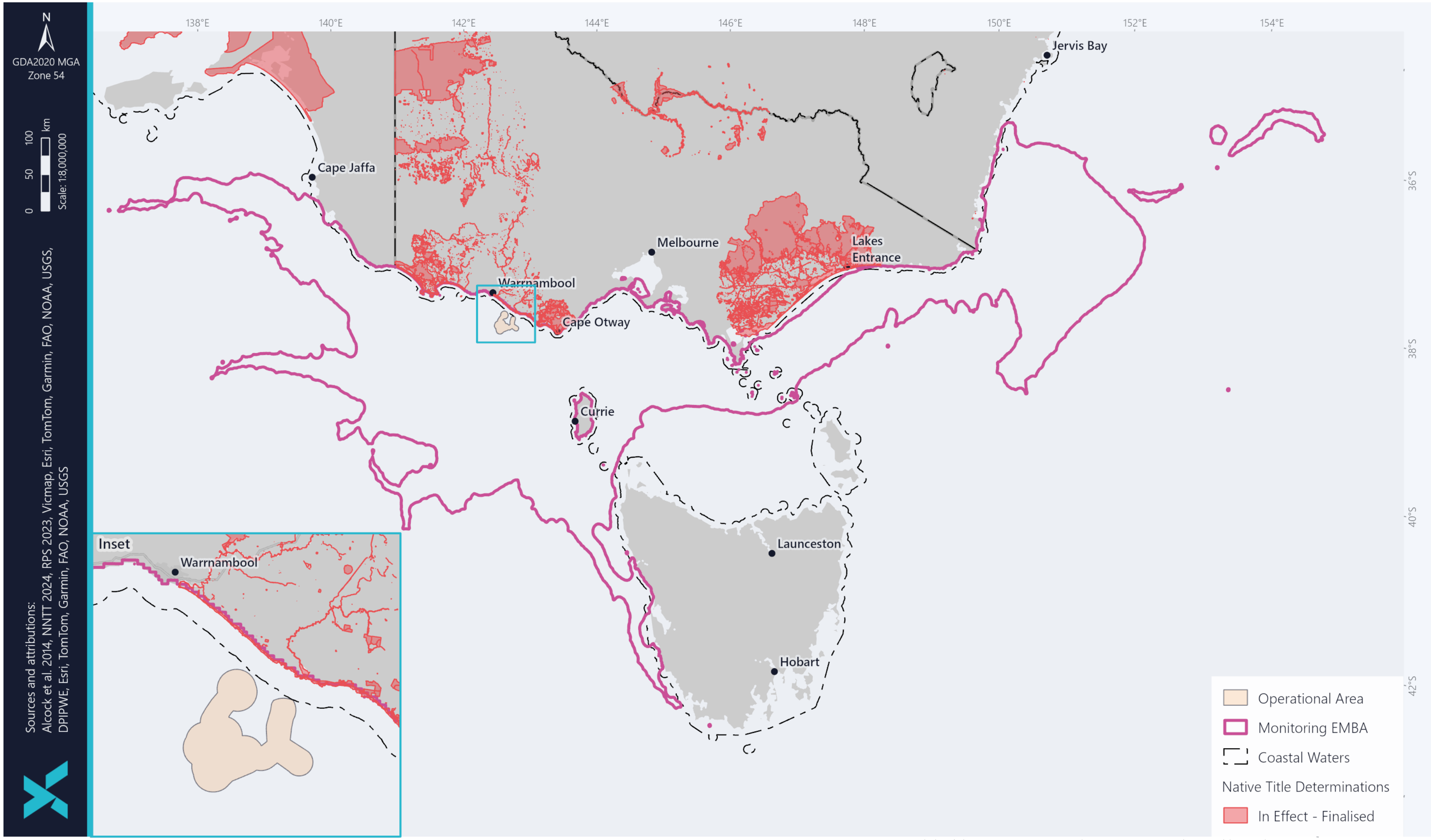
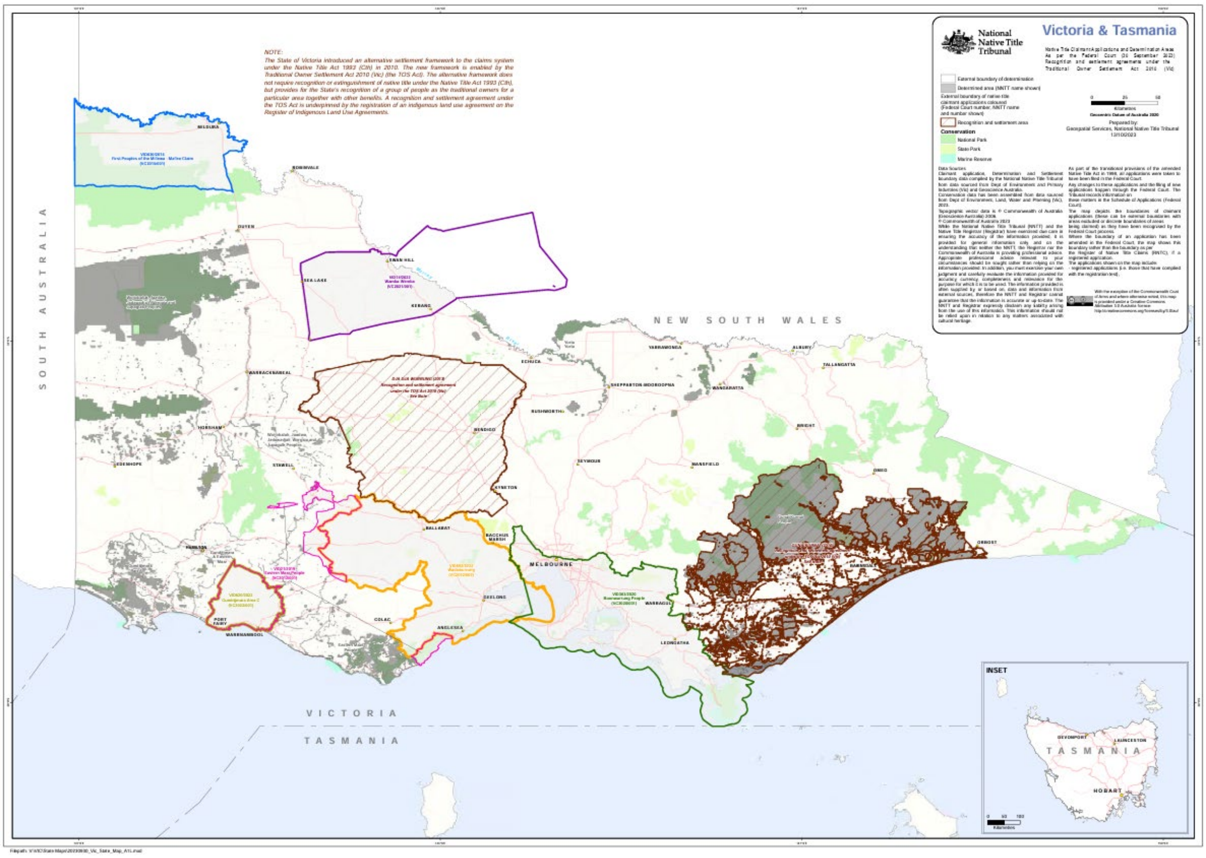


Figure 6-112: Native Title Determinations overlapped by the monitoring EMBA



Source: NNTT, 2023b

Figure 6-113: ILUAs within the State of Victoria

6.8.3.6 Indigenous Protected Areas

Indigenous Protected Areas (IPA) are a key element of Australia's National Reserve System (parks, reserves and protected areas) designed to protect the nation's biodiversity. IPAs protect cultural heritage, provide employment opportunities, education and training for Indigenous people. The program strengthens the conservation and protection of marine and coastal environments. On 7 May 2022 numerous Sea Country IPA consultation projects were announced to support Indigenous-led consultation with Traditional Owners and other stakeholders, management planning, and on-sea/on-land management with five of these included within the Otway and Gippsland Environment Sectors as shown in Figure 6-114.

Source: (DCCEEW, 2022f)

Figure 6-114: Sea Country Indigenous Protected Areas Programs - Consultation Projects

Indigenous land and sea management projects on coastal areas in the EMBA as shown by the National Indigenous Australians Agency include:

- Deen Maar IPA – sand dunes, limestone ridges, river, lake and wetlands proximate to Yambuk
- Preminghana IPA – 524 hectares of land in the north-west of Tasmania protecting historic Aboriginal engraving sites and the endangered Preminghana daisy.

and

- In 2022, GlaWAC signed an agreement with the Federal Government to start the process of establishing a Sea Country IPA from Nanjet east of Wilsons Promontory, to Mallacoota, on the Vic/NSW Border.

6.8.3.7 Values and Sensitivities

The cultural features of the environment may include heritage sites, and values relating to First Nations people's traditional culture and customs (NOPSEMA, 2024). Values and sensitivities associated with cultural features of the environment have been identified based on the presence of heritage sites and First Nations people's values of Country in the monitoring EMBA.

First Nations cultural heritage values and sensitivities are defined as follows:

- Values are the core principles, concerns and goals that guide First Nations people's way of life (Victorian Aboriginal Heritage Council, 2021; Smyth and Bahrdt Consultants, 2004;

Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023; Eastern Maar Aboriginal Corporation, 2014; Gunaikurnai Land and Waters Aboriginal Corporation, 2015).

- Sensitivities comprise objects and places or 'areas of cultural heritage sensitivity' herein termed heritage sites:
  - Objects as defined in the Burra Charter, are physical materials that contribute to the cultural significance of a place.
  - Places as defined in the Burra Charter, area geographically defined areas. They may include elements, objects, spaces and views. Place may have tangible (physical or material) and intangible (spiritual connection to place) dimensions.
  - 'Areas of cultural heritage sensitivity' are defined in the Victorian Aboriginal Heritage Regulations 2018 as landforms and soil types where First Nations cultural heritage places are more likely to be located (First Peoples – State Relations, 2021).

6.8.3.7.1 Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values

First Nations people are considered Cooper Energy's primary source for identifying relevant First Nations cultural heritage sites and values. Consultation with First Nations organisations has informed identification of particular values and sensitivities. Where direct communication has not been possible, publications produced by / in conjunction with First Nations people have been used as secondary sources.

Secondary sources include First Nations people Country Plans developed by RAPs that have application areas within the EMBA and The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance (Australia ICOMOS Burra Charter, 2013).

First Nations cultural heritage values are as diverse as the Victorian First Nations groups themselves. Guidance from the documents in Table 6-24 has informed identification of cultural features of the environment relating to First Nations people's heritage sites and values.

Table 6-24: Guidance documents used to develop the First Nations people cultural heritage impact assessment

Guidance Document	Document Type	Relevance to the East Coast Project
Gunditjmara Nyamat Mirring Plan 2023 – 2033 (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023)	Gunditjmara Sea Country Plan	The Gunditjmara Sea Country Plan outlines concerns for Sea Country, and the changes needed for Gunditjmara to fulfil responsibilities to Country. It includes a framework that describes goals and priority actions to achieve those goals. The plan was used to help define cultural heritage values. This has informed an assessment of potential impacts and risks, and helped define acceptability levels in this OPP.
Eastern Maar Meerreengeeye Ngakeeppoorryeeyt (Eastern Maar Aboriginal Corporation, 2014)	Eastern Maar Country Plan	The Eastern Maar Country Plan includes details on cultural knowledge, values and perspectives, and ideas and priorities. It defines the Eastern Maar vision for the future with identified goals and objectives. The plan was used to help define cultural heritage values. This has informed an assessment of potential impacts and risks, and helped define acceptability levels in this OPP.
Paleert Tjaara Dja Let's make Country good together 2020 – 2030 – Wadawurrung Country Plan (Wadawurrung Traditional Owners Aboriginal Corporation, 2020)	Wadawurrung Country Plan	The Wadawurrung Country Plan consolidates information gathered from many Wadawurrung people including stories about Country. It articulates how Wadawurrung Sea Country is to be cared for and managed over the next 10 years. The plan lists particular values, and threats to those values. The plan was used to help define cultural heritage values. This has informed an assessment of potential impacts and risks, and helped define acceptability levels in this OPP.

Guidance Document	Document Type	Relevance to the East Coast Project
Gunaikurnai Whole-of-Country Plan (Gunaikurnai Land and Waters Aboriginal Corporation, 2015)	Gunaikurnai Whole-of-Country Plan	The Gunaikurnai Whole-of-Country Plan provides a description of heritage, Country and threats to Country. It provides a strategic framework that contains principles, strategic goals, and success measures. The plan was used to help define cultural heritage values. This has informed an assessment of potential impacts and risks, and helped define acceptability levels in this OPP.
Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) Code of Ethics for Aboriginal and Torres Strait Islander Research (AIATSIS, 2020)	Methodology guide	This AIATSIS code applies to all First Nations people research including planning, collection, analysis and dissemination of information or knowledge which is about or may affect First Nations people collectively or individually. This OPP contains research that concerns First Nations people in the following ways: • Information about First Nations people societies, culture and/or knowledge, and policies • Impact assessment targeted on populations of First Nations people • Contributions of First Nations people through consultation. • Use of information relating to First Nations peoples in the impact assessment. • Description and considerations of First Nations land and sea Country within the impact assessment.
Australian Government Style Manual (Australian Public Service Commission (APSC), 2023)	Terminology and style guide	The Australian Government Style Manual, in conjunction with respective Country Plans, was considered to help ensure culturally appropriate and respectful language was used when writing in relation to First Nations cultural heritage.
The Burra Charter	Terminology guide	The Burra Charter outlines the steps in planning for and managing a place of cultural significance. The Burra Charter also defines objects and places of cultural significance relevant to First Nations values and sensitivities.

Identified cultural features of the environment relating to First Nations people's heritage sites and values based on review of the Country Plans, as well as consultation with First Nations peoples, participation in cultural experiences and training led by Gunditjmara on Gunditjmara Country, are detailed in Table 6-25.

Table 6-25: Cultural features of the environment relating to First Nations people's heritage sites and values proximal to Cooper Energy Offshore Title Areas

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
Tangible Cultural Heritage						
Gunditj Mirring **Wadawurrung** **Eastern Maar** **Gunaikurnai** **Bunurong**	Gunditjmara Wadawurrung Gunditjmara Gunaikurnai Bunurong	Coastal/ island places and objects	**Victoria Wide** A search of the Victorian Aboriginal Heritage Register undertaken by Biosis identified 5,636 recorded Aboriginal places across the entire Victorian coastline (Biosis, 2023). The dominant Aboriginal places located in the study area are shell middens (46.82%), artefact scatters (39.21%) and low-density artefact distribution (LDADs) (5.70%). Shell middens, artefact scatters and LDADs are considered cultural heritage objects for the purposes of this EP. Review of relevant Country Plans found 5 coastal/island places within Victoria that are considered significant locations: **The Convincing Ground** The 'Convincing Ground' in Allestree at Portland Bay, approximately 10 km from Portland, is a significant site of early conflict on Gunditjmara Country. This conflict may be the first recorded massacre of First Nations people. It is believed that the Convincing Ground will always hold the spirits of the Kilcarer Gunditj who were murdered there and as such is considered deeply significant for the Gunditjmara and other clans throughout south-west Victoria. Prior to the arrival of settlers, the site of the Convincing Ground held social values for association with Country as a place where Gunditjmara would gather and feast. **Deen Maar** Deen Maar includes Deen Maar IPA on mainland Victoria, near the town of Yambuk, and Deen Maar Island (Julia Percy Island), approximately 10km off the coast of Yambuk. Deen Maar is Central to the creation of Country and has been important in burial rituals for First Nations Peoples (see below 'sacred sites' which Discusses the Intangible values of Deen Maar).	1, 2, 3, 4, 5, 6, 7, 8, 19	-	✓

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
			Dean Maar Island was formed by volcanic eruptions millions of years ago. The island comprises a grassy plateau above steep rocky shores that are exposed to the ocean. Access to Deen Maar Island requires a permit. A rabbit eradication program is currently planned for the island in a collaboration between Parks Victoria, EMAC and GMTOAC (ABC, 2023; Victoria State government, 2023). There is a large fur seal colony which inhabits the rocky shore, which are identified as a culturally significant species, and little penguins, that access the island via the exposed rocky shore. The land above the shore around Yambuk on the mainland includes natural surface (rain-water collecting) wells used by First Nations Peoples, property run by first nations peoples, and wind turbines which have been developed around existing cultural features (AMCI (2010)). **Discovery Bay Coastal Park** Discovery Bay is an example of the continuous, connected landscape between Nyamat Mirring and Gunditjmara Country. The dune systems of Discovery Bay hold numerous cultural heritage sites such as middens. Discovery Bay Coastal Park is currently managed by Parks Victoria with an aim to establish a governance model enabling Gunditjmara to lead management as a priority Nyamat Mirring location. **Wilsons Promontory and associated land bridge** According to the Victorian Aboriginal Heritage Register, the area of Wilsons Promontory contains 384 registered sites which are predominantly comprised of shell middens, artefact scatters and earth features. Wilsons Promontory is also significant as a place of passing on cultural knowledge and practices and is thought to be a critical place for intergenerational knowledge sharing for the Gunaikurnai and Bunurong peoples. Gunaikurnai inhabited the area of Wilsons Promontory from at least 6,500 years ago including what were previously terrestrial habitats prior to the inundation of the Bassian Land Bridge. A spirit called Loän (or Kŭlŭngrŭk) protected its inhabitants from invasions. Prior to sea level rise, Gunaikurnai would have hunted and gathered terrestrial and aquatic animals, fruits, yams and eggs according to seasonal abundance. Bark			

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
			canoes were used to harvest fish and travel around the area once the sea level rise began. **Tyrendarra Lava Flow** The Preminghana IPA in the north-west of Tasmania is a significant location for First Nations people of Tasmania. Within the GMTOAC` Sea Country Plan, and during consultation, GMTOAC shared stories of the creation of the Tyrendarra lava flow which is associated with the World Heritage listed Budge Bim aquaculture system. This lava flow begins at Mt Eccles and extends across coastal plains and offshore 5-10km to the east of Portland at Julia Reef. Recent lava flows (circa 30,000 y) are linked to stories of creation, and these landforms have been engineered by Gunditjmara for thousands of years into aquaculture systems, enabling the collection, fattening up, harvest and trade of Kooyong (short-finned eel).			
Gunditj Mirring	Gunditjmara	Submerged sites	Review of relevant Country Plans identified potential submerged sites significant to First Nations people including the ancient Land Bridge, submerged landscapes (lava flows), and underwater cultural heritage sites. Sea Country is considered to extend beyond the formally defined RAP area to include sea and submerged lands to the edge of the continental shelf which may include submerged historical sites and landscapes and extensions to landscape features such as the Tyrendarra lava flow which extends offshore; these young (circa 30,000) lava flows are connected to stories of creation.	1, 2, 3, 4, 5, 6, 7, 9, 10, 18, 19	Possible	✓
Wadawurrung	Wadawurrung					
Eastern Maar	Gunditjmara					

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
Gunaikurnai	Gunaikurnai		The Gunaikurnai community have identified that 10,000 years ago, Victoria was connected to Tasmania by a land bridge. At this time, the marine parks and reserves around Wilsons Promontory were terrestrial habitats, inhabited by Gunaikurnai ancestors. It is estimated that rising sea levels at the end of the Ice Age (~14,000 years ago) flooded most of the Bassian Land Bridge, leaving the shallowest crossing readily passable on foot in an area east of Wilsons Promontory in Victoria and north of Hogan Island (located outside of the Otway Basin, in the Bass Strait). Based on bathymetric and topographic data of the land and seafloor of the Bass Strait, ~12,000 years ago, the Bassian Land Bridge was estimated to be completely submerged. The original surface of the Land Bridge is likely to have been eroded and removed, with any remaining artefacts likely buried beneath sediment deep below the ocean. Rising sea levels following the last glacial maximum and the known sea states of the Otway Coast (water depths and velocities) would make preservation of any "recently" buried anthropogenic structures or sites highly unlikely. Underwater cultural heritage objects Within the Sea Country Plan, and during consultation, the Gunditjmara people shared stories of the creation of significant landscape features such as the Tyrendarra lava flow associated with the World Heritage listed Budge Bim aquaculture system. This lava flow begins at Mt Eccles and extends across coastal plains and offshore 5-10km to the east of Portland at Julia Reef. Julia Reef is a popular spot for recreational fishing, particularly yellowtail kingfish. The potential for lava flows within Cooper Energy's operated offshore Otway acreage was investigated by evaluating high-quality 3D seismic imagery. The review found no geological evidence of volcanic or hydrothermal flow events within the sedimentary record			
Bunurong	Bunurong					

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
			of the past 500,000 years within Cooper Energy's operated offshore Otway acreage. As a result, the presence of lava flows within the operational area is not expected.			
Intangible Cultural Heritage						
Gunditj Mirring **Eastern Maar** **Gunaikurnai** **Wadawurrung** **Bunurong**	Gunditjmara Gunditjmara Gunaikurnai Wadawurrung Bunurong	Sea Country	RAPs have defined area boundaries which extend to coastal waters. However, Sea Country is considered to extend beyond the formally defined RAP area to include sea and submerged lands to the edge of the continental shelf. Sea Country is an intrinsic value to First Nations people. It includes parts of open ocean, beaches, land and freshwater on the coast, habitats and encompasses all living things, culturally significant species, beliefs, values, creation spirits and cultural obligations connected to an area.	1, 2, 3, 4, 5, 6, 7	Possible	✓
Gunditj Mirring **Eastern Maar** **Gunaikurnai** **Wadawurrung** **Bunurong**	Gunditjmara Gunditjmara Gunaikurnai Wadawurrung Bunurong	Creation/ Dreaming sites, Songlines, sacred sites and Ancestral beings	Stories and Songlines link First Nations people to ancestors, culture, and Country. Dreaming stories further reinforce the memories and Songlines relating to the flooding associated with the last significant sea level rise and significant connection to Sea Country. Dreaming Songlines link tribal kings such as Umbarra or King Merriman to Wallaga Lake, and Borun the pelican who created songlines and storylines as he walked through Gunaikurnai Country. For Gunditjmara, sites important for Dreaming include Deen Maar. Deen Maar Island is believed to be the place where Bunjil the creator, left this world (Framlington Aboriginal Trust and Winda Mara Aboriginal Corporation (2004), AMCI (2010). Clark (2007) describes the story of a cave on the mainland, opposite Dean Maar Island, and of a passage between the two. The Cave and Deen Maar are both spiritually and visually connected. Grass found at the mouth of the	1, 2, 3, 4, 5, 6, 12, 13, 14	Possible	✓

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
			cave provided proof that a good spirit had transferred the body of a recently buried person through the cave to Deen Maar Island and conveyed their spirit to the clouds. See Coastal / Island / Places for a physical description of Deen Maar Island. Ceremonial sites are places where Ceremonies are performed. Aboriginal people need access to Country to perform Ceremonies which is important for knowledge sharing and cultural practices. The Convincing Ground remains a place of ceremony for the Gunditjmara people who gather at the site annually to reflect on the ongoing impacts of colonisation on their people.			
Gunditj Mirring **Wadawurrung** **Eastern Maar** **Gunaikurnai** **Bunurong**	Gunditjmara Wadawurrung Gunditjmara Gunaikurnai Bunurong	• Connection to Country • Cultural obligations to care for Country • Knowledge Systems	• First Nations people maintain strong spiritual ties to Country. Spiritual connection to Country includes how Country provides spiritual life-giving resources for species and landscapes, places where the spirits of Ancestors rest (Deen Maar) or where spirits reside including water bodies; where peace, direction and purpose originates. Limitations on First Nations peoples accessing or enjoying areas of Sea Country may damage Traditional Owners connection to Country. • First Nations People are culturally obligated and inherently responsible to care, protect and heal Country for present and future generations. The roles held relating to taking care of Country and knowledge holding vary amongst individuals and within clans and family groups. Roles include taking care of culturally significant species or habitats of significant species known to be important food resources, and culturally significant landscapes and places. • First Nations peoples ecological, spiritual, traditional and cultural knowledge is passed through the generations using cultural practices (dreaming stories, ceremony, song and dance) where knowledge holders (Elders) are the custodians of knowledge. This knowledge includes culturally significant species, and landscape features that hold dreaming and creation stories or are events and ceremonial places critical for intergenerational knowledge sharing and cultural practice. Knowledge holders	1, 2, 3, 4, 5, 6	✓	✓

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
			have responsibility for traditions, observances, customs or beliefs associated with specific areas.			
			Habitats and species			
Gunditj Mirring **Wadawurrung** **Eastern Maar** **Gunaikurnai** **Bunurong**	Gunditjmara Wadawurrung Gunditjmara Gunaikurnai Bunurong	Culturally significant species/ food resources: Fish, sharks, rays, eels, shellfish and crustaceans collection from coastal and riverine environments.	Fish, sharks, rays, eels, crayfish, yabbies, mussels and oysters are a valued source of food and hold significance for First Nations people. GMOATC have highlighted short-finned eels (Kooyang) as of particular significance to Gunditjmara people, who developed complex aquaculture systems to trap and store eels. The aquaculture systems were engineered from the volcanic formations associated with the Tyrendarra Lava flow to create Budj Bim. The eels which are a valued source of food, were captured, fattened up, harvested, smoked and traded, and continue to hold cultural significance for Gunditjmara. Today there are cultural tours at Budj Bim, run by Gunditjmara peoples. The short-finned eel species migrates through State waters and Commonwealth Marine Area of the Otway Region between freshwater systems in Victoria including within Gunditjmara Country, to / from spawning grounds in the Coral Sea, thousands of km to the north. Based on the observed migratory route of short-finned eels, short-finned eels in adult and glass eel forms may pass the operational area during seasonal migrations. During late summer and autumn adult eels will enter the Otway Basin and Bass Strait to commence their migration to the Coral Sea. During mid-winter to late spring, the short-finned eel in larvae and glass eel forms will enter Victorian estuaries to complete the upstream migration. Upon entering the marine environment, eels disperse widely; individuals migratory paths are known to diverge widely, and timing of arrival in the Coral Sea is also variable.	1, 2, 3, 4, 5, 6, 15, 16	✓	✓
Gunditj Mirring	Gunditjmara	Culturally significant species:		1, 2, 3, 8	✓	✓

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
Wadawurrung	Wadawurrung	Cetaceans	First Nations people around Australia have long had a strong connection to whales, which are significant as totemic ancestors to some groups. Karntubul (whales) in Sea Country hold deep cultural significance to the Gunditjmara and feature in Dreaming stories, ceremony, song and dance traditions. Whale migration occurs through the operational area and EMBA. Whale migration is associated with the belief that whales are ancestors to some First Nations peoples and arrive to the coast, annually. Key whale species which would relate to 'calling in' are the southern right whale, which reproduce close to shore, and are often observable from shore. Multiple whale species have the potential to beach in the region, including, though not limited to the southern right whale, pygmy blue whale, and humpback whale. Whale beaching is of significance to First Nations people, as they can be used as a resource following beaching events.			
Eastern Maar	Gunditjmara					
Gunditj Mirring	Gunditjmara	Culturally significant species: Pinnipeds	Koorn Moorn (seals) are culturally significant for Gunditjmara people. They feature in song and dance and were collected as a food resource in traditional times by Gunditjmara women along the coast. The Australian sea-lion, southern elephant seal, New-Zealand fur seal, and Australian fur seal are known to occur within the monitoring EMBA including a large colony of Fur Seals at Deen Maar Island that haul out on the island's rocky shores.	1, 2, 4	Possible	✓
Wadawurrung	Wadawurrung					
Gunaikurnai	Gunaikurnai					
Gunditj Mirring	Gunditjmara	Culturally significant species: Seabirds	Different avian species hold deep connections to lore and represent spiritual emblems or totems. Magpie gees and Cape Barren geese	1, 2, 3, 4, 5, 6, 8	✓	✓
Wadawurrung	Wadawurrung					

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
Eastern Maar	Gunditjmara		were harvested for food from wetland habitats. Wetland habitat loss has reduced numbers of these species and harvesting not permitted in Victoria.			
Gunaikurnai	Gunaikurnai					
Bunurong	Bunurong					
Gunditj Mirring	Gunditjmara	Key Ecological Feature - Plankton	The Bonney upwelling system is valued by Gunditjmara for the cold waters and nutrients it brings to the region, which supports plankton growth, providing a food source for culturally significant species. The Bonney upwelling is a large-scale oceanographic system and key ecological feature that influences the Otway coast (Appendix 3); the feature is active in Autumn and Summer depending on the strength and frequency of alongshore winds (Bulter et al., 2002). The area is significant as one of the largest and most predictable upwellings in south-eastern Australia, and most prominent upwelling system driven by prevailing south-easterly winds.	1, 13	-	✓
Gunditj Mirring	Gunditjmara	Water quality	Water including freshwater and marine, is of particular cultural significance to First Nations people as an integral part of songs, ceremonies, hunting and collecting, and other activities that bind people to Country and each other. First Nations communities in Victoria maintain strong connections to water and culture. Increased pollution from coastal communities, agriculture and industry, changes sea hydrology and impacts marine species and harms Country. Water is an intrinsic value to First Nations people.	1, 2, 3, 4, 5, 6	✓	✓
Wadawurrung	Wadawurrung					
Eastern Maar	Gunditjmara					
Gunaikurnai	Gunaikurnai					
Bunurong	Bunurong					
Gunditj Mirring	Gunditjmara	Nearshore benthic habitats	Nearshore benthic habitats provide habitat for many culturally significant species such as macroalgal communities, fish, sharks and rays. Julia Reef is within sea country adjacent to Gunditj Mirring RAP and is an extension of the volcanic feature connected to Budj Bim. Julia Reef marks the seaward extent of the Tyrendarra lava flow, ending approximately 15 km offshore and 10-15km east of	1, 18, 19	-	✓

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA
			Portland. Julia Reef is a preferred fishing spot for recreational fishers.			
Gunditj Mirring	Gunditjmara	Intertidal communities and shorelines	Intertidal communities and shorelines include mangroves, macroalgae, seagrass, coastal saltmarsh, rocky and sandy shorelines. Intertidal reefs and sandy shorelines are important cultural heritage sites and are important habitats for marine fauna and culturally significant species such as seabirds and migratory shorebirds, fish, sharks, rays, eels, and pinnipeds. Sea Country for Wadawurrung people includes coastal habitats such as seagrass and saltmarsh.	1, 2, 3, 4, 5, 6	-	✓
Wadawurrung	Wadawurrung					
Eastern Maar	Gunditjmara					
Gunaikurnai	Gunaikurnai					
Bunurong	Bunurong					
Gunditj Mirring	Gunditjmara	Marine Park/ coastal reserves / wetlands	The First Nations people residing within the EMBA have strong cultural associations with Sea Country and have cultural responsibilities of the waters and Marine Parks and Reserves that are located within Country. Some First Nations groups including the Gunaikurnai people have joint management over the Marine Parks and reserves within Country. Marine parks and reserves around Wilsons Promontory and Ninety Mile Beach National Park were inhabited Gunaikurnai ancestors. Marengo Reef Marine Park holds cultural significance for the Eastern Maar people. The marine park includes rocky features with high structural diversity, and provides for numerous filter-feeding organisms, such as tube worms and barnacles, and are surrounded by bull kelp. Islands within the park are known as a haul out site for fur seals. Wadawurrung Country covers the Avalon Coastal reserve.	1, 2, 3, 4, 5, 6, 11	-	✓
Wadawurrung	Wadawurrung					
Eastern Maar	Gunditjmara					
Gunaikurnai	Gunaikurnai					
Bunurong	Bunurong					

Sources:

1. Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023
2. Wadawurrung Traditional Owners Aboriginal Corporation, 2020
3. Eastern Maar Aboriginal Corporation, 2014
11. Smyth, Egan, and Kennett, 2018
12. Nunn and Reid, 2016
13. CoA, 2015a
14. Victorian Aboriginal Heritage Council, 2021

First Nations Group	Representing	Identified Cultural Features of the Environment relating to First Nations People's Heritage Sites and Values	Intrinsic link between Cultural Features and First Nations People's Heritage Sites and Values	Sources	Potential for overlap of Operational Area	Potential for overlap of Monitoring EMBA

4. Gunaikurnai Land and Waters Aboriginal Corporation, 2015
5. Biosis 2023
6. Bunurong Land Council Aboriginal Corporation, 2024
7. The University of Adelaide, 2023
8. Parks Victoria, 2019
9. Adeleye et al., 2021
10. Hamacher et al., 2023
15. Koster et al. 2021
16, Church et al. 2006
17. DCCEEW, 2024l
18. VFA, 2022a
19. Builth, 2004

6.8.3.7.2 First Nations People's Tangible Cultural Heritage

First Nations people's tangible cultural heritage includes objects and places with intangible values, such as (PV, 2019):

- Ancestral remains
- Middens
- Flaked stone tools, ground edge axes, axe-grinding grooves and griding stones
- Historic and contemporary cultural harvesting of marine fauna and flora
- Sea and landscape features that hold dreamtime and creation stories, such as offshore islands (Deen Maar) and lava flows. Associated evidence of habitation and connection.
- Different marine and avian species that hold deep connections to lore and represent spiritual emblems or totems
  - Karntubul (whales) found in Sea Country hold deep cultural significance to the Gunditjmara and feature in Dreaming stories, ceremony, song and dance traditions
- Marine species that are valued sources of food
  - Shellfish such as mussels and oysters
  - Crustaceans such as crayfish and yabbies
  - Fish such as the short-finned eel.

Locations and landforms where Aboriginal burials may have been more likely to occur include sandy lunettes and alongside water, sand dunes near beaches, aboriginal middens, in bushland, near trees or rock shelters (PV, 2019). Earth features include mounds, rings and hearths which are the result of First Nations people living in particular places of the landscape. Stone arrangements comprise a construct of stones of boulders resulting in a place of cultural significance and are usually found in volcanic areas of Victoria. These include stone houses, fish or eel traps, ceremonial arrangements and rockwells (PV, 2019).

Middens are shell deposits that have built up over time, often as a result of Indigenous people gathering and eating shellfish and molluscs (PV, 2019). They can be found near water sources throughout Victoria and may be present alongside bones, grinding stones, charcoal and ancestral remains (PV, 2019). Coastal shell middens, charcoal and hearth stones from fires, and items such as bone and stone artefacts are typically located within sheltered positions in the dunes, coastal scrub and woodlands, within rock shelters or on exposed cliff tops with good vantage points (Aboriginal Victoria, 2008). Coastal shell middens are found as layers of shell exposed in the side of dunes, banks or cliff tops or as scatters of shell exposed on eroded surfaces. Threats to coastal shell middens include exposure by wind and water erosion; degradation by human or animal interference; burrowing animals; people destabilizing ground using unregulated tracks or off-road vehicles.

Stone tools are flakes of stone shaped into tools such as scrapers, blades or spears. These are found everywhere across Victoria and were made in many forms from many types of stone. Ground edge axes are stone axe-heads made from large flakes of hard stone. Axe-grinding grooves occur from the sharpening and shaping of stones axes along stone platforms or outcrops. They can be found in many places across Victoria, especially near water. Grinding stones are large slabs of abrasive rocks often left at camps. (PV, 2019).

In 2023, ConocoPhillips commissioned Biosis to develop an Otway Exploration Cultural heritage desktop assessment (Biosis, 2023). The study area for the Otway Exploration Cultural heritage desktop assessment is highly representative of the EMBA for the East Coast Project, and therefore used to provide details on tangible First Nations cultural heritage sensitivities within the EMBA. The desktop assessment included a search of the Victorian Aboriginal Heritage Register undertaken by Biosis on the 21 December 2022 which identified 5,636 recorded Aboriginal places across the Victorian coastline (Biosis, 2023). The dominant Aboriginal places located in the study area are shell middens (46.82%), artefact scatters (39.21%) and low-density artefact distribution (LDADs) (5.70%).

Review of the 5,636 recorded Aboriginal places found 5 First Nations cultural heritage places within the EMBA that are significantly mentioned within relevant Country Plans:

- The Convincing Ground
- Deen Maar
- Discovery Bay Coastal Park
- Land Bridge and Submerged features
- Wilsons Promontory.

The Convincing Ground

The 'Convincing Ground' in Allestree at Portland Bay, approximately 10 km from Portland, is a significant site of early conflict on Gunditjmara Country (Biosis, 2023). Whalers and sealers visited Gunditjmara shores as early as 1810 leading to the establishment of one of Victoria's first whaling stations in Portland in 1829. Conflict arose when a whale beached at the site. The Kilcarer Gunditj clan gathered at the beached whale and whalers used the gathering to murder approximately 60 people, leaving only 2 surviving members of the clan. The exact date of the massacre is unknown but is estimated to have occurred between 1832 and 1833 (GMTOAC, 2023). This conflict may be the first recorded massacre of First Nations people. It is believed that the Convincing Ground will always hold the spirits of the Kilcarer Gunditj who were murdered there and as such is considered deeply significant for the Gunditjmara and other clans throughout south-west Victoria (Victorian Heritage Database, 2006). Prior to the arrival of settlers, the site of the Convincing Ground held social values for association with Country as a place where Gunditjmara would gather and feast (Heritage Council Victoria, 2010).

In 2006 the site was officially listed as a Heritage Place on the Victorian Heritage Register (VHR #H2079). Several land parcels at the site have since been returned to the Gunditjmara with an aim of creating a landscape for the space which adequately reflects the significance for the area. The Convincing Ground remains a place of ceremony for the Gunditjmara who gather at the site annually to reflect on the ongoing impacts of colonisation on their people (GMTOAC, 2023).

Deen Maar

Deen Maar Island holds deep significance for the Gunditjmara and Eastern Maar peoples, who jointly hold native title to the island and its surrounding waters (see Section 6.8.3.4).

The site is featured in the Gunditjmara creation story and is significant both spiritually and ecologically. As such, the site is considered a priority Nyamat Mirring location. Deen Maar is considered a dreaming place for the Gunditjmara as a resting place for the spirits of their Ancestors. As an island, Deen Maar connects Sea Country with other types of Country while hosting abundant resources of fish and coastal vegetation and is regarded as a place for Gunditjmara to access and practice culture (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023).

On the coast opposite Deen Maar, a cave 'Tarn Weerreeng' marks a path between Deen Maar and the mainland and serves as a burial place where bodies are wrapped in grass and placed inside the cave. When the grass is found at the mouth of Tarn Weerreeng, the body and its belongings are thought to have been carried to Deen Maar and the spirit carried to the clouds (Biosis, 2023; DTP, 2021).

The Eastern Maar often bury their people facing Deen Maar with the belief that after death, their spirits go to Deen Maar before going to the stars, as Bunjil had done (Eastern Maar Aboriginal Corporation, 2014).

Discovery Bay Coastal Park

Discovery Bay is an example of the continuous, connected landscape between Nyamat Mirring and Gunditjmara Country. The dune systems of Discovery Bay hold numerous cultural heritage sites such as middens which are under increasing threat from vehicle disturbance, including those associated with the commercial and recreational pipi fishery as well as recreational 4WDs. The remoteness of the area poses a challenge in protecting the area by making surveillance difficult and possibly lowering the level of compliance with regulations (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023).

Discovery Bay Coastal Park is currently managed by Parks Victoria with an aim to establish a governance model enabling Gunditjmara to lead management as a priority Nyamat Mirring location (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023).

Further details on the ecological and tourism values of Discovery Bay are provided in Section 6.6.5.1.

Land Bridge and Submerged landscapes

Between ~18,000 and ~12,000 years ago, the Bassian Land Bridge joined Tasmania with the mainland of Australia during periods of low sea level and potentially facilitated mass movement of Tasmanian Aboriginal (Palawa) people between these regions (Figure 6-115; Adeleye et al., 2021; Hamacher et al., 2023). It is estimated that rising sea levels at the end of the Ice Age (~14,000 years ago) flooded most of the Bassian Land Bridge, leaving the shallowest crossing readily passable on foot in an area east of Wilsons Promontory in Victoria and north of Hogan Island (located outside of the Otway Basin, in the Bass Strait). Based on bathymetric and topographic data of the land and seafloor of the Bass Strait, ~12,000 years ago, the Bassian Land Bridge was estimated to be completely submerged.

The original surface of the Land Bridge is likely to have been eroded and removed, with any remaining artefacts likely buried beneath sediment deep below the ocean (Biosis, 2023). Rising sea levels following the last glacial maximum and the known sea states of the Otway Coast (water depths and velocities) would make preservation of any “recently” buried anthropogenic structures or sites highly unlikely.

The area of the Land Bridge is also culturally significant to the Gunaikurnai peoples particularly as a place of intergenerational knowledge sharing (Gunaikurnai Land and Waters Aboriginal Corporation, 2015). Dreaming stories further reinforce the memories and songlines relating to the flooding and significant connection to Sea Country (Biosis, 2023; Nunn and Reid, 2016). These stories also serve as a testament to the longevity and significance of oral tradition in a global context (Nunn and Reid, 2016).

Within the Sea Country Plan, and during consultation, GMTOAC shared stories of the creation of significant landscape features such as the Tyrendarra lava flow associated with the World Heritage listed Budge Bim aquaculture system (GMTOAC, 2023). This lava flow begins at Mt Eccles and extends across coastal plains and offshore 5-10km to the east of Portland at Julia Reef (Builth, 2004). Julia Reef is a popular spot for recreational fishing, particularly yellowtail kingfish (VFA, 2022b)

Known cultural heritage sites are generally constrained to the shoreline and near shore limits, within state coastal waters (ACHRIS, 2023). Evaluation of high-quality 3D seismic imagery has indicated there is no geological evidence of recent (500,000 years or less) volcanic or hydrothermal flow events within Cooper Energy’s operated offshore Otway acreage. Several crater complexes and lava flows are present within the region, however, are unlikely to extend into the Cooper Energy acreage

Wilsons Promontory

According to the Victorian Aboriginal Heritage Register, the area of Wilsons Promontory contains 384 registered sites which are predominantly comprised of shell middens, artefact scatters and earth features (Biosis, 2023). Shell middens are scattered along the coast or otherwise near flowing water, with the largest cluster totalling 163 middens occurring along the western coast of the Promontory. Artefact scatter sites primarily follow water sources inland (Biosis, 2023).

Wilsons Promontory is also significant as a place of passing on cultural knowledge and practices and is thought to be a critical place for intergenerational knowledge sharing for the Gunaikurnai and Bunurong peoples.

Gunaikurnai inhabited the area of Wilsons Promontory from at least 6,500 years ago including what were previously terrestrial habitats prior to the inundation of the Bassian Land Bridge. A spirit called Loän (or Kŭlŭngrŭk) protected its inhabitants from invasions. Prior to sea level rise, Gunaikurnai would have hunted and gathered terrestrial and aquatic animals, fruits, yams and eggs according to seasonal abundance. Bark canoes were used to harvest fish and travel around the area once the sea level rise began (Gunaikurnai Land and Waters Aboriginal Corporation, 2015).

The modern-day terrestrial and marine protected areas of Wilsons Promontory recognise the significant natural and cultural values of the area. The Gunaikurnai aim to propose alternative management models to improve natural and cultural outcomes while providing benefits to Gunaikurnai people (Gunaikurnai Land and Waters Aboriginal Corporation, 2015). Further information regarding the ecological and tourism values of Wilsons Promontory is provided in Section 6.6.5.1.

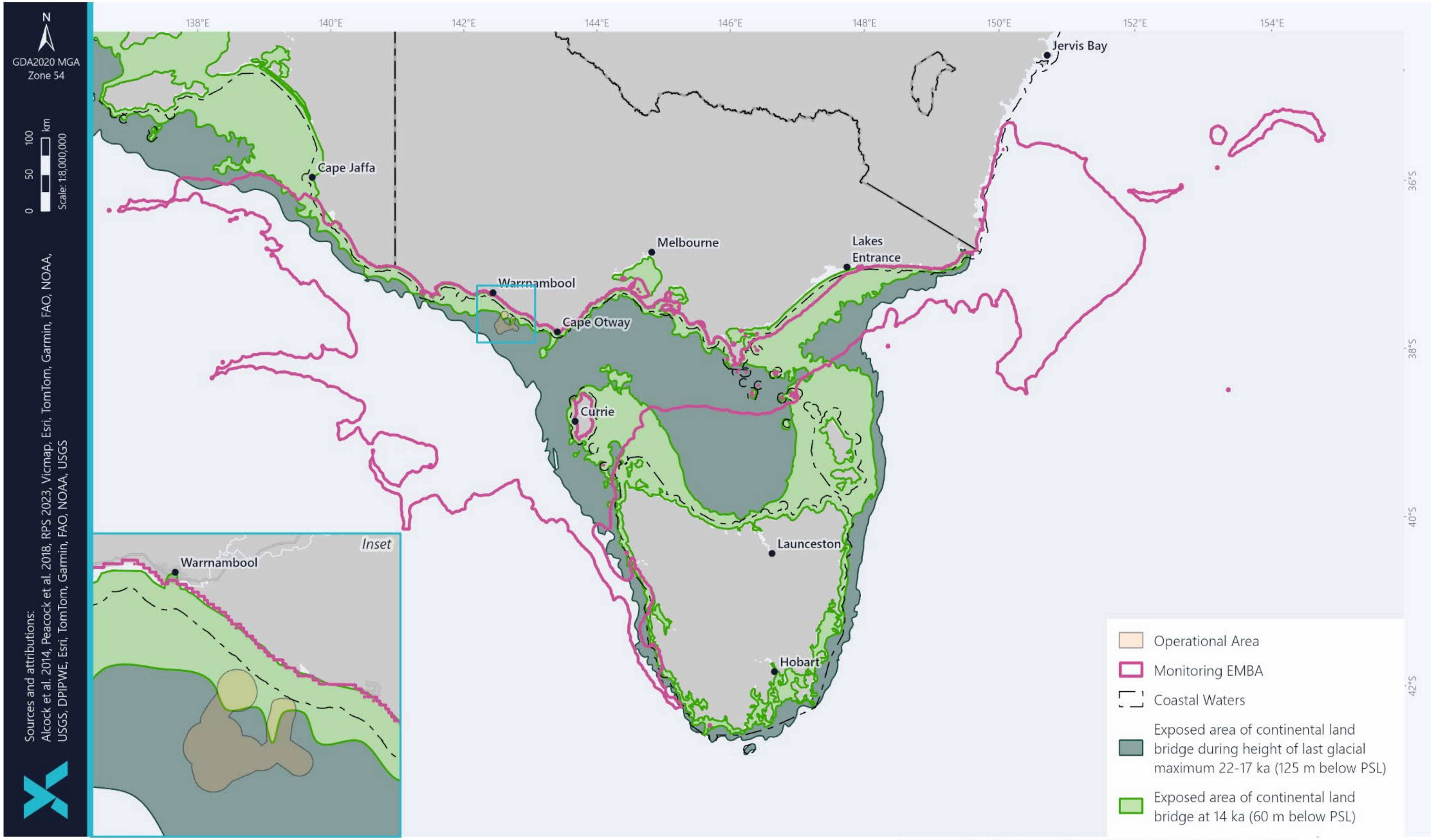


Figure 6-115: Exposed area of continental land bridge between Tasmania and mainland Australia at 27-17 ka and 14 ka

7 Impact and Risk Assessment

A description of the methodology used to identify and evaluate the environmental risks and impacts of the activities associated with the East Coast Project, as described in Section 4, is required by the OPGGS(E)R.

This OPP provides the environmental impact and risk evaluation for the activities associated with the East Coast Project by adopting the Cooper Energy Risk Management Protocol (CMS-RM-PRO-0001). This Protocol is consistent with the approach outlined in ISO 14001 (Environmental Management Systems), ISO 31000:2009 (Risk Management) and HB 203:2012 (Environmental Risk Management – Principles and Process).

Figure 7-1 provides the six-step process adopted for the evaluation of impacts and risks associated with the activity. This process is integrated into the Cooper Energy risk assessment methodology.

Figure 7-1: CEMS Risk Management Protocol

Further details of the environmental impact and risk assessment methodology are provided in the following sections, including criteria for assessment and risk ratings.

7.1 Definitions

A list of terminology and definitions applied during the impact and risk assessment process are defined below:

- **Activity**: An activity refers to a component or task within a project which results in one or more environmental aspects.
- **Aspect**: An environmental aspect is an element or characteristic of an activity, product, or service that interacts or can interact with the environment. Environmental aspects can cause environmental impacts or may create a risk to one or more environmental receptors.
- **Consequence**: The consequence of an impact (or risk event) is the outcome of the event on affected receptors. Consequence can be positive or negative.
- **Environmental Performance Outcome (EPO)** – a measurable level of performance required for the management of the environmental aspects of the activity to ensure the environmental impacts or risks will be of an acceptable level.
- **Impact**: An environmental impact is a change to one or more environmental receptors that is caused either partly or entirely by one or more environmental aspects. An

impact is something which is certain to occur. An environmental aspect can have either a direct impact on the environment or contribute only partially or indirectly to a larger environmental change. An environmental aspect may result in a change which puts one or more receptors at risk of being impacted. The relationship between environmental aspects and environmental impacts is one of cause and effect. The term 'impact' is associated with planned activities and known outcomes.

- **Cumulative impact**: Cumulative impacts and risks may include additive effects of activities within the same project, additive effects from other activities within the region or potentially affecting the same environmental receptors as the project or the long-term cumulative effects of a project lasting many years or decades. Refer to Section 10 for a detailed cumulative impact assessment methodology.
- **Likelihood**: The likelihood (or probability) of the consequence occurring. Likelihood only applies to risk and risk events.
- **Residual risk**: Residual risk is the risk remaining after additional control measures have been applied (i.e., after impact or risk treatment).
- **Risk:** An environmental risk (or risk event) is a change which could occur to one or more environmental receptors, caused either partly or entirely by one or more environmental aspects. A risk event has a degree of likelihood, it is not certain to occur. The term 'risk' is associated with planned and unplanned activities where the change elicited on or by a particular receptor is uncertain.
- **Risk severity**: The risk severity level is determined from the point on the risk matrix where the consequence intersects the likelihood.

7.2 Risk Management Process Steps

This section provides a detailed overview of the risk management process steps.

7.2.1 Establish the Context

All components of the petroleum activity relevant to this scope, described in detail in Section 4, are identified and individual aspects are evaluated in the impact and risk assessment. Regulatory requirements, government policies and guidelines, industry standards and stakeholder consultation outcomes all contribute to aspect identification.

7.2.1.1 Petroleum Activity

Petroleum activities associated with the East Coast Project, including potential emergency conditions, have been grouped into the following phases to allow for a clear description and evaluation:

- surveys
- well construction
- installation and commissioning
- operations
- decommissioning
- support activities (undertaken across all project phases).

Further detail of the phases and their associated activities is provided in Section 4.

7.2.1.2 Environmental Values and Sensitivities

The environment, along with the particular values and sensitivities, within the operational area and the monitoring EMBA have been described in detail in Section 6. In accordance with Section 7(3) of the OPPGS (E)R, Cooper Energy has identified the particular values and sensitivities relevant to this OPP, as per the EPBC Act to be:

- presence of Listed migratory species

- presence of Listed threatened species and ecological communities
- values and sensitives that exist in, or in relation to, the Commonwealth marine area
- ecological character of a declared RAMSAR wetland
- values of a declared National heritage places
- values of a declared World heritage places
- other values, including social, economic and cultural values.

In addition to establishing the context of the environment, consideration for environmental legislation and other requirements is provided to guide decisions, manage impacts and demonstrate acceptability. Recovery and management plans, guidelines and conservation advice relating to the protection of threatened species and ecological communities are considered within the impact and risk assessment. These legislative requirements are described in Section 2.

7.2.1.3 Relevant Environmental Aspects

After describing the petroleum activity associated with the East Coast Project, an assessment was carried out to identify potential interactions between the East Coast Project and the environment. These assessments were attended by project personnel spanning operations, well engineering, subsea, HSEC disciplines and supported by other specialists. Potential interactions with safety and health of the workforce, and assets are addressed under separate regulatory approval documents, and are outside the scope of this OPP.

Environmental aspects included within the impact and risk assessment of the East Coast Project are scoped against activities in Table 7-1. These aspects have corresponding headings within Section 8 and Section 9.

Table 7-1: Relationship between identified activities and aspects

Activity	Aspect														
	Physical Presence		Planned Emissions					Planned Discharges		Unplanned Impacts		Accidental Release			
	Seabed Disturbance	Interaction with Other Marine Users	Light Emissions	Atmospheric Emissions	GHG emissions	Underwater Sound Emissions - Impulsive	Underwater Sound Emissions - Continuous	Planned Discharges - Operational	Planned Discharges - Drilling	Interaction with Marine Fauna	Introduction of IMS	Loss of Material or Waste Overboard	Minor Loss of Containment	Accidental Release - MDO	Accidental Release - LOWC
Surveys															
Geophysical survey						✓									
Geotechnical survey	✓														
Well Construction															
MODU positioning	✓														
Drilling operations	✓						✓		✓			✓			✓
BOP installation and testing									✓						
Drilling cuttings and fluids	✓								✓						
Cementing operations	✓								✓						
Well completions									✓						
Well clean-up / flow-back			✓	✓	✓										
Well suspension									✓						
Installation and Commissioning															
Pre-lay works	✓							✓				✓			
Flowlines and umbilicals	✓											✓			
Installation of subsea structures	✓							✓				✓			
Post-lay works	✓											✓			
Testing, preservation and start-up				✓				✓		✓		✓	✓		
Operations															
Hydrocarbon extraction and transport		✓			✓		✓								✓
Inspection, Maintenance and Repair	✓							✓			✓	✓	✓		
Well Intervention			✓	✓	✓				✓						✓
Decommissioning															
Well abandonment	✓		✓	✓	✓				✓			✓			✓
Flowline and umbilical decommissioning	✓							✓			✓	✓			
Removal of remaining subsea infrastructure	✓							✓			✓	✓			
Support Operations															

Activity	Aspect														
	Physical Presence		Planned Emissions					Planned Discharges		Unplanned Impacts			Accidental Release		
	Seabed Disturbance	Interaction with Other Marine Users	Light Emissions	Atmospheric Emissions	GHG emissions	Underwater Sound Emissions - Impulsive	Underwater Sound Emissions - Continuous	Planned Discharges - Operational	Planned Discharges - Drilling	Interaction with Marine Fauna	Introduction of IMS	Loss of Material or Waste Overboard	Minor Loss of Containment	Accidental Release - MDO	Accidental Release - LOWC
MODU operations		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
Vessel operations	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
ROV operations	✓						✓				✓	✓	✓		
Helicopter operations				✓	✓		✓			✓			✓		
Diver operations													✓		

7.2.2 Risk Analysis

Utilising the understanding of these environmental interactions, relevant impacts or risks resulting from each aspect have been defined. Identified impacts and risks are then analysed. Impact and risk analysis require assessing a level of consequence for each impact or risk event. For each risk event, the likelihood of occurrence is determined.

Impacts and risks are evaluated using the Cooper Energy Risk Matrix (Table 7-3), which includes:

- A six-level likelihood table to assess the probability of risk occurrence
- A five-level consequences table to assess the risk impact against business objectives (Table 7-2)
- A matrix of likelihood versus consequence that defines four levels of risk severity and allows a risk to be assessed and plotted
  - The outcome of the plotted risks is termed a 'Heat Map' and provides a graphic representation of the risks, their respective severities and likelihood
- A four-level risk severity table that defines the actions and escalation required for risks at different severity levels.

Table 7-2: Consequence Assessment Criteria

Consequence level	Environmental Consequence Description
1	Minor local impacts or disturbances to flora/fauna, nil to negligible remedial/recovery works on land/ water systems.
2	Localized short-term impacts to species or habitats of recognized conservation value not affecting local ecosystem function; remedial/recovery work to land, or water systems over days/weeks.
3	Localized medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function; remedial/recovery work to land/water systems over months/year.
4	Extensive medium to long-term impact on highly valued ecosystems, species populations or habitats; remedial/recovery work to land/ water systems over 1 – 10 years.
5	Severe long-term impact on highly valued ecosystems, species, or habitats. Significant remedial/recovery work to land/water systems over decades.

The Risk Severity can be:

- **Extreme (red):** inherent risk at this level is not within the Company's risk appetite. Activity cannot proceed until the Managing Director approves treatment plans that eliminates or reduces Health, Safety and Environment risks to ALARP / SFARP and reduce risks in other categories in line with the Company's risk appetite. The Board must be informed of the risk and its treatment.
- **High (orange):** Inherent risk at this level requires the respective ELT Member to approve the treatment plans before the activity proceeds. Treatment plans are required to eliminate or reduce Health, Safety and Environment risks to ALARP / SFARP and reduce risks in other categories in line with the Company's risk appetite The Managing Director and the Board must be informed of the risk and its treatment.
- **Moderate (yellow):** Inherent risks at this level may be acceptable if they are in line with the Company's risk appetite. Except for Health, Safety and Environment risks which must be eliminated or demonstrated as reduced ALARP / SFARP. Appropriate Managers or Functional Leaders must approve treatment plans and risks should be reported during regular reporting.

- **Low (green):** This level of risk is broadly acceptable; however, Health, Safety and Environment risks must be eliminated or demonstrated as reduced ALARP / SFARP with treatment plans approved by assigned persons. For risks in other categories, as a minimum, a review of existing control measures should occur, and the risk should be regularly monitored for deterioration.

** Key descriptor words relating to duration, spatial extent and magnitude from these definitions, are used during the impact and risk assessment process for consideration of all elements of the environment, including biological, physical and social receptors. These receptors are identified within the existing environment section and integrated into the risk assessment through activity-aspect interaction scoping.*

Table 7-3: Cooper Energy qualitative risk matrix

LIKELIHOOD						CONSEQUENCE				
Qualitative					Quantitative					
Rating	**Level**	**Probability**	**Time Period**	**Description**		**1**	**2**	**3**	**4**	**5**
A	Almost certain	> 80%	More than once a year	Expected to occur in most circumstances and/or more than once a year, or repeatedly during the activity.	> 10^{-2}	Moderate	Moderate	High	Extreme	Extreme
B	Likely	> 50%	Every 1 – 2 years	Not certain to happen, but an additional factor may result in an occurrence. Expected to occur from time to time during the activity.	≤ 10^{-2}	Low	Moderate	Moderate	High	Extreme
C	Possible	> 20%	Every 4 – 5 years	Could happen when additional factors are present. Easy to postulate a scenario for the occurrence but considered doubtful. Expected to occur once during the activity.	≤ 10^{-3}	Low	Moderate	Moderate	High	High
D	Unlikely	> 5%	Every 5 – 20 years	A rare combination of factors would be required for an occurrence. Conceivable and could occur at some time. This could occur during the activity.	≤ 10^{-4}	Low	Low	Moderate	Moderate	High
E	Remote	> 1%	Every 20 – 100 years	A freak combination of factors would be required for an occurrence. Not expected to occur during the activity. Occur in exceptional circumstances.	≤ 10^{-5}	Low	Low	Moderate	Moderate	High
F	Hypothetical	< 1%	Not in 100 years	Generally considered hypothetical or non-credible. Black Swan.	≤ 10^{-6}	Low	Low	Low	Low	Moderate

7.2.3 Risk Evaluation

7.2.3.1 Identify and Evaluate Controls

Controls are any measures exercised that modify the impact or risk. Controls act on an impact cause to reduce the consequence of the impact. Controls that act on a risk cause to reduce the likelihood of the risk occurring are termed preventative controls. Reactive controls are those that modify the consequence once the risk event has occurred. For each risk, all controls are captured.

Risk evaluation requires each control to be assessed for its effectiveness in managing the risk causes and consequences. This may be different from the effectiveness of the control to deliver its original designed purpose.

In future activity-specific EPs, an evaluation will be undertaken to ensure impacts and risks are reduced to as low as reasonably practicable (ALARP), in alignment with NOPSEMA's ALARP Guidance Note (N-04300-GN0166, June 2020).

7.2.4 Risk Acceptability

The Environment Regulations Section 7 of the OPPGGS requires that the East Coast Project OPP must include:

(5) The proposal must include:

- *(a) details of the environmental impacts and risks of the activities that are part of the project; and*
- *(b) and evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk.*

Cooper Energy considers a range of factors when evaluating the acceptability of environmental impacts or risks associated with its activities. This evaluation is informed by NOPSEMA's Guidance Note for OPP Content Requirements (N-04790-GN1663, January 2024) and NOPSEMA's Guideline for Offshore Project Proposal Decision Making (N-04790-GL1816, January 2024).

The acceptability evaluation for each aspect associated with this activity is undertaken in accordance with Table 7-4 and through comparison between defined acceptable levels and predicted levels of impact and risk. This criteria is discussed further in the sections below.

Table 7-4: Cooper Energy Acceptability Evaluation

Factor	Criteria / Test
Cooper Energy Risk Management Protocol	For Risks, is the risk severity Extreme (i.e., not within the Company's risk appetite), or High (i.e., requires involvement from the Managing Director to approve the treatment plan)? For impacts, is the Consequence Level 4 or 5?
Principles of Ecologically Sustainable Development (ESD) **(Refer to Section 7.2.4.1 for further details)**	Is there the potential to affect biological diversity and ecological integrity? (Consequence Level 4 and 5). Do activities have the potential to result in serious or irreversible environmental damage? If yes: is there significant scientific uncertainty associated with the aspect? If yes: has the precautionary principle been applied to the aspect?
Legislative and Other Requirements **(Refer to Section 7.2.4.2 for further details)**	Are there any good practice control measures which have not been adopted, including those identified in relevant EPBC listed species recovery plans or approved conservation advices? If not adopted, have alternate control measures been adopted that provide equal or better levels of protection?

Factor	Criteria / Test
Internal Context **(Refer to Section 7.2.4.3 for further details)**	Is the impact or risk provided for within Cooper Energy Management System (CEMS) Standards and Processes? If not, what additional provisions will be made?
External Context **(Refer to Section 7.2.4.4 for further details)**	\Was feedback from stakeholders received that informs the values and sensitivities / existing environment, impacts and risks, performance outcomes or mitigation measures? If yes, has it been considered?

7.2.4.1 Principles of Ecologically Sustainable Development

The principles of Ecological Sustainable Development (ESD), as defined in Section 3A of the EPBC Act, are considered in Table 7-5 in relation to acceptability evaluations.

Under the EPBC Act, the Minister must also consider the precautionary principle in determining whether or not to approve the taking of an action. The precautionary principle (Section 391(2) of the EPBC Act) is that lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there may be threats of serious or irreversible environmental damage.

Table 7-5: Principles of ESD

ESD Principle		Relevance to Acceptability
A	Integration Principle Decision-making processes should effectively integrate long-term and short-term economic, environmental, social, and equitable considerations.	This principle is met through integrating relevant feedback from consultation and public comment where relevant in the OPP; including in the evaluation of environmental impacts and risk to the physical, ecological, socio-economic, and cultural features of the environment that may be affected by the project and demonstration of acceptability.
B	Precautionary Principle If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	This principle is met through: • the evaluation of environmental impacts and risks • reasons and evidence in support of how the impacts and risks will be of an acceptable level • the assessment of scientific uncertainty associated with predictions of environmental impacts and risks • implementation of effective management measures in controlling impacts and risks • commitments to apply measures designed to manage residual scientific uncertainty • assessment of the predicted severity, and persistence (including recovery potential) of environmental impacts and risks.
C	Intergenerational principle The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.	This principle is met through commitment to measures to avoid and minimise environmental impacts and risks such that they will be managed to be an acceptable level for the duration of the environmental impact(s) generated by project. Through the impact assessment process, and description of control measures it is demonstrated how impacts and risks will be managed to acceptable levels, which are defined so as not to forego the health, diversity and productivity of the environment for future generations. There is conservatism throughout the impact and risk assessment process, through the definition and evaluation of multiple different and/or worst case scenario's, by consideration of environmental, social and cultural contexts, and by the application of the precautionary principle where

		there are threats of serious or irreversible environmental damage.
D	Biodiversity Principle The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.	This principle is demonstrated through the evaluation of environmental impacts to the biodiversity and ecological values of the environment affected, including matters of National Environmental Significance; and the levels of performance for management.
E	Valuation Principle Improved valuation, pricing and incentive mechanisms should be promoted	This principle is only considered relevant as part of the alternatives analysis for the project when evaluating economic viability of alternatives and as part of the demonstration of acceptability for GHG emissions in relation to cost of carbon for business activities.

7.2.4.2 Legislative and Other Requirements

The requirements identified in Section 2 relevant to environmental receptors were considered in acceptability evaluations. These include, but are not limited to:

- requirements from Commonwealth legislation and regulations
- relevant Commonwealth policies and guidance
- relevant international agreements and conventions
- relevant industry standards.

Matters protected under Part 3 of the EPBC Act are included in the acceptability evaluation such that impacts and/or risks are consistent with relevant objectives and actions of relevant policies, guidelines, recovery/management plans, conservation advice and bioregional plans.

7.2.4.3 Internal Context

The risk assessment process used to develop this OPP, and control measures adopted were undertaken within the Cooper Energy Management System (CEMS) Standards.

7.2.4.4 External Context

Cooper Energy has considered the environment and stakeholder consultation during the acceptability evaluation of impacts and risks. Consultation also informs the values and sensitivities described within the OPP.

Existing and new stakeholders for the East Coast Project and the existing CHN facilities were involved in consultation of this OPP (see Section 3).

In addition, any comments received during the public comment period will be considered within the second stage of the OPP assessment.

7.3 Defined Acceptable Levels and Environmental Performance Outcomes

As described in NOPSEMA's Guidance Note for OPP Content Requirements (N-04790-GN1663, January 2024), the "acceptable level" is *the maximum level of change in environmental parameters before the environmental effects become unacceptable*. To define the acceptable level, regard should be given to all relevant factors, as described in above in Table 7-4. The level of impact, and whether that impact is significant, is specific to the sensitivity, vulnerability, recoverability of receptors.

As such, the defined acceptable levels are informed by:

- OPGGS Act
- EPBC Act
- Statutory instruments under the EPBC Act including management plans, bioregional plans and conservation advice (if relevant; Section 2.1.2.2)

- Acceptability criteria (Section 7.2.4), including the principles of ESD and legislative and other requirements, internal context and external context
- NOPSEMA Offshore project proposal decision making Guideline (N-04750-GL1721 A524696, Jan 2024), NOPSEMA Offshore project proposal content requirements Guidance Note (N-04790-GN1663 A473026, January 2024)
- Scientific literature.

Table 7-6 presents the defined acceptable levels for the East Coast Project and justification for these levels which are based on the above listed criteria.

Table 7-6 also provides a summary of the EPOs against the relevant defined acceptable levels.

EPOs are defined in Section 5 of the OPGGS(E)R as:

> *"specific to the particular activity and environment in which the activity is to be undertaken. Outcomes are required to be set so titleholders can demonstrate their environmental performance meets or betters the acceptable level of impacts or risks for the activity. Titleholders are required to set specific, measurable benchmarks for their environmental performance that can be monitored and can enable a determination as to whether those outcomes are being met".*

Cooper Energy has developed EPOs for the East Coast Project that are consistent with the principles of ESD; encompass the relevant acceptable level and environmental impact and/ or risk; and establish environmental performance levels better than or below the defined acceptable levels, as per NOPSEMA's Guidance Note for OPP Content Requirements (N-04790-GN1663, January 2024).

The demonstration acceptability, including the comparison of predicted levels of impact and risk against defined acceptable levels, justification for how each aspect meets the principles of ESD and how the environmental performance outcomes are met (including control measures) is provided in the Demonstration of Acceptability and Environmental Performance sections within Section 8 and Section 9.

For unplanned aspects, the EPO is that the unplanned risk event ('top event') does not occur. As such, acceptable levels are defined for impacts and risks associated with planned aspects; and for impacts only for unplanned aspects.

Table 7-6: Defined acceptable levels

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
Change in air quality	**AL1**: Impacts and risks to air quality from activities defined in this OPP will not lead to a substantial change in air quality which adversely impacts biodiversity and ecological integrity, or human health and well-being.	**EPO1:** Impacts to air quality from atmospheric emissions will be limited to localised and temporary changes.	NA	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • National Environment Protection (Ambient Air Quality) Measure (CoA, 1998) • EPBC Act • principles of ESD (biodiversity principle). **How the defined acceptable level considers (and is consistent with) the above sources** The National Environment Protection (Ambient Air Quality) Measure environmental performance outcome is for 'ambient air quality that allows for the adequate protection of human health and well-being'. These standards are incorporated into the acceptable level such that impacts and risks to air quality below or at the defined acceptable level will not compromise human health and well-being. The Commonwealth marine area, which includes the airspace over Commonwealth waters, is a protected matter under the EPBC Act. The EPBC Act requires an assessment of potential environmental impacts to protected matters which includes impacts to the airspace of the Commonwealth marine area. The significant impact guidelines for MNES defines an action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will result in a substantial change in air quality which may adversely impact on biodiversity, ecological integrity, social amenity or human health. This significant impact criterion is incorporated into the acceptable level to meet the objects of the EPBC Act to provide for the protection of the environment and to promote the conservation of biodiversity.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				By aligning with the NEPM environmental performance outcome and the objects of the EPBC Act, the acceptable level also aligns with the biodiversity principle of ESD. The acceptable level aligns with the biodiversity principle of ESD as impacts to air quality at or below this level would not prevent the conservation of biological diversity and ecological integrity. **How the EPO is consistent with the defined acceptable level** The EPO is specific to relevant aspects of the East Coast Project with the potential to change air quality (non-GHG atmospheric emissions). As per the EPO, any change to air quality associated with the release of atmospheric emissions (non GHG) is limited to a localised and temporary change. This EPO is consistent with the defined acceptable level given the level of impact defined within the EPO is limited to localised and temporary change, as defined in Section 8.4.5, and as such will not lead to adverse effects to human health or well-being, biodiversity or ecological integrity. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Section 8.4.6.
Change in water quality	**AL2:** Impacts and risks to water quality from activities defined in this OPP will not lead to a substantial change in water quality which adversely impacts biodiversity and ecological integrity.	**EPO2:** Impacts to water quality from drilling and operational discharges are limited to localised, temporary changes in the vicinity of the discharge location.	**EPO22:** No unplanned release of chemicals or hydrocarbons to the marine environment.	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) • EPBC Act • principles of ESD (biodiversity principle). **How the defined acceptable level considers (and is consistent with) the above sources** The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) outline levels of protection for marine water quality. The operational area is

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				considered a 'slightly to moderately disturbed system' for the purpose of defining an acceptable level of impact to water quality against these guidelines. This is defined as ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity and these are typically marine systems adjacent to metropolitan areas (ANZG, 2018). The guidelines state that the key objective is maintenance of biological diversity and advise a precautionary approach for assessment (ANZG, 2018). The Commonwealth marine area, which includes Commonwealth waters, is a protected matter under the EPBC Act. The EPBC Act requires an assessment of potential environmental impacts to protected matters which includes impacts to water of the Commonwealth marine area. The significant impact guidelines for MNES defines an action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will result in a substantial change in water quality which may adversely impact on biodiversity, ecological integrity, social amenity or human health. This significant impact criterion is incorporated into the acceptable level to meet the objects of the EPBC Act to provide for the protection of the environment and to promote the conservation of biodiversity. By aligning with the objective of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and the objects of the EPBC Act, the acceptable level also aligns with the biodiversity principle of ESD. The acceptable level aligns with the biodiversity principle of ESD as impacts to water quality at or below this level would not prevent the conservation of biological diversity and ecological integrity.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				How the EPO is consistent with the defined acceptable level The EPO is specific to aspects of the East Coast Project with the potential to change water quality (operational and drilling discharges). As per the EPO, any change to water quality associated with these aspects is temporary and limited to a localised area within the vicinity of the discharge location. The EPO is consistent with the defined acceptable level given the level of impact defined within the EPO is localised and temporary, as defined in Sections 8.6.5 and 8.7.5, and as such will not lead to substantial adverse effects on biodiversity and ecological integrity. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Sections 8.6.6 and 8.7.6.
Change in sediment quality	**AL3:** Impacts to sediment quality from activities defined in this OPP will not lead to changes that adversely affect biodiversity , and ecological integrity.	**EPO3:** Impacts to sediment quality are limited to localised, changes in the vicinity of the discharge location.	NA	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) • EPBC Act • principles of ESD (biodiversity principle). **How the defined acceptable level considers (and is consistent with) the above sources** The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) identifies toxicants for sediment quality. The operational area is considered a 'slightly to moderately disturbed system' for the purpose of defining an acceptable level of impact to sediment quality against these guidelines. This is defined as ecosystems in which aquatic biological diversity may have been adversely affected to a relatively small but measurable degree by human activity and these are typically marine systems adjacent to metropolitan areas (ANZG, 2018). The guidelines state that the key objective is maintenance of biological diversity and advise a precautionary approach for assessment (ANZG, 2018).

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				The Commonwealth marine area, which includes the seabed under Commonwealth waters, is a protected matter under the EPBC Act. The EPBC Act requires an assessment of potential environmental impacts to protected matters which includes impacts to the seabed of the Commonwealth marine area. The significant impact guidelines for MNES defines an action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will result changes to seabed quality that adversely affect biodiversity and ecological integrity, social amenity or human health. This significant impact criterion is incorporated into the acceptable level to meet the objects of the EPBC Act to provide for the protection of the environment and to promote the conservation of biodiversity. By aligning with the key objective of the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and the objects of the EPBC Act, the acceptable level also aligns with the biodiversity principle of ESD. The acceptable level aligns with the biodiversity principle of ESD as impacts to sediment quality at or below this level would not prevent the conservation of biological diversity and ecological integrity. **How the EPO is consistent with the defined acceptable level** The EPO is specific to aspects of the East Coast Project with the potential to change sediment quality (operational and drilling discharges). As per the EPO, any change to sediment quality associated with these aspects is limited to localised changes in the vicinity of the discharge. The EPO is consistent these with the defined acceptable level given the level of impact defined within the EPO is limited to localised areas , as defined in Sections 8.6.5 and 8.7.5, and as such

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				will not lead to adverse effects on biodiversity and ecological integrity. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Sections 8.6.6 and 8.7.6.
Change in ambient light	**AL4**: Impacts to ambient light from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity.	**EPO4:** Impacts to ambient light levels from light emissions associated with the activity will be short-term.	NA	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • EPBC Act • principles of ESD (biodiversity principle). **How the defined acceptable level considers (and is consistent with) the above sources** The Commonwealth marine area is a protected matter under the EPBC Act. The EPBC Act requires an assessment of potential environmental impacts to protected matters which includes modification of important or substantial areas of habitat within the Commonwealth marine area. The significant impact guidelines for MNES defines an action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will modify an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area. This significant impact criterion is incorporated into the acceptable level to meet the objects of the EPBC Act to provide for the protection of the environment and to promote the conservation of biodiversity. By aligning with the objects of the EPBC Act, the acceptable level also aligns with the biodiversity principle of ESD. The acceptable level aligns with the biodiversity principle of ESD as impacts to ambient light at or below this level would not prevent the conservation of biological diversity and ecological integrity.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				How the EPO is consistent with the defined acceptable level The EPO is specific to aspects of the East Coast Project with the potential to change ambient light (light emissions). As per the EPO, impacts from light emissions are temporary and relatively localised (within 49 km), with no introduction of permanent light sources, and no use of lights near (within 3km, per DCCEEW 2023) to seabird rookeries, as defined in Section 8.3.5.The EPO is consistent the with the defined acceptable level given the level of impact defined within the EPO is limited to localised areas. . Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in the Section 8.3.6.
Change in ambient sound	**AL5:** Impacts to ambient sound from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity.	**EPO5:** Impacts to ambient sound from underwater sound emissions associated with the activity vessels and survey equipment will be limited to intermittent and short-term changes.	NA	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • EPBC Act • principles of ESD (biodiversity principle). **How the defined acceptable level considers (and is consistent with) the above sources** The Commonwealth marine area is a protected matter under the EPBC Act. The EPBC Act requires an assessment of potential environmental impacts to protected matters which includes modification of important or substantial areas of habitat within the Commonwealth marine area. The significant impact guidelines for MNES defines an action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will modify an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area. This significant impact criterion is incorporated into the acceptable level to

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				meet the objects of the EPBC Act to provide for the protection of the environment and to promote the conservation of biodiversity. By aligning with the objects of the EPBC Act, the acceptable level also aligns with the biodiversity principle of ESD. The acceptable level aligns with the biodiversity principle of ESD as impacts to ambient sound at or below this level would not prevent the conservation of biological diversity and ecological integrity. **How the EPO is consistent with the defined acceptable level** The EPO is specific to aspects of the East Coast Project with the potential to change ambient sound (impulsive and continuous underwater sound emissions). As per the EPO, impacts to ambient sound will be limited intermittent and short-term changes. The EPO is consistent with the defined acceptable level given the level of impact defined within the EPO limited to intermittent and short term changes, as defined in Section 8.1.6 and 8.2.6, and as such will not modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Sections 8.1.7 and 8.2.7
Change in habitat	**AL6:** Impacts and risks to benthic habitat from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity.	**EPO6:** Impacts to benthic habitats from drilling discharges and seabed disturbance are limited to localised, changes. **EPO7:** Impacts to benthic habitat from drilling discharges and seabed disturbance are limited to localised, changes which will not adversely impact the ecosystem functioning or	**EPO21**: No unplanned release of waste to the marine environment.	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • EPBC Act • principles of ESD (biodiversity principle). **How the defined acceptable level considers (and is consistent with) the above sources** The Commonwealth marine area is a protected matter under the EPBC Act. The EPBC Act requires an assessment of potential environmental impacts to protected matters which

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
		integrity of the shelf rocky reef KEF.		includes modification of important or substantial areas of habitat within the Commonwealth marine area. The significant impact guidelines for MNES defines an action is likely to have a significant impact on the environment in a Commonwealth marine area if there is a real chance or possibility that the action will modify an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area. KEFs are considered to be of regional importance for either a region's biodiversity or its ecosystem function and integrity. Therefore, substantial modification of KEFs is considered a significant impact. This significant impact criterion is incorporated into the acceptable level to meet the objects of the EPBC Act to provide for the protection of the environment and to promote the conservation of biodiversity. By aligning with the objects of the EPBC Act, the acceptable level also aligns with the biodiversity principle of ESD. The acceptable level aligns with the biodiversity principle of ESD as impacts to benthic habitats at or below this level would not prevent the conservation of biological diversity and ecological integrity. **How the EPO is consistent with the defined acceptable level** The EPO is specific to aspects of the East Coast Project with the potential to change habitat (drilling discharges and seabed disturbance). As per the EPO, impacts to benthic habitat are expected to be localised. The EPO is consistent with defined acceptable level given the level of impact defined within the EPO is localised, as defined in Sections 8.6.5 and 8.8.5, and as such will not modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Sections 8.6.6 and 8.8.6.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
Increase in GHG emissions	**AL7:** GHG Emissions from activities defined in this OPP will not prevent Australia from meeting greenhouse gas commitments as per the Paris Agreement, *Climate Change Act 2022* and *Climate Change Act 2017*.	**EPO8:** Manage direct and indirect GHG emissions from the East Coast Project consistent with Australia's international GHG emissions commitments, as outlined in the *Climate Change Act 2022* (Cwth).	NA	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • *Climate Change Act 2022,* • *Climate Change Act 2017* • principles of ESD (intergenerational principle) • international greenhouse gas commitments, including the Paris Agreement. **How the defined acceptable level considers (and is consistent with) the above sources** The Australian Government is signatory to the Paris Agreement which set global long-term temperature goals. Under Article 2 a long-term temperature goal was set to hold the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change. The *Climate Change Act 2017* (Vic) set out climate change policy frameworks and targets in line with the Paris Agreement. The long-term objective is a target of net zero greenhouse gas emissions by 2050, with five-yearly interim objectives also set to meet this target. Australia's Nationally Determined Contribution (NDC) was updated under the *Climate Change Act 2022*. This commits Australia to a target of net zero emissions by 2050 and to reduce Greenhouse gas emissions by 43% from 2005 levels. AL7 ensures the activity aligns with Australia's climate targets, consistent with the intergenerational principle of ESD and the Paris Agreement. By not preventing Australia reaching these targets, this effort is recognised to significantly reduce the risks and impacts of climate change. The Paris Agreement recognises that addressing climate change promotes intergenerational equity. As a result, by not preventing Australia reaching these targets, the activity will not forego the health, diversity and productivity of the environment for future generations, consistent with the inter-generational principle of

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				ESD. With respect to GHG emissions, this is achieved through managing emissions within the framework set by relevant State and National Regulations and Policy, which are designed to limit the effects of climate change in accordance with international agreements, including the Paris Agreement. **How the EPO is consistent with the defined acceptable level** As per the EPO, direct and indirect GHG emissions from the East Coast Project will be consistent with Australia's international GHG emissions commitments, as outlined in the *Climate Change Act 2022*. The EPO is consistent with the defined acceptable level given it requires management of emissions associated with the project in accordance with these commitments, as described in Section 8.5.5. Control measures which ensure the EPO is achieved and impacts are at or below the defined acceptable levels are outlined in Section 8.5.6.
Change in climate systems	Refer to AL7.			Refer to the justification for AL7.
Change in ecosystems	**AL8:** GHG emissions from activities defined in this OPP will not prevent Australia from meeting its GHG commitments under relevant climate legislation (including the Paris Agreement), therefore will not prevent the conservation of biodiversity, maintenance of ecosystem health or protection of threatened species. Refer also to AL7.			**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • *Climate Change Act 2022* • *Climate Change Act 2017* • principles of ESD (biodiversity principle) • international greenhouse gas commitments, including the Paris Agreement. **How the defined acceptable level considers (and is consistent with) the above sources.** Refer also to the justification for AL 7. AL8 ensures the activity aligns with Australia's climate targets, consistent with the biodiversity principle of ESD and the Paris Agreement. By not preventing Australia reaching these

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				targets, this effort is recognised to significantly reduce the risks and impacts of climate change. The Paris Agreement recognises that addressing climate change ensures the integrity of all ecosystems, including oceans, and the protection of biodiversity. As a result, by not preventing Australia reaching these targets, the activity will not prevent the conservation of biological diversity and ecological integrity, consistent with the biodiversity principle of ESD. With respect to GHG emissions, this is achieved through managing emissions within the framework set by relevant State and National Regulations and Policy, which are designed to limit the effects of climate change in accordance with international agreements, including the Paris Agreement. **How the EPO is consistent with the defined acceptable level** As per the EPO, direct and indirect GHG emissions from the East Coast Project are consistent with Australia's international GHG emissions commitments, as outlined in the *Climate Change Act 2022* (Cwth).The EPO is consistent with the defined acceptable level given emissions associated with the project will have a minor contribution to carbon budgets in line with these commitments, as described in Section 8.5.5, and as such will not have prevent the conservation of biodiversity, maintenance of ecosystem health or protection of threatened species. Control measures which ensure the EPO is achieved and impacts are at or below the defined acceptable level are outlined in Section 8.5.6.
Change in socio-economic factors	**AL9:** GHG emissions from activities defined in this OPP will not prevent Australia from			**Sources for acceptable level definition** The acceptable level is consistent with the following sources:

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
	meeting its GHG commitments under relevant climate legislation (including the Paris Agreement), therefore will not compromise the rights of other marine users or result in substantial adverse effects on the sustainability of commercial fisheries. Refer also to AL7.			• *Climate Change Act 2022* • *Climate Change Act 2017* • principles of ESD (intergenerational principle) • international greenhouse gas commitments, including the Paris Agreement. **How the defined acceptable level considers (and is consistent with) the above sources.** Refer also to the justification for AL 7. AL9 ensures the activity aligns with Australia's climate targets, consistent with the intergenerational principle of ESD and the Paris Agreement. By not preventing Australia reaching these targets, this effort is recognised to significantly reduce the risks and impacts of climate change. The Paris Agreement recognises the fundamental priority of safeguarding food security, and the particular vulnerabilities of food production systems to the adverse impacts of climate change. As a result, by not preventing Australia reaching these targets, the activity will ensure the rights of other marine users and sustainability of fisheries are protected, consistent with the inter-generational principle of ESD where productivity of the environment is maintained for the benefit of future generations. With respect to GHG emissions, this is achieved through managing emissions within the framework set by relevant State and National Regulations and Policy, which are designed to limit the effects of climate change in accordance with international agreements, including the Paris Agreement.. **How the EPO is consistent with the defined acceptable level** As per the EPO, direct and indirect GHG emissions from the East Coast Project are consistent with Australia's international

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				GHG emissions commitments, as outlined in the *Climate Change Act 2022* (Cwth). The EPO is consistent with the defined acceptable level as emissions associated with the project will have a minor contribution to carbon budgets in line with these commitments, as described in Section 8.5.5, and as such will not prevent the protection of ecological values for other users. Control measures which ensure the EPO is achieved and impacts are at or below the defined acceptable level are outlined in Section 8.5.6.
Change in fauna behaviour	**AL10:** Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species.	**EPO9:** Impacts to marine fauna from light emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts. **EPO10:** Impacts to marine fauna from noise emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts **EPO11:** Activities do not cause displacement of any blue whale from a foraging area. **EPO12:** Activities do not prevent any southern right whale from utilising a migration BIA or HCTS.	**EPO22:** No unplanned release of chemicals or hydrocarbons to the marine environment.	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • principles of ESD (biodiversity principle and intergenerational principle) • objectives of species recovery plans and conservation advice (see Table 2-3) EPBC Act **How the defined acceptable level considers (and is consistent with) the above sources**. Primary or long-term objectives of species recovery plans and conservation advice include: • Minimise anthropogenic threats to improve the population status of species, leading to the removal of the species from the threatened species list of the EPBC Act • Ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future. • Minimise further loss of habitat critical to the survival of species throughout Australia (including habitat predicted to become habitat critical in the future because of climate change). These objectives of species recovery plans and conservation advice are created in accordance with the EPBC Act and principles of ESD.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
		EPO13: The risk of behavioural disturbance to southern right whales inside and adjacent to BIAs and HCTS is minimised.		Acceptable levels 10 and 11 are consistent with the biodiversity principle of ESD as these levels have regard to maintaining biodiversity and ecological integrity through the alignment to objectives of species recovery plans and conservation advice listed above. The acceptable levels are consistent with the intergenerational principle as impacts at or below these levels would not forego the health, diversity and productivity of the environment for future generations. **How the EPO is consistent with the defined acceptable level** The EPOs are specific to aspects of the East Coast Project with the potential to cause a change in fauna behaviour (impulsive and continuous underwater sound emissions and light emissions), injury/ mortality to fauna. These EPOs are consistent with the defined acceptable levels as meeting these EPOs ensures threatened and migratory species and important behaviours withinBIAs and HCTS are protected in line with the objectives of relevant EPBC management plans, as demonstrated in sections 8.1.6, 8.2.6 and 8.3.5. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Sections 8.1.7, 8.2.7 and 8.3.6.
Injury / mortality to marine fauna	Refer to AL10 and AL11.	**EPO14:** Impacts to marine fauna from operational and drilling discharges will not change the viability of the population of EPBC Act listed threatened or migratory species. **EPO15:** Impacts to marine fauna from operational and drilling discharges will not impact the recovery or conservation status of EPBC Act listed threatened or	**EPO21:** No unplanned release of waste to the marine environment **EPO22:** No unplanned release of chemicals or hydrocarbons to the marine environment. **EPO23:** No unplanned interactions between the project vessels and other marine users.	Refer to the justification for AL10 and AL11. **How the EPO is consistent with the defined acceptable level** The EPOs are specific to aspects of the East Coast Project with the potential to cause injury/ mortality to fauna (light emissions, planned drilling discharges, operational discharges and seabed disturbance). EPO14, EPO15 and EPO16 are consistent with the defined acceptable levels as meeting these EPOs ensures threatened and migratory species are protected in line with the objectives of relevant EPBC management plans, as demonstrated in Section 8.3.5. EPO 6 and EPO7 are consistent with the defined acceptable levels

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
		migratory species, with no population level impacts. **EPO16:** Impacts to marine fauna from light emissions will not impact the recovery or conservation status of EPBC Act listed threatened or migratory species, with no population level impacts. **EPO6:** Impacts to benthic habitats from drilling discharges and seabed disturbance are limited to localised changes. **EPO7:** Impacts to benthic habitat from drilling discharges and seabed disturbance are limited to localised, changes which will not adversely impact the ecosystem functioning or integrity of the shelf rocky reef KEF.	**EPO24:** No physical interactions by support operations within the operational area with EPBC Act listed threatened or migratory species.	given the level of impacts to benthic habitat is limited to localised and change as defined in Sections 8.6.5, 8.7.5 and 8.8.5, and as such will not prevent the recovery of species. Control measures which ensure the EPOs are achieved and impacts and risks are at or below the defined acceptable levels are outlined in Sections 8.3.6, 8.6.6., 8.7.6 and 8.8.6.
Auditory injury	Refer to AL10 and AL11.	**EPO17:** Any whale can continue to utilise the area without injury (PTS or TTS).	NA	Refer to the justification for AL10 and AL11. **How the EPO is consistent with the defined acceptable level** EPO17 is specific to impacts from impulsive and continuous underwater sound. As per the EPO, whales will continue to utilise the area without injury. This is consistent with the defined acceptable levels given this outcome ensures threatened and migratory species are protected in line with the objectives of relevant EPBC management plans, as demonstrated in Sections 8.1.6 and 8.2.6 . Control measures which ensure the EPOs are achieved and impacts and risks

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				are at or below the defined acceptable levels are outlined in Sections 8.1.7 and 8.2.7.
Changes to the functions, interests and activities of other users	**AL12:** Social and commercial amenity values of the Commonwealth Marine Area within the region are maintained consistent with the rights of all marine users.	**EPO18:** Marine users are not excluded from areas other than those defined for the purpose of safe operations, and for which agreed notifications have been issued.	**EPO22:** No unplanned release of chemicals or hydrocarbons to the marine environment. **EPO25:** No introduction, establishment or spread of invasive marine species. **EPO23:** No unplanned interactions between the project vessels and other marine users.	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • the OPGGS Act principles of ESD (intergenerational principle) **How the defined acceptable level considers (and is consistent with) the above sources** AL12 is consistent with section 280(2)(a) and (b) of the OPGGS Act regarding the interference with navigation and fishing, respectively. This section outlines that a person (the first person) carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with a range of other marine activities including navigation or fishing, to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person. AL12 is consistent with this requirement as impacts at or below the defined levels would not compromise the rights of other users or sustainability of commercial fisheries to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the Titleholder.The acceptable level is consistent with the principle of inter-generational equity as it ensures the potential impacts and risks from activities do not forego the health, diversity and productivity of the environment for future generations through ensuring the rights of other marine users or sustainability of fisheries are not compromised as per the OPGGS Act.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				How the EPO is consistent with the defined acceptable level EPO18 is specific to aspects of the East Coast Project with the potential to cause displacement of other marine users. EPO18 is consistent with AL12 as this outcome ensures other users are only excluded from areas defined for the purpose of safe operations temporarily, as defined in Section 8.9.5, and as such the rights of other users and sustainability of fisheries is not compromised. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Section 8.9.6.
	AL13: Impacts and risks to other marine users associated with activities defined in this OPP will not lead to substantial adverse effects on the sustainability of commercial fisheries.	**EPO19**: Impacts will not result in substantial adverse impacts to commercially targeted species.	**EPO22:** No unplanned release of chemicals or hydrocarbons to the marine environment.	**Refer to the justification for AL8.** **How the EPO is consistent with the defined acceptable** EPO19 is specific to aspects which have the potential to impact commercially targeted fish species (seabed disturbance). The EPO is consistent with defined acceptable level given the level of impact is limited to not have a-substantial adverse effects to commercially targeted fish species, as defined in Section 8.8.5, and as such will not lead to substantial adverse effects on the sustainability of commercial fisheries. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Section 8.8.6
Change in cultural heritage value	**AL14:** Impacts and risks from activities defined in this OPP will not prevent the protection and conservation of underwater cultural heritage as defined under the *Underwater Cultural Heritage Act 2018.*	**EPO20**: The Activity is managed such that: • It does not prevent any cultural practice from taking place • It does not destroy any element of the	NA	**Sources for acceptable level definition** The acceptable level is consistent with the following sources: • Underwater *Cultural Heritage Act 2018* (UCH Act) • Guidelines on the application of the *Underwater Cultural Heritage Act 2018* principles of ESD (intergenerational principle).

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
		environment which is a cultural feature, or which forms part of a cultural feature • There is no destruction of underwater cultural heritage		**How the defined acceptable level considers (and is consistent with) the above sources** The objective of the UCH Act is to provide for the identification, protection and conservation of Australia's underwater cultural heritage. The Act protects remains of vessels and aircraft (including Aboriginal and Torres Strait Islander traditional watercraft) that have been wholly or partially submerged in Australian waters for 75 years or longer. Other types of underwater cultural heritage, including First Nations archaeological heritage associated with dry-land habitation on the submerged Pleistocene landscapes on the Australian continental shelf and remains of shipwrecks or aircraft younger than 75 years, can also be declared by the Minister upon discovery (DCCEEW, 2024n). Protections are further defined under the UCH Act (DCCEEW, 2024n). The acceptable level is consistent with the principle of inter-generational equity as it ensures cultural heritage values are protected for future generations through managing activities to levels in accordance with the UCH Act. **How the EPO is consistent with the defined acceptable level** The EPO is specific to aspects of the East Coast Project with the potential to change cultural heritage values. As per the EPO, the activity will be managed to prevent the destruction of underwater cultural heritage. The EPO is consistent with AL10 as meeting this EPO ensures impacts and risks will not exceed levels which prevent protection and conservation of underwater cultural heritage, which is consistent with the objective of the UCH Act to protect and conserve Australia's underwater cultural heritage, as demonstrated in Section 8.6.5, 8.8.5, 9.1.5, and 10.4. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outline in Section 8.6.6, 8.8.6, 9.1.6 and 10.5.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
	AL15: Impacts and risks from activities defined in this OPP will not lead to injury or desecration of objects or areas declared for protection under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984.*			**Sources for acceptable level definition** The acceptable level is consistent with the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (ATSHIP Act) and principles of ESD (intergenerational principle). **How the defined acceptable level considers (and is consistent with) the above sources**. The ATSHIP Act provides protection to places and objects of particular significance from injury or desecration (DCCEEW, 2023s). The Commonwealth Minister for the Environment and Water can use the ATSIHP Act to make a declaration to protect an area or object for a specified period of time. The ATSIHP Act states that an area will be taken to be injured or desecrated if: • it is used or treated in a manner inconsistent with Aboriginal tradition • by reason of anything done in, on or near the area, the use or significance of the area in accordance with Aboriginal tradition is adversely affected, or • passage through or over, or entry upon, the area by any person occurs in a manner inconsistent with Aboriginal tradition' The acceptable level is established in accordance with this Act. The acceptable level is consistent with the principle of inter-generational equity as it ensures objects or areas of significance under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* are maintained for future generations through managing activities in accordance with this legislation.

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	**Unplanned aspects**	
				How the EPO is consistent with the defined acceptable level The EPO is specific to aspects of the East Coast Project with the potential to change cultural heritage values. As per the EPO, the activity will be managed to not destroy any element of the environment which is a cultural feature, or which forms part of a cultural feature. The EPO is consistent with AL15 as meeting this EPO ensures impacts and risks will not lead to injury or desecration of objects or areas declared for protection under the ATSHIP Act, of which significant Aboriginal areas or objects are considered elements of the environment which is a cultural feature, as demonstrated in Section 8.8.5, 9.1.5, and 10.4. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outline in Section 8.8.6, 9.1.6 and 10.5.
	AL16: Impacts and risks from activities defined in this OPP will not interfere with native title rights or interests as defined under section 233 of the *Native Title Act 1993* (Cth), to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the Titleholder.			**Sources for acceptable level definition** The acceptable level is consistent with the *Native Title Act 1993* and principles of ESD (intergenerational principle). *OPGGS Act Section 280(2)* **How the defined acceptable level considers (and is consistent with) the above sources**. The acceptable level is consistent with the *Native Title Act 1993,* as this Act recognises and protects the rights and interests of native title holders. Section 280(2) of the OPGGS Act allows for a level of impact and risk within reason for the exercise of the Titleholders rights and duties. The acceptable level is consistent with the principle of inter-generational equity as this level ensures the potential impacts

Impact type	Defined acceptable level of impact	EPO		Justification
		Planned aspects	Unplanned aspects	
				and risks from activities do not forego the health, diversity and productivity of the environment for future generations through not interfering with of native title and the rights of users as per the *Native Title Act 1993.* No native title determinations or claims overlap the operational area. **How the EPO is consistent with the defined acceptable level** The EPO is specific to aspects of the East Coast Project with the potential to change cultural heritage values. As per the EPO, the activity will be managed to not prevent any cultural practice from taking place. The EPO is consistent with AL16 as meeting this EPO ensures impacts and risks will not (excessively) interfere with native title rights or interests as defined under section 233 of the *Native Title Act 1993* where interest in relation to land or waters means a restriction of the use of the land or waters, as demonstrated in Section 8.8.5, 9.1.5, and 10.4. Control measures which ensure the EPO is achieved and impacts and risks are at or below the defined acceptable level are outlined in Section 8.8.6, 9.1.6 and 10.5.

8 Impact Evaluation

8.1 Underwater Sound Emissions – Impulsive

8.1.1 Cause of Aspect

Surveys and well construction activities associated with the East Coast Project will generate impulsive underwater noise emissions that will temporarily introduce impulsive sounds and increase ambient underwater sound levels in the marine environment.

The impulsive noise emissions that will occur as a result of the East Coast Project activities are identified in Table 8-1, and described in further detail in subsections below.

Table 8-1: Activities undertaken during the East Coast Project that may generate impulsive sound emissions

Cause of Aspect / Phase	Activity component
Surveys	Geophysical survey
Well Construction	Logging

8.1.2 Aspect Characterisation

8.1.2.1 Survey

Geophysical surveys will introduce localised and temporary impulsive sound into the marine environment of the operational area.

Most geophysical survey techniques use acoustics, generating short, pulsed underwater sound, such as MBES, SSS, SBP and SVP. Each survey may take ~7 days to complete and a survey campaign is expected to take up to ~3 weeks.

The sound source characteristics of these acoustic positioning systems are shown in Table 8-2, based on a literature review by McPherson and Koessler 2021 and acoustic modelling for an Otway exploration drilling program (Welch et al., 2023) undertaking similar geophysical survey techniques to those identified within Section 4.3.1. Assessment of these were conducted to ensure the most conservative and applicable sound sources were utilised. At this stage in the planning process, the source frequencies and sound levels for example equipment identified within Table 8-2 are considered to be comparable and representative to those expected for the East Coast Project. Activity specific modelling of confirmed survey techniques and known frequencies and sound levels will be undertaken in future EPs, if required. SVP and CTD techniques are anticipated to have sound source levels like MBES given the operation principle is similar to an echosounder (Makar, 2022).

Table 8-2: Positioning and survey equipment source frequencies and sound levels

Emission source	Example equipment	Source frequency range	Source sound level
MBES	R2Sonic 2024 Reson SeaBat 8101	200–400 kHz	SPL: 221 dB re 1 µPa @ 1 m SEL_{SS}: 130 dB re 1 µPa^{2}s @ 40 m PK: 170 dB re 1 µPa @ 40 m
Sidescan sonar	EdgeTech 4200	70–400 kHz	SPL: 205 dB re 1 µPa @ 1 m SEL_{SS}: 176 dB re 1 µPa^{2}s @ 1 m PK: 210 dB re 1 µPa @ 1 m
Sub-bottom profiler (with boomer)	Applied Acoustics AP3000	100–1,000 Hz	SPL: 203.3 dB re 1 µPa @ 1 m SEL_{SS}: 172.6 dB re 1 µPa^{2}s @ 1 m
Sub-bottom profiler (with CHIRP)	Edgetech X-star system CHIRP	2–16 kHz	SPL: 191.7 dB re 1 µPa PK: 215 dB re 1 µPa^{2}m^2

	Applied Acoustics AA301		

Note: SEL_{SS} is per-pulse SEL (i.e., not an accumulated value).

8.1.2.2 Well Construction

Well logging is expected to take up to 24-48 hours for wireline operations and 5-10 days for LWD operations. Logging while drilling (LWD) and logging via wireline may use acoustic transducers to transmit localised and temporary impulsive sound into the rock surrounding the near wellbore, from a device lowered around 2km below the seabed. Noise from logging activities are not anticipated to be audible within the overlying ocean. Studies which have recorded sound during a range of drilling and logging activities did not identify a discernible increase in subsea noise levels over general vessel noise when logging was underway (Jimenez-Arranz, 2020). Logging, therefore, is not assessed further.

8.1.3 Underwater Noise Modelling

To determine the spatial extent for impact and risk evaluation, a review of comparative underwater sound modelling was undertaken to define relevant impulsive sound EMBAs:

- McPherson, C, and M Koessler. 2021. Empirical estimation of underwater noise and effect from survey equipment. Memo, Capalaba, Queensland, Australia: JASCO Applied Sciences
- Welch, S.J., M.-N. R. Matthews, D.H. Stroot, A.M. Muellenmeister, and C.R. McPherson. 2023. Otway Exploration Drilling Program: Acoustic Modelling for Assessing Marine Fauna Sound Exposures. Document 02760, Version 3.0 FINAL. Technical report by JASCO Applied Sciences for Xodus Group.

Modelling by Welch et al. (2023) produced for ConocoPhillips' Otway Exploration Drilling Program and used 3 sound propagation models (MONM-BELLHOP, FWRAM and VSTACK), for a SBP sound source located approximately 18 km south of the operational area.

Empirical estimation by McPherson and Koessler (2021) reviewed literature and used a simple spreading loss calculation where there were gaps in literature.

Comparing the predicted underwater sound level increases from both studies found results of modelling by Welch et al. (2023) to provide the most relevant estimates of impulsive sound propagation ranges relevant to all sources of impulsive sound generated by the East Coast Project. The seabed lithology, a key factor in sound propagation, is described as silty carbonate sand overlaying limestone within the study by Welch et al (2023), whereby more sand results in further propagation. Based on modelling conducted for the East Coast Project (Connell et al., 2023) for continuous sound emissions, the seabed lithology within the East Coast Project includes some areas of bare limestone, and some areas with overlying sand as described in Connell et al. (2024). The effect of water depth upon sound propagation is relatively minor (Connell et al. 2024). Welch et al. (2023) is therefore considered as providing an appropriate (and conservative) basis for an EMBA by impulsive sound associated with the East Coast Project. Where empirical estimations provide a more conservative estimate, predictions by McPherson and Koessler (2021) were used, where appropriate.

8.1.4 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from impulsive noise emissions are:

- Change in ambient sound.

Potential risk:

- Change in fauna behaviour, including:
  - Marine mammals
  - Marine turtles
  - Fish including eggs and larvae

- Auditory impairment (masking, temporary threshold shift (TTS), recoverable injury), or auditory injuries (mortality or potential mortal injuries, permanent threshold shift (PTS)) to marine fauna, including:
  - Marine mammals
  - Marine turtles
  - Fish including eggs and larvae.

Socio-economic impacts on commercial fisheries have not been evaluated further, as there are no discernible impacts to behaviour and distribution expected at the population level given the limited nature and scale of activities and associated impulsive underwater sound emissions.

8.1.5 Impact and Risk Evaluation

8.1.5.1 Impacts: Change in Ambient Sound

Ambient underwater sound is the level of sound which exists in the environment without the presence of the activity. Ambient underwater sound refers to the background level in a soundscape and can include physical, biological and anthropogenic sound (Erbe et al., 2016a). Ambient underwater sound levels in the operational area are expected to range between 110 and 161 dB re 1 µPa. The ambient levels are inferred from passive acoustic monitoring, commissioned by Origin, conducted 5 km offshore from the coastline east of Warrnambool (Duncan et al., 2013).

Underwater sound modelling predicted increased levels of underwater sound up to 110 dB re 1 µPa would extend 3.37 km from a SBP sound source in the Otway Basin (Welch et al., 2023).

Given that impulsive sound sources of the East Coast Project are related to activities that are intermittent, of a short-term duration and highly localised (change above an SPL of 110 dB re 1 µPa approximately 3.37 km from the SBP sound source), the consequence of this impact has been evaluated as Level 1, as underwater sound will return to existing ambient levels following completion of the activity with no remedial or recovery work required.

8.1.5.2 Risk: Change in Fauna Behaviour – Marine Mammals

Inherent Consequence Evaluation

Impulsive sound emissions may cause behavioural changes to marine mammals depending on the frequency and sound levels received, such that:

- Impulsive sound levels greater than 160 dB re 1 µPa (SPL) is the behavioural threshold for marine mammals including otariid seals, high-frequency cetaceans and very high-frequency cetaceans (NOAA 2019)
- Impulsive sound levels greater than 140 dB re 1 µPa (SPL) has a 50% probability of causing behavioural changes to migrating mysticetes which have been applied to southern right whales and therefore is conservatively defined as the behavioural threshold for low-frequency cetaceans (Wood et al., 2012 cited in Welch et al., 2023).

Underwater sound modelling predicted the impulsive behavioural threshold for otariid seals, high-frequency cetaceans and very high-frequency cetaceans was not reached at any distance from a SBP sound source in the Otway Basin (Welch et al., 2023). This infers East Coast Project impulsive underwater sound emissions do not have the potential to cause behavioural changes to otariid seals, high-frequency cetaceans and very high-frequency cetaceans.

However, underwater sound modelling predicted the impulsive behavioural threshold for low-frequency cetaceans could be reached within 130 m of a SBP source in the Otway Basin (Welch et al., 2023). This infers East Coast Project impulsive underwater sound emissions from some sources have the potential to cause behavioural changes to low-frequency cetaceans, if they are in very close proximity.

A 130 m buffer around the operational area defines the behavioural EMBA for low-frequency cetaceans exposed to impulsive sounds. Table 8-3 provides details on the presence of low-frequency cetaceans, the potential behavioural changes that may occur and the resulting inherent consequence level for each low-frequency cetacean species.

Table 8-3: Inherent Consequence Levels - Impulsive Sound - Behavioural Changes to Marine Mammals

Low-frequency cetacean (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
Minke whale **EPBC Act listed** • Cetacean	May occur. No BIAs overlapped.	Exposure from sonar resulting in horizontal avoidance or ceasing to call (Durbach et al., 2021).	Minor local (small, variable, temporary behavioural changes within 130 m from the source) potential impacts or disturbances to fauna. Not expected to result in population level impacts.	Level 1
Sei whale **EPBC Act listed** • Vulnerable • Cetacean • Migratory	Likely to occur. No BIAs overlapped.	Movement away from impulsive source and call cessation/ modification inferred from studies of other baleen cetaceans.	Localized (130 m from the source) and short-term (~3-week SBP survey) potential impacts to species of recognized conservation value not affecting local ecosystem function. Not expected to result in population level impacts.	Level 2
Blue whale **EPBC Act listed** • Endangered • Cetacean • Migratory	Known to occur. Foraging and distribution BIAs overlapped. During January to June, blue whales migrate through the operational area.	Cessation of deep feeding (deep feeding at water depths of 75 to 175 m) to increased swimming speed and directed travel away from the sound source (from 160 to 210 dB re 1 µPa RMS) (Goldbogen et al., 2013).	Localized (130 m from the source) and short-term (~3-week SBP survey) potential impacts to species of recognized conservation value not affecting local ecosystem function. The risk of stopping blue whale individuals from deep feeding within the behavioural EMBA is not expected to result in population level impacts.	Level 2
Fin whale **EPBC Act listed** • Vulnerable • Cetacean • Migratory	Likely to occur. No BIAs overlapped.	Modify song characteristics under increased background noise conditions, and temporary displacement (Castellote et al., 2012).	Localized (130 m from the source) and short-term (~3-week SBP survey) potential impacts to species of recognized conservation value not affecting local ecosystem function. Not expected to result in population level impacts.	Level 2
Pygmy right whale **EPBC Act listed** • Cetacean • Migratory	May occur. No BIAs overlapped.	Movement away from impulsive source and call cessation/ modification inferred from studies of other baleen cetaceans.	Minor local (small, variable, temporary behavioural changes within 130 m from the source) potential impacts or disturbances to fauna. Not expected to result in population level impacts.	Level 1
Southern right whale **EPBC Act listed** • Endangered • Cetacean	Known to occur. Migration BIA overlapped. During May-June and	Behaviours inferred from related species (North Atlantic right whale), immediately stopped foraging (abandoned their current foraging dive prematurely), quickly approached the surface when exposed to amplitude	Localized (130 m from the source) and short-term (~3-week SBP survey) impacts to species of recognized conservation value not affecting local ecosystem function. The risk of behavioural change to migrating southern right whale	Level 2

Low-frequency cetacean (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
• Migratory	September-October southern right whales pass through the operational area to move to and from coastal aggregation areas.	modulated signals with a maximum source level of 173 dB re 1 µPa at 1 m, 2 minutes after tagging a whale (Nowacek et al. 2004; Matthews and Parks, 2021). Changes to vocalisations including call cessation/ modification is inferred from studies of other baleen cetaceans.	individuals within highly localized area within the behavioural EMBA is not expected to result in population level impacts. Logans beach is ~24km from the operational area; no overlap with behavioural disturbance contours from activity vessels is predicted considering the limited extent of contours associated with survey equipment.	
Humpback whale **EPBC Act listed** • **Cetacean** • **Migratory**	Likely to occur. No BIAs overlapped.	When exposed to an active seismic array, the magnitude and rate of behavioural change were small, variable, temporary when compared with typical behaviours, such as their movement patterns, dive/respiratory parameters and rates of breaching (Dunlop et al., 2017). Based on exposure to greater impulsive sound source levels from seismic array, it is inferred that behavioural changes to humpback whales from exposure to lower impulsive sound source levels from geophysical surveys may also result in small, variable, temporary behavioural changes.	Minor local (small, variable, temporary behavioural changes within 130 m from the source) potential impacts or disturbances to fauna. Not expected to result in population level impacts.	Level 1

Inherent Likelihood

The likelihood of behavioural changes to marine mammals depends on the impulsive sound source used, the potential presence of low-frequency cetaceans within the behavioural EMBA, and the relative sensitivity of different species and individuals to noise.

SBP operating frequencies overlap vocalisation frequencies of low-frequency cetaceans (McPherson and Koessler, 2021). This overlap could potentially mask vocalisations from low-frequency cetaceans causing behavioural changes.

MBES and SSS operating frequencies do not overlap vocalisation frequencies of low-frequency cetaceans. As a result, there is no likelihood of behavioural change to low-frequency cetaceans during MBES and SSS operations.

For the risk event of behavioural changes to marine mammals to occur, the following combination of factors are required:

- Impulsive underwater sound emissions (i.e. from SBP operations)
- Low-frequency cetaceans present within 130 m of the impulsive sound source.

With the combination of the above factors there is a 50% probability impulsive sounds will cause small, variable, temporary behavioural changes (Wood et al., 2012, Table 8-3). As a result, the likelihood of the impact occurring is based on the potential presence of low-frequency cetaceans within a very small radius (130 m) of the impulsive sound source at the same time it is in use.

Table 8-4 provides details on the frequency of recorded sighting of low-frequency cetaceans in the Otway Basin to infer presence within the behavioural EMBA, description of likelihood and the resulting inherent likelihood level for each low-frequency cetacean species.

Table 8-4: Inherent Likelihood Levels - Impulsive Sound - Behavioural Changes to Marine Mammals

Low-frequency cetacean	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
Minke whale	May occur. No BIAs overlapped. Between 2002 and 2013, 123 aerial surveys recorded one sighting of an individual minke whale (Gill et al., 2015).	A freak combination of factors would be required for a minke whale to be present within the behavioural EMBA (within 130m of the sound source) during activities generating impulsive sound emissions. Behavioural changes to minke whales are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)
Sei whale	Likely to occur. No BIAs overlapped. Between 2002 and 2013, 123 aerial surveys recorded 12 sightings of 14 individual sei and like sei whales (Gill et al., 2015).	A freak combination of factors would be required for a sei whale to be present within the behavioural EMBA (within 130m of the sound source) during activities generating impulsive sound emissions. Behavioural changes to sei whales are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)
Blue whale	Known to occur. Foraging and distribution BIAs overlapped. Between June 2012 and March 2013, a cetacean survey recorded 120 individual blue whales in the Otway Basin (Origin, 2018). Between 1887 and 2018, 159 observation and occurrence records of blue whales were identified off the coast of Victoria (Atlas of Living Australia, 2024).	A rare combination of factors would be required for a blue whale to be present within the behavioural EMBA (within 130m of the sound source) during activities generating impulsive sound emissions. Any individuals proximal to the activities may or may not alter behaviour. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Fin whale	Likely to occur. No BIAs overlapped. Between 2002 and 2013, 123 aerial surveys recorded 7 sighting of 8 individual fin and like fin whales (Gill et al., 2015).	A rare combination of factors would be required for a fin whale to be present within the behavioural EMBA (within 130m of the sound source) during activities generating impulsive sound emissions. Any individuals proximal to the activities may or may not alter behaviour. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Pygmy right whale	May occur. No BIAs overlapped. Between 2002 and 2013, 123 aerial surveys recorded one sighting of 100 individual pygmy right whales (Gill et al., 2015).	A freak combination of factors would be required for a pygmy right whale to be present within the behavioural EMBA (within 130m of the sound source) during activities generating impulsive sound emissions. Behavioural changes to pygmy right whales are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)

Low-frequency cetacean	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
Southern right whale	Known to occur. Migration BIA overlapped. Between 1993 and 2018, 375 individual southern right whales (including 48 breeding females) were identified in south-eastern Australia (east of the SA/Victorian border) (Watson et al., 2021).	A rare combination of factors would be required for a southern right whale to be present within the behavioural EMBA (within 130m of the sound source) during activities generating impulsive sound emissions. Any individuals proximal to the activities may or may not alter behaviour. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Humpback whale	Likely to occur. No BIAs overlapped. Between 2002 and 2013, 123 aerial surveys recorded 10 sightings of 18 individual humpback whales (Gill et al., 2015).	A rare combination of factors would be required for a humpback whale to be present within the behavioural EMBA (within 130m of the sound source) during activities generating impulsive sound emissions. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Remote (E)

Inherent Risk Severity

The highest inherent risk severity of behavioural changes to marine mammals from impulsive sound emissions is considered **Low**.

Table 8-5 lists the inherent risk severity for each low-frequency cetacean.

Table 8-5:Inherent Risk Severity - Impulsive Sound - Behavioural Changes to Marine Mammals

Low-frequency cetacean	Inherent consequence level	Inherent likelihood level	Inherent Risk Severity
Minke whale	1	E	**Low**
Sei whale	2	E	**Low**
Blue whale	2	D	**Low**
Fin whale	2	D	**Low**
Pygmy right whale	1	E	**Low**
Southern right whale	2	D	**Low**
Humpback whale	1	E	**Low**

8.1.5.3 Risk: Auditory Injury to Marine Mammals

Inherent Consequence Evaluation

Auditory injury is defined by DCCEEW (formally DAWE, 2021) as both permanent and temporary hearing impairment and any other form of physical harm arising from anthropogenic sources of underwater noise (DAWE, 2021). Permanent and temporary hearing impairment for the purposes of this evaluation is the onset of PTS and TTS, respectively. PTS and TTS thresholds defined by Southall et al. (2019) have been used to determine the range in which the onset of auditory injury will occur to marine mammals from exposure to impulsive sound (Table 8-6).

Table 8-6:Impulsive underwater sound PTS and TTS onset thresholds for 24-hour sound exposure level (SEL_{24h}) and peak (PK) (Southall et al. 2019)

Hearing Group	PTS onset thresholds		TTS onset thresholds	
	Weighted SEL_{24h}	PK	Weighted SEL_{24h}	PK

	(db re 1 µPa^2.s)	(db re 1 µPa)	(db re 1 µPa^2.s)	(db re 1 µPa)
Low-frequency cetaceans	183	219	168	213
High-frequency cetaceans	185	230	170	224
Very high-frequency cetaceans	155	202	140	196
Otariid seals	183	232	168	226

Underwater sound modelling of a SBP activity in the Otway Basin was based on a AP3000 triple-plate boomer system towed at a depth of 2 m, where the specifications for the operating frequency (broadband) and per-pulse SEL source level were 200 Hz to 16 kHz and 169 dB 1 Welch et al., 2023 Table 8-2, please note the difference in units used for the modelling study. MBES and SSS are considered point-like sources, whereas SBP boomer is not a point-like source and expected to emit sound waves over a larger area (Welch et al., 2023).

Results of this study predicted the onset of TTS for very high-frequency cetaceans, based on SEL_{24h} thresholds, if very high frequency cetaceans remain within 20 m of an SBP sound source for 24 hours (Welch et al., 2023). SEL_{24h} thresholds for other hearing groups were not reached. PK thresholds for all hearing groups were also not reached. SEL_{24h} is a cumulative metric representing the total noise exposure over 24 hours. It assumes continuous exposure at a fixed point, providing a worst-case scenario. Realistically, very high-frequency cetaceans are mobile and would not remain in an injury inducing ensonified area for 24 hours. As a result, distances to potential injurious accumulated SEL thresholds does not guarantee injury to marine mammals.

Review of the EPBC listed marine mammal species (or species habitat) that may occur within the operational area (Table 6-9) indicates no presence of any very high-frequency cetaceans such as true porpoises, river dolphins, pygmy/dwarf sperm whales or some oceanic dolphins (Southall et al., 2019). In the event highly mobile oceanic dolphins pass the very localised ensonified area where sound may exceed the TTS threshold, it is unlikely oceanic dolphins would remain within in close proximity for 24 hours for the onset of TTS to occur. Oceanic dolphins traveling through the area might experience brief exposure, however this exposure is not expected to not cause injury. As such, auditory injury to marine mammals from East Coast Project impulsive sound emissions are not credible and not evaluated further.

Inherent Likelihood

Not applicable.

Inherent Risk Severity

Not applicable.

8.1.5.4 Risk: Change in Fauna Behaviour - Marine Turtles

Impulsive sound emissions may cause behavioural changes to turtles depending on the frequency and sound levels received, such that:

- Impulsive sound levels greater than 166 dB re 1 µPa (SPL) is the behavioural threshold for turtles (McCauley et al., 2000).

Results of underwater modelling of a SBP activity in the Otway Basin did not predict the potential onset of behavioural change to turtles (Welch et al., 2023).

However, empirical estimates predicted the impulsive behavioural threshold for turtles is reached within 130 m of the sound source (McPherson and Koessler, 2021). This is consistent with the relative risk criteria from Popper et al. (2014) that suggest that behavioural changes (e.g., avoidance, diving) would only be expected for individuals near the source (high risk of behavioural impacts within tens of metres of source and moderate risk of behavioural impacts within hundreds of metres of the source) (McPherson and Koessler, 2021). This infers East Coast Project impulsive underwater sound emissions have the potential to cause behavioural changes to turtles. Though there is some small inherent uncertainty in defining behavioural effects to the exact meter; additional effort to characterise the effect radius is not considered warranted given the low sensitivity of marine turtle species and their populations to impulsive noise from the project.

A 130 m buffer around the operational area defines the behavioural EMBA for turtles exposed to impulsive sounds. Table 8-7 provides details on the presence of EPBC listed low-frequency cetaceans within the behavioural EMBA, potential behavioural changes that may occur and the resulting inherent consequence level for marine turtle.

Table 8-7: Inherent Consequence Levels – Impulsive Sound – Behavioural Changes to Turtles

Turtle (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of consequence	Inherent consequence
Loggerhead turtle **EPBC Act listed** • Endangered • Marine • Migratory	Likely to occur. No BIAs overlapped.	Interrupted basking behaviour and dove in response to sound generated during airgun operations (DeRuiter and Doukara, 2012).	Localized (130 m from the source) and short-term (~3-week SBP survey) impacts to species of recognized conservation value not affecting local ecosystem function. As there are no BIA's for the species within the temperate south east region, only small numbers (if any) may occur in the area over the life of the project. No discernible effects are expected.	Level 1
Green turtle **EPBC Act listed** • Vulnerable • Marine • Migratory	May occur. No BIAs overlapped.	Displayed increased swimming speed and erratic behaviour when exposed sound generated by pile driving, airguns, and sonar (Papale et al., 2020).	Localized (130 m from the source) and short-term (~3-week SBP survey) impacts to species of recognized conservation value not affecting local ecosystem function. As there are no BIA's for the species within the temperate south east region, only small numbers (if any) may occur in the area over the life of the project. No discernible effects are expected.	Level 1
Leatherback turtle **EPBC Act listed** • Endangered • Marine • Migratory	Likely to occur. No BIAs overlapped.	Increase swimming speeds, induce diving and erratic behaviour inferred from studies of other turtle species.	Localized (130 m from the source) and short-term (~3-week SBP survey) impacts to species of recognized conservation value not affecting local ecosystem function. As there are no BIA's for the species within the temperate south east region, only small numbers (if any) may occur in the area over the life of the project. No discernible effects are expected.	Level 1

Inherent Likelihood

The likelihood of behavioural changes to turtles depends on the impulsive sound source used and the potential presence of turtles within the behavioural EMBA, as well as the relative sensitivity of different species and individuals to noise.

Only SBP operating frequencies overlap hearing frequencies of turtles (McPherson and Koessler, 2021). This overlap could potentially mask turtle hearing causing behavioural changes.

MBES and SSS operating frequencies are outside of hearing frequencies of turtles (McPherson and Koessler, 2021). As a result, there is no likelihood of behavioural change to turtles during MBES and SSS operations.

For the risk event of behavioural changes to turtles to occur, the following combination of factors are required:

- SBP operations
- Turtles present within 130 m of the SBP sound source.

Table 8-8 provides details on the frequency of recorded sighting of EPBC Act listed turtles in the Otway Basin to infer presence within the behavioural EMBA, description of likelihood and the resulting inherent likelihood level for each turtle species.

Table 8-8: Inherent Likelihood Levels - Impulsive Sound - Behavioural Changes to Turtles

Turtle	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
Loggerhead turtle	Likely to occur. No BIAs overlapped. The Victorian Biodiversity Atlas (VBA) showed no observations or occurrences of loggerhead turtles in the behavioural EMBA (Victorian Department of Environment, Land, Water and Planning, 2023).	A freak combination of factors would be required for a loggerhead turtle to be present within the behavioural EMBA during activities generating impulsive sound emissions. Behavioural changes to green turtles are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)
Green turtle	May occur. No BIAs overlapped. The VBA showed no observations or occurrences of green turtles in the behavioural EMBA (Victorian Department of Environment, Land, Water and Planning, 2023).	A freak combination of factors would be required for a green turtle to be present within the behavioural EMBA during activities generating impulsive sound emissions. Behavioural changes to green turtles are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)
Leatherback turtle	Likely to occur. No BIAs overlapped. The VBA showed no observations or occurrences of green turtles in the behavioural EMBA (Victorian Department of Environment, Land, Water and Planning, 2023).	A freak combination of factors would be required for a leatherback turtle to be present within the behavioural EMBA during activities generating impulsive sound emissions. Behavioural changes to green turtles are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)

Inherent Risk Severity

The highest inherent risk severity of behavioural changes to turtles from impulsive sound emissions is **Low**.

Table 8-9 lists the inherent risk severity for each turtle.

Table 8-9: Inherent Risk Severity - Impulsive Sound - Behavioural Changes to Marine Mammals

Turtle	Inherent consequence level	Inherent likelihood level	Inherent Risk Severity

Loggerhead turtle	1	E	**Low**
Green turtle	1	E	**Low**
Leatherback turtle	1	E	**Low**

8.1.5.5 Risk: Auditory Injury to Marine Turtles

Inherent Consequence Evaluation

Results of underwater modelling of a SBP activity in the Otway Basin did not predict the potential onset of auditory injury to marine turtles (Welch et al., 2023). This risk is not evaluated further.

Inherent Likelihood

Not applicable.

Inherent Risk Severity

Not applicable.

8.1.5.6 Risk: Change in Fauna Behavioural – Fish

Inherent Consequence Evaluation

Behavioural changes to fish including eggs and larvae from East Coast Project impulsive sound emissions will generally be within tens of metres of the source based on the qualitative guidelines by Popper et al. (2014). As such, the behavioural EMBA is has been conservatively defined as a 130 m radius around the operational area of the East Coast Project. Though there is some small inherent uncertainty in defining behavioural effects to the exact meter; additional effort to characterise the effect radius is not considered warranted given the low sensitivity of the fish species and their populations to impulsive noise from the project.

Table 8-10 provides details on the presence of fish species that are EPBC Act listed, or which have been identified as culturally significant through consultation, within the behavioural EMBA, potential behavioural changes that may occur and the resulting inherent consequence level for each fish species.

Table 8-10: Inherent Consequence Levels - Impulsive Sound - Behavioural Changes to Fish

Fish (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
White shark **EPBC Act listed** • Vulnerable • Migratory	Known to occur. BIA overlapped. Seasonal presence in southern Australia during early summer.	Showed no significant difference in behaviour when exposed to artificial irregularly pulsed sound (Chapius et al., 2019).	Despite the conservation status of the white shark, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
School shark **EPBC Act listed** • Critically endangered	May occur. No BIAs overlapped.	Inferred behavioural changes based on coastal sharks less inquisitive behaviours when exposed to irregularly pulsed sound (Chapius et al., 2019).	Despite the conservation status of the school shark, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source)	Level 1

Fish (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
			impacts or disturbances to fauna.	
Shortfin mako **EPBC Act listed** • Migratory	Likely to occur. No BIAs overlapped.	Inferred behavioural changes based on coastal sharks less inquisitive behaviours when exposed to irregularly pulsed sound (Chapius et al., 2019).	Minor local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Mackerel shark **EPBC Act listed** • Migratory	Likely to occur. No BIAs overlapped.	Inferred behavioural changes based on coastal sharks less inquisitive behaviours when exposed to irregularly pulsed sound (Chapius et al., 2019).	Minor local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Australian grayling **EPBC Act listed** • Vulnerable	May occur. No BIAs overlapped.	Inferred behavioural changes based on coastal pelagic fish schools dispersing or change in depth when exposed to sonar/echosounder (Hawkins et al., 2014).	Despite the conservation status of the Australian grayling, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Blue warehou **EPBC Act listed** • Critically endangered	Known to occur. No BIAs overlapped.	Inferred behavioural changes based on coastal pelagic fish schools dispersing or change in depth when exposed to sonar/echosounder (Hawkins et al., 2014).	Despite the conservation status of the blue warehou, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Southern bluefin tuna **EPBC Act listed** • Critically endangered	Likely to occur. No BIAs overlapped.	Inferred behavioural changes observed by seabass exposed to impulsive sound including startle responses, increased swimming speed, increased group cohesion, and diving to the bottom (Neo et al., 2014).	Despite the conservation status of southern bluefin tuna, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Pipefish, pipehorse, seadragon and seahorse species **EPBC Act listed** • Marine	May occur. No BIAs overlapped.	Inferred behavioural changes including startle responses, increased swimming speed, increased group cohesion, and diving to the bottom (Neo et al., 2014).	Minor local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1

Fish (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
Short-finned eels **Culturally significant to First Nations people (Koster et al., 2021)**	Seasonal presence in the Otway Basin and Bass Strait during spawning migration i.e. downstream migration of adult eels during late summer and autumn. Upstream migration of larvae and glass eels, where glass eels enter estuaries during mid-winter to late spring (VFA, 2022a).	A study on Anguillid eels under experimental conditions demonstrated that acoustic stimuli induced behavioural avoidance (increased swimming, speed and movements away from the source) in some European eel and river lamprey (Deleau et al., 2019). Studies on Sandeels revealed minor reactions to seismic shootings (Popper et al., 2014).	This species was identified through consultation as of particular cultural significance. Because of the negligible potential behavioural changes, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1

Inherent Likelihood

The likelihood of behavioural changes to fish including eggs and larvae depends on the impulsive sound source used, the potential presence of fish including eggs and larvae within the behavioural EMBA, and the relative sensitivity of different species and individuals to noise.

SBP operating frequencies overlap hearing frequencies of fish (McPherson and Koessler, 2021). This overlap could potentially mask fish hearing causing behavioural changes.

MBES and SSS operating frequencies are outside of hearing frequencies of fish (McPherson and Koessler, 2021). As a result, it is expected that there will be no discernible behavioural change to fish during MBES and SSS operations.

For the risk event of behavioural changes to fish to occur, the following combination of factors are required:

- Impulsive underwater sound emissions (i.e. SBP operations)
- Fish species present within 130 m of the impulsive sound source.

Table 8-11 provides details on the frequency of recorded sighting of EPBC Act listed fish in the Otway Basin to infer presence within the behavioural EMBA, description of likelihood and the resulting inherent likelihood level for each fish species.

Table 8-11: Inherent Likelihood Levels - Impulsive Sound - Behavioural Changes to Fish

Fish	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
White shark	Known to occur. BIA overlapped.	The risk event could happen when additional factors are present, such that a white shark is present within the behavioural EMBA during activities generating impulsive sound emissions. White sharks are known to occur within the behavioural EMBA; therefore, it is easy to postulate a scenario for the occurrence but considered doubtful.	Possible (C)
School shark	May occur. No BIAs overlapped.	A freak combination of factors would be required for a school shark to be present within the behavioural EMBA during activities generating impulsive sound emissions. Behavioural changes to school sharks are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)

Fish	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
Shortfin mako	Likely to occur. No BIAs overlapped.	A rare combination of factors would be required for a shortfin mako to be present within the behavioural EMBA during activities generating impulsive sound emissions. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Mackerel shark	Likely to occur. No BIAs overlapped.	A rare combination of factors would be required for a mackerel shark to be present within the behavioural EMBA during activities generating impulsive sound emissions. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Australian grayling	May occur. No BIAs overlapped.	A freak combination of factors would be required for an Australian grayling to be present within the behavioural EMBA during activities generating impulsive sound emissions. Behavioural changes to the Australian grayling are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)
Blue warehou	Known to occur. No BIAs overlapped.	The risk event could happen when additional factors are present, such that a blue warehou is present within the behavioural EMBA during activities generating impulsive sound emissions. Blue warehou are known to occur within the behavioural EMBA; therefore, it is easy to postulate a scenario for the occurrence but considered doubtful.	Possible (C)
Southern bluefin tuna	Likely to occur. No BIAs overlapped.	A rare combination of factors would be required for southern bluefin tuna to be present within the behavioural EMBA during activities generating impulsive sound emissions. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Pipefish, pipehorse, seadragon and seahorse species	May occur. No BIAs overlapped.	A freak combination of factors would be required for syngnathidae to be present within the behavioural EMBA during activities generating impulsive sound emissions. Behavioural changes to syngnathidae are not expected to occur from East Coast Project impulsive underwater sound emissions.	Remote (E)
Short-finned eels **Culturally significant to First Nations people (Koster et al., 2021)**	Seasonal presence in the Otway Basin and Bass Strait during spawning migration i.e. downstream migration of adult eels during late summer and autumn. Upstream migration of larvae and glass eels, where glass eels enter estuaries during mid-winter to late spring (VFA, 2022a).	The risk event could happen when additional factors are present, such that short-finned eels as adults during downstream spawning migration or as larvae / glass eels during upstream spawning migration is present within the behavioural EMBA during use of SBP operations. Based on known distributions during migration it is assumed some short-finned eels may migrate through the behavioural EMBA. Therefore, it is easy to postulate a scenario for the occurrence but considered doubtful that there would be a discernible behavioural change.	Possible (C)

Inherent Risk Severity

The highest inherent risk severity of behavioural changes to fish including eggs and larvae from impulsive sound emissions is **Low.**

Table 8-12 lists the inherent risk severity for each EPBC Act listed fish.

Table 8-12: Inherent Risk Severity - Impulsive Sound - Behavioural Changes to Fish

Fish	Inherent consequence level	Inherent likelihood level	Inherent Risk Severity
White shark	1	C	**Low**
School shark	1	E	**Low**
Shortfin mako	1	D	**Low**
Mackerel shark	1	D	**Low**
Australian grayling	1	E	**Low**
Blue warehou	1	C	**Low**
Southern bluefin tuna	1	D	**Low**
Pipefish, pipehorse, seadragon and seahorse species	1	E	**Low**
Short-finned eels	1	C	**Low**

8.1.5.7 Risk: Auditory Injury to Fish

Inherent Consequence Evaluation

Results of underwater modelling of a SBP activity in the Otway Basin did not predict the potential onset of auditory injury to fish, nor eggs and larvae (Welch et al., 2023). This risk is not evaluated further.

Inherent Likelihood

Not applicable.

Inherent Risk Severity

Not applicable.

8.1.6 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-13.

Table 8-13: Impulsive Sound Emissions Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Impact: Change in ambient sound	Consequence: Level 1
	Risk: Change in fauna behaviour	Risk: Low – marine mammals Risk: Low – marine reptiles Risk: Low – fish
	Risk: Auditory impairment (masking, TTS, recoverable injury), or auditory injuries (mortality or potential mortal injuries, PTS) to marine fauna	N/A
	A) 'Integration principle'	

Principles of ESD	The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Impacts and risks from underwater sound emissions – impulsive was identified as: • Level 1 consequence for change in ambient sound • Low risk for change in fauna behaviour. The above predicted levels of impact and risks due to underwater sound emissions – impulsive from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology and the Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process. • The highest consequence ranking for impulsive underwater sound emissions was evaluated as Level 2, specifically for marine mammals, and the highest inherent risks for impulsive underwater sound emissions was evaluated as Low; therefore, impulsive underwater sound emissions from the East Coast Project will not result in serious or irreversible environmental damage. • There is a broad set of literature on the subject of underwater noise; whilst there remain some uncertainties as to exactly how and when individual whales may react to noise of different sources, the potential population level effects from impulsive noise are able to be relatively well characterised through existing knowledge of species distribution and population studies overlayed with published literature on impact thresholds, and an understanding of the levels of noise produced by project equipment. There is little scientific uncertainty associated with predicted environmental impact and the anticipated effectiveness of management measures. The potential impacts and risks from impulsive underwater sound emissions are well-understood, and management measures are well established and regulated in Australian waters.
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest inherent risks for impulsive underwater sound emissions was evaluated as Low and therefore will not forego the health, diversity and productivity of the environment for future generations through protection of environmental values. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.1.7). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as:

	• The relevant environmental values and sensitivities to impulsive underwater sound emissions were evaluated in Section 8.1.5 and the highest inherent risk for impulsive underwater sound emissions was evaluated as Low. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.1.7). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained through protection of the values of the Commonwealth Marine Area as per the objectives of bioregional plans.		
Legislative and Other requirements	**Requirement**	**Relevant Objective / Action**	**Demonstration of Requirement**
	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	Objective: Ensure whales and dolphins are not harmed by offshore interactions with vessels. Management action: Vessels adhere to the distances and vessel management practices of EPBC Regulations (Part 8) with caution zone of 300 m between whales and project vessels.	Adoption of the following control measures: CM1: Marine Assurance Process CM2: Offshore Operational Procedures CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process
	EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines, adapted for SBP operations	Objective: Ensure whales are not harmed during offshore seismic activities. The following actions are adapted to the nature and scale of the ECP SBP operations. Management action: Precaution zones surrounding SBP acoustic source (adjusted according to equipment acoustic characteristics relative to sensitivity of Threatened whale species) source: • Observation zone: horizontal radius from the SBP acoustic source. • If a whale is sighted within the SBP observation zone, then activation will be delayed until the source is at least the distance of the observation zone from the whale, or 30 minutes has lapsed since the last whale sighting within the observation zone. • SBP survey will not commence at night if there have been three or more delays to the start-up of the equipment due to whales in the previous 24 hours. • Use of suitably trained personnel to observe for whales. • Once the survey has commenced EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans applies where a caution zone of 300 m radius applies to whales.	
	Blue Whale Conservation Management Plan 2015 – 2025 (2015)	Recovery objective: Minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 4: Anthropogenic threats are demonstrably minimised.	

		Management action A.2.2: Assessing the effect of anthropogenic noise on blue whale behaviour. Section 8.1.5.2 assesses the effects of anthropogenic noise from the East Coast Project on blue whale behaviour. Management action A.2.3: Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. The Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process provides details on level of whale observation effort, triggers for actions and the actions to be taken to manage potential impacts to endangered whales with BIAs in the region (blue whales and southern right whales). Management Action A.2.3 will be implemented in accordance with DAWE guidance on key terms (2021), where the action is needed to achieve the objective of the Blue Whale Conservation Management Plan. This will involve: Application of conservative criteria including suitable thresholds to establish parameters for impact and risk assessment. Actions and adaptive management measures, will be implemented as described and adapted for SBP operations from 'EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines', to reduce the risk of blue whale injury and/or displacement within foraging BIA.	
	National Recovery Plan for the Southern Right Whale (DCCEEW. 2024l)	Long term recovery objective: is that the population has increased in size to a level that the conservation status has improved, and the species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria. Interim Objective 2: Anthropogenic threats are managed consistent with ecologically sustainable development principles to facilitate recovery of southern right whales. Management action A.5: Assess, manage, and mitigate impacts from anthropogenic noise. Management action A.5.2: Actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that it does not prevent any southern right whale from utilising the area or cause auditory impairment. Management action A.5.3: Actions within and adjacent to southern right	

		whale BIAs and HCTS should demonstrate that the risk of behavioural disturbance is minimised. The Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process provides details on level of whale observation effort, triggers for actions and the actions to be taken to manage potential impacts to endangered whales with BIAs and HCTS in the region (blue whales and southern right whales). Management action A.5.4: Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy (e.g., EPBC Act Policy Statement 2.1) and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to southern right whales to the lowest possible level. Actions and adaptive management measures will be implemented as described and adapted for SBP operations from 'EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines', to ensure that actions do not prevent any southern right whale from utilising the BIA and HCTS area, cause auditory impairment, and risks to behavioural disturbance are minimised. :	
	Conservation Advice *Balaenoptera borealis* Sei Whale (TSSC, 2015e)	Identifies anthropogenic noise acoustic disturbance as a minor threat. The advice contains no relevant management actions.	
	Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC, 2015f)	Identifies anthropogenic noise acoustic disturbance as a minor threat. The advice contains no relevant management actions.	
	Listing Advice *Megaptera novaeangliae* Humpback Whale (TSSC, 2022)	Identifies anthropogenic noise as a concern. The advice contains no relevant management actions.	
	Recovery plan for marine turtles in Australia 2017–2027	Recovery objective: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: Anthropogenic threats are demonstrably minimised.	

		The recovery plan contains no relevant management actions.	
	Recovery Plan for the White Shark (*Carcharodon carcharias*) 2013	Recovery objective: Ensure that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future. The recovery plan contains no relevant management actions.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	Cooper Energy has previously sought advice from the Australian Antarctic Division (AAD) in relation to the management of impacts from noise. The consultation outcomes are presented within the BMG Closure Project Phase 1 EP (NOPSEMA ID: 6825) and are not repeated here. The AAD advice has informed the assessment and definition of management measures for the ECP such as adjusting processes within MS09 to consider vessel noise during tendering, development of a Whale Disturbance Risk Management Process and within that, the allocation of dedicated marine mammal observers and shut-down criteria for particular activities.		
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to impulsive sound emissions is AL5, AL10 and AL11 identified in Table 8-14. These acceptable levels defined for a change in ambient underwater sound, a change in fauna behaviour and auditory injury are defined in Table 7.6. The worst-case predicted impacts assessed in Section 8.1.4 are: • Change in ambient sound from impulsive sound emissions is limited to intermittent and short-term geophysical survey activities (i.e. ~3 week SBP survey). Ambient underwater sound levels are expected to immediately return to existing levels following completion of survey activities. • Behavioural changes to fish (including eggs and larvae) are predicted to be generally within tens of metres of the source; and for marine mammals and marine reptiles, predicted to be within 130 m of the source (i.e. SBP). • Impulsive sound sources are short-term (i.e. ~3 week SBP survey) and will cause small, variable, temporary behavioural changes, not affecting local ecosystem function; with no population level impacts. • Results of underwater modelling of a SBP activity did not predict the potential onset of auditory injury to marine turtles or fish. • For marine mammals, in the event highly mobile oceanic dolphins pass the very localised ensonified area where sound may exceed the TTS threshold, it is unlikely they would remain within in close proximity for 24 hours for the onset of TTS to occur. As such, auditory injury to marine mammals from East Coast Project impulsive sound emissions are not credible and not evaluated further. • The highest consequence ranking for impulsive underwater sound emissions was evaluated as Level 2, specifically for marine mammals, and the highest inherent risks for impulsive underwater sound emissions was evaluated as Low. Therefore, at its worst-case, the predicted impact from impulsive sound emissions would not: • Modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Lead to loss of habitat critical to the survival of species.		

	Therefore, the predicted level of impact due to impulsive sound emissions from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to impulsive sound emissions are acceptable, based on: • Predicted levels of impact (evaluated in Section 8.1.5) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • Relevant historical feedback from stakeholders (AAD) for activities of similar nature and scale to the East Coast Project has been used to inform mitigation measures. To manage impacts to receptors to at or below the defined acceptable levels the following EPOs have been applied: **EPO5**: Impacts to ambient sound from underwater sound emissions associated with the activity vessels and survey equipment will be limited to intermittent and short-term changes. **EPO10:** Impacts to marine fauna from noise emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts. **EPO11**: Activities do not cause displacement of any blue whale from a foraging area. **EPO12**: Activities do not prevent any southern right whale from utilising a migration BIA or HCTS. **EPO13:** The risk of behavioural disturbance to southern right whales inside and adjacent to BIAs and HCTS is minimised. **EPO17:** Any whale can continue to utilise the area without injury (PTS or TTS).

8.1.7 Environmental Performance

Table 8-14 lists the acceptable level and EPO defined for impulsive sound emissions and the adopted control measures to achieve the outcome.

Table 8-14: Environmental Performance Summary – Impulsive sound emissions

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL5: Impacts to ambient sound from activities defined in this OPP will not modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity	**EPO5:** Impacts to ambient sound from underwater sound emissions associated with the activity vessels and survey equipment will be limited to intermittent and short-term changes.	CM1: Marine Assurance Process Equipment generating impulsive sound emissions will be operated and maintained in accordance with manufacturer's instructions to ensure efficient operation.
AL10: Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities	**EPO10:** Impacts to marine fauna from noise emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts **EPO11**: Activities do not cause displacement of any	CM2: Offshore Operational Procedures All vessels will adhere to the distances and vessel management practices of EPBC Regulations (Part 8 Division 8.1 interacting with cetaceans) as a minimum. CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process The Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process acknowledges legislative requirements and establishes the criteria and methods by which potential disturbance to

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
defined in this OPP will not lead to loss of habitat critical to the survival of species.	blue whale from a foraging area. **EPO12**: Activities do not prevent any southern right whale from utilising a migration BIA or HCTCS. **EPO13:** The risk of behavioural disturbance to southern right whales inside and adjacent to BIAs and HCTS is minimised. **EPO17:** Any whale can continue to utilise the area without injury (PTS or TTS).	relevant whale species is identified. The process identifies management measures for different types of offshore activity, accounting for nature and scale of the potential impacts and risks, to ensure they remain within acceptable levels, and are managed to ALARP. Provisions within the process include: • Consideration for vulnerable species during sensitive life stages most susceptible to noise emissions via a planning-phase risk review, integrating latest published Government Plans and scientific literature. This will consider scheduling of activities outside of higher sensitivity period where practicable, and review of control measures to ensure levels of impact and risk remain ALARP. Where there is a risk of TTS or PTS to whales, or a risk of behavioural disturbance to southern right whales or blue whales, the following provisions apply: • Establishment of a communications protocol between Marine Fauna Observers (MFO), vessel master and project team. • Dedicated MFO for the hours of daylight (defined as sunset to sunrise), with relief available to manage MMO fatigue. • Dedicated MFOs shall have demonstrated prior experience in the ID of large baleen whales, distance estimation and systems of recording and reporting. • Inducted vessel crew observers to support dedicated MMO during rest breaks. • Application of whale observation and noise shutdown zones out to furthest observable extent, up to a radius equivalent to the behavioural disturbance thresholds of the vessel. • Pre-DP start observation for the 30 minutes prior to commencing DP for the planned activity. DP will not commence until southern right or blue whales are not observed within the shutdown zone, or are observed departing the shutdown. • Suspend DP operations when safe to do so (as determined by vessel master or delegate in command) if blue whales or southern right whales are within the behavioural disturbance radius for the activity. Adopt favourable heading to reduce thruster load (and associated noise) and slowly increase separation from the whale(s) if safe to do so (as determined by vessel master or delegate in command). • Apply 30-minute prestart observations before recommencing DP for the planned activity. • Operations using DP at night will be avoided where 3 or more separate sightings of southern right whales or blue whales have occurred within the vessel shutdown zone in the 3-hours prior to sunset, if safe to do so (as determined by vessel master or delegate in command). Cooper Energy will engage with other the Otway Basin Petroleum Titleholders to share planned work schedules with the aim of minimising the potential for cumulative impacts associated with underwater sound from petroleum activities.

8.2 Underwater Sound Emissions – Continuous

8.2.1 Cause of Aspect

The East Coast Project well construction, operations and support activities phases will generate continuous noise emissions that will increase ambient underwater sound levels in the marine environment.

Relevant continuous noise emitting activities for each phase are identified in Table 8-15, which are described in further detail in subsections below.

Table 8-15: Activities undertaken during the East Coast Project that may generate continuous sound emissions

Cause of Aspect / Phase	Activity component
Well Construction	Drilling operations
Operations	Hydrocarbon extraction and transport
Support Operations	MODU operations
	Vessel operations
	Helicopter operations
	ROV / AUV Operations

8.2.2 Aspect Characterisation

8.2.2.1 Well Construction

Well construction operations will introduce localised and temporary continuous sound into the marine environment of the operational area.

During drilling operations, onboard equipment vibrations and the rotating drill string will transmit continuous sound into the water column (Austin et al., 2018).

Drilling operations will be temporary. Up to 15 production wells may be drilled within the scope of this OPP. Each well is expected to take up to 60 days to drill or up to 180 days for drilling campaigns with multiple wells. A maximum of 7 drilling campaigns are expected during the East Coast Project.

The sound source characteristics of drilling operations representative of a MODU which is anchored, and drilling is defined in Table 8-16 (Connell et al., 2023).

Table 8-16: Drilling operation source frequencies and sound level

Emission source	Example equipment	Source frequency range	Source sound level
MODU while anchored and drilling	Ocean Onyx MODU	10 Hz to 31 kHz	SPL: 175.4 dB re 1 µPa m

8.2.2.2 Operations

Hydrocarbon extraction and transport operations will introduce localised and ongoing continuous sound into the marine environment of the operational area.

The transport of gas through pipes and valves may generate continuous underwater sound from cavitation i.e. formation or collapse of bubbles in extracted gas transported through subsea infrastructure (Salgado-Kent et al., 2016; Wang et al., 2021).

Hydrocarbon extraction and transport operations will be ongoing during the operations phase of the East Coast Project. The estimated duration of the operations phase is 5-12 years.

The sound source characteristics of hydrocarbon extraction and transport operations is defined in Table 8-17 (Salgado-Kent et al., 2016). Ambient underwater sound levels in the operational area are expected to range between 110 and 161 dB re 1 µPa (Duncan et al., 2013). The sound source level for hydrocarbon extraction and transport operations (Table 8-17) is within ambient underwater sound levels in the operational area. Continuous underwater sound from hydrocarbon extraction and transport operations, therefore, is not assessed further.

Table 8-17: Hydrocarbon extraction and transport operations source frequencies and sound level

Emission source	Example equipment	Source frequency range	Source sound level
An operating wellhead and pipelines	Wellhead and pipelines associated with Cossack Pioneer FPSO operations is referred to as a proxy	100 Hz to 2.5 kHz Wellhead noise probably extended to higher frequencies.	SPL: 113 dB re 1 µPa RMS

8.2.2.3 Support Operations

MODU, vessel, helicopter and ROV / AUV operations will introduce localised and temporary continuous sound into the marine environment of the operational area.

All East Coast Project phases require the temporary use of support operations at varying durations (Table 4-11).

Continuous underwater sound radiated from support operations is primarily produced from propeller and thruster cavitation (Connell et al., 2023). Review of sound source characteristics of support operations determined the highest sound levels will be generated from contracted vessels whilst they are using thrusters for dynamic positioning (DP).

The sound source characteristics of support operations used during the East Coast Project is defined in Table 8-18 (Connell et al., 2023; Jimenez-Arranz et al., 2020; Griffiths et al., 2001).

Table 8-18: Support operations source frequencies and sound level

Emission source	Example equipment	Source frequency range	Source sound level
MODU operations	MODU while anchored drilling	10 Hz to 31 kHz	Energy Source Level (ESL): 175 dB re 1 $\mu Pa^2 m^2$.s
Vessel operations	Anchor Handling Tug Supply (AHTS) stationary under DP	Decidecade frequency-band	ESL: 194 dB re 1 $\mu Pa^2 m^2$.s
	AHTS slow transit	Decidecade frequency-band	ESL: 173 dB re 1 $\mu Pa^2 m^2$.s
	Infield Support Vessel (ISV) pipelaying	Decidecade frequency-band	ESL: 188 dB re 1 $\mu Pa^2 m^2$.s
	Dive Support Vessel (DSV) stationary under DP	Decidecade frequency-band	ESL: 187 dB re 1 $\mu Pa^2 m^2$.s
Helicopter operations	Medium Utility Helicopter	Dominant 22 Hz tone	SPL: 151 dB re 1 µPa @ 1 m
ROV / AUV operations	AUV autosub	100 Hz to 5 kHz	SPL: 124 dB re 1 µPa @ 1 m

8.2.2.4 Concurrent activities

Concurrent activities may occur during the East Coast Project. This means that for example, campaigns relating to well construction and installation and commissioning phases have the potential to occur at the same time during the East Coast Project (refer to Section 4.1.3).

Where activities do occur concurrently, and which result in multiple vessels operating in field at the same time, may result in a larger noise footprint, but for less time compared to if those same activities were to occur sequentially.

For the purposes of this evaluation, scoping between Cooper Energy and JASCO Applied Sciences (Australia) Pty Ltd (JASCO) was undertaken to define realistic cases for concurrent operations and identified the largest expected ensonified area over the course of the East Coast Project, accounting for from multiple simultaneous sound sources.

The largest case identified for concurrent activities included the following continuous sound sources:

- Elanora-1 well construction operations:
  - 1x MODU anchored while drilling
  - 1x AHTS stationary (on DP)
  - 1x AHTS slow transit.
- Flowline installation between Annie-2 and Casino-5:
  - 1x ISV pipelaying (on DP).

The sound source characteristics of each continuous sound source is detailed in Table 8-18.

8.2.3 Underwater Noise Modelling

Cooper Energy commissioned JASCO to undertake a modelling study of underwater sound levels associated with drilling and support operations to define relevant continuous sound EMBAs (Connell et al., 2023).

Results of the study define the spatial extent of potential acoustic impact to ambient sound and the spatial extent of potential impact thresholds to marine mammals, turtles and fish including eggs and larvae. The predicted spatial extent for the onset of relevant impact thresholds is detailed in the following subsections.

The continuous underwater sound modelling study represented the East Coast Project through 8 scenarios of potential drilling and support operations, including the concurrent activities (Table 8-19).

Table 8-19: Description of the 8 scenarios modelled for continuous sound

Scenario	Description	Number of continuous sound sources per scenario
1	**Pre-lay activity** represented by a single AHTS pre-laying anchors for drilling operations. Modelled separately at Annie-2 and Elanora-1 well sites.	1x AHTS under DP
2	**MODU positioning / installation** represented by a MODU generating no noise, assisted by 3 AHTS. Modelled separately at Annie-2 and Elanora-1 well sites.	2x AHTS slow transit 1x AHTS under DP
3	**Drilling operations** represented by an anchored MODU drilling. Modelled separately at Annie-2 and Elanora-1 well sites.	1x MODU while anchored drilling
4	**Drilling operations** represented by an anchored MODU drilling, assisted by a single AHTS. Modelled separately at Annie-2 and Elanora-1 well sites.	1x MODU while anchored drilling 1x AHTS under DP
5	**Drilling operations** represented by an anchored MODU drilling, assisted by 2 AHTS. Modelled separately at Annie-2 and Elanora-1 well sites.	1x MODU while anchored drilling 1x AHTS slow transit 1x AHTS under DP
6	**Installation of an EHU** represented by an ISV pipelaying. Modelled between Annie-2 and Casino-5 well sites.	1x ISV pipelaying

Scenario	Description	Number of continuous sound sources per scenario
7	**Installation of other subsea infrastructure** represented by a single DSV. Modelled at Annie-2 well site only.	1x DSV stationary under DP
8	**Concurrent activities** represented by an anchored MODU drilling, assisted by 2 AHTS and an ISV pipelaying. Modelled drilling operations at Elanora-1 well site. Modelled ISV pipelaying between Annie-2 and Casino-5 well sites.	1x MODU while anchored drilling 1x AHTS slow transit 1x AHTS under DP 1x ISV pipelaying

8.2.4 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from continuous noise emissions are:

- Change in ambient sound.

Potential risk:

- Change in fauna behaviour, including:
  - Marine mammals
  - Marine turtles
  - Fish
- Auditory impairment (masking, temporary threshold shift (TTS), recoverable injury), or auditory injuries (mortality or potential mortal injuries, permanent threshold shift (PTS)) to marine fauna, including:
  - Marine mammals
  - Marine turtles
  - Fish including eggs and larvae.

Socio-economic impacts on commercial fisheries have not been evaluated further, as there are no discernible impacts to behaviour and distribution expected at the population level given the limited nature and scale of activities and associated underwater sound emissions.

8.2.5 Impact and Risk Evaluation

8.2.5.1 Impacts: Change in Ambient Sound

Inherent Consequence Evaluation

Ambient underwater sound levels in the operational area are expected to range between 110 and 161 dB re 1 μPa (Duncan et al., 2013).

Underwater sound modelling (Connell et al., 2023) predicted increased levels of underwater sound to 110 and 160 dB re 1 μPa would extend:

- 92 km to 0.07 km from the concurrent operation (Scenario 8: inclusive of 4 sound sources).
- 81 km to 0.06 km from a drilling operation represented by a moored MODU with 3 AHTs under DP (Scenario 2: inclusive of 3 sound sources from AHTS, moored MODU generates no noise).

Drilling operations and concurrent operation scenarios would be intermittent and temporary. The consequence of a short-term change in ambient sound within (up to) 92 km of the project activities has been evaluated as Level 1, as underwater sound will return to existing ambient levels following completion of the activity with no remedial or recovery work.

8.2.5.2 Risk: Change in Fauna Behaviour – Marine Mammals

Inherent Consequence Evaluation

Continuous sound emissions may cause behavioural changes to marine mammals depending on the frequency and sound levels received.

Continuous sound levels greater than 120 dB re 1 µPa (SPL) is adopted as a conservative behavioural change threshold for marine mammals including otariid seals, low- frequency cetaceans, high-frequency cetaceans and very high-frequency cetaceans (NOAA, 2019). The 120 dB re 1 µPa threshold is associated with continuous sources and was derived based on studies examining behavioural responses to drilling and dredging (NOAA 2018b), referring to Malme et al. (1983), Malme et al. (1984), and Malme et al. (1986), which were considered in Southall et al. (2007). Malme et al. (1986) found that playback of drillship noise did not produce clear evidence of disturbance or avoidance for levels below 110 dB re 1 µPa (SPL), possible avoidance occurred for exposure levels approaching 119 dB re 1 µPa. Malme et al. (1984) determined that measurable reactions usually consisted of rather subtle short-term changes in speed and/or heading of the whale(s) under observation. It has been shown that both received level and proximity of the sound source is a contributing factor in eliciting behavioural reactions in humpback whales (Dunlop et al., 2017; Dunlop et al., 2018).

Underwater sound modelling predicted the behavioural threshold for marine mammals was reached within 0.44 km for a single continuous sound source (Scenario 1: single support vessel), 7.87 km for 3 continuous sound sources at nearshore locations (Scenario 2: MODU positioning with three support vessels at Annie-2), 21.7 km for 3 continuous sound sources at offshore locations (Scenario 2: MODU positioning with three support vessels and Scenario 5: MODU drilling with two support vessels both at Elanora-1), and up to 30.70 km for 4 continuous sound sources during concurrent activity (Scenario 8: concurrent operations – combination of Scenario 5 and 6) in the operational area (Connell et al., 2023).

The modelling results predicted for the credible concurrent operations (Scenario 8) differ from the other scenarios modelled, as the ensonified field is not a uniform radius from the sound source. Instead the distance is based off the maximum horizontal distance to reach the behavioural response thresholds between the 2 combined scenarios. As such, the maximum distance between the offshore extent of Scenario 5 and the furthest nearshore extent from Scenario 6. Figure 8-1 and Figure 8-2 presents the behavioural EMBA for this scenario in relation to the pygmy blue whale and southern right whale BIAs, respectively. See Appendix 3 for further details of the modelling report (Connell et al., 2023).

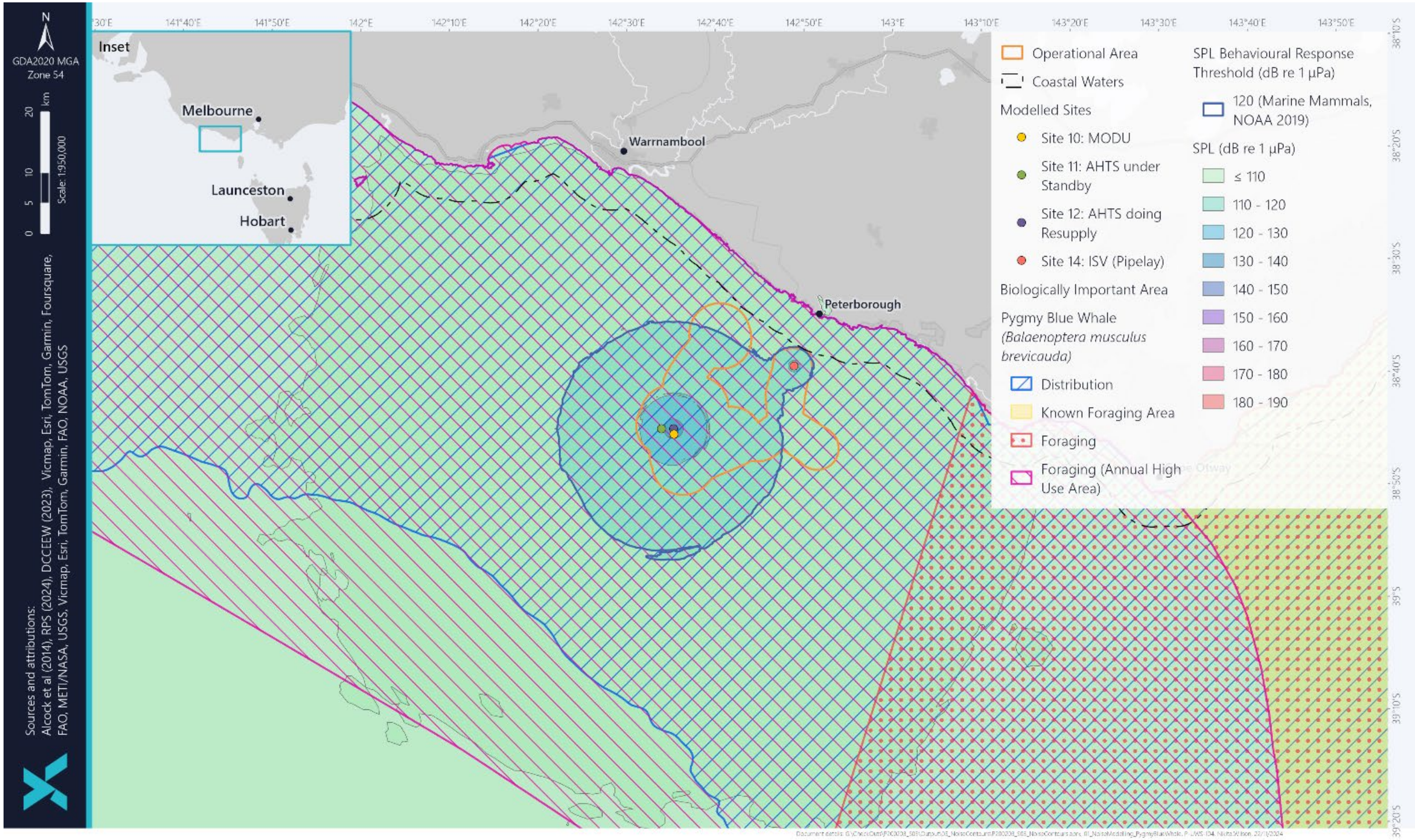


Figure 8-1: Scenario 8: Concurrent Operations Noise EMBA and pygmy blue whale BIAs

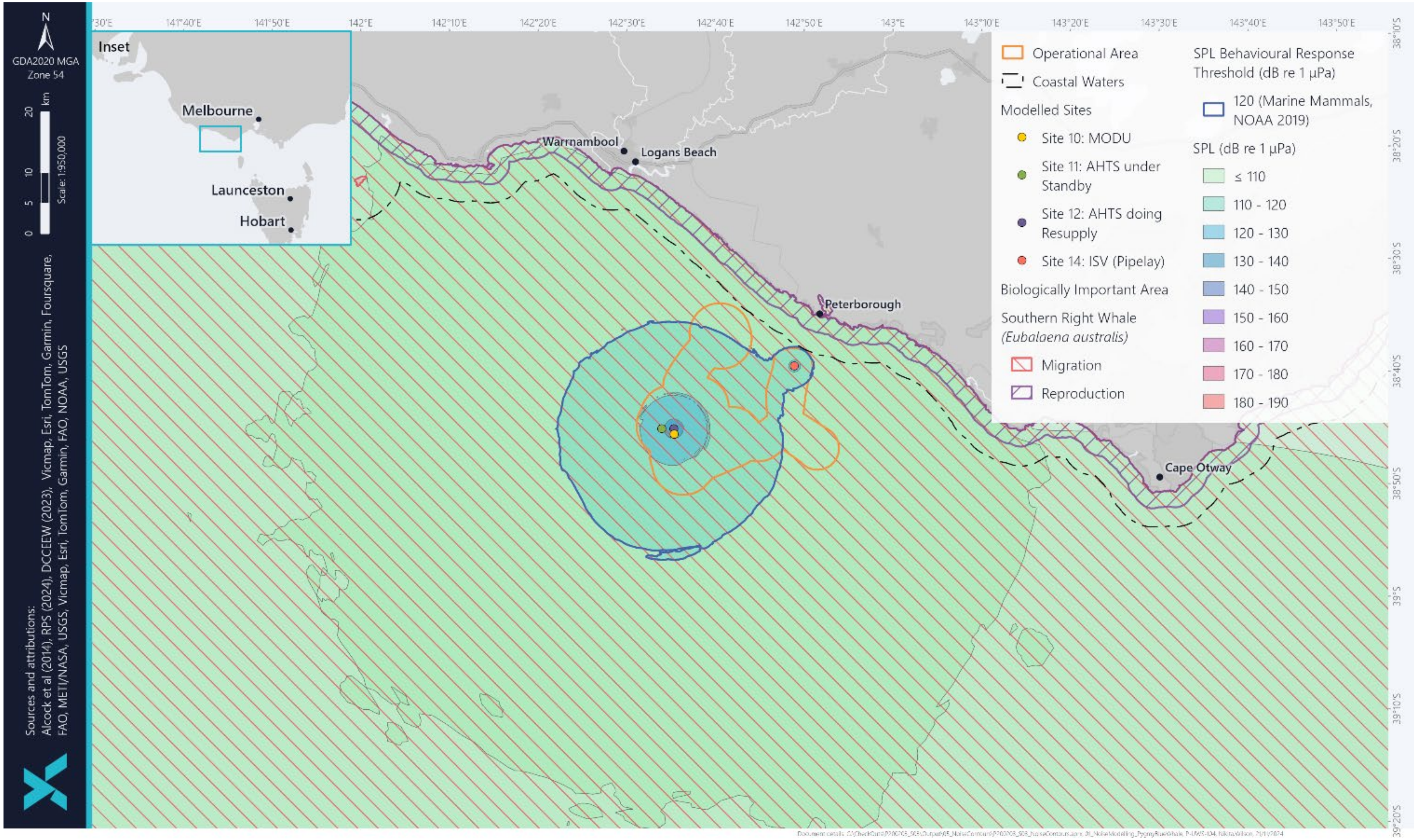


Figure 8-2: Scenario 8: Concurrent Operations Noise EMBA and southern right whale BIAs

In the event that concurrent activities are not occurring; a 22 km radius around the operational area for offshore locations, such as Elanora-1, defines the furthest behavioural EMBA for marine mammals exposed to continuous sounds. For the locations closer to shore, such as Annie-2, an 8 km radius defines the behavioural EMBA for marine mammals.

The difference in sound propagation is due to the differences in substrate compositions found at the nearshore and offshore locations. Connell et al. (2023) describe the difference in the sound attenuation levels for Annie-2 and Elanaora-1 (see Appendix 5). The substrate type which is found at Annie-2, limestone caprock with little sand coverage, has been shown to attenuate sound more than the sandy substrate type that is expected at the Elanora-1 location; the sand coverage above the caprock does not attenuate sound to the same degree as exposed caprock. This effect has also previously been reported by Duncan et al. (2009) and measured recently during drilling operations in the Otway Region (McPherson et al., 2021b). Due to the water depths, proximity to the coastline, and available site-information the nearshore locations, such as Pecten East, Juliet and Nestor, Netherby, and Henry are expected to be analogous of Annie-2 and the offshore locations. Heera and Isabella are assumed to be analogous withElanora-1. Table 8-20 provides details on the presence of marine mammals that are EPBC Act listed. Though there are a range of potential incidental impacts associated with vessel noise, including attraction, avoidance, and changes to vocalisation, the assessment below focuses on the potential behavioural changes which may be detrimental; this informs the inherent consequence level attributed below.

Table 8-20: Inherent Consequence Levels - Continuous Sound - Behavioural Changes to Marine Mammals

Marine mammals (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
Pinnipeds				
New Zealand fur-seal **Australian fur-seal** **Australian sea-lion** EPBC Act listing • Marine (All) • Endangered (Australian Sea-lion)	May occur as per PMST report, however, are considered known to occur based on occurrence records available for the Otway (ALA, 2024) and sightings by marine mammal observers during offshore campaigns (e.g. Seiche Environmental, 2020) No BIAs overlap.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Seals are frequently observed offshore and around vessels; hundreds of sightings of seals were recorded in close proximity to vessels on DP over the course of the BMG Closure Project – Phase 1 in offshore Gippsland during 2024. Marine mammal observers for the project reported behaviours including foraging, milling and swimming.	Despite the conservation status of the Australian sea-lion, because of the insignificance of behavioural change to pinnipeds, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Very High-frequency cetaceans				
Pygmy sperm whale	May occur. No BIAs overlapped.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Minor behavioural changes (avoidance, no response, and attraction) have the potential to occur	Minor local (small, variable, temporary behavioural changes within the behavioural EMBA) impacts or disturbances to fauna.	Level 1
High-frequency cetaceans				
Dolphins (Risso's, dusky, common,	May or likely to occur.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response	Minor local (small, variable, temporary behavioural changes within the behavioural	Level 1

Marine mammals (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
Indian Ocean bottlenose, bottlenose) **Toothed whales (killer, false killer)** EPBC Act listed • Cetacean • Migratory	No BIAs overlapped.	threshold. Dolphins are frequently observed offshore and around vessels; hundreds of sightings of dolphins were recorded in close proximity to vessels on DP over the course of the BMG Closure Project – Phase 1 in offshore Gippsland during 2024. Marine mammal observers for the project reported behaviours including foraging, milling and swimming. Minor behavioural changes (avoidance, no response, and attraction) have the potential to occur.	EMBA impacts or disturbances to fauna.	
Low-frequency cetaceans				
Minke whale EPBC Act listed • Cetacean	May occur. No BIAs overlapped.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Minor behavioural changes (avoidance, no response, and attraction) have the potential to occur.	Minor local (small, variable, temporary behavioural changes within the behavioural EMBA) impacts or disturbances to fauna.	Level 1
Sei whale EPBC Act listed • Vulnerable • Cetacean • Migratory	Likely to occur. No BIAs overlapped.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Minor behavioural changes (avoidance, no response, and attraction) have the potential to occur.	Localized (the behavioural EMBA) and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2
Blue whale EPBC Act listed • Endangered • Cetacean • Migratory	Known to occur. Foraging and distribution BIAs overlapped. During January to June, blue whales migrate through the operational area.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Minor behavioural changes (avoidance, no response, and attraction) have the potential to occur. Change in blue whale song due to presence of ships increasing background noise levels (Melcon et al., 2012). Vocalisations of blue whales may continue in the presence of vessels, however changes in call level and rate may occur (McKenna, 2011). Inferred modification of foraging efficiency because of effects on masking.	The risk of changing blue whale individuals foraging behaviour is not expected to result in population level impacts. There is limited and spatial area (within the behavioural EMBA) potentially affected which is slight compared to the total area available for foraging (Figure 6-44). There are no barriers or potential stressors introduced by the activity which would be expected to have a discernible effect on prey or predator distribution given the natural broad scale and dynamic distribution of both prey and predator. Overall opportunities for foraging would not therefore be expected to	Level 2

Marine mammals (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
			be discernible from inherent variability. The potential impacts to individuals are therefore assessed as localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	
Fin whale EPBC Act listed • Vulnerable • Cetacean • Migratory	Likely to occur. No BIAs overlapped.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Modify song characteristics under increased background noise conditions, and temporary displacement (Castellote et al., 2012).	Localized (the behavioural EMBA) and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2
Pygmy right whale EPBC Act listed • Cetacean • Migratory	May occur. No BIAs overlapped.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Minor behavioural changes (avoidance, no response, and attraction) have the potential to occur.	Minor local (small, variable, temporary behavioural changes within the behavioural EMBA) impacts or disturbances to fauna.	Level 1
Southern right whale EPBC Act listed • Endangered • Cetacean • Migratory	Known to occur. Reproduction and migration BIAs overlapped. During May-June and September-October southern right whales pass through the operational area to move to and from coastal reproduction areas.	Section 8.2.5.2 describes nominal behavioural responses associated with the behavioural response threshold. Potential increase in stress levels and vocal adaptation in response to increased background noise from shipping, inferred from studies of right whales in the northern hemisphere (Parks et al., 2010; Rolland et al., 2012). Note among southern right whale populations in preferred reproduction habitats, vocalisations are low amplitude and relatively infrequent, inferred as a strategy to decrease the risk of acoustically alerting predators (e.g. killer whales) of their presence (DCCEEW 2022s). Disturbance to resting southern right whales nearshore (within preferred calving/resting habitat) has been reported as being triggered by close encounters with humans,	Much of the Australian coastline, particularly within the south-east marine region, has been identified as a reproduction BIA for southern right whale (DCCEEW 2024). The Draft National Recovery plan for the southern right whale (DCCEEW, 2022s) proposes this Reproduction BIAs as habitat critical to the survival of the southern right whale (DCCEEW, 2022a). Noise produced when peak breeding behaviours (i.e. mating calving and nursing) are occurring (May and October) could result in behavioural disturbances to females within the reproduction BIA. Behavioural responses to breeding females, could therefore, affect the body conditions of calving and lactating mothers, subsequently impacting	Level 2

Marine mammals (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
		including surfers (e.g. ABC News, 2023), with mother and calf subsequently travelling 20km within a few hours. As subsea noise generated by surfers is likely to be negligible, this may illustrate disturbance triggers could be both audible and/or visual (i.e. something observed as approaching which results in a threat response). Within Portland Harbour, which resides the Otway region, within the designated Reproduction BIA for southern right whales, and is an active hub for large international merchant ships, there are recurring sightings during the migration and reproduction seasons (ALA, 2024). Noise generated by shipping activities is comparable to the noise generated by vessels likely to be used for the East Coast Project activities (Section 6.4.9). Potential behavioural responses also includes avoidance behaviours by breeding females within the reproductive BIA leading to changes to breeding behaviours. Breeding females are known to have the greatest energy demands due to the energy associated with gestation and lactation (DCCEEW, 2024l). The act to avoid an area could increase the energy requirements of the individual, potentially depleting the finite energy stores, and subsequently the ability to undertake breeding behaviours.	the fitness of the offspring (DCCEEW, 2024l). Noise modelling of various activity scenarios indicates behavioural change thresholds are not exceeded within the reproduction BIA (see Figure 8-2). Evaluation of the sound level contour maps produced for the modelling scenarios (Appendix 4: Figures 7-23) demonstrate that the closest maximum behavioural change threshold to the reproductive BIA is from Scenario 2 (MODU positioning within at Annie-2) which extends 7.87 km from the sound sources. Given the East Coast Project activities are within Cwth waters approximately ~9km from the Reproductive BIA, the noise from the t activities (primarily temporary vessel sourced noise) are therefore not expected to result in a change in behaviour of southern right whales utilising the reproduction BIA. The East Coast Project activities are outside of the preferred reproduction habitat of southern right whales but are within the Migratory BIA which encompasses the majority of the ocean off the southern coasts of Australia (Figure 6-47). Noise from vessels (as may their visible presence) could elicit a behavioural response, such as avoidance. This could increase the energy requirements of whales at a time when their energy budgets are reduced. The activities are not of the nature or scale that could present a barrier to migration and the sound from project vessels	

Marine mammals (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
			would not be expected to significantly alter overall migration distances, which can be multiple thousands of km during the reproduction season (Watson et al., 2021). Logans beach is ~24km from the operational area; no overlap with behavioural disturbance contours from activity vessels is expected to occur considering smaller radii of modelled contours closer to shore, applicable to the shallower well sites, and larger radii of modelled contours further offshore, applicable to the deeper well sites. Relatively slight (if any) adjustments in migratory course around temporary project vessels is not expected to result in population level impacts. The potential impacts to individuals are therefore assessed as localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	
Humpback whale EPBC Act listed • Cetacean • Migratory	Likely to occur. No BIAs overlapped.	Short-term behavioural impacts include alterations of dive patterns, swim speeds, swim orientation, group cohesiveness, behavioural state and changes in acoustic behaviour (Sprogis et al., 2020; Arranz et al., 2021).	Marine Mammal Observers were offshore throughout Cooper Energy's recent BMG subsea wells decommissioning campaign in 2023/24. These activities were completed in the Gippsland basin, offshore Victoria, and are of similar nature and scale to the East Coast Project well construction campaigns. MMOs reported whales near to and approaching vessels whilst on DP, no indications of disturbance were observed. Conservatively, potential impacts to Humpback whales are assessed as Minor local (small, variable, temporary	Level 1

Marine mammals (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of potential consequence	Inherent consequence
			behavioural changes within the behavioural EMBA). Impacts are not expected to result in population level effects.	

Inherent Likelihood

The likelihood of behavioural changes to marine mammals depends on the continuous sound source used, the potential presence of low-frequency cetaceans within the behavioural EMBA as well as the relative sensitivity of different species and individuals.

Sound source levels of underwater continuous sound from hydrocarbon extraction and transport operations is below the behavioural change threshold for marine mammals. As a result, there is no likelihood of behavioural change to marine mammals during hydrocarbon extraction and transport operations.

For the risk event of behavioural changes to marine mammals to occur, the following combination of factors are required:

- Continuous underwater sound emissions (i.e. from drilling operations, MODU operations and / or vessel operations)
- Marine mammals present within the behavioural disturbance range of the of continuous sound source.

Table 8-21 provides details on the frequency of recorded sightings of EPBC Act marine mammals in the Otway Basin to infer presence within the behavioural EMBA, description of likelihood of incidental detrimental behavioural impacts and the resulting inherent likelihood level assessed for each marine mammal species.

Table 8-21: Inherent Likelihood Levels - Continuous Sound - Behavioural Changes to Marine Mammals

Marine Mammals (EPBC Act listing)	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood
Pinnipeds			
• **New Zealand fur-seal** • **Australian fur-seal** • **Australian sea-lion**	May occur as per PMST report, however, are considered known to occur based on occurrence records available for the Otway (ALA, 2024) and sightings by marine mammal observers during offshore campaigns (e.g. Seiche Environmental, 2020) No BIAs overlap.	Fur seals are likely to occur within the behavioural EMBA; however behavioural changes are not certain to happen. Cooper Energy Marine Mammal Observers made hundreds of observations of fur seals proximal to vessels on DP during the BMG Phase 1 wells decommissioning campaign (2023/24). Minor behavioural changes (ranging from avoidance, no response, and attraction) to high-frequency cetaceans could occur. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Very high-frequency cetaceans			
Pygmy sperm whale,	May occur. No BIAs overlap. There are <50 records for pygmy sperm whales across the Otway between 1988 and 2024. None of these	A freak combination of factors would be required for very high frequency cetaceans to be present within the behavioural EMBA during activities generating continuous sound emissions and for noise from the project to have a discernible effect. Any individuals proximal to the activities may or may not alter behaviour.	Remote (E)

Marine Mammals (EPBC Act listing)	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood
	sightings occurred proximal to the East Coast Project operational area.		
High-frequency cetaceans			
• **Dolphins** (Risso's, dusky, common, Indian Ocean bottlenose, bottlenose) • **Toothed whales** (killer, false killer)	May occur. No BIAs overlap. Between 2002 and 2013, 123 aerial surveys recorded 390 dolphin sightings and 83 sightings of toothed whales (Gill et al., 2015).	High-frequency cetaceans are likely to occur within the behavioural EMBA; however behavioural changes are not certain to happen. Cooper Energy Marine Mammal Observers made hundreds of observations of dolphins including, common and bottlenose dolphins, and pilot whales proximal to vessels on DP during the BMG Phase 1 wells decommissioning campaign (2023/24). Minor behavioural changes (ranging from avoidance, no response, and attraction) to high-frequency cetaceans could occur. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Low-frequency cetaceans			
Minke whale	May occur. No BIAs overlap. There are no records of minke whale within the Otway region within the ALA (2024). Between 2002 and 2013, 123 aerial surveys off western Victoria and SA recorded one sighting of a minke whale (Gill et al., 2015).	A freak combination of factors would be required for a minke whale to be present within the behavioural EMBA during activities generating continuous sound emissions, and for noise from the project to have a discernible effect. Any individuals proximal to the activities may or may not alter behaviour. Behavioural change to minke whales is not expected to occur from East Coast Project continuous underwater sound emissions.	Remote (E)
Sei whale	Likely to occur. No BIAs overlapped. The ALA (2024) holds 3 records of sei whales between the Otway and King Island. Between 2002 and 2013, 123 aerial surveys off western Victoria and SA recorded 12 sighting of sei whales (Gill et al., 2015).	A rare combination of factors would be required for a sei whale to be present within the behavioural EMBA during activities generating continuous sound emissions and for noise from the project to have a discernible effect. Any individuals proximal to the activities may or may not alter behaviour. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Blue whale	Known to occur. Foraging and distribution BIAs overlapped. The ALA (2024) holds over 300 records of blue whale sightings between the Otway and King Island between 1990 and 2021; this includes sightings of groups and individuals. Between June 2012 and March 2013, a cetacean survey recorded 120 individual blue whales in the Otway Basin (Origin, 2018).	The risk event could happen when additional factors are present, such that a blue whale is present within the behavioural EMBA during activities generating continuous sound emissions. Blue whales are known to occur within the behavioural EMBA; any individuals proximal to the activities may or may not alter behaviour. Therefore, it is easy to postulate a scenario for the occurrence but considered doubtful.	Possible (C)

Marine Mammals (EPBC Act listing)	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood
Fin whale	Likely to occur. No BIAs overlapped. Between 2002 and 2013, 123 aerial surveys recorded 7 sighting of sei whales off western Victoria and SA (Gill et al., 2015).	A rare combination of factors would be required for a fin whale to be present within the behavioural EMBA during activities generating continuous sound emissions, and for noise from the project to have a discernible effect. Any individuals proximal to the activities may or may not alter behaviour. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Pygmy right whale	May occur. No BIAs overlap. The ALA (2024) holds <15 records of pygmy right whale sightings in the Otway since 1946. Between 2002 and 2013, 123 aerial surveys recorded one sighting of a pygmy right whale (Gill et al., 2015).	A freak combination of factors would be required for a pygmy right whale to be present within the behavioural EMBA during activities generating continuous sound emissions, and for noise from the project to have a discernible effect. Any individuals proximal to the activities may or may not alter behaviour. Behavioural changes to pygmy right whales are not expected to occur from East Coast Project continuous underwater sound emissions.	Remote (E)
Southern right whale	Known to occur. Reproduction and migration BIAs overlapped. The ALA (2024) holds >4000 records of southern right whale sightings in the Otway, with most reported in the years since 1980, with the vast majority of sightings in coastal waters.	The risk event could happen when additional factors are present, such that a southern right whale is present within the behavioural EMBA during activities generating continuous sound emissions. Southern right whales are known to occur within the behavioural EMBA; any individuals proximal to the activities may or may not alter behaviour. Therefore, it is easy to postulate a scenario for the occurrence but considered doubtful.	Possible (C)
Humpback whale	Likely to occur as per PMST report, however, is considered known to occur based on ALA sightings data and in field observations. No BIAs overlap.	The risk event could happen when additional factors are present, such that a blue whale is present within the behavioural EMBA during activities generating continuous sound emissions. Humpback whales are known to occur within the behavioural EMBA; any individuals proximal to the activities may or may not alter behaviour. Therefore, it is easy to postulate a scenario for the occurrence but considered doubtful.	Possible (C)

Inherent Risk Severity

The highest inherent risk severity of behavioural changes to marine mammals from continuous sound emissions is considered **Moderate**.

Table 8-22 lists the inherent risk severity for each marine mammal species.

Table 8-22: Inherent Risk Severity - Continuous Sound - Behavioural Changes to Marine Mammals

Low-frequency cetacean	Inherent consequence level	Inherent likelihood level	Inherent Risk Severity
Pinnipeds			
• **New Zealand fur-seal** • **Australian fur-seal** • **Australian sea-lion**	1	D	**Low**

Low-frequency cetacean	Inherent consequence level	Inherent likelihood level	Inherent Risk Severity
Very high-frequency cetaceans			
• **Pygmy sperm whale**	1	E	**Low**
High-frequency cetaceans			
• **Dolphins** (Risso's, dusky, common, Indian Ocean bottlenose, bottlenose) • **Toothed whales** (killer, false killer)	1	D	**Low**
Low-frequency cetaceans			
Minke whale	1	E	**Low**
Sei whale	2	D	**Low**
Blue whale	2	C	**Moderate**
Fin whale	2	D	**Low**
Pygmy right whale	1	E	**Low**
Southern right whale	2	C	**Moderate**
Humpback whale	1	D	**Low**

8.2.5.3 Risk: Auditory Injury to Marine Mammals

Auditory injury is defined by DCCEEW (formally DAWE, 2021) as both permanent and temporary hearing impairment and any other form of physical harm arising from anthropogenic sources of underwater noise (DAWE, 2021).

Depending on the sound levels received, continuous sound emissions may cause auditory injury to marine mammals, such that:

- Temporary auditory impairment is where an animals hearing threshold is elevated and recoverable over time. This is also referred to as an auditory temporary threshold shift (TTS)
- Permanent auditory impairment is when the hearing threshold is elevated and never recovers. This is also referred to as an auditory permanent threshold shift (PTS)

Modelling of continuous underwater sound sources from the activity (vessel thrusters) predicted the TTS and PTS thresholds for marine mammals was reached within distances listed in Table 8-23 (Connell et al., 2023). TTS and PTS thresholds for marine mammals are based on a cumulative metric that assumes a receptor is consistently exposed to a defined sound exposure level for a 24-hour period (SEL24h). Distances predicted for the onset of TTS and PTS thresholds (SEL24h) listed in Table 8-23 infers that the East Coast Project continuous underwater sound emissions have, in theory, the potential to cause:

- TTS within marine mammals within a maximum range of ~5 km
- PTS within marine mammals within a maximum range of 320 m.

The range where the potential onset of auditory impairment and injury may occur is within the operational area. As a result, the operational area is used to define the potential auditory impairment and injury EMBA for marine mammals.

Table 8-23: Distance to TTS and PTS Thresholds for Marine Mammals

Marine Mammal Hearing Group	Threshold (SEL_{24h}, dB re 1 µPa²·s) (Southall et al., 2019)	Maximum Distance (km)	Relevant Scenario/s
TTS			
Low-frequency cetaceans	179	5.23	Scenario 2: MODU positioning / installation at Elanora-1
High-frequency cetaceans	178	0.16	Scenario 5: Drilling operations with 2 AHTS at Elanora-1 and Annie-2 Scenario 8: Concurrent operations.
Very high-frequency cetaceans	153	1.67	Scenario 5: Drilling operations with 2 AHTS at Elanora-1 and Annie-2 Scenario 8: Concurrent operations.
Otariid Seals (pinnipeds)	199	0.08	Scenario 2: MODU positioning / installation at Annie-2
PTS			
Low-frequency cetaceans	199	0.32	Scenario 2: MODU positioning / installation at Elanora-1
Very high-frequency cetaceans	173	0.24	Scenario 5: Drilling operations with 2 AHTS at Elanora-1 and Annie-2 Scenario 8: Concurrent operations.
High-frequency cetaceans	198	0.05	Scenario 5: Drilling operations with 2 AHTS at Annie-2
Otariid Seals (pinnipeds)	219	0.05	Scenario 5: Drilling operations with 2 AHTS at Annie-2

The exposure criteria identified by Southall et al., (2019) shown in Table 8-33 are based on a cumulative SEL over a period of 24 h. Therefore, the PTS and TTS criteria are only relevant to those receptors that have potential to be within the area of exposure for a period of 24 hours. Subsequently, marine mammals that may be undertaking biologically important activities, such as breeding behaviours (i.e., mating, calving and nursing), foraging, and migrating, which would cause them to remain within the area of exposure for a period of 24 hours or longer have had the PTS and TTS criteria applied in the assessment below.

Table 8-24 provides details on the presence of EPBC Act listed marine mammals within the operational area, potential impairment or injury that may occur and the resulting inherent consequence level for each marine mammal species.

Table 8-24: Inherent Consequence Levels - Continuous Sound - Auditory Impairment or Injury to Marine Mammals

Marine mammals	Presence within behavioural EMBA	Potential auditory impairment or injury	Description of consequence	Inherent consequence
Pinnipeds				
• **New Zealand fur-seal** • **Australian fur-seal** • **Australian sea-lion**	May occur as per PMST report, however, are considered known to occur based on occurrence records available for the	For the onset of TTS and PTS to occur, pinnipeds would need to remain in-water within 80 and 50 m (respectively) of continuous subsea sound sources for 24-hours (Table 8-23). Seals have been observed to dive and stay submerged for up to two	Not credible	Not applicable

Marine mammals	Presence within behavioural EMBA	Potential auditory impairment or injury	Description of consequence	Inherent consequence
	Otway (ALA, 2024) and sightings by marine mammal observers during offshore campaigns (e.g. Seiche Environmental, 2020) No BIAs overlap.	hours (Brix, 2018). Seals will then surface from dives to breath and rest. The longer the dive the longer the surface recovery time required (Brix 2018). It is not credible for seals to remain submerged in-water for 24-hours for the onset of TTS and PTS to occur based on the limited dive duration.		
Very High Frequency Cetaceans				
• **Pygmy sperm whale**	May occur. No BIAs overlap.	For the onset of TTS and PTS to occur, very high-frequency cetaceans would need to remain within 1.67 and 0.24 km of continuous sound sources for 24-hours, respectively (Table 8-23). TTS and PTS values do not incorporate animal movement within the region. Given no BIAs were identified, any individuals present would be transiting through the area, with movements that would likely preclude reaching the range required for auditory impairment and injury to occur. Therefore, it is not credible for very high-frequency cetaceans to remain within 1.67 and 0.24 km of continuous sound sources for 24-hours for the onset of TTS and PTS to occur given the species' oceanic range and highly mobile behaviours. Cooper Energy have observed during the BMG Closure Project – Phase 1 in offshore Gippsland during 2024 dolphins approach DP vessels whilst undertaking foraging behaviours. However, observations indicate that groups and individuals transit quickly through the area, and do not remain in the area long enough for TTS and PTS to occur	Not credible	Not applicable
High-frequency cetaceans				
• **Dolphins** (Risso's, dusky, common, Indian Ocean bottlenose, bottlenose**)** • **Toothed whales** (killer, false killer)	May or likely to occur. No BIAs overlapped.	For the onset of TTS and PTS to occur, high-frequency cetaceans would need to remain within 0.16 and 0.05 km of continuous sound sources for 24-hours, respectively (Table 8-23). TTS and PTS values do not incorporate animal movement within the region. Given no BIAs were identified, any individuals present would be merely transiting through the area, with movements that would	Not credible	Not applicable

Marine mammals	Presence within behavioural EMBA	Potential auditory impairment or injury	Description of consequence	Inherent consequence
		likely preclude reaching the range required for auditory impairment and injury to occur. Therefore, it is not credible for high-frequency cetaceans to remain within 0.16 and 0.05 km of continuous sound sources for 24-hours for the onset of TTS and PTS to occur given the species oceanic range, highly mobile behaviours. Cooper Energy have observed during the BMG Closure Project – Phase 1 in offshore Gippsland during 2024 dolphins approach DP vessels whilst undertaking foraging behaviours. However, observations indicate that groups and individuals transit quickly through the area, and do not remain in the area long enough for TTS and PTS to occur		
Low-frequency cetaceans				
• **Minke whale** • **Sei whale** • **Fin whale** • **Pygmy right whale** • **Humpback whale**	May or likely to occur. No BIAs overlapped.	For the onset of TTS and PTS to occur, low-frequency cetaceans need to remain within 5.23 and 0.32 km of continuous sound sources for 24-hours, respectively (Table 8-23). TTS and PTS values do not incorporate animal movement within the region. Given no BIAs were identified, any individuals present would be merely transiting through the area, with movements that would likely preclude reaching the range required for auditory impairment and injury to occur. For example, previous studies which tracked humpback whales recorded average swimming speeds to range from 2.5 – 4.0 km/h, with some individuals swimming rapidly up to 15.6 km/h (Noad and Cato, 2007). As the operational area does not support habitats that encourage sedentary behaviours given the absence of BIAs in the operational area, individuals are anticipated to move through the TTS zone well before TTS onset. Therefore, it is not credible for minke, sei, fin, pygmy right and humpback whales to remain within 5.23 and 0.32 km of continuous sound sources for 24-hours for the onset of TTS and PTS to occur given the absence of BIAs in the operational area and highly mobile movements outside of foraging and reproduction BIAs.	Not credible	Not applicable
Blue whale	Known to occur.	Despite the overlap with foraging and distribution BIAs, it is not credible for	Not credible	Not applicable

Marine mammals	Presence within behavioural EMBA	Potential auditory impairment or injury	Description of consequence	Inherent consequence
EPBC Act listed • Endangered • Cetacean • Migratory	Foraging and distribution BIAs overlapped. During January to June, Blue Whales migrate through the operational area.	blue whales to remain within 5.23 and 0.32 km of continuous sound sources for 24-hours for the onset of TTS and PTS to occur based on the following reasons: A type of foraging behaviour (observed in tagged blue whales) involving area restricted searches (ARS) was reported by Bailey et al. (2009). The area that the ARS occurred over ranged from 10 km up to 360 km in radius. Owen et al. (2016) also reported on ARS occurring across an area of 220 km^2 for a satellite tagged blue whale on the west coast of Australia. The maximum project TTS contours cover an area of <20 km^2. Therefore if ARS were to occur it could be expected to extend well beyond any project TTS contour and preclude the onset of TTS. If whales were to stop and feed within the TTS zone to feed on a discrete patch of krill for >24 hours, the movement of plankton (and krill) with the currents would move the feeding zone passively through the TTS zone before TTS onset. Minimum average currents in the operational area are around 0.15 m/s in April (RPS, 2024). A discrete patch of krill moving with the plankton (and therefore the current) would move at 540 m/h, moving through the TTS zone well before TTS onset. Blue whales have been recorded swimming at mean speeds of 2.8 km/hr +/- 2.2 km/hr whilst migrating and foraging (Owen, Jenner and Jenner, 2016) or faster (Möller et al., 2020). Accounting for swimming speeds across this range, a whale would be expected to move through any TTS zone associated with the project well before TTS onset. Recent activities within the Otway have overlapped pygmy blue whale foraging periods and blue whales were observed during the activity. Reported behaviours were in line with published information on foraging behaviours and movements, that is, blue whales were not stationary for extended periods of time, or significantly restricted in their range, and were never considered to be at risk of TTS (MMO observation data, comms Beach Energy, 2022).		

Marine mammals	Presence within behavioural EMBA	Potential auditory impairment or injury	Description of consequence	Inherent consequence
Southern right whale EPBC Act listed • Endangered • Cetacean • Migratory	Known to occur. Migration BIAs overlapped. During May-June and September-October southern right whales pass through the operational area to move to and from coastal reproduction areas.	Despite the overlap with the migration BIA, it is not credible for southern right whales to remain within 5.23 km and 0.32 km of continuous sound sources for 24-hours for the onset of TTS and PTS to occur based on the following reasons: TTS and PTS values do not incorporate animal movement (necessary for migration) which prevent Southern Right Whales reaching the range required for auditory impairment and injury to occur. Southern right whales are highly mobile species and are known to move throughout the region. Connecting range movements will prevent southern right whales to remain within the range for over 24-hours required for auditory impairment and injury to occur. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (DSEWPaC, 2012a). There is limited research on the swimming speeds of southern right whales. However, tagging studies conducted on the comparable North Atlantic right whale (a species in the same family as the southern right whale) recorded average swimming speeds of ~1.2 – 1.8 km/h across all activity types, including females with calves. The fastest swimming speed recorded for a migrating adult individual was 5.4 km/h (Hain et al., 2013). The operational area and TTS/PTS contours of the activity do not overlap the reproductive BIA (HTCS) or preferred calving/nursing habitat for southern right whales (<10 m water depth and within 1 km of shore) (DCCEEW, 2024l). There is no evidence of high-site fidelity for southern right whales within the operational area, or within the TTS or PTS radii of the activity, as a result, southern right whales, that may occur in the vicinity of the activity, would be expected to be migrating through the area before auditory impairment / injury can manifest. Logans beach (calving area) is ~24km from the operational area and does not overlap PTS or TTS contours from the activity.	Not credible	Not applicable

Details in Table 8-24 suggests that the presence of marine mammals for extended (≥24 hour) periods, and consistently within close proximity to continuous sound sources will not occur.

Inherent Likelihood

Not applicable.

Inherent Risk Severity

Not applicable.

8.2.5.4 Risk: Change in Fauna Behaviour - Marine Turtles

Inherent Consequence Evaluation

Continuous sound emissions may cause behavioural changes to marine turtles depending on the distance between individual turtles and a continuous sound source. Relative risk criteria proposed by Popper et al. (2014) suggests that continuous sound sources have a high chance of causing behavioural change to turtles within the near (tens of metres), and a moderate chance within the intermediate (hundreds of metres), vicinity of a sound source. The relative risk reduces to a low chance of behavioural change within the far (thousands of metres) vicinity of a sound source (Popper et al., 2014). This infers that the East Coast Project continuous underwater sound emissions have the potential to cause behavioural changes to turtles. Though there is some small inherent uncertainty in defining behavioural effects to the exact meter; additional effort to characterise the effect radius is not considered warranted given the low sensitivity of marine turtle species and their populations to noise from the project.

The operational area is used as a conservative behavioural EMBA for turtles exposed to continuous sounds. Table 8-25 provides details on the presence of EPBC listed turtles within the operational area, potential behavioural changes that may occur and the resulting inherent consequence level for each turtle species.

Table 8-25: Inherent Consequence Levels - Continuous Sound - Behavioural Changes to Marine Turtles

Turtle (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of consequence	Inherent consequence
Loggerhead turtle EPBC Act listed • Endangered • Marine • Migratory	Likely to occur. No BIAs overlapped.	Increase swimming speeds, and induce diving inferred from studies of other turtle species.	Localized (high chance within tens of metres from the source) and short-term impacts to species of recognized conservation value not affecting local ecosystem function. As there are no BIAs for the species within the temperate south east region, only small numbers (if any) may occur in the area over the life of the project. No discernible effects are expected.	Level 1
Green turtle EPBC Act listed • Vulnerable • Marine • Migratory	May occur. No BIAs overlapped.	Observed green turtles flee (increase swim speed and induce diving) from approaching vessels travelling at speeds less than 4 m/s in open waters (Hazel et al., 2007).	Localized (high chance within tens of metres from the source) and short-term impacts to species of recognized conservation value not affecting local ecosystem function. As there are no BIAs for the species within the temperate south east region, only small numbers (if any) may occur	Level 1

Turtle (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of consequence	Inherent consequence
			in the area over the life of the project. No discernible effects are expected.	
Leatherback turtle EPBC Act listed • Endangered • Marine • Migratory	Likely to occur. No BIAs overlapped.	Increase swimming speeds, and induce diving inferred from studies of other turtle species.	Localized (high chance within tens of metres from the source) and short-term impacts to species of recognized conservation value not affecting local ecosystem function. As there are no BIAs for the species within the temperate south east region, only small numbers (if any) may occur in the area over the life of the project. No discernible effects are expected.	Level 1

Inherent Likelihood

The likelihood of behavioural changes to turtles depends on the temporal overlap of the potential presence of turtles whilst continuous sound sources are in the operational area, and the sensitivity of different species and individuals to noise.

For a high chance of the risk event of behavioural changes to turtles to occur, the following combination of factors are required:

- Drilling operations, support vessel operations (vessel noise)
- Turtles present within tens of metres of continuous sound source.

Table 8-26 provides details on the frequency of recorded sighting of EPBC Act listed turtles in the Otway Basin to infer presence within the operational area, description of likelihood and the resulting inherent likelihood level for each turtle species.

Table 8-26: Inherent Likelihood Levels - Continuous Sound - Behavioural Changes to Marine Turtles

Turtle	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
Loggerhead turtle	Likely to occur. No BIAs overlapped. The Victorian Biodiversity Atlas (VBA) showed no observations or occurrences of loggerhead turtles in the operational area (Victorian Department of Environment, Land, Water and Planning, 2023).	A rare combination of factors would be required for a loggerhead turtle to be present within the operational area during activities generating continuous sound emissions. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Green turtle	May occur. No BIAs overlapped. The VBA showed no observations or occurrences of green turtles in the behavioural EMBA (Victorian Department of Environment, Land, Water and Planning, 2023).	A freak combination of factors would be required for a green turtle to be present within the operational area during activities generating continuous sound emissions. Behavioural changes to green turtles are not expected to occur from East Coast Project continuous underwater sound emissions.	Remote (E)
Leatherback turtle	Likely to occur. No BIAs overlapped. The VBA showed no observations or occurrences of leatherback turtles in the behavioural EMBA (Victorian Department of Environment, Land, Water and Planning, 2023).	A rare combination of factors would be required for a leatherback turtle to be present within the operational area during activities generating continuous sound emissions. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)

Inherent Risk Severity

The highest inherent risk severity of behavioural changes to turtles from continuous sound emissions is Low.

Table 8-27 lists the inherent risk severity for each turtle.

Table 8-27: Inherent Risk Severity - Continuous Sound - Behavioural Changes to Marine Turtles

Turtle	Inherent consequence level	Inherent likelihood level	Inherent Risk Severity
Loggerhead turtle	1	D	**Low**
Green turtle	1	E	**Low**

Leatherback turtle	1	D	**Low**

8.2.5.5 Risk: Auditory Injury to Marine Turtles

Inherent Consequence Evaluation

Depending on the sound levels received, continuous sound emissions may cause auditory injury to turtles from the onset of TTS and PTS, respectively.

Underwater sound modelling predicted the continuous TTS and PTS thresholds for turtles was reached within distances listed in Table 8-28 (Finneran et al., 2017; Connell et al., 2023). TTS and PTS thresholds for turtles are based on SEL24h which assumes a turtle is consistently exposed threshold levels for a 24-hour period. Distances predicted for the onset of TTS and PTS thresholds (SEL24h) listed in Table 8-28 infers East Coast Project continuous underwater sound emissions have the potential to cause:

- Potential TTS to turtles within 290 m.
- Potential PTS to turtles within 50 m.

The EMBA for turtles exposed to continuous sounds is small (290 m radius from the noise source that can operate throughout the operational area).

Table 8-28: Distance to TTS and PTS Threshold for Marine Turtles

Threshold Type	Threshold (SEL_{24h}, dB re 1 µPa²·s) (Finneran et al. 2017)	Maximum Distance (km)	Relevant Scenario/s
TTS	200	0.29	Scenario 5: Drilling operations with 2 AHTS at Annie-2
PTS	220	0.05	Scenario 2: MODU positioning / installation at Elanora-1

It is not credible for turtles to remain within 290 and 50 m of continuous sound sources for 24-hours for the onset of TTS and PTS to occur given the absence of BIAs in the operational area and wider south-east marine region. Any individuals which do occur within the area would be migrating and likely on the move. As such, auditory injury to turtles from East Coast Project continuous sound emissions is not evaluated further.

Inherent Likelihood

Not applicable.

Inherent Risk Severity

Not applicable.

8.2.5.6 Risk: Change in Fauna Behaviour - Fish

Inherent Consequence Evaluation

Continuous sound emissions may cause behavioural changes to fish including eggs and larvae depending on the distance between fish and a continuous sound source. Relative risk criteria proposed by Popper et al. (2014) suggests a moderate risk of behavioural change to fish with no swim bladders, or those with bladders not involved in hearing, or to fish eggs or larvae, within the near (tens of metres) and intermediate (hundreds of metres) vicinity of a sound. Whereas fish with swim bladders involved in hearing have a high risk of behavioural change within the near (tens of metres), and a moderate chance within the intermediate (hundreds of metres) vicinity of a sound (Popper et al., 2014).

There is risk of change in fish behaviour within hundreds of metres of vessels operating within the operational area. As a conservative approach to identify fish BIAs and habitats the operational area is used as a conservative behavioural EMBA for fish including eggs and larvae exposed to continuous sounds. Table 8-29 provides details on the presence of fish species that are EPBC listed within the behavioural EMBA, potential behavioural changes that may occur and the resulting inherent consequence level for each fish species.

Table 8-29: Inherent Consequence Levels - Continuous Sound - Behavioural Changes to Fish

Fish (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of consequence	Inherent consequence
White shark EPBC Act listed • Vulnerable • Migratory	Known to occur. BIA overlapped. Seasonal presence in southern Australia during early summer.	No detectable relationship between vessel activity and shark residency for any species. This observation infers habituation of sharks to high levels of vessel activity (Rider et al., 2021). Anthropogenic underwater sounds may trigger investigative or aversive behaviour in some species of shark (Chapius et al., 2019). No significant behavioural change to sharks from continuous sound is anticipated.	Despite the conservation status of the white shark, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
School shark EPBC Act listed • Critically endangered	May occur. No BIAs overlapped.	No detectable relationship between vessel activity and shark residency for any species. This observation infers habituation of sharks to high levels of vessel activity (Rider et al. 2021). No significant behavioural change to sharks from continuous sound is anticipated.	Despite the conservation status of the school shark, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Shortfin mako EPBC Act listed • Migratory	Likely to occur. No BIAs overlapped.	No detectable relationship between vessel activity and shark residency for any species. This observation infers habituation of sharks to high levels of vessel activity (Rider et al., 2021). No significant behavioural change to sharks from continuous sound is anticipated.	Minor local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Mackerel shark EPBC Act listed • Migratory	Likely to occur. No BIAs overlapped.	No detectable relationship between vessel activity and shark residency for any species. This observation infers habituation of sharks to high levels of vessel activity (Rider et al., 2021). No significant behavioural change to sharks from continuous sound is anticipated.	Minor local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1

Fish (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of consequence	Inherent consequence
Australian grayling EPBC Act listed • Vulnerable	May occur. No BIAs overlapped.	Vessels can change fish behaviour (e.g., induce avoidance, alter swimming speed and direction, and alter schooling behaviour) (Popper et al., 2014).	Despite the conservation status of the Australian grayling, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Blue warehou EPBC Act listed • Critically endangered	Known to occur. No BIAs overlapped.	Vessels can change fish behaviour (e.g., induce avoidance, alter swimming speed and direction, and alter schooling behaviour) (Popper et al., 2014).	Despite the conservation status of the blue warehou, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Southern bluefin tuna EPBC Act listed • Conservation dependent	Likely to occur. No BIAs overlapped.	Vessels can change fish behaviour (e.g., induce avoidance, alter swimming speed and direction, and alter schooling behaviour) (Popper et al., 2014).	Despite the conservation status of southern bluefin tuna, because of the insignificance of behavioural change, the consequence is considered minor and local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Pipefish, pipehorse, seadragon and seahorse species EPBC Act listed • Marine	May occur. No BIAs overlapped.	A study on seahorses in an aquarium found loud ambient noise to result in behavioural responses (Anderson et al., 2011). Noise from vessels may also be a disturbance to syngnathidae fish (Reef Watch 2014). Based on these observations, it is inferred that vessels can change syngnathidae fish behaviour (e.g., induce avoidance, alter swimming speed and direction, and alter schooling behaviour) (Popper et al., 2014).	Minor local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1
Short-finned eels **Culturally significant to First Nations people (Koster et al., 2021)**	Seasonal presence in the Otway Basin and Bass Strait during spawning migration i.e. downstream	A study on Anguillid eels under experimental conditions demonstrated that acoustic stimuli induced behavioural avoidance (increased swimming, speed and	Minor local (small, variable, temporary behavioural changes within tens of metres of the source) impacts or disturbances to fauna.	Level 1

Fish (EPBC Act listing)	Presence within behavioural EMBA	Potential behavioural changes	Description of consequence	Inherent consequence
	migration of adult eels during late summer and autumn. Upstream migration of larvae and glass eels, where glass eels enter estuaries during mid-winter to late spring (VFA, 2022a).	movements away from the source) in some European eel and river lamprey (Deleau et al., 2019).		

Inherent Likelihood

The likelihood of behavioural changes to fish including eggs and larvae depends on the temporal overlap of the potential presence of fish with continuous sound sources in the operational area, and the sensitivity of the species and individual.

For a moderate chance of the risk event of behavioural changes to fish to occur, the following combination of factors are required:

- Continuous underwater sound emissions (i.e. from drilling operations, MODU operations and / or vessel operations) where fish are present within tens of metres of continuous sound source.

Table 8-30 provides details on the frequency of recorded sighting of EPBC listed fish in the Otway Basin to infer presence within the behavioural EMBA, description of likelihood and the resulting inherent likelihood level for each fish species.

Table 8-30: Inherent Likelihood Levels - Continuous Sound - Behavioural Changes to Fish

Fish	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
White shark	Known to occur. BIA overlapped.	The risk event could happen when additional factors are present, such that a white shark is present within the behavioural EMBA during drilling and support operations. White sharks are known to occur within the behavioural EMBA; therefore, it is easy to postulate a scenario for the occurrence but considered doubtful. Expected to occur once during the East Coast Project.	Possible (C)
School shark	May occur. No BIAs overlapped.	A freak combination of factors would be required for a school shark to be present within the behavioural EMBA during activities generating continuous sound emissions, and which result in the onset of discernible behavioural changes. Behavioural changes to school sharks are not expected to occur from East Coast Project continuous underwater sound emissions.	Remote (E)
Shortfin mako	Likely to occur. No BIAs overlapped.	A rare combination of factors would be required for a shortfin mako to be present within the behavioural EMBA during activities generating continuous sound emissions and which result in the onset of discernible behavioural changes. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Mackerel shark	Likely to occur.	A rare combination of factors would be required for a mackerel shark to be present within the behavioural	Unlikely (D)

Fish	Presence within behavioural EMBA	Description of likelihood	Inherent likelihood level
	No BIAs overlapped.	EMBA during activities generating continuous sound emissions, and which result in the onset of discernible behavioural changes. The risk event is considered conceivable and could occur at some time during the East Coast Project.	
Australian grayling	May occur. No BIAs overlapped.	A freak combination of factors would be required for an Australian grayling to be present within the behavioural EMBA during activities generating continuous sound emissions, and which result in the onset of discernible behavioural changes. Behavioural changes to the Australian grayling are not expected to occur from East Coast Project continuous underwater sound emissions.	Remote (E)
Blue warehou	Known to occur. No BIAs overlapped.	The risk event could happen when additional factors are present, such that a blue warehou is present within the behavioural EMBA during activities generating continuous sound emissions. Blue warehou are known to occur within the behavioural EMBA; therefore, it is easy to postulate a scenario for the occurrence but considered doubtful.	Possible (C)
Southern bluefin tuna	Likely to occur. No BIAs overlapped.	A rare combination of factors would be required for southern bluefin tuna to be present within the behavioural EMBA during activities generating continuous sound emissions, and which result in the onset of discernible behavioural changes. The risk event is considered conceivable and could occur at some time during the East Coast Project.	Unlikely (D)
Pipefish, pipehorse, seadragon and seahorse species	May occur. No BIAs overlapped.	A freak combination of factors would be required for syngnathidae to be present within the behavioural EMBA during activities generating continuous sound emissions, and which result in the onset of discernible behavioural changes. Behavioural changes to syngnathidae are not expected to occur from East Coast Project continuous underwater sound emissions.	Remote (E)
Short-finned eels **Culturally significant to First Nations people (Koster et al., 2021)**	Seasonal presence in the Otway Basin and Bass Strait during spawning migration i.e. downstream migration of adult eels during late summer and autumn. Upstream migration of larvae and glass eels, where glass eels enter estuaries during mid-winter to late spring (VFA, 2022a).	The risk event could happen when additional factors are present, such that short-finned eels as adults during downstream spawning migration or as larvae / glass eels during upstream spawning migration is present within the behavioural EMBA during drilling and support operations. Short-finned eels are known to occur within the behavioural EMBA; therefore, it is easy to postulate a scenario for the occurrence but considered doubtful.	Possible (C)

Inherent Risk Severity

The highest inherent risk severity of behavioural changes to fish including eggs and larvae from continuous sound emissions is **Low**.

Table 8-31 lists the inherent risk severity for each EPBC Act listed fish.

Table 8-31: Inherent Risk Severity- Continuous Sound - Behavioural Changes to Fish

Fish	Inherent consequence level	Inherent likelihood level	Inherent Risk Severity
White shark	1	C	**Low**
School shark	1	E	**Low**
Shortfin mako	1	D	**Low**
Mackerel shark	1	D	**Low**
Australian grayling	1	E	**Low**
Blue warehou	1	C	**Low**
Southern bluefin tuna	1	D	**Low**
Pipefish, pipehorse, seadragon and seahorse species	1	E	**Low**
Short-finned eels	1	C	Low

8.2.5.7 Risk: Auditory Injury to Fish

Inherent Consequence Evaluation

Depending on the sound levels received, continuous sound emissions may cause auditory injury to fish including eggs and larvae from the onset of TTS and recoverable injury, respectively.

Underwater sound modelling predicted the continuous TTS and recoverable injury thresholds for fish including eggs and larvae was reached within distances listed in Table 8-32 (Popper et al., 2014; Connell et al., 2023). TTS threshold for fish is based on SEL12h which assumes a fish is consistently exposed threshold levels for a 12-hour period. Whereas recoverable injury thresholds for fish are based on SEL48h which assumes a fish is consistently exposed threshold levels for a 48-hour period. Distances predicted for the onset of TTS and recoverable injury thresholds listed in Table 8-32 infers East Coast Project continuous underwater sound emissions have the potential to cause:

- Potential TTS to fish within 40 m.
- Potential recoverable injury to fish within 130 m.

A 130 m buffer at proposed well locations and associated flowline routes defines the impairment and injury EMBA for fish exposed to continuous sounds.

Table 8-32: Distance to TTS and PTS Thresholds for Fish

Threshold Type	Threshold (Popper et al., 2014)	Maximum Distance (m)	Relevant Scenario/s
TTS	158 dB SPL for 12 hours	40	Scenario 5: Drilling operations with 2 AHTS at Annie-2
Recoverable injury	170 dB SPL for 48 hours	130	Scenario 5: Drilling operations with 2 AHTS at Annie-2

It is not credible for fish to remain within 40 and 130 m of continuous sound sources for 48-hours and 12-hours for the onset of TTS and recoverable injury, respectively. The impairment and injury EMBA does not support habitats that encourage site fidelity for fish including eggs and larvae. As such, auditory impairments or injuries to fish from East Coast Project continuous sound emissions is not evaluated further.

Inherent Likelihood

Not applicable.

Inherent Risk Severity

Not applicable.

8.2.6 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-33.

Table 8-33: Continuous Sound Emissions Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Impact: Change in ambient sound	Consequence: Level 1
	Risk: Change in fauna behaviour	Risk: Moderate – marine mammals Risk: Low – marine reptiles Risk: Low – fish
	Risk: Auditory impairment (masking, TTS, recoverable injury), or auditory injuries (mortality or potential mortal injuries, PTS) to marine fauna	N/A
Principles of ESD	A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Impacts and risks from underwater sound emissions – continuous was identified as: • Level 1 consequence for change in ambient sound • Low to moderate risk for change in fauna behaviour. The above predicted levels of impact and risk due to underwater sound emissions – continuous from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology and the Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process. Specialist modelling was conducted, tailored to this particular area of the Otway. This modelling factored in the specific attenuation characteristics of the seabed in this area, which have been measured in situ in this region; these studies reduce uncertainty around the potential extent of noise EMBAs.	

	• The highest consequence ranking for continuous underwater sound emissions was evaluated as Level 2, specifically for marine mammals, and the highest inherent risks for continuous underwater sound emissions was evaluated as Moderate; therefore, continuous underwater sound emissions from the East Coast Project will not result in serious or irreversible environmental damage. • There is scientific uncertainty with regards to swimming speeds of southern right whales. The impact evaluation uses swimming speeds of the southern right whale's northern counterpart, the North Atlantic right whale, to infer southern right whale swimming speeds. The southern right whale and Northern Atlantic right whale are comparable species given both are right whales of the genus *Eubalaena* and share the same characteristics of being found close to shore and are slow swimming (Best et al., 2001; IWC, 2024). The uncertainty relating to southern right whale swimming speeds does not affect the predictions of environmental impacts and risks and the anticipated effectiveness of management measures in controlling the impacts and risks. The use of comparable data to predict environmental impacts is considered appropriate and acceptable given the National Recovery Plan for the Southern Right Whale also uses comparable data of other whale species to define potential impacts, such as behavioural responses of humpback whales from vessels infers there is potential disturbance to southern right whales from vessels, (DCCEEW, 2024). • There is a broad set of literature on the subject of underwater noise; whilst there remain some uncertainties as to exactly how and when individual whales may react to noise of different sources, the potential population level effects from impulsive noise are able to be relatively well characterised through existing knowledge of species distribution and population studies overlayed with published literature on impact thresholds, and site specific modelling. • The potential impacts and risks from continuous underwater sound emissions are well-understood, and management measures are well established and regulated in Australian waters.		
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest inherent risks for continuous underwater sound emissions was evaluated as Moderate and therefore will not forego the health, diversity and productivity of the environment for future generations through protection of environmental values. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.2.7). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.		
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant environmental values and sensitivities to continuous underwater sound emissions were evaluated in Section 8.2.5 and the highest inherent risk for continuous underwater sound emissions was evaluated as Moderate. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.2.7). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained through protection of the values of the Commonwealth Marine Area as per the objectives of bioregional plans.		
Legislative and Other requirements	**Requirement**	**Relevant Objective / Action**	**Demonstration of Requirement**
	EPBC Regulations 2000 – Part 8 Division	<u>Objective:</u> Ensure whales and dolphins are not harmed during	

	8.1 interacting with cetaceans	offshore interactions with vessels. Management action: Vessels adhere to the distances and vessel management practices of EPBC Regulations (Part 8) with increased caution zone of 500 m between whales and project vessels.	Adoption of the following control measures: CM1: Marine Assurance Process CM2: Offshore Operational Procedures CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process
	Blue Whale Conservation Management Plan 2015 – 2025 (2015)	Recovery objective: Minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 4: Anthropogenic threats are demonstrably minimised. Management action A.2.2: Assessing the effect of anthropogenic noise on blue whale behaviour. Section 8.2.5.3 assesses the effects of anthropogenic noise from the East Coast Project on blue whale behaviour. Management action A.2.3: Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area. The Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process provides details on level of whale observation effort, triggers for actions and the actions to be taken to manage potential impacts to endangered whales with BIA's in the region (blue whales and southern right whales). Management Action A.2.3 will be implemented in accordance with DAWE guidance on key terms (2021), where the action is needed to achieve the objective of the Blue Whale Conservation Management Plan. This will involve: Application of realistic conservative criteria including suitable thresholds to establish parameters for impact and risk assessment. Actions and adaptive management measures, as detailed in the Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process, will be implemented for vessel activities to reduce the	

		risk of blue whale injury and/or displacement.	
	National Recovery Plan for the Southern Right Whale (DCCEEW, 2024l)	Long term recovery objective: is that the population has increased in size to a level that the conservation status has improved, and the species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria. Interim Objective 2: Anthropogenic threats are managed consistent with ecologically sustainable development principles to facilitate recovery of southern right whales. Management action A.5: Assess, manage, and mitigate impacts from anthropogenic noise. Management action A.5.2: Actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that it does not prevent any southern right whale from utilising the area or cause auditory impairment. Management action A.5.3: Actions within and adjacent to southern right whale BIAs and HCTS should demonstrate that the risk of behavioural disturbance is minimised. Actions and adaptive management measures, as detailed in the Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process, will be implemented for vessel activities to reduce the risk of southern right whale impacts from anthropogenic noise.	
	Conservation Advice *Balaenoptera borealis* Sei Whale (TSSC, 2015e)	Identifies anthropogenic noise acoustic disturbance as a minor threat. No relevant management actions.	
	Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC, 2015f)	Identifies anthropogenic noise acoustic disturbance as a minor threat. No relevant management actions.	
	Listing Advice *Megaptera novaeangliae* Humpback Whale (TSSC, 2022)	Identifies anthropogenic noise as a concern. No relevant management actions.	
	Recovery plan for marine turtles in Australia 2017–2027	<u>Recovery objective</u>: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they	

		can be removed from the EPBC Act threatened species list. <u>Interim objective 3</u>: Anthropogenic threats are demonstrably minimised. No relevant management actions.	
	Recovery Plan for the White Shark (*Carcharodon carcharias*) 2013	<u>Recovery objective</u>: Ensure that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future. No relevant management actions.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	Cooper Energy has previously sought advice from the Australian Antarctic Division (AAD) in relation to the management of impacts from noise. The consultation outcomes are presented within the BMG Closure Project Phase 1 EP (NOPSEMA ID: 6825) and are not repeated here. The AAD advice has informed the assessment and definition of management measures for the ECP such as adjusting processes within MS09 to consider vessel noise during tendering, development of a Whale Disturbance Risk Management Process and within that, the allocation of dedicated marine mammal observers and shut-down criteria for particular activities.		
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to continuous sound emissions is AL5, AL10 and AL11 identified in Table 8-34. These acceptable levels defined for a change in ambient underwater sound, a change in fauna behaviour and auditory injury are defined in Table 7.6. The worst-case predicted impacts assessed in Section 8.2.5 are: • Change in ambient sound from continuous underwater sound emissions is limited to the intermittent and short-term presence of support operation activities and drilling operations. The longest duration the MODU may be present at each well location is ~60 days, during well construction. Outside of drilling, ISVs and/or support vessels may be in the operational area for ~45 days at a time. Whereas, up to 4 vessels undertaking drilling activities or concurrent activities can be on site for up to ~180 days. Ambient underwater sound levels are expected to immediately return to existing levels following completion of support operation activities and drilling operations. • Highest consequence for behavioural changes from continuous underwater sound emissions is for marine mammals. Despite having the highest consequence, the risk of behavioural changes to marine mammals are localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function, with no population level effects. • The behavioural EMBA overlaps reproduction and migration BIAs for the southern right whale. Noise modelling of various activity scenarios indicates behavioural change thresholds are not exceeded within the reproduction BIA for southern right whales. Potential impacts are slight (if any) changes to migratory course around temporary project vessels. • The behavioural EMBA overlaps a foraging BIA for blue whales. Overall opportunities for foraging are not expected to be discernible from inherent variability. • For marine mammals, turtles or fish it is unlikely they would remain within the distances of continuous sound sources for 24-hours for the onset of TTS and PTS to occur. As such, auditory injury to marine fauna from East Coast Project continuous sound emissions are not credible and not evaluated further.		

	• The highest consequence ranking for behavioural changes from continuous underwater sound emissions was evaluated as Level 2, specifically for marine mammals, and the highest inherent risks for continuous underwater sound emissions was evaluated as Moderate (blue whale and southern right whale). The highest inherent risks for marine turtles and fish were evaluated as Low. Therefore, at its worst-case, the predicted impact from continuous sound emissions would not: • Modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Lead to loss of habitat critical to the survival of species. Therefore, the predicted levels of impact and risk due to continuous sound emissions from the East Coast Project are equal to or better than the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to continuous sound emissions are acceptable, based on: • Predicted levels of impact (evaluated in Section 8.2.5) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • Relevant historical feedback from stakeholders (AAD) for activities of similar nature and scale to the East Coast Project has been used to inform mitigation measures. To manage impacts to receptors to at or below the defined acceptable levels the following EPOs have been applied: **EPO5**: Impacts to ambient sound from underwater sound emissions associated with the activity vessels and survey equipment will be limited to intermittent and short-term changes. **EPO10:** Impacts to marine fauna from noise emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts. **EPO11**: Activities do not cause displacement of any blue whale from a foraging area. **EPO12**: Activities do not prevent any southern right whale from utilising a migration BIA or HCTS. **EPO13:** The risk of behavioural disturbance to southern right whales inside and adjacent to BIAs and HCTS and is minimised. **EPO17:** Any whale can continue to utilise the area without injury (PTS or TTS).

8.2.7 Environmental Performance

Table 8-34 lists the acceptable level and EPO defined for continuous sound emissions and the adopted control measures to achieve the outcome.

Table 8-34: Environmental Performance Summary – Continuous sound emissions

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL5: Impacts to ambient sound from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity.	**EPO5:** Impacts to ambient sound from underwater sound emissions associated with the activity vessels and survey equipment will be limited to intermittent and short-term changes.	CM1: Marine Assurance Process Power generation and propulsion systems on vessels will be operated in accordance with manufacturer's instructions and ongoing maintenance in accordance with vessel planned maintenance system, to ensure efficient operation.

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL10: Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species.	**EPO10:** Impacts to marine fauna from noise emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts **EPO11**: Activities do not cause displacement of any blue whale from a foraging area. **EPO12**: Activities do not prevent any southern right whale from utilising a migration BIA or HCTS. **EPO13:** The risk of behavioural disturbance to southern right whales inside and adjacent to BIAs and HCTS is minimised. **EPO17:** Any whale can continue to utilise the area without injury (PTS or TTS).	CM2: Offshore Operational Procedures All helicopters and vessels will adhere to the distances and vessel management practices of EPBC Regulations (Part 8 Division 8.1 interacting with cetaceans).
		CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process The Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process acknowledges legislative requirements and establishes the criteria and methods by which potential disturbance to relevant whale species is identified. The process identifies management measures for different types of offshore activity, accounting for nature and scale of the potential impacts and risks, to ensure they remain within acceptable levels, and are managed to ALARP. Provisions within the process include: • Consideration for vulnerable species during sensitive life stages most susceptible to noise emissions via a planning-phase risk review, integrating latest published Government Plans and scientific literature. This will consider scheduling of activities outside of higher sensitivity period where practicable, and review of control measures to ensure levels of impact and risk remain ALARP. Where there is a risk of TTS or PTS to whales, or a risk of behavioural disturbance to southern right whales or blue whales, the following provisions apply: • Establishment of a communications protocol between Marine Fauna Observers (MFO), vessel master and project team. • Dedicated MFO for the hours of daylight (defined as sunset to sunrise), with relief available to manage MMO fatigue • Dedicated MFOs shall have demonstrated prior experience in the ID of large baleen whales, distance estimation and systems of recording and reporting. • Inducted vessel crew observers to support dedicated MMO during rest breaks. • Application of whale observation and noise shutdown zones out to furthest observable extent, up to a radius equivalent to the behavioural disturbance thresholds of the vessel. • Pre-DP start observation for the 30 minutes prior to commencing DP for the planned activity. DP will not commence until southern right or blue whales are not observed within the shutdown zone, or are observed departing the shutdown • Suspend DP operations when safe to do so (as determined by vessel master or delegate in command) if blue whales or southern right whales are within the behavioural disturbance radius for the activity. Adopt favourable heading to reduce thruster load (and associated noise) and slowly increase separation from the whale(s) if safe to do so (as determined by vessel master or delegate in command). • Apply 30-minute prestart observations before recommencing DP for the planned activity.

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
		• Operations using DP at night will be avoided where 3 or more separate sightings of southern right whales or blue whales have occurred within the vessel shutdown zone in the 3-hours prior to sunset, if safe to do so (as determined by vessel master or delegate in command). Cooper Energy will engage with other Otway Basin Petroleum Titleholders to share planned work schedules with the aim of minimising the potential for cumulative impacts associated with underwater sound from petroleum activities.

8.3 Light Emissions

8.3.1 Cause of Aspect

The East Coast Project's well construction, operations, decommissioning and support activities phases will generate localised and temporary light emissions that will change ambient light levels in the marine environment at night. No permanent source of light will be introduced as part of the East Coast Project.

Relevant light emitting activities for each phase are identified in Table 8-35, which are described in further detail in subsections below.

Table 8-35: Activities undertaken during the East Coast Project that may generate light emissions

Cause of Aspect / Phase	Activity Component
Well Construction	Well clean-up and flowback
Operations	Well intervention
Decommissioning	Well abandonment
Support activities	Vessel operations MODU operations

8.3.2 Aspect Characterisation

8.3.2.1 Well Construction

Well clean up and flowback activities may introduce localised and temporary light emissions into the marine environment if flaring is required to safely manage contents circulated out of the well; this may include gas, condensate, base oil and completion fluids (e.g., brine). Burning of these fluids creates a yellow/orange flame.

Flaring will have a duration of ~36 hours with ~60 MMscf being flared over that duration (i.e. average flare rate of 40 MMscf/day). Flaring would only occur from one well at a time.

8.3.2.2 Operations

Well intervention activities, specifically well testing and flowback, may introduce localised and temporary light emissions into the marine environment if flaring is required.

Depending on well performance, well intervention activities may involve flaring of reservoir fluids, base oil and completion fluids.

If well intervention is required, it will be infrequent, and if flaring is required, the duration is estimated at ~1 day per well. Flaring will only occur from one well at a time.

8.3.2.3 Decommissioning

Well abandonment activities may introduce localised and temporary light emissions into the marine environment if flaring is required.

During well abandonment remaining gas in the well fluids may be directed to a burner boom and flared if required.

Flaring will have a maximum duration of 1 day at a rate of ~18 MMscf/well/day. Flaring will only occur from one well at a time. A maximum of 15 wells will be abandoned under this OPP.

8.3.2.4 Support Activities

Vessel and MODU operations will introduce localised and intermittent light emissions from navigation and safety lighting into the marine environment.

Navigation and safety light emissions will be continuous while vessels / MODU are in use in the operational area.

An individual MODU will be in the operational area throughout the well construction phase, during well abandonment, and will be used as needed during operations (e.g., for well intervention). The longest duration the MODU may be present at each well location is ~60 days, during well construction. Outside of drilling, ISVs and/or support vessels may be in the operational area for ~45 days at a time.

Depending on the phase, the number of vessels in the operational area will range from a single IMR vessel during the operations phase and up to 4 vessels during the well construction phase or concurrent activities (refer to Section 4.1.3 and Section 4.3.6 for further information with regards to concurrent activities).

Duration of vessel operations in the operational area also depends on the phase. A single IMR vessel undertaking inspection activities during the operations phase can be on site for ~2-4 weeks per year depending on the type of inspection and complexity. Whereas, up to 4 vessels undertaking drilling activities or concurrent activities can be on site for up to 180 days; Figure 4-3 provides indicative vessel numbers and associated campaign durations.

8.3.2.5 Concurrent activities

As described in Section 4.1.3, concurrent activities could occur. Cooper Energy assessed reasonably foreseeable concurrent activity scenarios and identified that the potential concurrent activities of drilling operations at Elanora-1 and flowline installation between Annie-2 and Casino-5 represents the activity scenario that contains the greatest number of vessels within the operational area, operating concurrently. This is called the “concurrent activity” and would involve 3 vessels and a MODU operating at once (further details in Section 8.2.2.4).

The concurrent activity includes 4 light emission sources, defined as follows:

- Elanora-1 well construction operations:
  - 1x MODU – flaring
  - 2x AHTS – navigation and safety lighting
- Flowline installation between Annie-2 and Casino-5:
  - 1x ISV – navigation and safety lighting.

Concurrent activities could occur for around 50 days; if pipelay and commissioning are undertaken at the same time, the example given is pipelay at Annie (50 days) whilst drilling is underway in the Elanora field. There are variations to these whereby concurrent activities could extend if drilling or installation activities to integrate additional fields overlap with decommissioning activities of fields that have ceased production (Figure 4-3), though in any case, flaring, which creates the largest light EMBA of the project sources, is limited to short periods during well construction, well intervention or P&A.

Flaring from the MODU will be used as the basis for the area of illuminance above ambient light intensity levels (spatial extent of light emissions) for the concurrent activity. The 3 sources of vessel navigation and safety lighting in the concurrent activity are not expected to increase the spatial extent of light emissions due to their much smaller scale and/or temporary and transient nature (Xodus, 2023).

As a result, the flaring light EMBA based on flaring light emissions spatial extent of 49 km (Section 8.3.4) also considers the spatial extent of light emissions from the concurrent activity.

8.3.3 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impact from light emissions is:

- Change in ambient light.

Potential risks:

- Change in fauna behaviour.
- Injury/mortality to marine fauna.

Socio-economic impacts on commercial fisheries have not been evaluated further, as there are no discernible impacts to behaviour and distribution expected at the population level given the limited nature and scale of activities.

8.3.4 Impact and Risk Evaluation

To determine the spatial extent for impact and risk evaluation, a review of three comparative light emissions modelling as summarised in Table 8-36 was undertaken to define the spatial extent of the potential impact area from artificial light emissions during the East Coast Project. The spatial extent is compared against the minimum light threshold of 20 km as defined in the National Light Pollution Guidelines threshold (DCCEEW, 2023k).

Table 8-36: Comparative light emissions modelling analogues

Project	Infrastructure and height (m)	Flare rate (MMscf/day)	Light spatial extent (km)	
			Lighting	Lighting and Flaring
Otway Drilling T/49 (Xodus, 2023)	MODU flare tip, 45 m MODU navigation lights, 85 m	40	9	49
Dorado Development (Pendoley, 2020)	FPSO flare tip, 110 m FPSO lights, 47 m	125	18	42.2
Corowa Development (Xodus, 2020)	MODU flare tip, 105 m MODU navigation lights, 99 m	17	9	34

The three light emissions modelling studies provide a suitable basis for defining the light spatial extent for the East Coast Project due to very similar operational activities.

Light emissions modelling conducted by Xodus for ConocoPhillips Australia's Otway exploration drilling campaign calculated that ambient light intensity levels are reached beyond 49 km of a flare with a flowrate of 40 MMscf/day located 45 m above sea level (Xodus, 2023). For MODU navigation lighting (on the derrick) located 84 m above sea level, ambient light intensity levels are reached beyond 9 km of the derrick (Xodus, 2023).

Light modelling by Pendoley Environmental Pty Ltd for Santos' Dorado Development used a Flare radiance interpreted from satellite radiance data of known maintenance (worst-case) flaring events of existing LNG facilities, ~500 uW/m^2/sr. For the Dorado development; worst case flaring events were described as occurring over <48 hours and at a rate of ~125 MMscf/d. The modelling study indicated light from the flare is no longer visible at 42.4 km, when the flare drops below the horizon.

The flare height was conservatively estimated as 110 m above sea level (Pendoley, 2020). For FPSO navigation lighting located 47 m above sea level, light emissions were reduced to ambient levels at ~18 km from the navigational light source (Pendoley, 2020).

Light modelling conducted by Xodus Group for KATO Energy's Corowa Development used flaring from the MODU as the light source, with a flare flowrate 17 MMscf/day and a flare tip of 105 m above sea level. The light study estimated a spatial extent of 34 km (Xodus, 2020).

Overall, the review in Table 8-36 shows that with a flare flowrate between 17 to 125 MMscf/day, flare tip between 45 to 110 m, and navigation lights between 47 to 99 m, the light EMBA is expected to range from 34 to 49 km for the flaring scenario (inclusive of both flaring and operational lighting), and 9 to 18 km for the lighting scenario.

In general, the light emissions spatial extent is affected predominantly by the lighting power and the flaring flowrate. At this stage, the heights and lighting design of the infrastructure (i.e., MODU) are not known. ConocoPhillips Australia's Otway exploration drilling campaign is considered to be most representative, as the study parameters (flow rate, flare tip height, vessels and lighting) are likely to be most similar to the East Coast Project.

The navigational and operational light emissions spatial extent of 18 km from the source predicted by Pendoley Environmental Pty Ltd, is similar to the 20 km National Light Pollution Guidelines threshold (DCCEEW, 2023k); which has been adopted as the spatial extent for navigational/operational lighting except for the short period when flaring would be occurring.

The light emissions spatial extent (or EMBA) of 49 km for flaring has been adopted based on the flaring scenario in the ConocoPhillips Australia's Otway exploration drilling campaign (Table 8-36) for impact and risk assessment.

8.3.4.1 Impact: Change in Ambient Light

At night the moon is a source of natural light and was selected as a proxy for ambient light levels (Pendoley, 2020). Ambient light conditions are defined as the illuminance equivalent to a new moon / moonless clear night sky (Xodus, 2023; Pendoley, 2020).

Modelling predictions by Xodus (2023) and Pendoley (2020) were used to infer ambient light intensity levels are reached beyond 49 km of a flare and beyond 20 km of MODU or vessel navigational/operational lighting which are suitable worst-case light EMBA distances for use during the East Coast Project.

Navigational/operational lighting is a short-term source of light, given there are no permanent topsides facilities on the East Coast Project. The longest duration the MODU may be present at each well location is ~60 days, during well construction. Outside of drilling, ISVs and/or support vessels may be in the operational area for ~45 days at a time.

Given that light emission sources of the East Coast Project are related to activities that are intermittent, of a short-term duration and relatively localised (change from ambient light levels within 49 km of the light EMBA), the consequence of this impact has been evaluated as **Level 1**, as light levels will return to existing ambient levels following completion of the activity with no remedial or recovery work required.

8.3.4.2 Risk: Change in Fauna Behaviour – Marine Invertebrates

Inherent Consequence Evaluation

Light emissions may cause behavioural changes to marine invertebrates. The operational area is in water depths ranging from 55 m to 85 m. At these water depths mobile marine invertebrates in the operational area may include cephalopods such as the arrow squid (Kailola et al., 1993) and crustaceans such as rock lobsters (Section 5.4.4).

Arrow squid is a targeted species for the Southern Squid Jig Fishery. Squid are highly attracted to artificial lights at night. This is demonstrated by the use of lights at night while jigging which is an active fishing method used by the Southern Squid Jig Fishery (AFMA, 2022). Light emissions in the operational area are expected to temporarily attract squid and other cephalopods up to the sea surface towards the light source (Imbrahim and Hajisamae, 1999).

Lobsters and other crustaceans that are generally nocturnal and highly active at night, are not expected to exhibit behavioural changes from exposure to artificial light at night based on observations of no effect on heart rate or locomotor activity (Steell et al., 2020). Laboratory studies have shown that artificial light at moderate levels at night (4–15 lux) observed suppressed activity and altered behaviour in four species of North American crayfish, and observations of Japanese spiny lobster exposed to low levels of artificial light at night also found suppressed activity (Nagata and Koike, 1997). Light emissions in the operational area have very limited potential to suppress nocturnal activities of crustacea and other organisms at the seabed given the depth of water (>50m) between the temporary light sources at sea surface and strong light attenuation in the upper 50m of the water column (McCafferty et al., 2004). Light will be used at depth for ROV operations; these are temporary sources of light with limited range inherent to subsea light sources, with potential for minimal incidental behavioural reactions.

Behavioural changes to marine invertebrates from artificial light at night is expected to be localised and short term based on expectations that navigational/operational light emissions sources are short-term and relatively localised, with a lighting spatial extent of 20 km. Flaring has a larger adopted spatial extent of 49 km, but is comparatively brief (up to 36 hours per well) and intermittent.

The predicted level of impact, i.e., the consequence, to marine invertebrates from light emissions is evaluated to have a consequence of **Level 1** based on:

- invertebrate communities in the operational area are representative of what is expected throughout the Otway Basin
- localised and short-term behavioural change to marine invertebrate is expected to be limited to temporary attraction of cephalopods and incidental behavioural suppression reactions in crustaceans on the seabed.

Inherent Likelihood

The scattered and patchy presence of marine invertebrate communities in the operational area presents a potential overlap of marine invertebrates with the light EMBA; therefore, it is likely the risk event will occur.

The inherent likelihood of a **Level 1** consequence occurring is therefore rated as **Likely (B).**

Inherent Risk Severity

The inherent risk severity of behavioural changes to marine invertebrates is considered **Low**.

8.3.4.3 Risk: Change in Fauna Behaviour – Fish

Inherent Consequence Evaluation

Light emissions may cause behavioural changes to fish including eggs and larvae. The National Light Pollution Guidelines for Wildlife (DCCEEW, 2023k) recognises artificial light at night can suppress the upward daily vertical migration of zooplankton (including fish eggs and larvae) which rise to the surface at night to feed. Inversely, some zooplankton at night are attracted towards illuminated parts of the ocean, where they become easy prey for predators (DCCEEW, 2023k). Suppressing or attracting zooplankton to the surface may disrupt zooplankton vertical migrations and in turn impact the movement and food availability for larger nocturnal fish predators. For example, adult benthopelagic fish have also been documented displaying large daily vertical migrations that match pelagic prey availability and movements of zooplankton (Afonso et al., 2014). Artificial light may also promote bringing diurnal fish foragers into competition with their nocturnal counterparts, thereby substantially increasing predation pressure to nocturnal prey and competition with nocturnal fish predators (DCCEEW, 2023k).

Short-finned eels also exhibit strong daily vertical migrations during the deep ocean spawning migration phase (Koster et al., 2021). A study tracked downstream spawning migration of adult short-finned eels released from south-western Victoria (Hopkins and Fitzroy River estuaries) and observed the adult eels moved east or south along the Australian continental shelf exiting the Bass Strait at the east to migrate north to spawning grounds in tropical waters of the Coral Sea (Koster et al., 2021). From the spawning site in the Coral Sea, migration of short-finned eel larvae are influenced by ocean currents that carry the larvae from the Coral Sea south along the east

Australian current and transport the developing larvae through the Bass Strait to the Victorian Coast (VFA, 2022a). Based on the observed migratory route of short-finned eels, transient short-finned eels may pass the operational area. During the offshore migration, eels exhibited daily vertical migrations and were presumed to stay along the seafloor during the day and ascended toward the sea surface at night. Anguillid eels such as short-finned eels do not feed during spawning migration, as a result the function of daily vertical migrations relates to predator avoidance, swimming efficiency, thermal regulation, and control of maturation (Koster et al., 2021). The change in light intensity triggers the onset of ascent and descent for short-finned eels (Koster et al., 2021). Studies have observed during the freshwater downstream migration phase for Anguillid eels, migrating eels tend to avoid artificially lit routes (by acceleration, retraction, switching and rejection) (Vowles and Kemp, 2021). Based on these studies, it is inferred that transient migrating short-finned eels in the operational area may not ascend towards the sea surface at night if artificial light is emitted during the East Coast Project reducing the change of being identified by visual predators.

The operational area overlaps the distribution BIA for the white shark but does not overlap known aggregations areas. As a result, individual white sharks are expected to be transient within the operational area. Given the ability of white sharks to detect changes in light and modify their hunting behaviour accordingly, exposure to intermittent flaring or navigational lighting during the East Coast Project could disrupt rhythmic behavioural activities of individuals (Carroll and Harvey-Carroll, 2023; Colefax et al., 2020). The increase presence of zooplankton and foraging fish at night may attract larger fish species including white sharks (Carroll and Harvey-Carroll, 2023).

Impacts, if any would be limited to temporary behavioural changes to small numbers of plankton and fish within proximity of artificial light sources in surface waters of the operational area. Zooplankton migrates upwards at dusk and downwards at dawn (Nocera et al., 2020), which for the basis of comparison, light levels at dawn and dusk are inferred as light levels at twilight. Based on light emissions modelling, light illuminance levels that reflects twilight levels are reached within 500 m of a flare (Xodus, 2023). It is anticipated that the suppression or attraction of plankton will occur within 500 m of flaring or MODU and vessel operations, which in turn may impact the localised movement and food availability for larger nocturnal fish predators.

Behavioural changes to fish and plankton (eggs and larvae) from artificial light at night is expected to be localised and short term based on expectations that navigational/operational light emissions sources, and flaring are short-term

Given the consequence of impact by light emissions to fish including eggs and larvae will be intermittent, short-term, and highly localised (behavioural changes within 500 m of the light source), the consequence levels have been evaluated as **Level 1**, as light levels will return to existing ambient levels following completion of the activity with no remedial or recovery work required.

Inherent Likelihood

The risk event could happen when additional factors are present, such that zooplankton, short-finned eels, nocturnal fish and diurnal fish are present within the light EMBA during well construction, operations, decommissioning and support operations where light is generated. Fish are known to occur within the light EMBA (Section 6.5.5) however plankton populations are expected to be highly variable both spatially and temporally (Section 6.5.3).

The highly variable presence of plankton and fish populations in the operational area presents a potential overlap of marine invertebrates with the light EMBA; therefore, it is likely the risk event will occur.

The inherent likelihood of a **Level 1** consequence occurring is therefore rated as **Likely (B).**

Inherent Risk Severity

The predicted level of risk, i.e., inherent risk severity, of behavioural changes to fish including eggs and larvae is considered **Low**.

8.3.4.4 Risk: Change in Fauna Behaviour – Marine Turtles

Inherent Consequence Evaluation

Light emissions may cause behavioural changes to marine turtles. Light emissions in offshore waters at night can disrupt in-water dispersal behaviours of marine turtles by interfering with natural lighting and silhouettes (DCCEEW, 2023k; CoA, 2017). Marine turtle hatchlings are attracted to lights at sea, based on observations of hatchlings swimming around lights on boats (DCCEEW, 2023k). The potential to disrupt critical dispersal behaviours of marine turtles is considered a threat to the recovery of marine turtles (CoA, 2017).

Critical behaviours for marine turtles are generally carried out within spatial extents defined by marine turtle BIAs and habitat critical to the survival of marine turtle species. The operational area does not overlap BIAs or habitat critical to the survival of marine turtle species. There are no marine turtle BIAs adjacent to the operational area and no nesting activities along Victorian coastlines. As a result, individual marine turtles are expected to be transient within the operational area.

Impacts, if any, would be limited to temporary behavioural changes to individual marine turtles which may travel through the light EMBA. The exposure of individual marine turtles to intermittent flaring or navigational lighting during the East Coast Project could temporarily attract individual marine turtles within 49 km of flaring sources and 20 km of MODU and vessel operations undertaken at night.

Behavioural changes to marine turtles from artificial light at night is expected to be localised and short term based on expectations that navigational/operational light emissions sources, and flaring are short-term Given the consequence of impact of light emissions to marine turtles will be intermittent, short-term, and relatively localised (within 49 km of the light source), the consequence levels have been evaluated as **Level 1**, as light levels will return to existing ambient levels following completion of the activity with no remedial or recovery work required.

Inherent Likelihood

The risk event could happen when additional factors are present, such that individual marine turtles are present within 49 km of night-time flowback and well intervention activities and 20 km of MODU and vessel operations. No BIAs or habitat critical to the survival of marine turtles overlaps the light EMBA, however loggerhead and leatherback turtles are known to occur in this area. Based on the absence of BIAs or habitat critical to the survival of marine turtles in the light EMBA, a rare combination of factors would be required for marine turtles to be present during night-time flowback and well intervention activities, MODU and vessel operations and decommissioning. The risk event is considered conceivable and could occur at some time during the East Coast Project.

Given the nature of this risk event, the inherent likelihood of a **Level 1** consequence occurring is rated **Unlikely (D).**

Inherent Risk Severity

The predicted level of risk, i.e., inherent risk severity, of behavioural changes to marine turtles is considered **Low**.

8.3.4.5 Risk: Change in Fauna Behaviour – Seabirds and Shorebirds

Inherent Consequence Evaluation

Light emissions may cause behavioural change to nocturnal seabirds by disrupting vision at night. Nocturnal seabirds include petrels, shearwaters, albatross, noddies, terns, prions, and some penguin species (DCCEEW, 2023k). Light emissions at night can disrupt critical behaviours for nocturnal seabirds by disrupting sea-finding cues provided by moonlight and starlight. This can disorient migrating and foraging nocturnal seabirds and cause them to divert from efficient migratory routes. Light emissions can disrupt other critical behaviours such as preventing fledglings from taking their first flight if their nesting habitat does not become dark (DCCEEW, 2023k). Disorientation of seabirds from night-time light emissions may cause interference with navigation and grounding of individuals on offshore vessels (Heswall et al., 2022). The potential of disorientation from light emissions is exacerbated with an increase in proximity of nesting sites or migrating sites to artificial light sources (DCCEEW, 2023k). Light emissions can also attract seabird prey including fish and squid, resulting in increased foraging opportunities for nocturnal seabirds at lit offshore areas (Marangoni et al., 2022).

The light EMBA overlaps 7 foraging BIAs for albatross species, one breeding BIA for the wedge-tailed shearwater, a foraging BIA for the short-tailed shearwater, and a foraging BIA for the Australasian gannet.

Albatross, Petrels and Shearwaters

No habitats critical to the survival of threatened albatross and petrel species occur within the light EMBA, this includes known nesting sites or migrating sites. Suitable albatross and petrel breeding islands in Australia are limited to remote offshore islands, of which the closest is Albatross Island located 250 km southeast of the operational area (DCCEEW, 2023e).

Albatrosses and petrels are capable of foraging at both day and night. During bright moonlit nights the number of foraging flights for albatrosses and petrels significantly increase compared to moonless nights (Phalan et al., 2007; Frankish et al., 2021). As a result, it is inferred that albatrosses and petrels may forage in the light EMBA on bright moonlit nights, however not in high numbers. Light emissions in the operational area at night may further increase foraging opportunities for albatrosses and petrels outside of bright moonlit nights.

No habitats critical to the survival of threatened shearwater species occur within either light spatial extent. However, the wedge-tailed shearwater breeding site, Muttonbird Island, is located within the monitoring EMBA. Based on a buffer of Muttonbird Island, the light spatial extent overlaps the wedge-tailed shearwater breeding BIA (see Figure 8-3) (CoA, 2022b). It is noted that the light EMBA does not overlap foraging (in high numbers) BIAs for the wedge-tailed shearwater.

Shearwaters are nocturnally active at breeding colonies and nest in burrows underground during daylight hours and forage by diving in the water column at night. The short-tailed shearwater has been observed foraging at Griffith Island in inshore habitat and over the continental shelf edge (20-240 km from the colony) (Berlincourt and Arnould., 2015). Diving seabirds, particularly petrels, are sensitive to artificial light emissions, which can disorient birds during flying and foraging (Marangoni et al., 2022). Artificial lights can also concentrate prey in marine environments which seabirds can take advantage of. Several gull species have been recorded to increase their foraging opportunities by increasing concentrations of fish, squid, and plankton in artificially lit areas in marine and coastal environments (Marangoni et al., 2022).

A study by Ravache et al. (2020) observed a positive relationship between greater seabird at-sea foraging and full-moon nights. As a result, shearwaters are expected within the operational area for nocturnal offshore foraging during the breeding season between August and May, however not in high numbers (CoA, 2022b). Light emissions in the operational area at night may further increase foraging opportunities for shearwaters outside of bright moonlit nights.

A critical phase of life for petrels and shearwaters is at fledgling when young birds move from parent-dependant life on land to become independent at sea. Fledglings are vulnerable to becoming disorientated during their first flight when exposed to artificial light, with some fledglings leaving the nest but becoming attracted towards artificial lighting. This disorientation can lead to injury or fatality from fallouts over the ocean, groundings or collisions with infrastructure (Rodríguez et al., 2017; Marangoni et al., 2022). Studies have shown that some fledglings will not make their first flight due to light emissions if the nesting habitat does not become dark (DCCEEW, 2023k). Fledging typically occurs towards the end of the breeding season and within the first two hours after sunset during the fledging period (Gineste, 2016 cited in Chevillion et al., 2022) which is often associated with the lunar cycle (Chevillion et al., 2022). It is widely accepted that the fledging period of the short-tailed shearwater occurs between the third week of April and the first week of May each year (Skira, 1991; Rodriguez et al., 2014; Price, 2022).

Known shearwater breeding locations within the vicinity of the operational area include Deen Maar and Griffiths Island, which are ~41.5 km 58.8 km and away, respectively, at the closest points (Section 6.5.7.1). Griffiths Island is located within the flaring light spatial extent; but not within the navigational/operational lighting spatial extent (see Figure 8-3). This species is nocturnally active at their breeding colonies with fledglings leaving their nests at nights (DCCEEW, 2023k). Breeding birds can be deterred from visiting breeding colonies when light emissions are close to breeding colonies. Studies have shown that the number of birds flying over a colony decreased with duration and intensity of light emissions. Increasing light emissions around breeding colonies could impact a seabirds breeding behaviour and chick provisioning, which has been indicated in studies showing that shearwater chicks situated closer to a high-light intensity emissions gained less weight than nests further away from the light emissions (Marangoni et al., 2022).

Based on the conservative spatial extent of light emissions described in Section 8.3.4, light emissions from intermittent flaring and navigational/operational lighting may result in light that is visible from coastal nesting locations. Nocturnal seabird species with breeding sites within the light spatial extents have been identified as shearwaters. As described above fledging is the period where shearwaters are the most susceptible to impacts from light emissions. Considering the fledging period of the short-tailed shearwater occurs over a 3-week period (between the end of April and beginning of May) each year there is potential that fledging coincides with flaring activities in the northwest extent of the operational area, ~41.5 km from Griffiths Island within the 49 km flaring spatial extent (Figure 8-3). Considering drilling activities are proposed to occur over a ~60-day period there is potential for only one flaring event (maximum 36 hours) to occur during the shearwater fledging period as light levels will return to ambient conditions following completion of the activity. If this occurs impacts to individual fledglings at Griffiths Island have the potential to occur. The short-tailed shearwater is the most abundant seabird in Australia inhabiting 285 colonies in south-eastern Australia each breeding season (NRE Tas, 2024a). Therefore, in the unlikely event that flaring occurs during the fledging period, impacts are not predicted to occur at the population level. This follows similar conclusions within studies that have specifically evaluated the effect of artificial light on fledgling shearwaters at sites close to urbanised areas on Phillip Island. These birds were close to urbanised areas (within 10km) and associated light sources. The study found that fledglings were particularly affected by light from traffic, and then susceptible to collision with vehicles, which was also the primary cause of mortality, though noted that even in this situation, there was a low proportion of fledglings affected relative to the overall production of the population (Rodriguez et al., 2014).

Other impacts, if any would be limited to temporary behavioural changes to foraging albatrosses, petrels and shearwaters within either light spatial extent. The exposure of foraging albatrosses, petrels and shearwaters to intermittent flaring or navigational lighting during the East Coast Project is likely to temporarily attract albatrosses, petrels and shearwaters to nocturnally feed within the offshore waters of flaring sources and MODU and vessel operations.

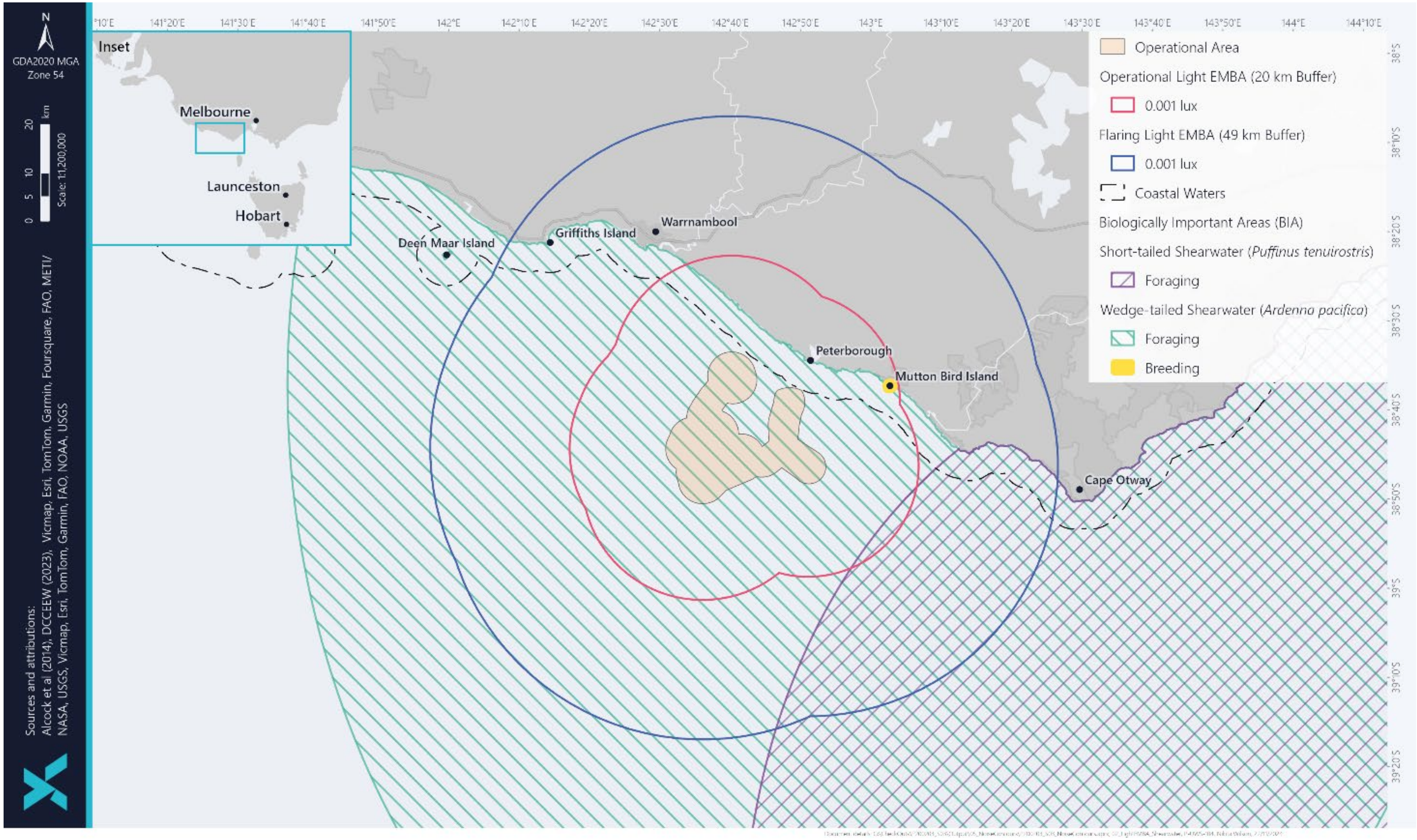


Figure 8-3: Light EMBAs and shearwater BIAs relevant to the East Coast Project

Orange-Bellied Parrot

The orange-bellied parrot is an EPBC-listed critically-endangered ground parrot, with breeding ranges restricted to the south-west coast of Tasmania. Although the orange-bellied parrot does not have a defined BIA or habitat critical within the navigational/operational or flaring light spatial extent, these areas do overlap a probable migration route and the species is identified as likely to occur (Section 6.5.7.3; Figure 6-41).

The orange-bellied parrot is endemic to south-eastern Australia (DELWP, 2016) and participates in yearly migrations over the Bass Strait from breeding grounds in Tasmania to the mainland Australia, each winter between late February to early April (Australian Museum, 2022). This migration route follows the west coast of Tasmania, with some individuals known to stop on King Island during the migration. Non-breeding individuals can be found along South Australia and Victoria within 3 km of the coastline in habitats such as saltmarsh, coastal dunes, and estuaries throughout the winter months. The possible migration route that has been identified for the species has the potential to overlap both light spatial extents, and timing of the East Coast Project activities (DELWP, 2016).

Migrating orange-bellied parrot individuals have been assumed to mostly travel at night (Australian Museum, 2022), however there is limited evidence of nocturnal migratory behaviour for this species. Because the wild population of this species is small and difficult to detect, published data on the distribution of the orange-bellied parrot is limited to known breeding and non-breeding locations. However, it is likely that other breeding locations and migratory routes may become important as the population increases (DELWP, 2016).

Illuminated structures, including vessels, therefore have been identified by the National Recovery Plan for the Orange-bellied Parrot (DELWP, 2016) as a potential ‘barrier’ that could modify the behaviour of individuals, if encountered on migrations routes. However, this is based predominantly on anecdotal evidence, with limited research to support this (Holdsworth, 2006).

The known migration route of the orange-bellied parrot is ~120 km from the operational area, between King Island and the west coast of Tasmania. The 20 km navigational/operational lighting spatial extent and 49 km flaring spatial extent both overlap with the western portion of the probable migration route near the Victorian coastline; and the area identified as the species likely to occur (Figure 6-41), though not the known migration route. Flaring activities would be intermittent and short-term (~36 hours from one well at a time) with light levels returning to ambient following completion of vessel activity. Overlap from the light spatial extents will be small and will not impact a large extent of the migration route. Therefore, only a small number of individuals (if any) have the potential to be impacted by the change to ambient light as a result of flaring activities. As changes in ambient light are expected to be short-term and predominantly outside of the species’ migratory corridor, significant behavioural changes to the species whilst migrating are not predicted.

Summary

Behavioural changes to seabirds and shorebirds from artificial light at night are expected to be localised and short term based on expectations that navigational/operational light emissions sources are short-term.

The predicted level of impact, i.e., the consequence, to seabirds and shorebirds because of light emissions is evaluated to have a consequence of **Level 1** based on:

- operational lighting on vessels and the MODU will be limited to that which is required for navigational and safety requirements; and will be short-term.
- the spatial extent is relatively localised for navigational/operational lighting (at 20 km); and larger for flaring (49 km) flaring will occur from one well at a time for up to ~36 hours per event.
- the flaring spatial extent overlaps 7 foraging BIAs for albatross species. Given the large areas typically covered by foraging individuals, and the transient nature of the species, light impacts are not expected to cause significant impacts to foraging behaviours.
- the flaring spatial extent overlaps with one breeding BIA for the wedge-tailed shearwater and one known breeding island of the short-tailed shearwater. The impact from flaring will

be intermittent and temporary and is therefore not expected to interrupt breeding behaviours or cause impacts at a population level.

- the fledging period of the short-tailed shearwater occurs over a 3-week period each year and may coincide with flaring in the northwest extent of the operational area (~41.5 km from Griffiths Island at its closest); however there is only potential for only one flaring event (maximum 36 hours) to occur during this window of sensitivity. Given the distance between Griffiths Island and the operational area, light from flaring received at Griffiths Island would be expected to be of lower intensity and negligible when considered alongside the lighthouse installed on the island, coastal sources of light and regular vessel traffic directly off the coast (Section 6.7.3.1).
- neither of the project light spatial extents are within the known migration route for the orange-bellied parrot, and the overlap with the western portion of the probable migration route near the Victorian coastline, and the area identified as the species likely to occur, is small in the context of the overall extent of these areas.
- Light emissions will be intermittent, short-term and localised and will return to ambient levels following completion of the activity. There are no long-term topsides facilities or light sources for the East Coast Project to which animals may habituate or which impact individuals over multiple sequential biologically important periods.

Inherent Likelihood

The risk event could happen when additional factors are present, such that night-time flowback and well intervention activities, MODU and vessel operations and decommissioning occur during orange-bellied parrot migration between February and April, the short-tailed shearwater fledging period between the end of April and beginning or May, the wedge-tailed shearwater breeding season between August and May, or when transient albatrosses and petrels opportunistically feed whilst passing through the light EMBA. Based on the overlap of seabird BIAs with the light EMBA, and considering the shorter duration of the greatest source of light (i.e. flaring), the risk event of minor local behavioural changes to nocturnal seabirds is considered possible.

Given the nature of this risk event, the inherent likelihood of a **Level 1** consequence occurring is rated **Possible C.**

Inherent Risk Severity

The predicted level of risk, i.e. inherent risk severity, of behavioural changes to seabirds is considered **Low**.

8.3.4.6 Risk: Injury/mortality to Marine Fauna – Seabirds and Shorebirds

Inherent Consequence Evaluation

The behavioural responses in seabirds and shorebirds due to artificial light described in Section 8.3.4.5 above can potentially cause injury or mortality. This may occur due to disorientation causing collisions with infrastructure, entrapment, stranding, grounding, interference with navigation (being drawn off course from usual migration route). Migratory shorebirds may use less preferrable nesting sites which avoid lighting but may be exposed to increased predation (DCCEEW, 2023k).

Knowledge on light-induced mortality at sea is quite limited (Gjerdrum et al., 2021), although it is known that adults can also be involved in attraction episodes. Stranding events are more likely during nights with little or no moonlight, but systematic searches for stranded birds, with clear monitoring protocols are needed to better understand how light characteristics, weather, and the location of sites influence strandings, and to monitor the effectiveness of light mitigation (Marangoni et al., 2022).

A study was undertaken on the number of fledging short-tailed shearwaters found grounded by evening and morning rescue patrols conducted at Phillip Island during a 15-year period (1999–2013) (Rodriguez et al. 2014). The study associated light from roads and traffic with the attraction, grounding and mortality of seabird fledglings, preventing a proportion of the population from making it to sea. During a 15-year period, rescue patrols on Phillip Island found 8,871 grounded fledgelings, mostly on and around roads; ~40% of those suffered mortality mainly through collision with vehicles.

Rodriguez et al suggest that light induced mortality is usually underestimated elsewhere, though also note a low proportion of affected fledglings relative to the overall production of the population.

The collision of birds with offshore oil and gas structures has been reported. A study on bird fatalities at an unmanned research platform in the North Sea found 34 species over the 4-year monitored period, and extrapolated there was an average of 150 birds killed by collision per year at the offshore structure (Huppop et al. 2016); further extrapolating the potential numbers of deaths to across the 1000+ structures offshore North Sea, Huppop et al conclude at the current rates of mortality are not alarming given at the species level, <1% of populations would be affected. The study identified the bird species to be mainly passerines, such as thrushes and European starlings, that can undertake intensive nocturnal migration. The East Coast Project does not have any ongoing presence of a topsides structure. Whilst artificial lighting will be required offshore, the sources would be temporary.

The flare itself may also present a hazard to birds, as component of the MODU such as the flare boom can provide a perch for individual birds that may migrate through or forage within the area. These birds could then be susceptible to burning by the flare. Due to the very short duration of flaring (~36 hours) on an intermittent basis, at one well at a time, this is not expected to occur and can be managed via standard practices such as flare watch and start-up procedures to manage the flare around the possible presence of birds.

Any injury or mortality to seabirds as a result of a behavioural response to light emissions is not expected to cause any impacts at a population level.

Inherent Likelihood

The risk event could occur when the change in fauna behaviour as a result of light emissions described in Section 8.3.4.5 could lead to injury or mortality of seabirds. The source of this hazard is lighting, and collision or stranding on the MODU, or contact with the flare itself. Over the course of Cooper Energy's offshore activities to date, there have been no reports of collisions of birds with vessels or MODUs, or interactions between flares and birds. Birds are observed on and from vessels and MODUs on a regular basis (Section 6.5.7.1); very rarely individual birds have exhibited signs of fatigue. One such event occurred during Cooper Energy's ~6 month well decommissioning campaign in the Gippsland region in 2024; where a petrel was observed seeking refuge on the campaign MODU during a strong cold front, before moving on within 24h. Based on the overlap of seabird BIAs with the light EMBA, and considering the likelihood of a change in behaviour resulting in injury or mortality, the inherent likelihood of a **Level 1** consequence occurring is rated **Unlikely D.**

Inherent Risk Severity

The predicted level of risk, i.e. inherent risk severity, of injury or mortality to seabirds is considered **Low**.

8.3.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-37.

Table 8-37: Light emissions acceptability assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Impact: Change in ambient light	Consequence: Level 1
	Risk: Change in fauna behaviour	Risk: Low – marine invertebrates Risk: Low – fish Risk: Low – marine turtles

<table>
<tr><th>Acceptability Criteria</th><th colspan="2">Demonstration of Acceptability</th></tr>
<tr><td></td><td></td><td>Risk: Low – seabirds</td></tr>
<tr><td></td><td>Risk: Injury/mortality to marine fauna</td><td>Risk: Low – seabirds</td></tr>
<tr><td>Principles of ESD</td><td colspan="2">A) ‘Integration principle’
The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate.
The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate.Pre-public comment, impacts and risks from light emissions was identified as:
• Level 1 consequence for change in ambient light
• Low risk for change in fauna behaviour
• Low risk for injury/mortality to marine fauna.
The above predicted levels of impact and risk due to light emissions from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).</td></tr>
<tr><td></td><td colspan="2">B) ‘Precautionary principle’
If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
The East Coast Project is consistent with the principle of ESD (b) for this aspect as:
• Evaluation of impacts and risks were conducted in accordance with Cooper Energy’s risk assessment methodology and the National Light Pollution Guidelines (DCCEEW, 2023k). Several proxy modelling studies were evaluated for their suitability to the East Coast Project, and from those, conservative parameters were selected.
• The highest consequence ranking for light emissions was evaluated as Level 1 and the highest inherent risks for light emissions was evaluated as Low; therefore, light emissions from the East Coast Project will not result in serious or irreversible environmental damage.
• There is little scientific uncertainty associated with predicted environmental impact and the anticipated effectiveness of management measures.
• The potential impacts and risks from light emissions are well-understood, and management measures are well established and regulated in Australian waters.</td></tr>
<tr><td></td><td colspan="2">C) ‘Intergenerational principle’
The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.
The East Coast Project is consistent with the principle of ESD (c) for this aspect as:
• The highest inherent risks for light emissions was evaluated as Low and therefore will not forego the health, diversity and productivity of the environment for future generations through protection of environmental values.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.3.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</td></tr>
<tr><td></td><td colspan="2">D) ‘Biodiversity principle’
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.</td></tr>
</table>

<table>
<tr><th>Acceptability Criteria</th><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td></td><td colspan="3">The East Coast Project is consistent with the principle of ESD (d) for this aspect as:
• The relevant environmental values and sensitivities to artificial light emissions were evaluated in Section 8.3.4 and the highest inherent risk for light emissions was evaluated as Low.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.3.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained through protection of the values of the Commonwealth Marine Area as per the objectives of bioregional plans.</td></tr>
<tr><td rowspan="5">Legislative and Other requirements</td><td>Requirement</td><td>Relevant Objective / Action</td><td>Demonstration of Requirement</td></tr>
<tr><td>Albatrosses and Giant Petrels as per National Recovery Plan for Albatrosses and Petrels 2022 (DCCEEW, 2022e)</td><td>N/a – Artificial light is not identified as a threat within the Conservation Management Plan for Albatrosses and Petrels.
Management action:
Minimise the effects of marine debris, plastics and pollution.</td><td rowspan="4">Adoption of the following control measures:
CM1: Marine Assurance Process
CM4: Light Management Measures</td></tr>
<tr><td>Wildlife Conservation Plan for Seabirds (CoA, 2020)</td><td>Objective: Seabirds and their habitats are identified, protected and managed in Australia.
Management action:
Action 2e: Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.</td></tr>
<tr><td>National Recovery Plan for the Orange-bellied Parrot (Neophema chrysogaster)</td><td>Objective:
To achieve a stable or increasing population in the wild within five years.
Management action
Assess and manage the risks from development proposals that may represent a barrier to migration or movement.</td></tr>
<tr><td>Recovery plan for marine turtles in Australia 2017–2027</td><td>Recovery objective: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list.
Interim objective 3: Anthropogenic threats are demonstrably minimised.
No relevant management actions.</td></tr>
</table>

Acceptability Criteria	Demonstration of Acceptability		
	Recovery Plan for the White Shark (*Carcharodon carcharias*) 2013	N/a – Artificial light is not identified as a threat within the Species Conservation Management Plan.	
N/a	**Guideline**	**Relevant considerations**	**Where Guideline is Considered**
	National Light Pollution Guidelines for Wildlife (DCCEEW, 2023k)	Objective: Artificial light will be managed so wildlife is: 1. Not disrupted within, or displaced from, important habitat 2. Able to undertake critical behaviours such as foraging, reproduction and dispersal. Management actions which will be considered where practicable: • Start with natural darkness and only add light for specific purposes. • Use adaptive light controls to manage light timing, intensity and colour. • Light only the object or area intended – keep lights close to the ground, directed and shielded to avoid light spill. • Use the lowest intensity lighting appropriate for the task. • undertaking an environmental impact assessment of effects of artificial light on listed species for which artificial light has been demonstrated to affect behaviour, survivorship or reproduction. Section 8.3.4 details the environmental impact and risk evaluation for listed species within the light EMBA.	CM1: Marine Assurance Process CM4: Light Management Measures
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07)		

Acceptability Criteria	Demonstration of Acceptability
	• Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11) Activities will be undertaken in accordance with the Implementation Strategy (Section 12).
External Context	No feedback from stakeholders has been received that would inform the values and sensitivities / existing environment, impacts and risks, performance outcomes or mitigation measures of light emissions.
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to light emissions is AL4, AL10 and AL11 identified in Table 8-38. These acceptable levels defined for a change in ambient light, a change in fauna behaviour and injury / mortality to marine fauna are defined in Table 7.6. The worst-case predicted impacts assessed in Section 8.3.4 are: • Localised and short-term change in ambient light is limited to the intermittent presence of vessels and MODU activities and drilling operations at night. Ambient light levels are expected to immediately return following completion of support operation activities and drilling operations. • The short-term temporal extent of change in ambient light is based on the intermittent presence of operational/navigational lighting on vessels and the MODU required for navigational and safety requirements (i.e. ~60 days per well for the MODU, and ~45 days per installation). Flaring will occur from one well at a time for a maximum of 36 hours per event. • The localised spatial extent of change in ambient light is 20 km for navigational/operational lighting; and 49 km for flaring. • The flaring spatial extent overlaps with one breeding BIA for the wedge-tailed shearwater and one known breeding island of the short-tailed shearwater. The impact from flaring will be intermittent and temporary and is therefore not expected to interrupt breeding behaviours or cause impacts at a population level. Although neither spatial extents are within the known migration route for the orange-bellied parrot, both have a relatively small overlap with the western portion of the probable migration route and the area identified as the species likely to occur. • Any injury or mortality to seabirds as a result of a behavioural response to light emissions is not expected to cause any impacts at a population level. • The highest consequence ranking for light emissions was evaluated as Level 1 and the highest inherent risks for light emissions was evaluated as Low. Therefore, at its worst-case, the predicted impact from light emissions would not: • Modify an important or substantial area of habitat which may lead to substantial adversely impact on biodiversity and ecological integrity. • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Lead to loss of habitat critical to the survival of species. Therefore, the predicted level of impact due to light emissions from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to light emissions are acceptable, based on: • Predicted levels of impact (evaluated in Section 8.3.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors; • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES.

Acceptability Criteria	Demonstration of Acceptability
	• No feedback from stakeholders has been received that would inform the values and sensitivities / existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to at or below the defined acceptable levels the following EPOs have been applied: **EPO4**: Impacts to ambient light levels from light emissions associated with the activity will be short-term. **EPO9**: Impacts to marine fauna from light emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts. **EPO16**: Impacts to marine fauna from light emissions will not impact the recovery or conservation status of EPBC Act listed threatened or migratory species, with no population level impacts.

8.3.6 Environmental Performance

Table 8-38 lists the acceptable level and EPOs defined for light emissions and the adopted control measures to achieve the outcome.

Table 8-38: Environmental performance summary – Light emissions

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL4: Impacts to ambient light from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity.	**EPO4:** Impacts to ambient light levels from light emissions associated with the activity will be short-term. .	CM1: Marine Assurance Process AMSA Marine Orders 21 and 30 for the safety of navigation and prevention of collisions require that onboard navigation, watchkeeping, radar equipment, and lighting meets the International Rules for Preventing Collisions at Sea (COLREGs) and industry standards.
AL10: Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species.	**EPO9**: Impacts to marine fauna from light emissions associated with the activity will not prevent biologically important behaviours of EPBC Act listed threatened or migratory species which could manifest in population level impacts. **EPO16:** Impacts to marine fauna from light emissions will not impact the recovery or conservation status of EPBC Act listed threatened or migratory species, with no population level impacts.	CM4: Light Management Measures MODU and the vessels will implement light management measures developed with consideration to the National Light Pollution Guidelines for Wildlife (DCCEEW, 2023k), these include, but are not limited to: • Outward facing lights will be reduced to minimum levels required for a safe work environment. • Directions to minimise the use of non-essential lights (e.g. close blinds, turn off lights when leaving a room) will be included in MODU and vessel inductions. • Recording and reporting of any seabirds found on the MODU or vessels in need of care. • Procedures to manage and care for any seabirds found on board requiring care, including remote advice from Zoos Victoria Marine Response Unit (MRU) or equivalent. • Consideration for vulnerable species during sensitive life stages most susceptible to artificial light via a planning-phase risk review, integrating latest published Government Plans and scientific literature. This will consider scheduling of activities outside of higher sensitivity period where practicable, and review of control measures

		to ensure levels of impact and risk remain ALARP.

8.4 Atmospheric Emissions

8.4.1 Cause of Aspect

Atmospheric emissions can be divided into greenhouse gas (GHG), and non-GHG emissions – also known as atmospheric pollutants. This section will only evaluate non-GHG emissions (atmospheric pollutants). GHG emissions are assessed in Section 8.5.

The atmospheric emissions produced by the MODU, vessels and machinery contain atmospheric pollutants. Atmospheric pollutants considered in this section include: Carbon monoxide (CO), Particulate Matter (PM) (i.e. dust in the air), typical pollutants for nitrogen oxides (NO_x), Ozone-depleting substances (ODS), Mercury (Hg), typical pollutant as sulphur oxides (SO_x), and Non-methane volatile organic compounds (NMVOCs), which includes aromatic (BTEX – benzene, toluene, ethylbenzene and xylene) and aliphatic (propane and long organic compound containing carbon and hydrogen joined together in straight chain).

Atmospheric emissions will be generated as a result of the East Coast Project activities, identified in Table 8-39.

Table 8-39: Activities undertaken in the East Coast Project that may generate atmospheric emissions

Cause of Aspect / Phase	Activity Component
Well Construction	Well clean-up and flowback
Installation and Commissioning	Testing, preservation and start-up
Operations	Well intervention
Support Operations	MODU operations Vessel operations Helicopter operations
Decommissioning	Well abandonment

8.4.2 Aspect Characterisation

8.4.2.1 Well Construction

Well construction will be carried out using a MODU and flaring may occur during flowback activities and well clean-up. Flaring is required to safely manage fluids circulated out of the well; this may include hydrocarbon gas, condensate, base oil and completion fluids (e.g. brine).

Throughout well clean-up and flowback activities, the well is flowed to remove contaminants including drilling or completions fluids, debris and solids that come from the formation. These contaminants are circulated back to the MODU and during this process, hydrocarbon gas may be removed from the well. For safety purposes, this gas will be flared and SO_2, NOx, CO, Hg and NMVOCs may be present in air emissions from gas flaring.

If required, flaring will occur from one well at a time and is estimated to take ~36 hours to complete per well.

8.4.2.2 Installation and Commissioning

Once flowline testing is complete, they will be flooded with preservation fluids (inhibited water). Before the production start-up from the wells, the subsea system is dewatered by displacing the lines with nitrogen gas. Nitrogen is used because it is an inert gas with no risk of ignition and is non-corrosive.

The predicted maximum volume of nitrogen gas across all flowlines (subject to detailed design) that will be pumped from a surface vessel via a downline into the subsea system is 3,232 m^3. The inhibited water is displaced to sea (at manifold or tie-in locations), until the system is filled with nitrogen gas. It is expected to be a once-off release, per flowline.

8.4.2.3 Operations

Flaring may be required as part of well intervention, similar to drilling. If well intervention is required, it will be infrequent, and if flaring is required, the duration is estimated at ~1 day per well.

During well intervention, small volumes of gas may need to be handled back to the MODU. Where the volume is too small to flare, it will be cold-vented to atmosphere.

8.4.2.4 Decommissioning

During abandonment of the wells, any remaining gas in the well fluids may be bled off or flared. If required, it will occur from one well at a time and is estimated to take a maximum of one day per well to complete at a rate of ~18 MMscf/well/day. A maximum of 15 wells will be abandoned under this OPP.

8.4.2.5 Support Activities (all phases)

Vessels and the MODU use diesel or gas to generate power for operation. Vessels will use marine diesel oil (MDO) or marine gas oil (MGO) instead of heavy fuel oil (HFO). Pollutants such as PM, CO, NOx, SO_2 and NMVOCs are released to the atmosphere during the combustion of these fuels.

The MODU will be present in the operational area during well construction, well intervention and for well abandonment activities. Up to 15 production wells may be drilled for the East Coast Project within the scope of this OPP, with each well expecting to take up to 60 days.

Vessels are expected to be present in the operational area during all phases of the East Coast Project. The maximum number of vessels in the operational area at a time is expected during well construction activities and is expected to be 3 anchor handler vessels or PSVs plus the MODU.

Installation and commissioning activities are included in the pre-operation phase, which could comprise of intermittent offshore activities for a duration of up to 6 years for all gas development opportunities and fields identified within this OPP. The post-operations phase could involve between 3 and 5 years of intermittent offshore activities. The largest vessel which could be used on the project is likely to be an Installation Support Vessel (ISV) or Reel-Lay vessel and could be in field for ~45 days per campaign.

Helicopters will be used during well construction and installation activities, primarily for crew change and medevac, and occasionally equipment and material transfers. Helicopter flights are expected to occur of 5-8 times a week during well construction, installation and commissioning and decommissioning phases, dependent on the progress of the drilling program, subsea installation, and logistical constraints. Helicopters use aviation fuel.

Vessels and the MODU may also be a source of fugitive emissions with the presence of diesel storage tanks on-board.

There may be ODSs present on board the vessels and MODU; however, these are typically found within old refrigeration and air conditioning units and their gradual phase out within the marine industry is managed at an international level under MARPOL Annex VI.

8.4.2.6 Concurrent activities

As described in Section 4.1.3, concurrent activities could occur. Cooper Energy assessed reasonably foreseeable concurrent activity scenarios and identified that the potential concurrent activities of drilling operations at Elanora-1 and flowline installation between Annie-2 and Casino-5 represents the activity scenario with the greatest number of vessels within the operational area, operating concurrently. This could involve 3 vessels and a MODU operating at once (further details in Section 8.2.2.4). These kinds of concurrent activities could occur over periods of ~50 days depending on the exact scope of works to be completed and availability of vessels and equipment. Drilling and related activities such as flaring would occur only from 1 well at a time.

8.4.3 Predicted Environmental Impacts and/or Risks (Consequence)

The predicted environmental impacts from atmospheric emissions are:

- Change in air quality.

Impacts to marine fauna within the operational area are not predicted, as a reduction in air quality is restricted to within the immediate proximity of the release source and is temporary as pollutants would be rapidly dispersed by the open ocean environment and prevailing winds of the Otway Basin. Therefore, impacts to marine fauna and social receptors from a change in air quality are not expected and have not been evaluated further.

8.4.4 Impact and Risk Evaluation

8.4.4.1 Impact: Change in Air Quality

A change in ambient air quality from atmospheric emissions as a direct result of the East Coast Project are most likely to result from combustion of fuels, such as diesel used to generate energy for equipment operation and flaring of hydrocarbon gas, condensate, base oil and completion fluids. The combustion of fuels and flaring will result in emission of GHGs such as carbon dioxide (CO_2), methane (CH_4) and N_2O, along with non-GHG such as sulphur oxides (SOX), nitrous oxides (NOX) and particulates.

Routine atmospheric emissions will be generated by the combustion of fuel for power generation by the vessel and helicopters. These emissions will be continuous whilst the vessels are in use, however intermittent and short term over the duration of the activity. Flaring during drilling, and well abandonment is a once-off and infrequent activity respectively. It is short-term (~36 hours per well).

Particulate matter from the combustion of fuel can be used as an indicator of potential exposure risk from combustion products. Exposure standards for airborne contaminants have been established for human work environments, including those working offshore. In 2024 Cooper Energy and their Service Partners commissioned a study to monitor diesel particulate matter from the engine exhaust of a semisubmersible MODU within the Bass Strait in 2024. The study was completed over a range of meteorological conditions and confirmed that exposure limits were not exceeded on the working decks of the MODU (Tetra Tech Coffey, 2024). With distance from the MODU, dispersion of exhaust products increases, and exposure levels would decrease further still. This indicates that there would be minimal exposure risk from exhaust emissions around the MODU or further afield. No local settlements or critical habitats are expected to be impacted by air quality changes arising from the East Coast Project. Due to the meteorological conditions, it is anticipated that any potential impacts on air quality will be localised and temporary. No adverse impact to local or regional biodiversity is expected.

Nitrogen gas is very stable in the atmosphere and is not significantly involved in chemical reactions. The release volume across all flowlines is relatively small of 3,232 m^3. Additionally, nitrogen gas is a natural constituent of the Earth's atmosphere, accounting for 78% of its total composition, thus not being considered a pollutant gas.

The predicted level of impact, i.e., the consequence, of change in air quality as a result of the East Coast Project is evaluated to have a consequence of **Level 1**, based on:

- localised and temporary nature of a direct reduction in air quality due to low level of emissions from support activities, and short-term infrequent emissions from commissioning and flaring activities
- the open ocean environment and prevailing winds of the Otway Basin atmospheric emissions will rapidly disperse to background levels close to the emissions source.

8.4.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table

7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-40.

Table 8-40: Atmospheric Emissions Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Impact: Change in air quality	Consequence: Level 1
Principles of ESD	‘A) ‘Integration principle’ The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, impacts from atmospheric emissions was identified as: • Level 1 consequence for change in air quality. The above predicted level of impact due to atmospheric emissions from the East Coast Project is equal to or better than the defined acceptable levels (Section 7.3).	
	B) ‘Precautionary principle’ If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy’s risk assessment methodology. • The highest consequence ranking for atmospheric emissions was evaluated as Level 1; therefore, atmospheric emissions from the East Coast Project will not result in serious or irreversible environmental damage. • The potential impacts of atmospheric emissions are well-understood, and measures are well established and regulated in Australian waters.	
	C) ‘Intergenerational principle’ The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as:	

	• The highest consequence ranking for atmospheric emissions was evaluated as Level 1 and therefore will not forego the health, diversity and productivity of the environment for future generations through protection of environmental values. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.4.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.		
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant environmental values and sensitivities to atmospheric emissions were evaluated in Section 8.4.4 and the highest consequence ranking for atmospheric emissions was evaluated as Level 1. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.4.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained through protection of the values of the Commonwealth Marine Area as per the objectives of bioregional plans.		
Legislative and Other requirements	**Requirement**	**Relevant Objective / Action**	**Demonstration of Requirement**
	Marine Order 97: Marine Pollution Prevention – Air Pollution	Vessels will comply with Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel including: Hold a valid International Air Pollution Prevention (IAPP) certificate. Engine NOx emission levels will comply with Regulation 13 of MARPOL 73/78 Annex VI. Sulphur content of diesel/fuel oil complies with Marine Order Part 97 and Regulation 14 of MARPOL 73/78 Annex VI.	Adoption of the following control measures: CM1: Marine Assurance Process

	Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	Key objectives are to: • control the manufacture, import, export, use and disposal of substances that deplete ozone in the stratosphere and contribute to climate change • achieve a faster and greater reduction in the levels of production and use of ozone depleting substances than are required under the Montreal Protocol • promote responsible management and handling of ozone depleting substances and synthetic greenhouse gases to minimise their impact on the atmosphere.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Operations Management (MS07) • External Affairs & Stakeholder Management (MS05) Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures.		
Comparison of Predicted Impact with Defined Acceptable Level	The defined acceptable level of impact relevant to impacts from atmospheric emissions is AL1, identified in Table 8-40. This acceptable level defined for a change in air quality is defined in Table 7-6. The predicted impacts assessed in Section 8.4.4 as worst-case include: • Localised and temporary change in air quality due to the low level of emissions from:		

		○ fuel combustion for intermittent support activities (i.e. ~60 days per well for the MODU, and ~45 days per installation) ○ short-term infrequent flaring activities (maximum of 36 hours per flaring event) ○ once-off release, per flowline of nitrogen gas (predicted maximum volume of nitrogen gas across all flowlines of 3,232 m^3). Ambient air quality levels are expected to immediately return to existing levels following completion of support activities and commissioning and flaring activities. • Localised change in air quality is expected close to the emissions source based on study by Tetra Tech Coffey (2024) confirmed exposure standards for airborne contaminants for human work environments were not exceeded on the working decks of the MODU from engine exhaust. • The open ocean environment and prevailing winds of the Otway Basin will rapidly disperse to background levels close to the emissions source. • The highest consequence ranking for atmospheric emissions was evaluated as Level 1. Therefore, at its worst-case, the predicted impact from atmospheric emissions would not lead to a substantial change in air quality which may adversely impact biodiversity, ecological integrity, or human health and well-being. Therefore, the predicted level of impact resulting from atmospheric emissions from the East Coast Project is at or below the defined acceptable level.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to atmospheric emissions are acceptable, based on: • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and	Cooper Energy has determined that impacts and risks related to atmospheric emissions are acceptable, based on: • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to, at or below the defined acceptable levels, the following EPO has been applied: **EPO1**: Impacts to air quality from atmospheric emissions will be limited to localised and temporary changes..

	risks, performance outcomes or mitigation measures. To manage impacts to receptors to, at or below the defined acceptable levels, the following EPO has been applied: **EPO1**: Impacts to air quality from atmospheric emissions will be limited to localised and temporary changes..	

8.4.6 Environmental Performance

Table 8-41 lists the acceptable level and EPO defined for atmospheric emissions and the adopted control measures to achieve the outcome.

Table 8-41: Environmental Performance Summary – Atmospheric emissions

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL1: Impacts and risks to air quality from activities defined in this OPP will not lead to a substantial change in air quality which adversely impacts biodiversity and ecological integrity, or human health and well-being.	**EPO1:** Impacts to air quality from atmospheric emissions will be limited to localised and temporary changes..	CM1: Marine Assurance Process AMSA Marine Order 97 Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel including: • Hold a valid International Air Pollution Prevention (IAPP) certificate. • Engine NOx emission levels will comply with Regulation 13 of MARPOL 73/78 Annex VI. • Sulphur content of diesel/fuel oil complies with Marine Order Part 97 and Regulation 14 of MARPOL 73/78 Annex VI.

8.5 GHG Emissions

8.5.1 Cause of Aspect

Greenhouse gas (GHG) emissions will be caused by the activity through the drilling, operations, support operations, decommissioning, processing, transmission and use of hydrocarbons. GHG are emitted to the atmosphere when hydrocarbons are burned, flared, released as fugitive emissions either at the plant or through transmission. GHG emissions include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), sulphur hexafluoride (SF_6) and specified kinds of hydrofluorocarbons and perfluorocarbons.

Direct GHG emissions will be generated because of East Coast Project activities, identified in Table 8-42.

Table 8-42: Activities undertaken in the East Coast Project that may generate GHG emissions

Cause of Aspect / Phase	Activity Component
Well Construction	Well clean-up and flowback
Operations	Hydrocarbon extraction and transport Well intervention
Support Activities	MODU operations Vessel operations

Cause of Aspect / Phase	Activity Component
	Helicopter operations
Decommissioning	Well abandonment

8.5.2 Aspect Characterisation

8.5.2.1 Well Construction

Well construction will be carried out using a MODU and flaring may occur during flowback activities and well clean-up.

As outlined in Section 1.3.1, the East Coast Project will be staged and developed incrementally, consistent with the existing fields. Therefore, not all gas-development opportunities will be developed in a single campaign, which may result in different phases occurring concurrently. This enables the drilling campaigns to be conducted in response to gas demand and reduce GHG emissions should later drilling campaigns not be required.

Throughout well clean-up and flowback activities, the well is flushed to remove contaminants including drilling or completions fluids, debris and solids that come from the formation. These contaminants are circulated back to the MODU, and hydrocarbon gas may also be returned to the MODU. For safety purposes, this gas is flared.

If required, flaring will occur from one well at a time and is estimated to take ~36 hours to complete per well.

8.5.2.2 Operations

The principal activity during the scope of the East Coast Project will be the flow and transportation of hydrocarbons from the wells to the existing CHN pipelines and then to the shore-based Athena Gas Plant.

Flaring may be required as part of well intervention, similar to drilling. If well intervention is required, it will be infrequent, and if flaring is required, the duration is estimated at ~1 day per well. Flaring will only occur from one well at a time.

During well suspension and intervention, small volumes of gas may need to be handled back to the MODU. Where the volume is too small to flare, it will be cold-vented to the atmosphere.

8.5.2.3 Support Activities (all phases)

Vessels and the MODU use diesel or gas to generate power for operation. Vessels will use marine diesel oil (MDO) or marine gas oil (MGO) instead of heavy fuel oil (HFO).

The MODU will be present in the operational area during drilling, well intervention and for P&A activities. Up to 15 production wells may be drilled for the East Coast Project within the scope of this OPP, with each well expecting to take up to 60 days.

Vessels will be used for several activities such as bunkering and bulk transfer, collection and potentially treatment of waste from the MODU, vessel positioning, towing the MODU and mooring installation. Vessels are expected to be present in the operational area during all phases of the East Coast Project. The maximum number of vessels in the operational area at a time is expected during drilling activities and is expected to be 3 anchor handler vessels or PSVs plus the MODU.

Installation and commissioning activities are included in the pre-operation phase, which is expected to last up to 6 years for all gas development opportunities and confirmed fields. Decommissioning activities are predicted to last between 3 to 5 years. The largest vessel is likely to be an Installation Support Vessel (ISV) or Reel-Lay vessel and would be expected to be in field for ~45 days per campaign.

Helicopters will be used during the drilling and installation activities, primarily for crew change and medevac, and occasionally equipment and material transfers. Helicopter flights are expected to occur of 5-8 times a week, dependent on the progress of the drilling program, subsea installation, and logistical constraints. Helicopters use aviation fuel.

Vessels and the MODU may also be a source of fugitive emissions with the presence of fuel storage tanks on board. That is considered immaterial, and it is not included in the GHG inventory.

8.5.2.4 Decommissioning

During well abandonment, any remaining gas in the well fluids may be bled off or flared. If required, it will occur over a maximum of one day per well at a rate of ~18 MMscf/well/day and only occur from one well at a time. A maximum of 15 wells will be abandoned under this OPP.

8.5.2.5 Concurrent activities

The GHG modelling (Section 8.5.2.6) has been undertaken for all activities for all phases of the East Coast Project and includes concurrent activities.

8.5.2.6 GHG Modelling

<u>Scoping</u>

GHG are described as direct or indirect emissions, where direct emissions occur as a direct result of the East Coast Project.

To reflect East Coast Project activities accurately, the terminology approach used in this section is elaborated below and illustrated in Table 8-43 as they relate to the East Coast Project.

Cooper Energy has commissioned an Otway Offshore Project Proposal - GHG Inventory Technical Note, included in Appendix 5, which describes assessment boundaries and methodologies.

Direct GHG Emissions

Direct GHG emissions are created as a direct result of the East Coast Project activities within Commonwealth jurisdiction, for all phases (surveys, drilling, installation and commissioning, operations and decommissioning) and support activities. These emissions originate from the use of support activities – MODU and vessels within Commonwealth waters, including flaring and fuel vessel use.

The direct emissions do not equate to scope 1 emissions (i.e., emissions under operational control of the organisation) under the *National Greenhouse and Energy Reporting Act 2007* (Cwth), as the:

- direct emissions in this inventory includes relevant Support Operations both within and outside of Copper Energy’s operational control.
- scope 1 emissions associated with the transport and processing of hydrocarbons outside of Commonwealth Waters are considered indirect emissions in this inventory.

Indirect GHG Emissions

Indirect emissions are generated as part of the gas processing at the onshore Athena Gas Plant. Cooper Energy has direct control of, and legislated responsibility for, the emissions associated with the onshore processing of hydrocarbons. Indirect emissions also include electricity used at the Athena Gas Plant, when purchased from the grid, is generated from a mix of renewable and non-renewable sources. GHG emissions are generated in the process of making the energy that supplies the grid.

Other key sources of indirect emissions include upstream purchased products and services, such as cement, corrosion-resistant alloy (CRA), carbon steel, flowlines, umbilicals, manifolds and waste generated (solid steel waste, flowline disposal, umbilicals disposal, mattresses disposal, and hazardous liquids disposal).

Downstream Indirect GHG Emissions

Once processed, the refined products are sold to domestic customers for various uses. The refined products that leave the Athena Gas Plant, and the emissions associated with the transmission, distribution and use of those products are known as downstream indirect emissions. Sales gas would be piped to end users from Athena Gas Plant to Cooper Energy's customers in Victoria and South Australia. Condensate product would be trucked to the Viva refinery in Geelong.

Cooper Energy does not have control of, or legislated responsibility for, emissions downstream of the process facility.

According to the 2024 Gas Statement of Opportunities (GSSO), gas will continue to be used by Australian households, business and industry during Australia's transition to a net zero emissions future (AEMO, 2024).

Table 8-43:Boundary of assessment and emissions sources (with baseline being the emissions form the existing CHN facilities)

Direct GHG Emissions Sources					**Indirect GHG Emissions Sources**	**Downstream Indirect GHG Emissions Sources**
			East Coast Project			
Survey	Drilling	Installation and Commissioning	Operations	Decommissioning	• Fuel gas usage • Flaring and venting • Diesel usage • Fugitives • Purchased goods and transportation • Purchased electricity • Other (vessels including ROV/AUV‡*, liquid fuel, waste generated and employee commuting)	• Combustion of products • Fugitive emissions from natural gas transmission and distribution • Condensate transportation
Vessels†	• MODU • Flaring • Vessels† • ROV/AUV†*	• Vessels† • ROV/AUV†*	• Vessels (IMR)† • ROV/AUV (IMR)†* • Flaring (well intervention)	• MODU • Flaring • Vessels† • ROV/AUV†		
			Baseline: the existing CHN Facilities			
-	-	-	-	-	• Fuel gas usage • Flaring and venting • Diesel usage • Fugitives • Purchased goods and transportation • Purchased electricity • Other (vessels including ROV/AUV‡*, liquid fuel, waste generated, leased assets, employee commuting, business travel, CHN and AGP decommissioning)	• Combustion of products • Fugitive emissions from natural gas transmission and distribution • Condensate transportation

† Within Commonwealth jurisdiction

‡ Within State jurisdiction

**No additional emissions from the ROV/AUV as they are powered by the vessel*

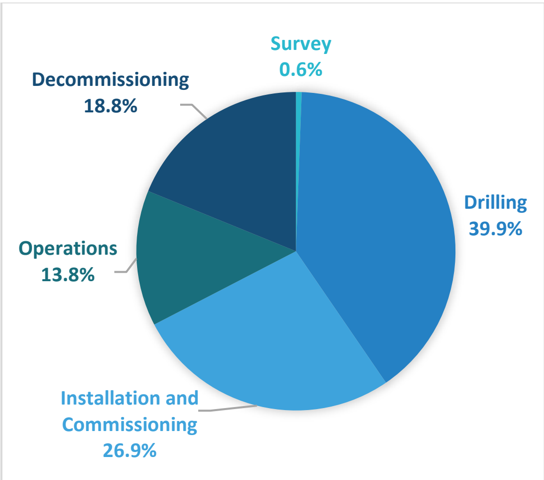
GHG Modelling Results

Results of the GHG modelling are detailed in Appendix 5 and are summarised below.

Direct GHG Emissions

The direct GHG emissions for the East Coast Project are estimated to be 1,000 kt CO_2-e over the project life. Figure 8-4A shows the emissions generated during each project lifecycle stage and embeds the support operations associated with each stage. Figure 8-4B extracts the associated support operations from each life cycle stage and presents these emissions as its own stage alongside the non-vessel related activities. Surveying is not presented in Figure 8-4B as all emissions relate to vessel operation.

As presented in (Figure 8-4B), approximately 895 kt CO_2-e or around 89% of the direct GHG emissions are attributed to support operations (i.e., use of vessels and MODU), ~105 kt CO_2-e or around 11% attributable during Well Construction, Operations and Decommissioning.



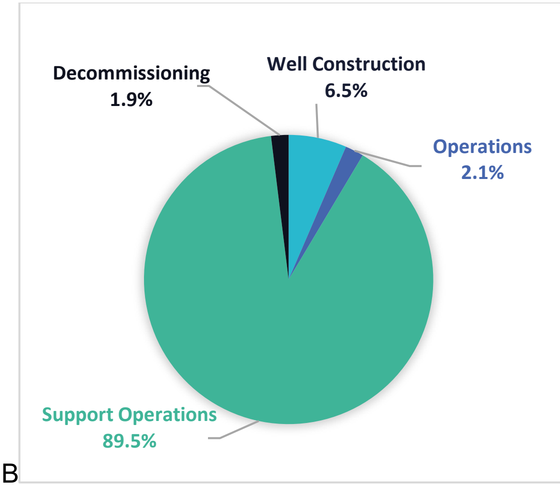


Figure 8-4: (a) Direct GHG emissions generated during each project lifecycle stage (with support operations embedded in each stage), (b) Direct GHG emissions breakdown into Well Construction, Operations, Decommissioning and Support Operations.

The maximum (peak) and average annual emissions for the East Coast Project are estimated to be less than 198 kt CO_2-e/year and 40 kt CO_2-e/year, respectively.

Indirect GHG Emissions

The indirect GHG emissions, excluding downstream indirect GHG emissions are estimated to be 1,581 kt CO_2-e over the project life. As summarised in Figure 8-5, the key emissions sources are fuel gas (40.0%), flaring and venting (23.9%), purchased electricity (14.1%), purchase goods and transportation (11.3%), fugitive emissions (9.4%), and others (1.3%).

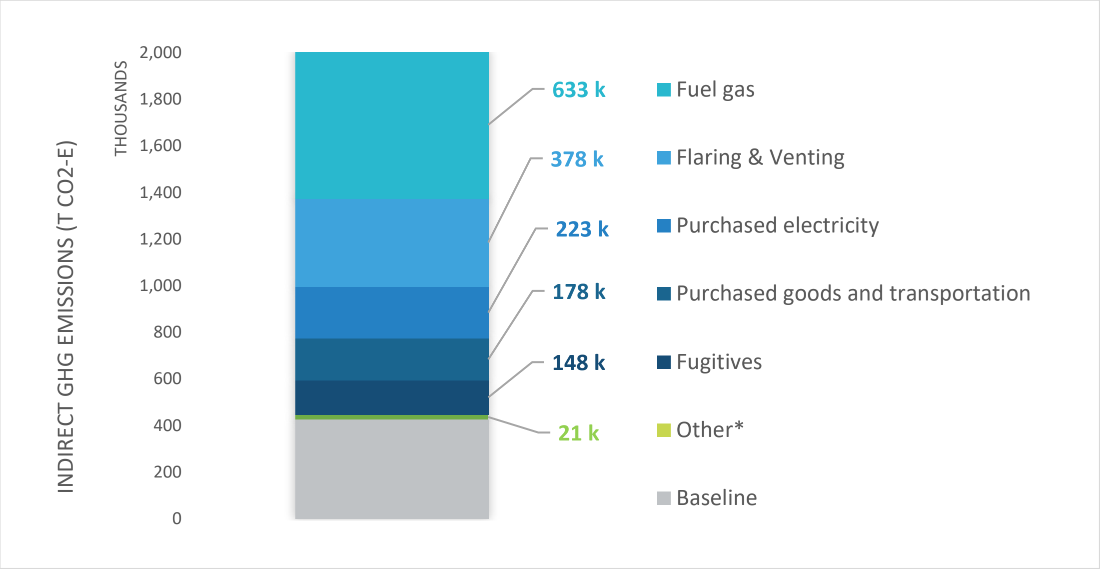


Figure 8-5: Indirect GHG emissions breakdown by emissions source

Downstream indirect emissions are estimated to be 38,561 kt CO_2-e.

Total GHG Emissions

Table 8-44 summarises the total direct and indirect GHG emissions for the East Coast Project. The direct emissions for the East Coast Project are estimated to be 1,000 kt CO_2-e over the project life, and the indirect emissions and downstream indirect emissions are estimated to be 1,581 and 38,561 kt CO_2-e, respectively.

Table 8-44: Total GHG emissions for the East Coast Project

Category	East Coast Project t $CO_{2\text{-e}}$	%	Baseline t $CO_{2\text{-e}}$	Total t $CO_{2\text{-e}}$
Direct GHG emissions	1,000,000	2.43	0	1,000,000
Indirect GHG emissions	1,581,000	3.84	422,000	2,003,000
Downstream indirect GHG emissions	38,561,000	93.73	2,065,000	40,626,000
Total GHG Emissions (t CO_2-e)	41,142,000	-	2,487,000	43,629,000

Figure 8-6 shows the indicative annual total GHG emissions for the East Coast Project over the project life, broken down to the emissions category. The maximum and average annual emissions (inclusive of the baseline) are estimated to be approximately 2,840 kt CO_2-e/year and 1,745 kt CO_2-e/year, respectively. The associated emissions intensity based on a representative production year (2035) is estimated to be 58 t CO_2-e/TJ.

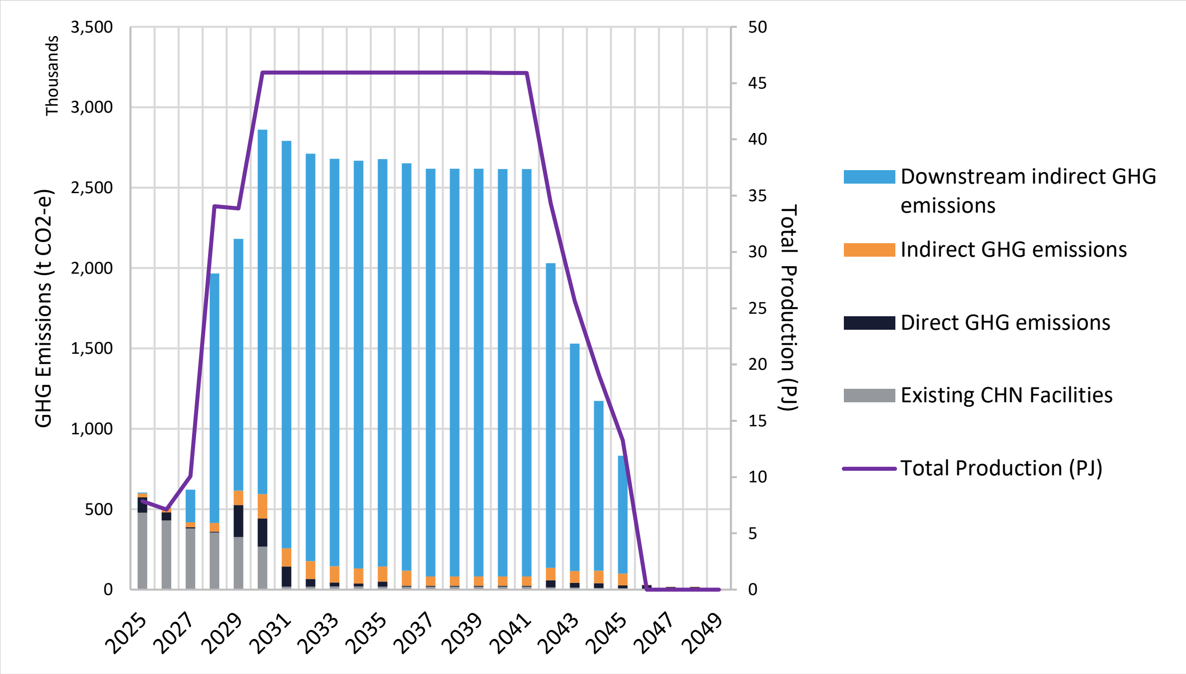


Figure 8-6: Annual total GHG emissions breakdown by category and production profile forecast

8.5.3 Predicted Environmental Impacts and/or Risks (Consequence)

The predicted environmental impacts from GHG emissions are:

- Increase in GHG emissions.

Potential risk:

- Change in climate systems
- Change in ecosystem
- Change in socio-economic factors.

8.5.4 Impact and Risk Evaluation

8.5.4.1 Impact: Increase in GHG Emissions

GHGs absorb longwave radiation reflected from the earth's surface, thereby trapping heat within the earth's atmosphere and contributing to the greenhouse effect. While the emissions from the East Coast Project add to the GHG load in the atmosphere resulting in global warming potential, they are small on a state and national scale.

Following the updated Nationally Determined Contribution (NDC) in June 2022, Australia committed to reduce GHG emissions to 43% below 2005 levels by 2030 and reaffirmed its target to achieve net zero emissions by 2050. These targets are legislated under the Climate Change Act 2022 (Cwth).

Based on forecasting conducted by the DCCEEW in 2023 the Commonwealth Government has forecasted the annual carbon budget including a scenario called 'with additional measures' that includes policies and measures in place at the time of publication. This includes the Safeguard Mechanism reforms and the 82% renewable energy target in Australia's electricity grid by 2030 (DCCEEW, 2023p).

In May 2023, Victoria State Government formalised emissions reduction target under Climate Change Act 2017 (Vic), committing to reduce Victoria's emissions from 2005 levels by 28 to 33% by 2025, 45 to 50% by 2030, 75 to 80% by 2035 and bring forward the date to achieve net-zero emissions from 2050 to 2045.

Carbon budgets under current policy settings can be developed for Australia and Victoria with the following approach:

- For Australian carbon budget: by summing the annual projected emissions of the 'with additional measures' scenario up to 2035, and assuming a linear decline to net zero emissions between 2035 to 2050 (DCCEEW, 2023p).
- For Victorian carbon budget: By extrapolating the emissions targets set by the Victorian State Government (for conservatism using the upper bound of the targets, i.e., 33% by 2025, 50% by 2030, 80% by 2035, and net zero by 2045) (Victorian State Government, 2023) against the 2005 baseline of 118 Mt/year.

For the duration of the Project, the total direct GHG emissions from the East Coast Project are estimated to be approximately 0.67% and 5.80% of the Australian and Victorian carbon budgets, respectively. The total indirect GHG emissions from the East Coast Project are estimated to be approximately 0.66% and 5.66% of the Australian and Victorian carbon budgets, respectively, the vast majority of which is attributable to the end use of gas for domestic electricity generation, industrial and residential use.

Within the OPP conservative emissions profiles have been estimated based on a scenario where all fields within scope are developed, and multiple fields are brought online simultaneously. As shown in the OPP, in this development scenario, and based on the gas reserves and rates we anticipate from each field, greenhouse gas emissions from the ECSP have the potential to exceed the safeguard threshold.

Exceedance of the safeguard threshold is not definitive at this stage of planning of the ECSP and is highly dependent on future detailed engineering and field sequencing which will determine when different fields within the ECSP will be brought online, as well as the volume and rate of gas that will be produced through the Athena Gas Plant. Though at this stage of planning, we consider it just as likely that emissions from the ECSP will not exceed the current safeguard threshold (because in the OPP we present a conservative emissions profile), it is also possible that the safeguard threshold could be lowered within the lifespan of the ECSP, over the next ~25 years.

Cooper Energy will engage with the Clean Energy regulator regarding facility boundaries for possible field development scenarios for the ECSP, to ensure the facility boundaries are appropriate under the NGER Act. Cooper Energy will refine production and emissions profiles as field development plans are matured and re-engage the Clean Energy Regulator where there is a risk that a safeguard threshold could be exceeded.

The predicted level of impact, i.e., the consequence of GHG emissions as a result of the East Coast Project is evaluated to be **Level 1**, based on:

- The minor contribution to Australian and Victorian carbon budgets to continue to meet demand to the south east domestic market, in alignment with the Governments' Future Gas Strategy.
- Cooper Energy having a robust emissions reduction process to monitor and address legislative requirements, and enable a systematic process to identify, assess and implement GHG emissions reduction opportunities, meaning the projects direct emissions will continue to be aligned with Australia's GHG emissions commitments.

  Since FY20 Cooper Energy has been certified carbon neutral by Climate Active in respect of its' scope 1, scope 2 and relevant scope 3 emissions[9]. This voluntary process includes calculating emissions, developing and implementing and emissions reduction strategy and using carbon offsets to compensate for the remaining emissions. The certification requires independent technical assessment and verification. It ultimately gives Cooper Energy a

[9] See Cooper Energy's 2023 Sustainability Report for detail.

detailed understanding of its emissions profile and provides a real cost of carbon for its business activities.

- Gas from the East Coast Project will be used exclusively within the domestic market, meaning the emissions associated with the end use of the product will fall exclusively within State and Commonwealth jurisdictions and be managed in line with Australia's emissions reduction targets, NDC under the Paris Agreement and in accordance with relevant GHG and emissions reduction legislation including the Safeguard Mechanism, *Climate Change Act 2022* (Cwth) and *Climate Change Act 2017* (Vic).

8.5.4.2 Risk: Change in Climate and Marine Systems

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (AR6) Working Group I was released in August 2021. The IPCC states with high confidence that many extreme heat events and global surface temperature rise would not have occurred without human influence and could be irreversible for several decades to millennia (IPCC, 2021).

This is reiterated in the AR6 Synthesis Report released in March 2023, "[H]uman activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850-1900 in 2011-2020. Global greenhouse gas emissions have continued to increase over 2010-2019, with unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumption and production across regions, between and within countries, and between individuals (high confidence). Human-caused climate change is already affecting many weather and climate extremes in every region across the globe" (IPCC, 2023).

According the AR6 Synthesis Report, heat extremes (including heatwaves) have become more frequent and more intense across most land regions since the 1950s while cold extremes have become less frequent and less severe. Marine heatwaves have approximately doubled in frequency since the 1980s. The frequency and intensity of heavy precipitation events have increased since the 1950s over most land areas for which observational data are sufficient for trend analysis. It is likely that the global proportion of major (Category 3–5) tropical cyclone occurrence has increased over the last four decades (IPCC, 2023).

Average sea surface temperature in the Australian region has warmed by 1.05°C since 1900, with eight of the 10 warmest years on record occurring since 2010 (BoM and CSIRO, 2022). A warming ocean affects the global ocean and atmospheric circulation, the cryosphere, global and regional sea levels, and causes losses in dissolved oxygen, impacts on marine ecosystems (BoM and CSIRO 2022), including changes to species abundance, community structure and increased frequency and intensity of thermally induced coral bleaching events (CSIRO, 2017).

Oceanic warming has also served to alter ocean currents around Australia. In response to both ocean warming and stratospheric ozone depletion, the East Australian Current has increased in strength by about 20% between 1978 and 2005 (Cai and Cowan, 2006). Sea surface temperatures are projected to continue to increase, with estimates of warming in the Southern Tasman Sea of between 0.6°C to 0.9°C and between 0.3°C to 0.6°C elsewhere along the Australian coast by 2030 (Church et al., 2006).

Global mean sea level increased by 0.20 m between 1901 and 2018. The average rate of sea level rise was 1.3 mm/year between 1901 and 1971, increasing to 1.9 mm/year between 1971 and 2006, and further increasing to 3.7 mm/ year between 2006 and 2018. Human influence was very likely the main driver of these increases since at least 1971 (IPCC, 2023).

Global mean sea level is predicted to rise between 0.18 m and 0.23 m by 2050, and between 0.38 m and 0.77 m by 2100 (IPCC, 2021). This global mean sea level rise is primarily caused by thermal expansion and mass loss from glaciers and ice sheets, with minor contributions from changes in land-water storage. Global mean sea level will continue to increase for centuries to millennia due to continuing deep ocean warming and ice sheet melt, and sea levels will remain elevated for thousands of years, at rates dependent on future emissions (IPCC, 2023). This will lead to some coastal inundation affecting mangroves, salt marshes and coastal freshwater wetlands. Furthermore, as CO2 is gradually absorbed by oceans and fresh water, the water becomes more acidic, which increases the solubility of calcium carbonate, the principal component of the skeletal material in aquatic organisms (Steffen et al., 2009).

The predicted level of impact, i.e., the consequence, of an impact on climate systems from an increase in GHG emissions as a result of the East Coast Project is evaluated to have a consequence of **Level 1**, based on:

- The minor contribution to Australian and Victorian carbon budgets to continue to meet demand to the south east domestic market, in alignment with the Governments' Future Gas Strategy.
- Gas from the East Coast Project will be used exclusively within the domestic market, meaning the emissions associated with the end use of the product will fall exclusively within State and Commonwealth jurisdictions and be managed in line with Australia's emissions reduction targets, NDC under the Paris Agreement and in accordance with relevant GHG and emissions reduction legislation including the Safeguard Mechanism, *Climate Change Act 2022* (Cwth) and *Climate Change Act 2017* (Vic).
- Cooper Energy having a robust emissions reduction process to monitor and acknowledge legislative requirements and enable a systematic process to identify, assess and implement GHG emissions reduction opportunities, meaning the East Coast Project's direct emissions will continue to be aligned with Australia's GHG emissions commitments. Since FY20 Cooper Energy has been certified carbon neutral by Climate Active in respect of its' scope 1, scope 2 and relevant scope 3 emissions10. This voluntary process includes calculating emissions, developing and implementing and emissions reduction strategy and using carbon offsets to compensate for the remaining emissions. The certification requires independent technical assessment and verification. It ultimately gives Cooper Energy a detailed understanding of its emissions profile and provides a real cost of carbon for its business activities.

8.5.4.3 Risk: Change in Ecosystems

As potential impacts to ecosystems due to GHG are driven by changes in climatic conditions they occur on a global scale and are not restricted to the vicinity of the emissions sources. Therefore this impact assessment considers ecosystems across Australia. Ecosystems that are particularly susceptible to adverse effects of climate change include alpine habitats, coral reefs, wetlands and coastal ecosystems, polar communities, tropical forests, temperate forests and arid and semi-arid environments (DoEE, 2019). In Australia, this includes coral reefs, alpine regions, rainforests, arid and semi-arid environments, mangroves, grasslands, temperate forests and sclerophyll forests. Future climate change (increased temperature and decreased, but more variable rainfall) has the potential to have a range of impacts on ecological factors and threaten biodiversity in the Australian Mediterranean ecosystem (CSIRO, 2017).

Redistribution and reorganisation of natural systems, driven by climate change is a major threat to biodiversity (Chapman et al., 2020). A report by Australia's Biodiversity and Climate Change Advisory Group summarises the potential impacts of climate change to marine and terrestrial species, habitats, and ecosystems across Australia (Steffen et al., 2009). The impacts to taxa are outlined in Table 8-45 and the impacts to ecosystems in Table 8-46.

[10] See Cooper Energy's 2023 Sustainability Report for detail.

Table 8-45: Overview of Impacts of Climate change to the Future Vulnerability of Particular Taxa (modified after Steffen et al., 2009)

Taxa	Potential Vulnerability
Mammals	Narrow-ranged endemics susceptible to rapid climate change in-situ; changes in competition between grazing macropods in tropical savannas mediated by changes in fire regimes and water availability; herbivores affected by decreasing nutritional quality of foliage because of CO_2 fertilisation.
Birds	Changes in phenology of migration and egg-laying; increased competition of resident species; breeding of waterbirds susceptible to reduction; top predators vulnerable to changes in food supply; rising sea levels affecting birds that nest on sandy and muddy shores, saltmarshes, intertidal zones, coastal wetlands, and low-lying islands; saltwater intrusion into freshwater wetlands affecting breeding habitat.
Reptiles	Warming temperatures may alter sex ratios of species with environmental sex determination to cope with warming in-situ.
Amphibians	Frogs may be the most at-risk terrestrial taxa. Amphibians may experience altered interactions between; pathogens, predators, and fires.
Fish	Freshwater species vulnerable to reduction in water flows and water quality; limited capacity for freshwater species to migrate to new waterways; all species susceptible to flow-on effects of warming on the phytoplankton base of food webs.
Invertebrates	Expected to be more responsive than vertebrates due to short generation times, high reproduction rates and sensitivity to climatic variables.
Plants	Climate change may impact various functional dynamics of plants due to changes in; increasing CO_2, fires, plant phenology and specific environmental characteristics.

Table 8-46: Projected Impacts of CO_2 Rise and Climate Change on Australian Ecosystems (modified after Steffen et al. 2009)

Key Component of Environmental Change	Projected Impacts of Ecosystems
Coral Reefs	
CO_2 increases leading to increased ocean acidity	Reduction in ability of calcifying organisms, such as corals, to build and maintain skeletons.
Sea surface temperature increases, leading to coral bleaching	If frequency of bleaching events exceeds recovery time, reefs will be maintained in an early successional state or be replaced by communities dominated by macroalgae. Temperature increases of 1°C above the long-term summer maximum for an area over 4-6 weeks is enough to cause mass coral bleaching and mortality (Baker et al., 2008; Hoegh-Guldberg, 1999; Hughes et al., 2017; Spalding and Brown, 2015). Coral mortality or die off following coral bleaching events can stretch across thousands of square kilometres of ocean (Gilmour et al., 2016; Hoegh-Guldberg, 1999; Hughes et al., 2017).
Ecosystems services	The impacts associated with a warming ocean, coupled with increasing acidification, are expected to undermine the ability of tropical coral reefs to provide habitat for fish and invertebrates, which together provide a range of ecosystem services such as food, livelihoods and coastal protection (Hoegh-Guldberg et al., 2018). Coral reefs are projected to decline by 70–90% as a result of 1.5°C of global warming (IPCC, 2023).
Oceanic Systems (including planktonic systems, fisheries, sea mounts and offshore islands)	
Ocean warming	Many marine organisms are highly sensitive to small changes in average temperature (1-2ºC), leading to effects on growth rates, survival, dispersal, reproduction and susceptibility to disease.
Changed circulation patterns, including	Distribution and productivity of marine ecosystems is heavily influenced by the timing and location of oceanic currents; currents transfer the reproductive phase of many

Key Component of Environmental Change	Projected Impacts of Ecosystems
increase in temperature stratification and decrease in mixing depth, and strengthening of the East Australia Current (EAC)	organisms. Climate change may suppress upwelling in some areas and increase it in others, leading to shifts in location and extent of productivity zones.
Changes in ocean chemistry	Increasing CO_2 in the atmosphere is leading to increased ocean acidity and a concomitant decrease in the availability of carbonate ions.
Estuaries and Coastal Fringe (including benthic, mangrove, saltmarsh, rocky shore, and seagrass communities)	
Sea level rise	Landward movement of some species as inundation provides suitable habitat, changes to upstream freshwater habitats will have flow-on effects to species.
Increase in water temperature	Impacts on phytoplankton production will affect secondary production in benthic communities. Mangrove ecosystems in Australia will face higher temperatures, increased evaporation rates and warmer oceans (McInnes, 2015) as well as an associated sea level rise (Hoegh-Guldberg et al., 2018).
Drought	Modelling indicates an increased likelihood of future severe and extended droughts across parts of Northern Australia (Dai, 2013). Consequently, mangrove ecosystems may increase their southern range because of warmer temperatures. However, higher temperatures and evaporation rates, and extended droughts could lead to die-offs in Northern Australia and a change in mangrove distribution and abundance (Duke et al., 2017). Mangrove systems should cope with rising sea levels by accumulating more peat or mud which will give them the opportunity to adjust to a rising sea level (Field, 1995).
Savannas and Grasslands	
Elevated CO_2	Shifts in competitive relationships between woody and grass species due to differential responses.
Increased rainfall in north and northwest regions	Increased plant growth will lead to higher fuel loads, in turn leading to fires that are more intense, frequent and occur over larger areas.
Tropical Rainforests	
Potential increases in frequency and intensity of fires	Increased probability of fires penetrating rainforest vegetation resulting in shift from fire-sensitive vegetation to communities dominated by fire-tolerant species.
Warming and changes in rainfall patterns	Potential increases in productivity in areas where rainfall is not limiting; reduced forest cover associated with soil drying projected for some Australian forests.
Seasonal variation	Changes in the timing of seasons (i.e., extended summers) could cause change in the seasonal response of plants, and alterations to species ranges and abundances (Hoegh-Guldberg et al., 2018).
Inland Waterways and Wetlands	
Reduction in precipitation, increased frequency and intensity of drought	Reduced river flows and changes in seasonality of flows.
Changes in water quality, including changes in nutrient flows, sediment, oxygen and CO_2 concentration	May affect eutrophication levels, incidence of blue-green algal outbreaks.
Sea level rise	Saltwater intrusion into low-lying floodplains, freshwater swamps and groundwater; replacement of existing riparian vegetation by mangroves.

Key Component of Environmental Change	Projected Impacts of Ecosystems
Arid and Semi-arid Regions	
Increasing CO_2 coupled with drying in some regions	Interaction between CO_2 and water supply critical, as 90% of the variance in primary production can be accounted for by annual precipitation.
Shifts in seasonality of intensity of rainfall events	Any enhanced runoff redistribution will intensify vegetation patterning and erosion cell mosaic structure in degraded areas. Changes in rainfall variability and amount will also impact on fire frequency. Dryland salinity could be affected by changes in the timing and intensity of rainfall.
Warming and drying, leading to increased frequency and intensity of fires	Reduction in patches of fire-sensitive mulga in spinifex grasslands potentially leading to landscape-wide dominance of spinifex.
Alpine and Montane Areas	
Reduction in snow cover depth and duration	Alpine systems are generally considered to be among the most vulnerable to future climate change (Hughes, 2003). The extent of true alpine habitat in Australia is very small (0.15% of Australian land surface) with limited high-altitude refuge (Hughes, 2003). Australian alpine regions are home to a variety of alpine vertebrates who rely on snow cover for their survival. Potential loss of species dependent on adequate snow cover for hibernation and protection from predators; increased establishment of plant species at higher elevations as snowpack is reduced. There is evidence of a reduction in populations of dusky antechinus, broad-toothed rats, and the mountain pygmy possum. The first two species are active under the snow throughout the winter season and are therefore subject to increased predation by foxes when snow is reduced (Hughes, 2003).

Extensive modelling and monitoring studies over the last twenty years provide considerable evidence that climate change is already affecting and will continue to affect species globally (Hoegh-Guldberg et al., 2018) however, these impacts are likely to be highly species-dependent and spatially variable. The most frequently observed and cited ecological responses to climate change include species distributions shifting towards the poles, upwards in elevation and shifts in phenology (Dunlop et al., 2012). Climate change may not only change species distributions but also life-history traits such as migration patterns, reproductive seasonality and sex-ratios (Table 8-45).

All terrestrial ecosystems are likely to be impacted by a changing climate (Table 8-46; Steffen et al., 2009; Hughes, 2011; Dunlop et al., 2012; Hoegh-Guldberg et. al., 2018). The predicted impact of climate change on these ecosystems is highly variable, both between ecosystems and within individual ecosystems (Dunlop et al., 2012). Impacts of climate change such as altering temperature, rainfall patterns and fire regimes are likely to lead to changes in vegetation structures across terrestrial ecosystems within Australia (Table 8-46, Dunlop et al., 2012). Increases in fire regimes will impact Australian ecosystems altering composition structure, habitat heterogeneity and ecosystem processes. Changes in climate variability, as well as averages, could also be important drivers of altered species interactions, both native and invasive species (Dunlop et al., 2012). Climate change could result in significant ecosystem shifts, as well as alterations to species ranges and abundances within those ecosystems (Hoegh-Guldberg et al., 2018).

The IPCC Special Report describes impacts of warming above pre-industrial levels to key receptor groups including terrestrial ecosystems, mangroves, warm-water corals, unique and threatened systems, and arctic regions (Hoegh-Guldberg et al. 2018). These receptor groups show varying sensitivity to warming conditions, with a range of responses shown at 1°C warming; from corals suffering moderate impacts, to mangroves not showing any detectable impacts that can be attributed to climate change (Hoegh-Guldberg et al. 2018). Once warming reaching 1.5°C, all receptor groups show impacts attributable to climate change with severity ranging from moderate impacts that are detectable and attributable to climate change (mangroves), to impacts that are severe and widespread (warm-water corals) (Hoegh-Guldberg et al. 2018). At the point where global temperature rise, due to climate change, reaches 2°C, increasing numbers of receptor groups suffer impacts which are high to very high, and likely to be irreversible (terrestrial ecosystems, warm-water corals, unique and threatened systems, and arctic regions) (Hoegh-Guldberg et al., 2018).

The State of the Environment (SoE) report is produced every five years by the Australian Government as a comprehensive review on the state of the Australian environment. The most recent report was released in July 2022. The SoE concluded that climate change and extreme weather events were impacting the Australian environment and especially impacting various taxa (DCCEEW, 2021). In many cases, the impacts of climate change on biodiversity are exacerbated by other pressures such as land clearing and invasive species, but in some cases, impacts can be unequivocally attributed to climate change. A summary of the SoE impacts from climate change is provided in Table 8-47.

Table 8-47: Summary of SoE Report Conclusions on Climate Change Impacts

Taxa	Potential Vulnerability
Mammals	Terrestrial mammals are subject to ongoing population declines due to climate change and changes within habitats
Birds	There is strong evidence of population declines in threatened bird species, waterbirds and migratory birds. Various extensive and persistent impacts contribute to declines, including climate change (particularly drought) and extreme events, habitat degradation, and invasive predators.
Reptiles	Reptile species in all areas of Australia have an increasing risk of extinction. Risk of extinction was recognised as primarily related to ongoing pressure from invasive predators, but compounded by pressure from habitat modification, climate change (particularly drought) and disease. Half of Australian freshwater turtle species are in drastic population decline due to climate change.
Amphibians	Droughts and fires are increasing pressures within habitats that impact amphibian species. The number of known threatened amphibian species, including those that are Critically Endangered in Australia, is increasing. Drought and fire are recognised as increasing pressures contributing to this decline.
Fish	Freshwater fish throughout Australia have more than a 50% risk of extinction in the next 20 years due to climate change and changes within freshwater habitats.
Invertebrates	Most threatened invertebrates are suffering from largescale habitat degradation and loss of biodiversity Changes in regional temperature, humidity and rainfall impact their distribution, development and reproduction.
Plants	Habitat destruction is the leading cause of vulnerability within plant species. However, changes in temperature, rainfall and fire regimes are contributing threats to plant species. Alpine ecosystems and biodiversity in Australia are particularly vulnerable to climate change that affects snow depth and the spatial and temporal extent of snow, which have all declined since the late 1950s.

Many EPBC protected species, including marine migratory seabirds, seabirds, turtles and whales have been identified as susceptible to climate change and climate variability in EPBC management plans, see Table 2-3. EPBC management plans identify ways that climate change and variability can impact species such as, reducing the extent of coastal nesting and foraging habitat, reducing prey abundance and distribution and influencing the timing of important behaviours such as breeding and migration.

Many EPBC protected species, including marine migratory seabirds, seabirds, turtles and whales have been identified as susceptible to climate change and climate variability in EPBC management plans, see Table 2-3. EPBC management plans identify ways that climate change and variability can impact species such as, reducing the extent of coastal nesting and foraging habitat, reducing prey abundance and distribution and influencing the timing of important behaviours such as breeding and migration.

The predicted level of impact, i.e., the consequence, of an impact on ecosystems from an increase in GHG emissions as a result of the East Coast Project is evaluated to have a consequence of **Level 1**, based on:

- The minor contribution to Australian and Victorian carbon budgets to continue to meet demand to the south east domestic market, in alignment with the Governments' Future Gas Strategy.
- Gas from the East Coast Project will be used exclusively within the domestic market, meaning the emissions associated with the end use of the product will fall exclusively within State and Commonwealth jurisdictions and be managed in line with Australia's emissions reduction targets, NDC under the Paris Agreement and in accordance with relevant GHG and emissions reduction legislation including the Safeguard Mechanism, *Climate Change Act 2022* (Cwth) and *Climate Change Act 2017* (Vic).
- Given the minor contribution to carbon budgets, the indirect emissions are not a substantial cause of the physical effects of climate change on MNES. Therefore these physical effects are not considered impacts, as per s527E of the EPBC Act.
- Cooper Energy having a robust emissions reduction process to monitor and acknowledge legislative requirements and enable a systematic process to identify, assess and implement GHG emissions reduction opportunities, meaning the East Coast Project's direct emissions will continue to be aligned with Australia's GHG emissions commitments.
- Since FY20 Cooper Energy has been certified carbon neutral by Climate Active in respect of its' scope 1, scope 2 and relevant scope 3 emissions[11]. This voluntary process includes calculating emissions, developing and implementing and emissions reduction strategy and using carbon offsets to compensate for the remaining emissions. The certification requires independent technical assessment and verification. It ultimately gives Cooper Energy a detailed understanding of its emissions profile and provides a real cost of carbon for its business activities.

8.5.4.4 Risk: Change in Socio-economic Factors

Changes to climate can result in an impact to social receptors that have values which include the ecological receptors previously discussed. This includes KEFs and AMPs. Climate change also impacts on the functions, interests or activities of other users which rely on ecological values, including commercial and recreational fisheries and tourism.

The social receptors that may be impacted in the region of this activity are discussed in Section 6.7.

The predicted level of impact, i.e. the consequence, of an impact on socio-economic factors from an increase in GHG emissions as a result of the East Coast Project is evaluated to have a consequence of Level 1, based on:

- The minor contribution to Australian and Victorian carbon budgets to continue to meet demand to the south east domestic market, in alignment with the Governments' Future Gas Strategy.
- Gas from the East Coast Project will be used exclusively within the domestic market, meaning the emissions associated with the end use of the product will fall exclusively within State and Commonwealth jurisdictions and be managed in line with Australia's emissions reduction targets, NDC under the Paris Agreement and in accordance with relevant GHG and emissions reduction legislation including the Safeguard Mechanism, *Climate Change Act 2022* (Cwth) and *Climate Change Act 2017* (Vic).

[11] See Cooper Energy's 2023 Sustainability Report for detail.

- Given the minor contribution to carbon budgets, the indirect emissions are not a substantial cause of the physical effects of climate change on MNES. Therefore these physical effects are not considered impacts, as per s527E of the EPBC Act.
- Cooper Energy having a robust emissions reduction process to monitor and acknowledge legislative requirements and enable a systematic process to identify, assess and implement GHG emissions reduction opportunities, meaning the East Coast Project's direct emissions will continue to be aligned with Australia's GHG emissions commitments.
- Since FY20 Cooper Energy has been certified carbon neutral by Climate Active in respect of its' scope 1, scope 2 and relevant scope 3 emissions[12]. This voluntary process includes calculating emissions, developing and implementing and emissions reduction strategy and using carbon offsets to compensate for the remaining emissions. The certification requires independent technical assessment and verification. It ultimately gives Cooper Energy a detailed understanding of its emissions profile and provides a real cost of carbon for its business activities.

8.5.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-48.

Table 8-48: GHG emissions acceptability assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Impact: Increase in GHG emissions	Consequence: Low
	Risk: Change in climate and marine systems	Level 1
	Risk: Change in ecosystem	Level 1
	Risk: Change in socio-economic factors	Level 1
Principles of ESD	A) 'Integration principle' Decision-making processes should effectively integrate long-term and short-term economic, environmental, social, and equitable considerations. The East Coast Project is consistent with the principle of ESD (a) for this aspect as: Cooper Energy integrates long and short-term economic, environmental, social and equity considerations, providing the framework, policies and processes to guide responsible decision making and subsequent implementation. East Coast Project will contribute to alleviating the gas supply shortfall identified in the GSOO (AEMO, 2024) and the Australian Governments Future Gas Strategy (DISR, 2024) which confirms gas as a key transition and firming fuel. The implementation is consistent with Australian and Victorian legislative requirements which transition electricity producers and large emitters to reduce emissions to meet Australia's NDC. As well as delivering energy to the Australian market, Cooper Energy's strategy is aimed at aligning with the energy and decarbonisation needs of Australia. For this reason, Cooper Energy implements its' Emissions Management Process, which	

[12] See Cooper Energy's 2023 Sustainability Report for detail.

Acceptability Criteria	Demonstration of Acceptability
	provides a framework for identifying, assessing and implementing emissions reduction opportunities and aligning these activities with other business processes.
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • The environmental impact of climate change is well understood and there are acceptable levels of impact established by the Paris Agreement and the EPBC Act. • The proposed control measures outlined below manage the threat of serious or irreversible environmental damage. Therefore, the East Coast Project is consistent with Australia's NDC, and the project is aligned with Paris Agreement and consistent with the EPBC Act. • The greatest consequence ranking for the risks associated with increasing GHG emissions was Level 1 and the highest inherent risks for GHG emissions was evaluated as low, therefore, GHG emissions from the East Coast Project will not result in serious or irreversible environmental damage.
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • East Coast Project will contribute to alleviating the gas supply shortfall identified in the GSOO (AEMO, 2024) and is aligned with the Australian Government's Future Gas Strategy (DISR, 2024) which confirms gas as a key transition and firming fuel. • Cooper Energy's processes, particularly it's emissions reduction process, ensures that the East Coast Project's direct emissions will continue to be aligned with Australia's GHG emissions commitments, which may evolve over the lifecycle of the project. • Gas from the East Coast Project will be used exclusively within the domestic market, meaning the emissions associated with the end use of the product will fall exclusively within State and Commonwealth jurisdictions and be managed in line with Australia's emissions reduction targets, NDC under the Paris Agreement and in accordance with relevant GHG and emissions reduction legislation including the Safeguard Mechanism, *Climate Change Act 2022* (Cwth) and *Climate Change Act 2017* (Vic). The domestic only use of the gas product within the context of such emissions reduction frameworks reduces the risks and impacts associated with climate change. • The highest inherent risks for GHG emissions was evaluated as low and therefore will not forego the health, diversity and productivity of the environment for future generations.
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect by: • adopting the United Nations' definition on Sustainable Development • the implementation of CEMS which drives the company to reduce impacts to ALARP and acceptable levels • specialist environment input and support • recording, reporting, investigation and management of incidents in accordance with Cooper Energy requirements

Acceptability Criteria	Demonstration of Acceptability		
	• maintaining a working knowledge of legal and statutory Environmental obligations • monitoring, evaluating and reporting environmental performance. • The relevant environmental values and sensitivities to GHG emissions were evaluated in Section 8.5.4 and the highest inherent risk for GHG emissions was evaluated as Low.		
	E) 'Valuation principle' Improved valuation, pricing and incentive mechanisms should be promoted. The East Coast Project is consistent with the principle for ESD (e) for this aspect by: The East Coast Project, including downstream indirect emissions, are governed by Australia's emissions management regulatory framework, including the Safeguard Mechanism. This incentivizes and necessitates business to transition to net zero. Since FY20 Cooper Energy has been certified carbon neutral by Climate Active in respect of its' scope 1, scope 2 and relevant scope 3 emissions[13]. This voluntary process includes calculating emissions, developing and implementing and emissions reduction strategy and using carbon offsets to compensate for the remaining emissions. The certification requires independent technical assessment and verification. It ultimately gives Cooper Energy a detailed understanding of its emissions profile and provides a real cost of carbon for its business activities.		
Legislative and Other requirements	Requirement	Relevant Objective / Action	Demonstration of Requirement
	Climate Change Act 2022 (Cwth)	Objective: Sets out Australia's GHG emissions reduction targets in a manner consistent with the Paris Agreement and Australia's NDCs. Management action: The Cooper Energy Emissions Management Process acknowledges legislative requirements and establishes a systematic process to identify, assess and implement GHG emissions reduction opportunities through a project's life cycle. The process sets a continual improvement cycle such that new technologies and approaches can be incorporated as they are developed. It ensures the East Coast Project's direct emissions will continue to be aligned with the Commonwealth's GHG legislative requirements, however these may evolve over the lifecycle of the project.	Adoption of the following control measures: CM1: Marine Assurance Process C5: Cooper Energy Emissions Management Process
	Climate Change Act 2017 (Vic)	Objective: provides Victoria with the legislative foundation to manage climate change risks, maximise opportunities	

[13] See Cooper Energy's 2023 Sustainability Report for detail.

Acceptability Criteria	Demonstration of Acceptability		
		that arise from decisive action, and drive the transition to a climate-resilient and net zero emissions by 2050. Management action: The Cooper Energy Emissions Management Process acknowledges legislative requirements and establishes a systematic process to identify, assess and implement GHG emissions reduction opportunities through a project's life cycle. The process sets a continual improvement cycle such that new technologies and approaches can be incorporated as they are developed. It ensures the East Coast Project's direct emissions will continue to be aligned with Victoria's GHG emissions legislative requirements, however these may evolve over the lifecycle of the project.	
	NGER Act and NGER Regulations 2008	Objective: single national framework for reporting company information about GHG emissions, energy production and energy consumption. Management action: Because NGER reporting is a regulatory requirement, no specific control measure has been adopted for this requirement.	
	Safeguard Mechanism rule 2015 (Cwth)	Objective: Key statutory instruments for regulating Australia's GHG emissions in line with Australia's NDCs under the Paris Agreement. Currently applies to facilities that emit more than 100,000 tCO_{2}-e of scope 1 emissions per annum, which may be the case during some years of the East Coast Supply Project. Management action: Cooper Energy monitors the status of its NGER facilities and legislative changes that may affect Safeguard eligibility.	
	Marine Order 97: Marine Pollution Prevention – Air Pollution	Objective: prevention of air pollution from vessels Management action: Vessels will comply with Marine	

Acceptability Criteria	Demonstration of Acceptability		
		Orders – Part 97: Marine Pollution Prevention – Air Pollution (as appropriate to vessel class) for emissions from combustion of fuel including: • Hold a current international energy efficiency certificate. • Have a Ship Energy Efficiency Management Plan (SEEMP) as per MARPOL 73/78 Annex VI.	

Internal Context	Since FY20 Cooper Energy has been certified carbon neutral by Climate Active in respect of its' scope 1, scope 2 and relevant scope 3 emissions[14]. This voluntary process includes calculating emissions, developing and implementing and emissions reduction strategy and using carbon offsets to compensate for the remaining emissions. The certification requires independent technical assessment and verification. It ultimately gives Cooper Energy a detailed understanding of its emissions profile and provides a real cost of carbon for its business activities. Cooper Energy's 'Climate Action Policy' outlines the Company's objective to commit to sustainable development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The Policy outlines three purpose statements:
	• To provide clean, reliable, and affordable energy, focused on south-eastern Australia, with active participation in society's decarbonisation journey.
	• To inspire our people to contribute to future energy solutions for our customers and our communities.
	• To operate in innovative and responsible ways, with an emphasis on care, shareholder value and sustainability.
	The Policy also commits the company to the following:
	• Recognise the important role of renewables and the key role gas plays in complementing and supporting the deployment of renewable technologies.
	• Making our contribution to a low emissions economy by prioritising Environmental, Social and Governance (ESG) with investment in offset projects and consideration of future sustainable energy projects.
	• Identify and, where practicable, implement opportunities for GHG emission reduction within our operations and through our supply chain.
	• Factor carbon pricing into business decisions and commercial models.
	• Identify, manage and mitigate material climate change risks to our activities.
	• Voluntarily align our climate change related disclosures, including our emissions, with the principles of ESD.
	• Disclose Cooper Energy's governance around climate change, including:
	  ○ material short, medium and long-term climate-related risks and opportunities on our business, strategy and financial planning and
	  ○ the resilience of our strategy, taking into account different climate scenarios, including Paris-aligned scenarios.
	• Align with our customers' sustainability and emissions reduction initiatives which will enable collaboration to address the broader challenge of reducing downstream indirect emissions.
	• Work with governments and stakeholders in the design of climate change regulation and policies and		

[14] See Cooper Energy's 2023 Sustainability Report for detail.

Acceptability Criteria	Demonstration of Acceptability
	• Cooper Energy's Risk and Sustainability Committee oversights the Company's sustainability policies and practices. Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).
External Context	Stakeholder feedback received. DEECA Earth Resources Regulator has advised that the OPP should consider the Victorian Gas Substitution Roadmap. As outlined in Section 8.5.2.1, the development of progressive drilling and production campaigns for the East Coast Project is conducted in response to supply demands and therefore consistent with the Gas Substitution Roadmap. AEMO in the GSOO 2024 identified that the gas supply in southern Australia is declining faster than projected demand (AEMO, 2024). As Australia transforms to meet a net zero emissions future, gas will continue to complement zero emissions and renewable forms of energy, and to provide a reliable and dispatchable form of electricity generation for domestic and industrial users and may provide potential pathways to incorporate hydrogen and other 'green' gases within Australia's energy landscape. The AEMO report '2022 Integrated Systems Plan' for the National Electricity Market is described by DCCEEW as Australia's roadmap to Net Zero. The report anticipates a continued critical role for gas-fired power generation for peak loads and firming through the time horizon to 2050, and describes how, over time, gas fired generation emissions will need to be offset elsewhere. Cooper Energy has already begun establishing the mechanisms to enable this, via detailed calculation and public reporting of its downstream scope 3 emissions intensity. In the 2024 report, AEMO states that despite falling gas consumption, investments are needed in the near term to ensure operational solutions to improve supply from 2026. Projections for gas demand in the SE Australian market are in the region of ~380 PJ / year and ~4000 PJ in aggregate over the next decade. Gas demand under accelerated energy transition scenarios may reduce the demand; Victoria's gas substitution roadmap predicts, for a rapid transition scenario, gas demand in the order of 1800 PJ in aggregate over the next decade (DELWP, 2022). Gas supplied from East Coast Project are projected to provide around 180 PJ aggregated gas into the SE market between 2022 and 2034, representing a small but crucial proportion of the projected domestic demand, via local, established infrastructure. Cooper Energy recognises the need to decarbonise as a responsible corporate citizen and consistent with the precautionary principle, a defining principle of ESD, has implemented measures to reduce the threat of serious or irreversible environmental degradation resulting from its direct GHG emissions. The activity will be undertaken in a manner consistent with relevant legislation, industry standards and guidelines, offshore practices and benchmarking. Emissions, energy consumption, and energy production data will be reported annually to the Clean Energy Regulator in accordance with the NGER requirements. Many of the Cooper Energy's customers (who generate indirect emissions by using products produced by this activity) are governed by the Safeguard Mechanism. The Safeguard Mechanism establishes a GHG baseline. Baseline exceedance is required to be offset through the purchase of carbon credits; the cost of the carbon credits provides a cost stimulus to abate emissions consistent with the baseline. The current Safeguard Mechanism reform is "to deliver emissions reductions consistent with Australia's Nationally Determined Contribution under the Paris Agreement" (DCCEEW, 2023p), 43% below 2005 levels by 2030 and the long-term goal of net zero emissions by 2050.
Predicted impact compared to	The defined acceptable level of impacts relevant to GHG emissions are AL7, AL8 and AL9 identified in Table 8-49. These acceptable levels defined for an increase in GHG

Acceptability Criteria	Demonstration of Acceptability
Defined Acceptable Level	emissions, a change in climate systems, ecosystems and socio-economic factors are defined in Table 7-6. The worst-case predicted impacts assessed in Section 8.5.4 are: • Given the minor contribution to carbon budgets, the indirect emissions are not a substantial cause of the physical effects of climate change on MNES. Therefore these physical effects are not considered impacts, as per s527E of the EPBC Act. • The minor contribution to Australian and Victorian carbon budgets to continue to meet demand to the south east domestic market, is in alignment with the Governments' Future Gas Strategy. • Cooper Energy only supplies the domestic Australian market, has a robust emissions reduction program, and since FY20 Cooper Energy has been certified carbon neutral by Climate Active in respect of its' scope 1, scope 2 and relevant scope 3 emissions. • The highest consequence ranking for GHG emissions was evaluated as Level 1 and the highest inherent risks for GHG emissions was evaluated as Low. Therefore, at its worst-case, the predicted impact from GHG emissions would not: • Contribute to Australia's GHG emissions such that it prevents Australia from meeting greenhouse gas commitments as per the Paris Agreement, *Climate Change Act 2022* and *Climate Change Act 2017*. • Have a significant contribution to GHG emissions such that it prevents the conservation of biodiversity, maintenance of ecosystem health or protection of threatened species. • Have a significant contribution to GHG emissions such that the rights of other marine users are compromised or there are substantial adverse effects on the sustainability of commercial fisheries. Therefore, the predicted level of impact due to GHG emissions from the East Coast Project is at or below the defined acceptable levels. Application of the Safeguard Mechanism to ECSP emissions Within the OPP conservative emissions profiles have been estimated based on a scenario where all fields within scope are developed, and multiple fields are brought online simultaneously. As shown in the OPP, in this development scenario, and based on the gas reserves and rates Cooper Energy anticipate from each field, greenhouse gas emissions from the ECSP have the potential to exceed the safeguard threshold. Exceedance of the safeguard threshold is not definitive at this stage of planning of the ECSP and is highly dependent on future detailed engineering and field sequencing which will determine when different fields within the ECSP will be brought online, as well as the volume and rate of gas that will be produced through the Athena Gas Plant. Though at this stage of planning, we consider it just as likely that emissions from the ECSP will not exceed the current safeguard threshold (because in the OPP we present a conservative emissions profile), it is also possible that the safeguard threshold could be lowered within the lifespan of the ECSP, over the next ~25 years. Cooper Energy will engage with the Clean Energy regulator regarding facility boundaries for possible field development scenarios for the ECSP, to ensure the facility boundaries are appropriate under the NGER Act. Cooper Energy will refine production and emissions profiles as field development plans are matured and re-engage the Clean Energy Regulator where there is a risk that a safeguard threshold could be exceeded.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to GHG emissions are acceptable, based on: • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advice, and significant impact guidelines for MNES.

Acceptability Criteria	Demonstration of Acceptability
	• Feedback received from stakeholders has been considered within the assessment of impacts, risks and project need and acceptability described above. To manage impacts to receptors to or below the defined acceptable levels the following EPO have been applied: **EPO8**: Manage direct and indirect GHG emissions from the East Coast Project consistent with Australia's international GHG emissions commitments, as outlined in the *Climate Change Act 2022* (Cwth).

8.5.6 Environmental Performance

Table 8-49 lists the acceptable level and EPO defined for GHG emissions and the adopted control measures to achieve the outcome.

Table 8-49: Environmental Performance Summary – GHG emissions

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL7: GHG Emissions from activities defined in this OPP will not prevent Australia from meeting greenhouse gas commitments as per the Paris Agreement, *Climate Change Act 2022* and *Climate Change Act 2017*. **AL8:** GHG emissions from activities defined in this OPP will not prevent Australia from meeting its GHG commitments under relevant climate legislation (including the Paris Agreement), therefore will not prevent the conservation of biodiversity, maintenance of ecosystem health or protection of threatened species. **AL9:** GHG emissions from activities defined in this OPP will not prevent Australia from meeting its GHG commitments under relevant climate legislation (including the Paris Agreement), therefore will not compromise the rights of other marine users or result in substantial adverse effects on the sustainability of commercial fisheries.	**EPO8**: Manage direct and indirect GHG emissions from the East Coast Project consistent with Australia's international GHG emissions commitments, as outlined in the *Climate Change Act 2022* (Cwth).	CM1: Marine Assurance Process AMSA Marine Order 97 Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel including: Hold a current international energy efficiency certificate. Have a Ship Energy Efficiency Management Plan (SEEMP) as per MARPOL 73/78 Annex VI.
		CM5: Cooper Energy Emissions Management Process The Cooper Energy Emissions Management Process acknowledges legislative requirements and establishes a systematic process to identify, assess and implement GHG emissions reduction opportunities throughout a project's life cycle. The process sets a continual improvement cycle such that new technologies and approaches can be incorporated as they are developed. The objectives of the Emissions Management Process are to: • Identify requirements relating to GHG emissions reduction. • Provide a framework for identifying, assessing and implementing emissions reduction opportunities. • Align emissions reduction activities with other business processes.

8.6 Planned Discharges – Drilling

8.6.1 Cause of Aspect

Drilling activities will generate drill cuttings, drilling fluids, cement, control fluids and completion fluids. When working in offshore regions, these materials and fluids are typically discharged into the marine environment, ensuring any limitations defined during the EP process are not exceeded.

Phases and associated activities that will generate drilling discharges are identified in Table 8-50, and described in further detail in subsections below.

Table 8-50: Activities undertaken in the East Coast Project that may result in drilling discharges

Cause of Aspect / Phase	Activity Component
Well Construction	Drilling operations
	BOP installation and testing
	Drilling cuttings and fluids
	Cementing operations
	Well completions
	Well suspension
Operations	Well intervention
Decommissioning	Well abandonment

8.6.2 Aspect Characterisation

8.6.2.1 Well Construction

The proposed East Coast Project plans to drill up to 15 production wells within the scope of this OPP. As described in Section 1.3.2, 3 of the wells may be drilled as exploration wells, with their construction provided for an Exploration EP, or, subject to further field development planning, as development wells. The latter scenario is included within the scope of the OPP. Activities subsequent to well construction, associated with the tie-in, operation and decommissioning of these wells are also in scope of the OPP.

Drilling activities are conducted from a MODU. The MODU may be at the well location for ~60 days. Drill cuttings, drilling fluids, cement, control fluids and completion fluids are discharged to surface waters or at the seabed depending on the stage of the drilling operations. Collectively, these discharges are herein termed drilling discharges. Details of each drilling discharge is described below:

- **Drill cuttings:** these comprise sediment and small rock chips generated by drilling into the seabed.
- **Drilling fluids**: often referred to as drilling muds, are a specialist mix of seawater, clay (or gel) and weighting additives such as barite, salt and chalk. Standard additives to the drilling fluids include polymer and polyamine to control fluid loss, viscosity and provide further formation inhibition. Drilling fluids perform a variety of functions such as cooling and lubricating the drill bit, transporting drill cuttings to the surface, and maintaining hydrostatic pressure higher than formation pressure which manages the risk of the uncontrolled influx of hydrocarbons into the wellbore.
- **Cement:** used during drilling to seal the casing of each section is a mixture of dry cement, additives, and water. The dry cement is generally Portland Cement and contains other minor components including crystalline silica.
- **Control fluids**: BOPs are typically controlled and operated using glycol-based control fluids; these are generally soluble/miscible in/with water and may contain additives such as corrosion inhibitors and dye.
- **Completion fluids:** completion fluids may be sodium chloride (NaCl) or potassium chloride (KCl) based with biocide and oxygen scavenger components. Completion fluids are used manage integrity of the wellbore and associated steel casing/tubing.

Table 8-51 details and lists drilling activities with discharges to surface waters and at the seabed.

Table 8-51: Volumes and location of drilling discharges

Activity Component	Discharge Type	Description of Discharge	Volume (approx. per well)
Surface water drilling discharges			
Bottom-hole drilling	Drill cuttings	Drill cuttings returned to the MODU will be processed through solids control equipment. Processed drill cuttings will be discharged below the water line.	~180 m^3
	Drill fluids	Drill fluids are separated from drill cutting when processed through the solids control equipment. Drill fluids that have reach the end of their usable life are discharged to surface waters.	~2,000 m^3, at 10-100 m^3 batched intervals
Cementing operations	Dry cement	Small amounts of dry cement will be released from dry bulk storage tank venting pipes.	Negligible
	Cement slurry	Cement slurry flushed overboard from the cement unit during testing.	~8 m^3
	Cement slurry	Cement slurry flushed overboard from the cement unit during cleaning.	<3m^3
Well completions	Completion fluids	Fluids not suitable for reuse are discharged overboard.	~500 m^3
Well suspension	Completion fluids	Prior to well shut-in, the well and SST barriers will be tested, and completion fluids may be flushed to sea.	~220 m^3
Seabed drilling discharges			
Top-hole drilling	Drill cuttings	Top-hole drilling will discharge cuttings from the wellbore and drilling fluids to the seabed.	~150 m^3
	Drill fluids		~1,500 m^3, at 10-100 m^3 batched intervals
BOP installation, testing	Control fluid	Control fluid will be discharged at the BOP located near the seabed during BOP testing and operation. 2-3 tests may be completed per well depending on construction duration.	~2.5 m^3/test
Cementing operations	Cement	Displacement fluid is pumped into the casing to displace cement out of the bottom of the casing. The direct footprint of the 'overflow' cement on the seabed is a 10 to 50 m radius from the well.	up to 40 m^3

8.6.2.2 Operations

During the operations phase, well intervention activities may be required for wellbore maintenance and repair. The frequency of well intervention activities will depend on well performance. Well intervention activities may result in discharge of completion and control fluids (Table 8-51). Completion fluids not suitable for reuse are discharged overboard with indicative volumes being ~500 m^3. Control fluids discharged near the seabed may occur during well testing activities i.e., BOP test resulting in control fluid discharge of ~2.5 m^3/test.

8.6.2.3 Decommissioning

Abandonment activities will be assisted by a MODU, and operations are expected to occur for ~25 days per well. Well abandonment operations involve setting a series of cement and mechanical plugs within the wellbore, to ensure isolation of the reservoir and mitigate the risk of reservoir fluid release into the marine environment. Plugs are then tested to confirm integrity. Well abandonment operations may result in the discharge of fluids (treated sea water, completions fluids, drilling fluids) as well as cement discharges (Table 8-51). A maximum of 15 wells will be abandoned under this OPP.

8.6.2.4 Concurrent activities

There will not be any concurrent drilling activities for the East Coast Project; as there would only ever be one MODU in the operational area at a time.

8.6.3 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from drilling discharges are:

- Change in water quality
- Change in sediment quality
- Change in benthic habitat.

Potential risks:

- Injury/mortality to marine fauna.

Socio-economic impacts on commercial fisheries have not been evaluated further, as there are no discernible impacts to behaviour or distribution expected at the population level given the limited nature and scale of activities associated with drilling discharges.

8.6.4 Impact and Risk Evaluation

8.6.4.1 Impact: Change in Water Quality

Inherent Consequence Evaluation

Intermittent drilling discharges will result in localised and temporary change in water quality from the discharge of cuttings, fluids and cement into the water column. The fate of drilling discharges to the sea has been studied extensively and indicate changes in water quality are temporary, associated with the increase in turbidity in the water column whilst the discharges disperse (Sanzone et al., 2016).

Surface water and seabed drilling discharges will temporarily elevate turbidity levels in surrounding waters. Drilling discharges will form a plume in the water column. This plume will contain cuttings, fluids and/or cement particles that will elevate the turbidity of surrounding waters. Turbidity of the drilling discharges plume is expected to be intermittent, and brief based on discharge durations and dispersion fates. The drilling discharge plumes will be heavily influenced by the prevailing currents which will disperse and dilute the plume in receiving waters (Sanzone et al., 2016).

A study conducted in the Northwest Shelf modelled and surveyed the fate of drill cuttings and fluids for three wells with a total discharge volume of 1,543 m^3 in water depths ranging from 20 to 120 m, and current speeds at ~0.11-0.38 m/s (Jones et al. 2021). With the cutting discharge rates ranging from ~0.8 kg/s to 9.3 kg/s, the study found sporadic and intermittent Total Suspended Solid (TSS) concentrations exceeded 600 mg/L close to the discharge outlet and dropped to 15 mg/L ~1000 m from the discharge point lasting over a period of minutes for each discharge event (Jones et al. 2021).

In context, water column turbidity on the Victorian coastline is subject to high natural variability. Wave-driven sediment resuspension generates high turbidity levels within coastal zones, commonly exceeding 50 mg/L (Section 6.4.6). The Bass Strait is a high-energy environment with average current speeds in the area range between 0.15 m/s to 0.24 m/s (Section 6.4.5.1).

As the water depths (~55-85 m) and current spends (0.15-0.24 m/s) of the East Coast Project are within the range of the study (Jones et al., 2021), assuming similar cutting discharge rates of 0.8-9.3 kg/s, the dispersion extents in Jones et al., 2021 are considered representative. It is expected that drilling discharges during the East Coast Project could increase turbidity levels in surrounding waters to up ~1000 m from the discharge point over a period of minutes, though would more likely reduce quickly to the point where changes would not be discernible from the background turbidity levels and high natural variability offshore Victoria.

Discharges of the nature described for this project have been undertaken historically in the region, and have been shown to result in little to no impact on water or sediment quality and associated amenity (Section 6.4.6 and Section 6.4.7).

Residual barite, bentonite and brine may also be discharged at the end of drilling as a slurry. Barite will have very low concentrations of mercury (Hg) and cadmium (Cd) (less than 1 mg/kg and 3 mg/kg, respectively). Crecelius et al. (2007) recorded the solubility of barite and trace metal compounds and observed that 1% of mercury and 15% of the cadmium dissolved from the barite after one week of exposure to the marine environment. As such, change to the water quality is anticipated to be negligible.

Biocides and chemical additives in drilling fluids are selected in accordance with the Cooper Energy Offshore Chemical Procedure to ensure ecotoxicity profiles are of an acceptable level, and that products with lower ecotoxicity profiles are selected. For context, chemicals that are highly toxic, highly bioaccumulative and highly persistent in the project and environment setting, would not be selected if they were to be discharged, and those with the lowest ecotoxicity profiles preferentially selected, where they also meet technical requirements.

Given that drilling discharges during the East Coast Project are related to activities that are intermittent, brief and result in localised changes to water quality (increase in turbidity within ~1000 m from the discharge point), the consequence of this impact has been evaluated as **Level 1**, as water quality levels will return to existing ambient levels following completion of the activity with no remedial or recovery work required.

8.6.4.2 Impact: Change in Sediment Quality

Inherent Consequence Evaluation

Surface water and seabed drilling discharges will create an in-water plume that is then expected to settle on the seabed. Deposition of drilling discharges on the seafloor has the potential to change seafloor sediment quality (Sanzone et al., 2016).

The deposition of drilling discharges on the seafloor introduces new materials to seabed, including metals (usually barium weighting agent often the most abundant solid ingredient in drilling fluids), suspended solids from drilling fluids, cement solids and additives.

Studies found drilling discharges in water depths less than 300 m generally results in deposition of drilling discharges on the seafloor within 200 m of the discharge location for a single well (Sanzone et al., 2016).

The physical persistence of drilling discharges on the seafloor depends on the energy of bottom waters and degradability of the discharged material. The greater Bass Strait is known for its complex, high energy wave climate and strong ocean currents. Scouring is a natural feature on the Otway shelf whereby currents may erode sediments around hard calcareous sediments (Ramboll, 2020b). Strong bottom currents in the operational area are expected to resuspend and transport drilling discharges deposited on the seafloor. Deposited drilling discharges may also be exposed to bioturbation and sedimentation of natural particulate matter which may further dilute the deposited drilling discharges. Water Based drilling fluids are comprised primarily of common, inorganic components such as Potassium Chloride with weighting agents such as barite. Most of these components are classified internationally as Posing Little or No risk to the Environment (PLONOR). Organic additives to drilling fluids are mostly biodegradable and are degraded by microbes on the seafloor (Folayan et al., 2023). These dispersive and degradative processes reduce the concentration of the materials over time (Sanzone et al., 2016).

A study at three continental shelf drilling discharge locations (37 to 119 m water depth) found seabed barium concentrations decreased from 2.4% by 80% in one year between first and second post-discharge surveys (Sanzone et al., 2016). It is expected that deposited drilling discharges on the seabed will change sediment quality within 200 m of the drilling location from the introduction of toxicants to seabed sediments. However, within the first couple of years post-drilling, concentration of drilling components are expected to decrease by up to 80% from natural dispersive and degradative processes influenced by the high energy environment in the operational area based on these comparable studies.

As discussed in Section 8.6.4.2, low concentrations of mercury (Hg) and cadmium (Cd) (less than 1 mg/kg and 3 mg/kg, respectively) found in the residual barite may be discharged at the end of drilling. Discharges are not expected to contribute to sediment toxicity due to the low bioavailability of mercury and cadmium (Schanning et al. 2002).

Discharges of the nature described for this project have been undertaken historically in the region, and have been shown to result in little to no impact on water or sediment quality and associated amenity (Section 6.4.6 and Section 6.4.7).

Biocides and chemical additives in drilling fluids are selected in accordance with the Cooper Energy Offshore Chemical Procedure to ensure ecotoxicity profiles are of an acceptable level, and that products with lower ecotoxicity profiles are selected. For context, chemicals that are highly toxic, highly bioaccumulative and highly persistent in the project and environment setting, would not be selected if they were to be discharged, and those with the lowest profiles preferentially selected, where they also meet technical requirements.

Given that drilling discharges during the East Coast Project are related to activities that are intermittent, brief and result in localised changes to sediment quality, the consequence of this impact has been evaluated as **Level 1**, as sediment quality levels will return to existing ambient levels following completion of the activity with no remedial or recovery work required.

8.6.4.3 Impact: Change in Habitat

Inherent Consequence Evaluation

Deposition of drilling discharges onto the seabed is expected to result in localised change to the benthic habitat and associated benthic assemblages. Hinwood et al. (1994) explains that the main environmental disturbance from discharging drilling cuttings and fluids is associated with the smothering and burial of sessile benthic and epibenthic fauna.

Studies have shown that impacts to benthic assemblages from drilling discharges are highly localised (Balcom et al., 2012; Sanzone et al., 2016). Surveys surrounding the drill centres of three wells in the Northwest Shelf found a high impact zone within a 75 m radius of the well contributed by seabed discharges from tophole drilling (Jones et al., 2021). The high impact zone was largely devoid of all epibenthic fauna and showed a clear loss of soft corals, sponges, and hydroids (Jones et al., 2021). The impact zones observed by the Northwest Shelf surveys coincide with observations of several monitoring studies reviewed by Sanzone et al. (2016) where the abundance and diversity of sessile and slow-moving benthic fauna were reduced within 50 to 100 m of the discharge site. This change in habitat is most likely the direct result of burial from drilling discharge deposition (Sanzone et al., 2016).

Beyond 100 m of the well, the deposition of drilling discharges may change the grain size and chemical properties of seabed sediments and may cover epibiota with sediment. These changes may influence the abundance of fauna, composition, and diversity of benthic habitats. The survey by Jones et al. (2021) defined a medium impact zone, within 200 m of the well, where sponges and soft corals were found to be covered by sediment (Jones et al., 2021). For the East Coast Project, it is expected that within 200 m of the well, solids from drilling discharges may settle onto benthic assemblages.

Observations of several monitoring studies reviewed by Sanzone et al. (2016) found that impacted benthic habitats and assemblages can rapidly recover post drilling. These studies demonstrated substantial recovery in benthic communities within one to a few years after impacts to drilling discharges.

As described in Section 6.4.7 and 6.5.1 Ramboll (2020a) and Ramboll (2020b) both found that benthic habitats within, and in close vicinity of the East Coast Project operational area to be composed of seabed sediments characterised by sand or gravelly / rubble and hard platform substrates. These findings are highly representative of the wider Otway region and consistent with other reports for the wider Bass Strait region (Ramboll, 2020b; Barton et al., 2012; Murray-Wallace and Woodroffe, 2014; Jones and Davies, 1993). Benthic assemblages proximal and within the operational area were surveyed (see Figure 6-17), and results observed an unmodified marine environment with scattered areas of hard ground supporting patchy areas of abundant epibiota, typically bryozoans, gorgonian, cnidarians and sponges (Ramboll, 2020b). While there is some residual uncertainty on exact benthic assemblage composition in the south-western portion of the operational area, as there is no historical survey data in that area; Ramboll (2020a) surveyed a similar water depth and distance offshore in a neighbouring title area (Figure 6-17; Section 6.5.1),) and which provide a reasonable proxy for the purpose of impact and risk assessment.No ecological communities listed as threatened under the EPBC Act were observed and the operational area does not overlap AMPs.

The operational area overlaps the shelf rocky reefs KEF (see Section 6.6.6); areas of rocky reefs and hard substrates along the continental shelf which provide seafloor habitat for diverse assemblages of species which align with the benthic fauna observations in the Ramboll (2020b) survey (see Section 6.5.1.3). This KEF has not been spatially delineated on the Government Conservation Values Atlas but are known to be common throughout the Otway between the shore and shelf. Shelf rocky reefs support a number of sessile invertebrate reef organisms, such as large sponges, macroalgae, sessile invertebrates, soft corals. Some of these will be impacted by the settling out of solids from drilling discharges on the seabed. Seabed surveys and facility inspections proximal to the East Coast Project, including over the existing network of wells and pipelines commonly show areas of hard ground and patchy epifauna transects, consistent with the description of the KEF (Santos, 2004; Ramboll, 2020b). These surveys show high colonisation of infrastructure consistent in appearance with the surrounding seabed communities (Figure 6-16). These observations indicate that the localised disturbance from installation of seabed infrastructure is recoverable and would not be expected to alter the habitat value associated with rocky reef and hard substrate.

For the East Coast Project, any impacts to benthic assemblages including to epibiota from smothering or burial is therefore expected to predominantly occur within ~200 m of the drill centre and anticipated to recover rapidly following the activity. Epibiota of the Otway region and values associated with the shelf rocky reef KEFs may experience localised and short-term impacts; however, due to their scattered distribution and ability to recovery rapidly this is not predicted to impact the ecosystem integrity or functioning of the KEF.

Drilling discharges during the East Coast Project are related to activities that are intermittent, brief and result in localised changes to habitat assemblages (deposition of drilling discharges resulting in changes to benthic assemblages within ~200 m from the discharge location). The consequence of this impact has been evaluated as **Level 1**, noting rocky reef KEF is well represented in the region, the scattered distribution of benthic assemblages in the operational area, and their ability to naturally recover following completion of the activity with no remedial or recovery work required.

8.6.4.4 Risk: Injury / Mortality to Marine Fauna

Inherent Consequence Evaluation

Marine fauna at risk of injury / mortality from drilling discharges include species that may pass through in-water drilling discharge plumes or are exposed to drilling discharge deposition on the seabed, including:

- Plankton
- Fish
- Marine reptiles
- Marine mammals.

Plankton, including fish eggs and larvae

Fish eggs and larvae are more susceptible to injury and mortality when exposed to in-water elevated turbidity levels. Eggs and larvae lack the ability to move and avoid potential drilling discharge plumes in the operational area and are also more sensitive to low turbidity levels i.e. TSS levels greater than 500 mg/L for one hour has the potential to trigger the onset of physiological stress (Johnson, 2018). Jenkins and McKinnon (2006) reported that levels of 100 mg/L may injure larvae of some species if exposed for periods greater than 96 hours.

RPS-APASA (2014) predicted the in-water extent of total suspended sediments by modelling drilling discharge for a well in the North West Shelf of Western Australia. The model predicted the extent of total suspended sediment concentrations at 2-3 mg/L at a distance of 225 m from the well. Using a highly conservative buffer of 225 m, fish larvae within this localised area may be vulnerable to impacts from an increase in total suspended sediments if exposed over 96 hours. The Bass Strait is known for a complex, high energy wave climate and strong ocean currents. High energy oceanographic processes in the operational area will result in rapid dispersion of the drilling discharges plume. Rapid dispersion of the plume prevents 96-hour exposure necessary for the onset of injury to occur fish eggs and larvae.

For plankton, including fish eggs and larvae, the intermittent and brief exposure of to in-water drilling discharge plume is unlikely to result in injury or mortality. Impacts to plankton, including fish eggs and larvae, will be limited to minor physiological stress, with populations expected to rapidly recover noting high levels of natural mortality and a rapid replacement rate (United Nations Environment Program (UNEP), 1985).

<u>Fish</u>

The intermittent and brief exposure nature of in-water drilling discharge plumes will preclude chronic exposure of marine organisms. As a result, mortality to adult and juvenile pelagic fish from drilling discharges is not a credible event.

Highly mobile adult and juvenile pelagic fish that swim through drilling discharge plumes will be exposed to temporary elevated levels of turbidity. Mobile fish passing through the plume may experience behavioural or sub-lethal effects (Johnson, 2018). Observations from numerous studies have identified that adult and larger fish can tolerate relatively high levels of turbidity and TSS for short periods (Johnson, 2018). Fish respond to elevated turbidity levels by actively avoiding the plume. This response prevents chronic exposure that may lead to sub-lethal impacts relating to minor physiological stress (increased coughing, increased respiration rate) which requires at least 6-day continuous exposure to elevated turbidity levels; drilling discharges are intermittent, and high turbidity localised and temporary. Pelagic fish in the operational area would not be exposed to high levels of turbidity (above background) for long periods (Section 8.6.4.1). Thirty-three fish species are listed as having the potential to occur within the operational area in the EPBC Act PMST (26 of which are pipefish, pipehorses, seadragons and seahorses). There are 5 threatened species within this list that may be present in the operational area including blue warehou, southern bluefin tuna, Australian grayling, white shark and eastern school shark. Migratory species include species that may be present within the operational area include white shark, shortfin mako and mackerel porbeagle. The operational area does not contain habitats to support aggregations or site fidelity for these listed fish species. Except for pipefish, pipehorses, seadragons and seahorses, all species are mobile and are expected to move away from the drilling discharge plume if it exceeds their levels of tolerance.

Sessile and slow-moving fish species including pipefish, pipehorses, seadragons and seahorses are susceptible to smothering and burial from drilling discharge deposition on the seabed. Smothering and burial of sessile benthic fish has the potential to result in injury and mortality. Pipefish, pipehorses, seadragons and seahorses found in a variety of habitats ranging from deep reefs to coastal algae, or weed or seagrass habitats (Kuiter, 2000). Certain seahorse species, such as the big-belly seahorse (*Hippocampus abdominalis*) have been identified in water depths up to 104 m; attached to sponges and colonial hydroids (DoE, 2024). The seabed proximal to the operational area does not include weed or seagrass habitats (Ramboll, 2020b). The majority of the area within and proximal to the operational area is reef and patches of sand substrate. This seabed type does support benthic fauna including sessile marine invertebrates such as sponges (Ramboll, 2020b).

Within the Otway the seabed is heavily influence by strong currents and storm events and which episodically elevate turbidity. The sessile communities are common within the region and have been frequently observed during surveys within and proximal to the existing and planned facilities. Existing equipment on the seabed has been substantially colonised by the sessile communities of similar appearance to the surrounding undisturbed seabed (Figure 6-16). Impacts to seabed are anticipated from the East Coast project; these impacts will be limited to the near vicinity of the activities at seabed, and are expected to recover, as demonstrated by surveys of existing infrastructure and adjacent seabed.

Overall, the potential for injury / mortality to fish is limited to sessile and slow-moving fish species with low mobility. However, any impacts from drilling discharges within 100 m of the well are not anticipated to change the viability of the population of these species. For pelagic fish, the intermittent and brief exposure to in-water drilling discharge plume is unlikely to result in injury or mortality. Impacts to adult and juvenile pelagic fish are limited to behavioural effects.

<u>Marine Reptiles</u>

The intermittent and brief exposure nature of in-water drilling discharge plumes will preclude chronic exposure of marine organisms. As a result, mortality to marine reptiles from drilling discharges is not a credible event.

Marine reptiles, specifically turtles, can experience behavioural and physiological effects that may lead from exposure to temporary increases in water turbidity (Johnson, 2018). Marine turtles are dependent on vision to forage, communicate and move through the water. Increase in turbidity from drilling discharges may result in plume avoidance by marine turtles when exposed to drilling discharge plumes in the operational area (Johnson, 2018).

The operational area does not overlap recognised BIAs for marine turtles and therefore only low numbers (if any) may move through the area. Marine turtles with the potential to be exposed to drilling discharge plumes in the operational area are therefore limited to transient individuals. Brief exposure to the plumes may result in minor behavioural changes that are unlikely to lead to sub-lethal injury given the absence of habitats that encourage long-term presence of marine turtles in the operational area.

As a result, impacts to marine reptiles from drilling discharges is limited to behavioural effects to individual foraging turtles, therefore no population impacts are expected.

<u>Marine Mammals</u>

The intermittent and brief exposure nature of in-water drilling discharge plumes will preclude chronic exposure of marine organisms. As a result, mortality to marine mammals from drilling discharges is not a credible event.

Marine mammals exposed to temporary elevated levels of turbidity may experience minor behavioural effects (Johnson, 2018). Increase in turbidity from drilling discharges may result in plume avoidance by marine mammals when exposed to drilling discharge plumes in the operational area (Johnson, 2018).

The operational area overlaps BIAs for the pygmy blue whale and southern right whale. The operational area is also within a region of the Bass Strait which is strongly influenced by the seasonal Bonney Upwelling system and is a known seasonal feeding aggregation area for pygmy blue whales. Pygmy blue whale aggregations may overlap the operational area and surrounds to feed from November and May (DoE, 2015a).

The Bonney Upwelling is a seasonal system that causes high natural variability of water column turbidity on the Victorian coastline. Marine mammals that regularly feed along the Victorian coastline are adapted to high natural variability of in-water turbidity. Given marine mammals in the region are adapted to temporary increases in turbidity, plumes generated by drilling discharges are not expected to have a discernible effect on foraging behaviours or movement patterns of individuals, nor therefore at a population level.

<u>Summary</u>

The predicted level of impact, i.e., the consequence, to marine fauna as a result of drilling discharges is evaluated to have a consequence of **Level 1** based on:

- Temporary and localised impacts to rocky reef / hard substrate and associated assemblages which is identified as a Key Ecological Feature, characteristic and widespread within the South East Marine Region. The feature has identified values: *'…provide attachment sites for macroalgae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity'*. The seabed characteristics are not expected to be modified to the extent that the identified values would be impacted beyond the very near vicinity of the wells sites, and temporarily. Drilling discharges and installed infrastructure have structural diversity and, as observed during inspections of existing facilities, colonisation of installed materials by invertebrates has occurred, often in a similar pattern to natural (exposed and sand covered) reef (Figure 6-16).
- The high energy oceanographic processes typical of the Otway Basin will result in rapid dilution and dispersion of operational discharges; exposure times to elevated turbidity within the water column will be short.
- The operational area is subject to high natural variation in turbidity levels, therefore, marine fauna present within the operational area will be adapted to brief and high levels of turbidity.
- Due to the intermittent and brief presence of drilling discharges plume in the operational area; discharges within the water column would be expected to disperse to below no-observed-effect-concentrations (NOEC) before marine fauna could be exposed for long enough to experience toxicity impacts.
- Potential impacts to the diversity and productivity of seabed assemblages will be localised and recoverable.

Inherent Likelihood

The operational area is known habitat for marine invertebrates, fish and foraging marine mammals. Drilling discharge plumes and seabed deposition in the operational area is likely to interact with sessile marine invertebrates resulting in minor impacts to distribution, which are observed as being recoverable; therefore, it is likely the risk event will occur.

The inherent likelihood of a Level 1 consequence occurring is rated **Likely (B).**

Inherent Risk Severity

The predicted level of risk, i.e., inherent risk severity, to marine fauna as a result of injury/mortality is considered **Low**

8.6.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-52.

Table 8-52: Drilling discharges acceptability assessment

Acceptability Criteria	Demonstration of Acceptability	
	Impact: Change in water quality	Consequence: Level 1

Cooper Energy Risk Management Protocol	Impact: Change in sediment quality	Consequence: Level 1
	Impact: Change in habitat	Consequence: Level 1
	Risk: Change in behaviour and injury/mortality to marine fauna	Risk: Low
Principles of ESD	A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, Impacts and risks from planned discharges – drilling was identified as: • Level 1 consequence for changes in water quality, sediment quality and habitat • Low risk for change in behaviour and injury/mortality to marine fauna. The above predicted levels of impact and risk due to planned discharges – drilling from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology and Cooper Energy Offshore Chemical Assessment Procedure. • The highest consequence ranking for drilling discharges was Level 1 and the highest inherent risk was evaluated as Moderate; therefore, drilling discharges from the East Coast Project will not result in serious or irreversible environmental damage. • The potential impacts and risks from drilling discharges are well-understood, and management measures are well established and regulated in Australian waters.	
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest consequence ranking for drilling discharges was Level 1 and the highest inherent risk was evaluated as Low and therefore will not forego the health, diversity and productivity of the environment for future generations through minimising disturbance to these environmental values.	

<table>
<tr><td rowspan="2"></td><td colspan="4">The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.6.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</td></tr>
<tr><td colspan="4">D) 'Biodiversity principle'
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
The East Coast Project is consistent with the principle of ESD (d) for this aspect as:
The relevant environmental values and sensitivities to drilling discharges were evaluated in Section 8.6.4 and the highest consequence ranking for drilling discharges was Level 1 and the highest inherent risk was evaluated as Low.
The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.6.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained through not disrupting the protection of fauna and habitat as per the objectives of species recovery plans and conservation advice.</td></tr>
<tr><td rowspan="3">Legislative and Other requirements</td><td>Requirement</td><td colspan="2">Relevant Objective / Action</td><td>Demonstration of Requirement</td></tr>
<tr><td>Recovery Plan for Marine Turtles in Australia, 2017 – 2027</td><td><u>Recovery objective:</u> Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list.
<u>Interim objective 3:</u> Anthropogenic threats are demonstrably minimised.
No relevant management actions.</td><td>Adoption of the following control measures:
CM2: Offshore Operational Procedures
CM6: Cooper Energy Offshore Chemical Assessment Procedure
CM7: Offshore Equipment
CM9: Underwater Cultural Heritage Disturbance Risk Management Measures
CM20: Campaign Risk Review</td><td rowspan="2">Adoption of the following control measures:
CM2: Offshore Operational Procedures
CM6: Cooper Energy Offshore Chemical Assessment Procedure
CM7: Offshore Equipment
CM9: Underwater Cultural Heritage Disturbance Risk Management Measures
CM20: Campaign Risk Review</td></tr>
<tr><td>Industrial Chemicals (Notification and Assessment Act) 1989</td><td colspan="2">Project Chemicals will be considered under the requirements of this Act prior to use as relevant.</td></tr>
</table>

<table>
<tr><td></td><td>Minamata Convention on Mercury</td><td>Cooper Energy will consider best available techniques and environmental practices to control releases of components containing mercury in future activity specific EPs.</td><td></td></tr>
<tr><td>Internal Context</td><td colspan="3">Relevant management system processes adopted to implement and manage hazards include:
• Risk Management (MS03)
• Technical Management (MS08)
• Health Safety and Environment Management (MS09)
• Supply Chain and Procurement Management (MS11)
• Operations Management (MS07)
• External Affairs & Stakeholder Management (MS05).
Activities will be undertaken in accordance with the Implementation Strategy (Section 12).</td></tr>
<tr><td>External Context</td><td colspan="3">No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures for drilling discharges.</td></tr>
<tr><td>Predicted impact compared to Defined Acceptable Level
.</td><td colspan="3">The defined acceptable level of impacts relevant planned drilling discharges is AL2, AL3, AL6, AL10 and AL11 identified in Table 8-51. These acceptable levels defined for a change in water quality, sediment quality, habitat quality and injury / mortality to marine fauna are defined in Table 7-6.
The worst-case predicted impacts assessed in Section 8.6.4 are:
• Drilling discharges are intermittent, brief and result in localised changes to sediment and water quality and benthic habitat assemblages (deposition of drilling discharges resulting in changes to benthic assemblages within ~200 m from the discharge location).
• Temporary and localised impacts to rocky reef / hard substrate and associated assemblages which is identified as the shelf rocky reef KEF are characteristic and widespread within the South East Marine Region.
• The drilling discharge plumes will be heavily influenced by the prevailing currents which will disperse and dilute the plume in receiving waters. Water quality will return to existing ambient levels following completion of the activity with no remedial or recovery work required.
• The greatest consequence ranking for drilling discharges was Level 1, and highest level of risk is Moderate.
Therefore, at its worst-case, the predicted impact from planned drilling discharges would not:
• Lead to a substantial change in water quality which may adversely impact biodiversity and ecological integrity.
• Lead to changes to seabed quality that adversely affect biodiversity, and ecological integrity.
• Modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity.
• Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species.
• Lead to loss of habitat critical to the survival of species.
Therefore, the predicted level of impact resulting from planned drilling discharges from the East Coast Project is at or below the defined acceptable levels.</td></tr>
<tr><td>Acceptability Outcome</td><td colspan="3">Cooper Energy has determined that impacts and risks related to drilling discharges are acceptable, based on:</td></tr>
</table>

	• Predicted levels of impact (evaluated in Section 8.6.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors. • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES. • No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPO have been applied: **EPO2**: Impacts to water quality from drilling and operational discharges are limited to localised, temporary changes in the vicinity of the discharge location.. **EPO3**: Impacts to sediment quality are limited to localised, changes in the vicinity of the discharge location.. **EPO6**: Impacts to benthic habitats from drilling discharges and seabed disturbance are limited to localised, changes. **EPO7:** Impacts to benthic habitat from drilling discharges and seabed disturbance are limited to localised, changes which will not adversely impact the ecosystem functioning or integrity of the shelf rocky reef KEF. **EPO14:** Impacts to marine fauna from operational and drilling discharges will not change the viability of the population of EPBC Act listed threatened or migratory species. **EPO15:** Impacts to marine fauna from operational and drilling discharges will not impact the recovery or conservation status of EPBC Act listed threatened or migratory species, with no population level impacts.

8.6.6 Environmental Performance

Table 8-53 lists the acceptable level and EPOs defined for drilling discharges and the adopted control measures to achieve the outcome.

Table 8-53: Environmental performance summary – Drilling discharges

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL2: Impacts and risks to water quality from activities defined in this OPP will not lead to a substantial change in water quality which adversely impacts biodiversity and ecological integrity.	**EPO2:** Impacts to water quality from drilling and operational discharges are limited to localised, temporary changes in the vicinity of the discharge location.	CM2: Offshore Operational Procedures Drilling and cementing procedures will define how each step of the well construction process is to be completed in accordance with relevant standards (as defined in the WOMP). Sufficient stocks of material, fluids and chemicals are available for well control. Detailed cementing procedures will be developed and implemented before cementing activities commence. Use of materials in well construction will be monitored and maintained within parameters set in respective Environment Plans. Seabed surveys (geophysical, geotechnical, visual and contaminant sampling) will be undertaken for the purposes of collecting information on, and where required for managing risks related to the benthic environment, underwater heritage, debris and hazards on the seafloor. These will be undertaken prior to finalising MODU position and location of mooring equipment, and prior to selection of final locations of wells and subsea infrastructure. CM6: Cooper Energy Offshore Chemical Assessment Procedure Project chemicals will meet the requirements of the Cooper Energy Offshore Chemical Assessment Procedure. This process is used to ensure the lowest toxicity, most biodegradable and least bioaccumulative chemicals are selected which meet the technical requirements, where their function necessitates discharge to sea. The process consults public chemical assessment repositories such as PLONOR list, OCNS Definitive Ranked List, OSPAR and OCNS listings for those chemicals to be discharged. Eco-toxicity is evaluated with any required control measures defined. Chemicals that are highly toxic, have high bioaccumulation potential, and have high persistence in organisms are screened out during the assessment process. Only chemicals that meet low ecotoxicity pre-screening criteria, or are further justified as ALARP can be approved for discharge. An accepted chemical list is issued to the

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
		offshore project team detailing which products may be discharged and in what circumstances. CM7: Offshore Equipment Additional equipment, such as solids equipment, will be available on the MODU. Equipment will assist with recovering and reducing the discharge of excess fluids and reduce the volume of oil on cuttings. CM9: Underwater Cultural Heritage Disturbance Risk Management Measures Cooper Energy Cultural Heritage Disturbance Risk Management Measures acknowledge legislative requirements and establishes the methods by which potential disturbance to cultural heritage is identified including via screening, consultation, and expert advice as required. The procedure identifies management measures applicable to the different phases of the offshore project to ensure impacts and risks throughout the project life cycle remain within acceptable levels and are managed to ALARP. CM20: Campaign Risk Review The Cooper Energy Environmental Protocol describes how environmental impact and risk management, including risk assessments, is undertaken for activities including offshore campaigns. As part of pre-campaign planning a risk review will be undertaken to re-assess campaign environmental impacts and risks to ensure acceptability criteria are met and that impacts and risks are reduced to ALARP. The risk review will consider aspects relevant to the campaign; where there is a risk that campaign discharges to sea may contain mercury, the risk review will consider the current best available techniques and environmental practices in order to control releases of mercury.

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL3: Impacts to sediment quality from activities defined in this OPP will not lead to changes that adversely affect biodiversity, and ecological integrity may be adversely affected.	**EPO3:** Impacts to sediment quality are limited to localised changes in the vicinity of the discharge location.	
AL6: Impacts and risks to benthic habitat from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity.	**EPO6:** Impacts to benthic habitats from drilling discharges and seabed disturbance are limited to localised changes. **EPO7:** Impacts to benthic habitat from drilling discharges and seabed disturbance are limited to localised changes which will not adversely impact the ecosystem functioning or integrity of the shelf rocky reef KEF.	
AL10: Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species.	**EPO14:** Impacts to marine fauna from operational and drilling discharges will not change the viability of the population of EPBC Act listed threatened or migratory species. **EPO15:** Impacts to marine fauna from operational and drilling discharges will not impact the recovery or	

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
	conservation status of EPBC Act listed threatened or migratory species, with no population level impacts.	

8.7 Planned Discharges – Operational

8.7.1 Cause of Aspect

Operational activities during installation and commissioning, operations, decommissioning and support operations phases of the East Coast Project will result in discharges to sea.

Discharges may be routine or non-routine. Routine discharges include those from contracted vessels when they work offshore on project activities. Vessel discharges can include cooling water and RO brine, deck drainage and bilge, food waste, greywater, and sewage. All of these types of discharges are regulated under existing marine pollution prevention laws. Non-routine discharges may include inhibited seawater, MEG, nitrogen gas, pigging fluids, grout, and chemicals used to assist clean-up or removal of calcareous deposits, typically sulfamic acid (or equivalent such as citric acid). These types of discharge are expected to occur infrequently during each phase of the East Coast Project; they are regulated through the OPGGS Act, Environment Regulations and associated EP process. Collectively, all discharges are herein termed operational discharges, and are assessed below.

Phases and associated activities that will generate operational discharges are identified in Table 8-54 and described in further detail in the subsections below.

Table 8-54: Activities undertaken during the East Coast Project that may result in operational discharges

Cause of Aspect / Phase	Activity Component
Support Activities	Vessel operations
	MODU operations
Installation and Commissioning	Pre-lay works
	Installation of subsea structures
	Testing, preservation and start-up
Operations	Maintenance and repair
Decommissioning	Flowline and umbilical decommissioning
	Removal of remaining subsea infrastructure

8.7.2 Aspect Characterisation

8.7.2.1 Installation and Commissioning

During installation and commissioning activities, operational discharges may result from pre-lay works, installation and commissioning and testing, preservation and start-up.

Pre-lay works may include installation of grout bags by pumping material (cement and water) through a hose from the vessel to fill them underwater (Section 4.3.3.1). Some displacement (~3 m^3 per bag) of grout may occur during filling of the bags and when the hose is flushed with seawater at the completion of operations, dispersing residual grout to sea.

During the installation and commissioning phase, internal cavities within subsea structures will be flooded for pre-commissioning tests to ensure they function correctly. Inhibited seawater, nitrogen gas and MEG may be discharged to the marine environment. Collectively, these discharges are termed non-routine commissioning discharges.

Table 8-55 details non-routine commissioning discharges to the marine environment. A contingency volume of 50% has been included in the volumes of inhibited seawater and MEG within Table 8-55

Table 8-55: Volumes and location of non-routine commissioning discharges

Discharge Type	Description of Discharge	Total Volumes
Inhibited seawater	Inhibited seawater is utilised in multiple pre-commissioning activities such as flooding, cleaning, hydrotesting and dewatering. It is a mixture of seawater and chemical additives (corrosion inhibitor, oxygen scavenger, biocide and dye) and is discharged subsea.	3,232 m^3
MEG*	MEG is used to prevent hydrate formation in pipelines and flowlines. It is typically mixed with water and will be discharged subsea.	3,232 m^3
Grout	Grout bags may be utilised for stabilization. The grout is a mixture of concrete and water. The bags may be filled subsea and residual grout may be dispersed into the marine environment.	3 m^3 per bag
Nitrogen gas	Nitrogen gas is an inert gas that will be used to dewater the flowlines ensuring that the system is safe to receive hydrocarbons. It will be used pushed to the onshore Athena Gas Plant for discharge which is outside the scope of the East Coast Project. Nitrogen gas is used as there is no risk of ignition and it is non-corrosive.	N/A

**10-100% discharged to sea close to seabed*

8.7.2.2 Operations

During the operations phase, hydrocarbon extraction and transport is controlled by an electro-hydraulic subsea control system, of which the hydraulic component (also referred to as cores) of the umbilical is open loop, meaning hydraulic fluids are released to sea as part of normal operations. Other cores within the umbilical are used to transport chemicals, such as MEG and corrosion inhibitor to the wells as part of subsea flow and integrity maintenance. These chemical cores are closed loop; the chemicals are injected at the XT into the produced fluids which are transported to shore via the subsea pipeline network. During maintenance and repair activities, replacement, intervention and re-termination of umbilicals may be required. In this event hydraulic fluids and chemicals, such as injected corrosion inhibitor, may be released to sea. In order to access equipment for inspection, maintenance and repair, marine growth which accumulates on the subsea system over time may require removal from some pieces of equipment. Discharges associated with this process include chemicals, such as sulfamic acid or equivalent, used to clean-up or remove limescale. Collectively, these discharges are termed non-routine operational discharges.

Table 8-56 details non-routine operational discharges to the marine environment. Pigging fluid volumes include a contingency of 50% based on the conservative flowline route length.

Table 8-56: Volumes and locations of non-routine operational discharges

Discharge Type	Description of Discharge	Estimated Volumes
Hydraulic fluids	IMR activities and use of an electro-hydraulic subsea control system during hydrocarbon extraction and transport may result in discharge of hydraulic fluids. Hydraulic fluids used in the open loop umbilical cores are generally a mix of water/glycol; they are designed to have lower potential for environmental impact compared to typical domestic hydraulic fluids used in closed loop system, transport etc., and are readily dispersible when displaced to sea during normal operation.	~3 m^3 per year

Discharge Type	Description of Discharge	Estimated Volumes
Pigging fluids	Pigging fluids may be used in IMR activities and may include a mixture of MEG/gel, water treated with corrosion inhibitor, oxygen scavenger, biocide and dye, and will be discharged subsea. Pipeline inspection campaigns may occur ~1-3 times over the life of the project depending on Integrity maintenance planning and reviews.	Nominal 3,232 m^3 per inspection campaign
Sulfamic acid (or equivalent)	Sulfamic acid (or an equivalent such as citric acid) and water are typical chemicals used to remove marine growth or limescale. The fluid is applied subsea and disperses into the water column over a short time.	3 m^3 per IMR campaign (500 L batch applications)

8.7.2.3 Decommissioning

During the decommissioning phase, best endeavours are made to clean and flush the flowline systems and subsea infrastructure. Where practicable, fluids used to flush the flowline system may be directed into the subsea wells, however, there is potential for 10-100% to be released into the marine environment post disconnection. Discharges associated with flushing and cleaning are similar to the installation and commissioning phase and include inhibited seawater, MEG and may include nitrogen gas (Table 8-55). Any scale contaminants that may have accumulated within the flowline systems may also be flushed. Prior to the removal of subsea equipment marine growth may require removal; this may be via a combination of mechanical removal and use of cleaning fluids (sulfamic acid or equivalent such as citric acid).

8.7.2.4 Support Operations

The East Coast Project would require support from vessels and a MODU for particular phases. The MODU will occur in the operational area during the drilling and decommissioning phases and may be required in the operations phase if well intervention is required.

Vessels will be present in the operational area temporarily during all phases within the scope of the East Coast Project. Vessel and MODUs will have intermittent routine discharges to sea (Section 8.7.1).

Table 8-57 details routine operational discharges to the marine environment based on a drilling activity utilising a MODU and three support vessels, with total POB of 320 within the operational area at once.

Table 8-57: Volumes and location of total routine operational discharges

Discharge Type	Description of Discharge	~Quantity
Sewage and greywater	Sewage and greywater are generated as a result of MODU and vessel cleaning activities, laundry, and kitchen operations and will be dependent on the number of people on board.	144 m^3 per day (0.45 m^3 pp/day)
Food waste	Food waste is generated from galley facilities during MODU and vessel operations and are discharged to the sea surface under certain regulatory criteria. Where those criteria cannot be met, food waste is returned to shore.	640 kg/day (2 kg pp/ day)
Cooling water	Cooling water is seawater that is utilised as a heat exchange medium for the cooling of machinery engines. Cooling water is dosed with chlorine following intake. Then and passed through heat exchangers and discharged. The discharges of seawater may have an elevated temperature (~2 to 5°C above ambient) and low residual chlorine concentrations.	~8,400 m^3/day
RO brine	RO brine is the by-product of potable water production (i.e., removal of salt molecules and ions from seawater) through reverse osmosis. The brine solutions	170 m^3/day

Discharge Type	Description of Discharge	~Quantity
	have an elevated salinity (~20-50% above ambient) and will be discharged to the sea surface.	
Deck drainage and bilge water	Deck drainage and bilge water is the result of water and fluids from rainfall, ocean spray, and washdown water that occurs on the deck of the vessel. Bilge water discharges are regulated and must meet strict conditions prior to discharge. Bilge water may be comprised of fresh water, sea water, oil, sediment, and other fluids such as hydraulic oil from equipment and storage spaces. Bilge water and is required to be treated through an oil-in-water separator prior to being discharged to the sea surface. If treatment criteria cannot be met, then it is sent ashore for treatment and disposal.	~1.5 m^3/day

8.7.2.5 Concurrent activities

As described in Section 4.1.3, concurrent activities could occur. Cooper Energy assessed reasonably foreseeable concurrent activity scenarios and identified that the potential concurrent activities of drilling operations at Elanora-1 and flowline installation between Annie-2 and Casino-5 represents the activity scenario with the greatest number of vessels within the operational area, operating concurrently. This could involve 3 vessels and a MODU operating at once (further details in Section 8.2.2.4). These kinds of concurrent activities could occur over periods of ~50 days depending on the exact scope of works to be completed and availability of vessels and equipment.

8.7.3 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from routine and non-routine operational discharges are:

- Change in water quality.
- Change in sediment quality.

Potential risks:

- Injury/mortality to marine fauna.

Socio-economic impacts on commercial fisheries have not been evaluated further, as there are no discernible impacts to behaviour or distribution expected at the population level given the limited nature and scale of activities.

8.7.4 Impact and Risk Evaluation

8.7.4.1 Impact: Change in Water Quality

Inherent Consequence Evaluation

Operational discharges into the marine environment will result in localised and temporary changes in water quality during installation and commissioning, operations, decommissioning and support phases. Operational discharges include mixtures of fluids with the potential to introduce concentrations of particulates, nutrients, biocides, and oils to offshore waters. These contaminants have the potential to impact waters surrounding the discharge point by:

- Particulates discharged in fluid mixtures including grout, sewage and greywater and food waste will temporarily elevate turbidity levels.
- Nutrients in fluid mixtures including sewage, greywater and food waste may locally increase nutrient levels, with potential for subsequent localised oxygen depletion as bacteria and plankton metabolise increased levels of food.
- Increased salinity concentrations from RO brine discharges.
- Increased chemical toxicity by introducing chemical additives within the marine environment from the discharge of chemicals such as sulfamic acid (or equivalent), and

those found in inhibited seawater, pigging fluids, contaminated scale, bilge water, MEG and cooling water.

- Residual machinery oils in deck drainage and bilge water.

Discharges will generate a plume within the water column of the receiving waters. The change in water quality from operational discharges during the East Coast Project is expected to be intermittent and brief based on discharge quantities and dispersive characteristics of the receiving environment. Operational discharges would be diluted within the receiving seawater, then mixed and dispersed by prevailing waves and currents to below no effect levels; components of the discharges will continue to disperse, biodegrade and break down over time (NERA, 2017; Shell, 2020).

The release of operational discharges has the potential to increase the toxicity within the receiving environment. Biocides and chemical additives in operational discharges are selected in accordance with the Cooper Energy Offshore Chemical Procedure to ensure ecotoxicity profiles are of an acceptable level. MEG, inhibited water, and hydraulic fluids are generally low toxicity, readily degradable or dispersible. The primary ecotoxicological criteria for MEG, inhibited water, hydraulic fluids, food and sewage, and deck drainage and bilge water are further described as follows:

MEG

MEG is classified internationally as posing little or no risk to the (marine) environment (PLONOR); it is effectively non-toxic in the marine environment, is readily biodegradable and has a low/no potential for bioaccumulation. MEG is readily dispersible in water and would only have a short-term, localised on water quality.

Inhibited Water

Inhibited water is seawater with chemical additives including corrosion inhibitor, oxygen scavenger, biocide and dye. Biocides are applied to protect the inside of steel tubular equipment and are toxic when applied at pre-determined concentrations. Residual biocide in inhibited water has the potential to be acutely toxic to sensitive species associated with benthic habitats, such as fish, molluscs, and echinoderms (Chevron, 2015). Dye, scale inhibitor and corrosion inhibitor are expected to be less toxic than the biocide (ConocoPhillips, 2018). However, the biocides routinely used in the oil and gas industry are expected to be consumed by microorganisms (e.g. bacteria) and not bioaccumulate once discharged to the marine environment (Shell, 2020).

Modelling on the discharge of inhibited water for the larger scale Crux Development, predicted biocide concentrations below levels required for acute toxicity to aquatic species approximately 5.7 km away from the discharge source for a discharge of 48,600 m^3 of inhibited water (Shell, 2020). The average current speeds found in the Otway Basin is typical of those found in the Northwest Shelf, with average current speeds ranging between 0.15 to 0.24 m/s (RPS, 2024) compared to the average current speed of 0.22 to 0.28 m/s in the Northwest Shelf (Shell, 2020). Therefore, it is anticipated that mixing with the receiving waters will rapidly occur. Furthermore, the modelled volume is 10 times greater than the worst-case single discharge of inhibited water for the East Coast Project (3,232 m^3). Therefore, it is expected that inhibited water will rapidly dilute to below no effect concentrations once released into the surrounding environment.

Hydraulic Fluids

Hydraulic fluids are used in the subsea systems, such as the open loop umbilical cores, and are generally a mix of water/glycol. Hydraulic fluids are likely to be low toxicity and water based. Releases are expected to be up to ~3 m^3/year and will rapidly dilute and dissipate in the marine environment. Due to the intermittent, non-continuous and short duration of the discharge, the potential for toxic exposure is limited. Small discharges such as these are anticipated to rapidly dilute and disperse upon release within open marine waters, which are typically influenced by large-scale ocean currents. Therefore, any change to water quality are limited and will be restricted to within proximity of the discharge source where concentrations are highest.

Sulfamic acid (or equivalent)

The volumes of the chemicals used for marine growth removal will be relatively small (3 m^3 per application and released in 500 L batches); these chemicals will be applied directly to the infrastructure. Due to the small volume released, the discharge is anticipated to rapidly disperse into the water column.

Contaminated scale

Studies have shown that elemental mercury may adsorb to surfaces in pipelines and bind to corrosion products (e.g. iron sulfides), and form sulfide species such as metacinnabar, forming a scale on the internal walls of pipelines (Gissi et al., 2022). The presence depends on the pipeline material, form of mercury, and presence of any internal coatings. Metal surfaces exposed to gas-phase hydrocarbons were identified as being the most likely locations for deposition of mercury scale (Kho et al., 2022). The interaction between mercury accumulation and flexible pipes or flowlines, anticipated to be used for the East Coast Project (see Section 4.2), are less well known and assumed to accumulate less deposit than rigid steel pipes (Kho et al., 2022).

The process of flushing and cleaning used to remove the scale may contribute to small quantities of mercury contaminants being released. Given the results of low mercury levels in the raw gas at the Athena Gas Plant and in the Annie-1 well (see Section 4.1.4), very low quantities of scale expected. Furthermore, the predominant types of mercury that may be present within pipelines are typically insoluble (i.e., elemental mercury (Hg^0) and mercury sulfide (HgS)) and will immediately disperse or mix in the surrounding sediments upon release (Kho et al., 2022).

Food waste and Sewage

Intermittently elevated nutrient levels from sewage, putrescible waste, and grey water discharges, which will either dilute in the receiving waters, settle out of the water column, chemically break down or be consumed by microorganisms (bacteria) (NERA, 2017).

Deck Drainage and Bilge Water

The bilge system of a vessel is designed to properly collect, hold, and discharge of oily water to reduce or avoid dumping hydrocarbons into the maritime environment. Before being released to sea, bilge water is treated using an oil-water separator. The discharge is intermittent and occurs at or near the surface of the water. These oily bilge discharges are predicted to dilute and disperse in surface waters due to the action of waves and currents, and any volatile elements in the oil will rapidly dissipate into the air or dissolve into the water column.

Change to water quality from contaminants in operational discharges is expected to be short-term and localised to waters surrounding the discharge point based on the following:

- All project chemicals are selected in accordance with the Cooper Energy Offshore Chemical Procedure to ensure ecotoxicity profiles are of an acceptable level.
- The major constituents of the fluids that may be released during operational activities are generally non-toxic, readily biodegradable and/or dispersible.
- Subsea discharges will rapidly dissipate into the environment with any minor toxic constituents (e.g., biocide) being diluted to predict no effect levels near the discharge point.
- Sewage discharge monitoring for another offshore project (Woodside Energy, 2014), found in-water concentrations from 10 m^3 of discharged sewage was reduced to 1% of its initial concentration within 50 m of the discharge point.
- Temperature and salinity impacts within the operational area are expected to be limited to the source of the discharge where concentrations are highest, as modelling undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex found that the discharged water temperature decreases quickly as it mixes with the receiving waters; with water temperature being <1° C above ambient temperatures within 100 m (horizontally) and 10 m (vertically) of the discharge point (Woodside Energy, 2014). The average current speeds found in the Otway Basin is typical of those found in the Northwest Shelf (Section

6.4.5.1). Therefore, it is anticipated that mixing with the receiving waters will rapidly occur, and any impact will be localised to the discharge point.

- Water quality within the operational area is expected to be representative of the expected quality found in the Otway Basin; an area which has provided for marine industries including fishing, shipping, tourism and energy for decades.
- Given the high energy marine environment of the Otway Basin, discharges during operations will dissipate rapidly; any change in water quality will be localised and temporary.

Inherent Consequence Level

Changes to water quality are likely to be localised and temporary based upon the relatively small volumes associated with operational discharges. There are no continuous discharges over the life of the project. The consequence of this impact has been evaluated as **Level 1**, as water quality levels will return to existing ambient levels shortly after the discharge occurs with no remedial or recovery work required.

8.7.4.2 Impact: Change in Sediment Quality

Inherent Consequence Evaluation

Operational discharges on the seafloor have the potential to change seafloor sediment quality (Sanzone et al., 2016). Operational discharges to the environment will enter the water column of the receiving waters. Components of these discharges could settle out as particulates, or with naturally occurring particulates in the water column; this could result in localised and temporary changes in sediment quality during installation and commissioning, operations, decommissioning and support phases. Operational discharges include mixtures of fluids with the potential to introduce particulates, nutrients, biocides, and oils to the seabed. These contaminants have the potential to interact with, and impact sediments surrounding the discharge point.

As assessed in Section 8.7.4.1, the impact to sediment quality from changes in water quality from operational discharges is expected to be intermittent and brief based on discharge quantities and dispersive characteristics of the receiving environment. Operational discharges would be diluted within the receiving seawater, then mixed and dispersed by prevailing waves and currents to below no effect levels; components of the discharges will continue to disperse, biodegrade and break down over time (NERA, 2017; Shell, 2020). Discharges of the nature described for this project have been undertaken historically in the region, and have been shown to result in little to no impact on water or sediment quality and associated amenity (Section 6.4.6 and Section 6.4.7).

Traces of scale found within the flowlines have the potential to contain mercury and may be released during the flushing and cleaning. Mercury is one of the most toxic metals in the environment and has been reported to have a range of effects on marine organisms. However, due to the low bioavailability of mercury the toxicity effects are not immediate (Schanning et al., 2002). It is the adsorption and desorption processes of mercury by benthic sediments which are critical to the distribution of mercury and its transport, transformation, uptake, and toxicity (Gissi et al., 2022).

BHP conducted a mercury survey on the Minerva export pipeline, located immediately downstream of the Minerva-3 and Minerva-4 wells, within the Otway Basin (Woodside, 2024). The study analysed for mercury concentration using pXRF, which found that majority of the sections tested had surface mercury concentrations below the pXRF limit of detection. Three representative coupons selected from along the length of the pipeline were analysed for total mercury in steel using acid digestion. Total mercury concentrations in these three coupons were low; between 0.004 mg/kg and 0.014 mg/kg, with very little soluble organic mercury present. Metal surfaces, such as those surveyed by the study, have been identified as being the most likely locations for deposition of mercury scale (Kho et al., 2022). Therefore, the study is considered conservative for the East Coast Project’s flexible flowlines.

Given the results of low mercury levels in the raw gas at the Athena Gas Plant and in the Annie-1 well (see Section 4.1.4), the low solubility and the very low quantities of scale expected; discharges of contaminated scale is anticipated to have low impacts to sediment quality.

Biocides and chemical additives in operational discharges are selected in accordance with the Cooper Energy Offshore Chemical Procedure to ensure ecotoxicity profiles are of an acceptable level, and that products with lower ecotoxicity profiles are selected. For context, chemicals that are highly toxic, highly bioaccumulative and highly persistent in the project and environment setting, would not be selected if they were to be discharged, and those with the lowest ecotoxicity profiles preferentially selected, where they also meet technical requirements (discussed in Section 8.7.4.1).

Inherent Consequence Level

Changes to sediment quality are likely to be localised and temporary based upon the relatively small volumes associated with operational discharges. There are no continuous discharges over the life of the project. The consequence of this impact has been evaluated as **Level 1**, as sediment quality levels will return to existing ambient levels shortly after the discharge occurs with no remedial or recovery work required.

8.7.4.3 Risk: Injury / Mortality to Marine Fauna

Inherent Consequence Evaluation

Marine fauna at risk of injury / mortality from operational discharges include species that may pass through in-water discharge plumes:

- Plankton
- Fish
- Marine reptiles
- Marine mammals.

<u>Plankton</u>

Plankton, including fish eggs and larvae, are more susceptible to injury and mortality when exposed to in-water elevated turbidity levels, and toxic exposure from chemicals discharged during operations. This is due to the fact that they are less mobile, and often lack the ability to move and avoid potential operational discharge plumes. Acute impacts may occur and would be limited to small numbers of juvenile fish, larvae, and planktonic organisms. The greater Bass Strait, including the Otway Basin, is known for a complex, high energy wave climate and strong ocean currents. High energy oceanographic processes in the operational area will result in rapid dispersion of the operational discharge plume. Therefore, rapid dispersion of the plume prevents long-term exposure required for the onset of injury to occur to plankton, such as fish eggs and larvae.

Mortality rates for plankton are naturally high, with highly variable distribution linked to seasonal variances already identified to occur within the south-east region (Section 6.5.3). Plankton are expected to rapidly recover once the activity ceases, as they are known to have high levels of natural mortality and a rapid replacement rate (United Nations Environment Program (UNEP), 1985). Therefore, impacts from operational discharges are not expected to have discernible impacts at the population level.

<u>Fish</u>

As mentioned above, residual biocide in inhibited water has the potential to be acutely toxic to sensitive species associated with benthic habitats, such as certain fish species (Chevron, 2015). Dye, scale inhibitor and corrosion inhibitor are expected to be less toxic than the biocide (ConocoPhillips, 2018). However, early life stages of fish (embryo and larvae) and other plankton are the most susceptible to toxicity as they have limited mobility, thus are more likely to be exposed to toxic effects compared to juvenile and adult fish.

The potential release of mercury contaminated scale may impact marine organisms (Gissi et al., 2022).

The intermittent and brief exposure nature of in-water operational discharge plumes will preclude chronic exposure of marine organisms. To be impacted, fish species would need to pass directly through any discharge plume almost immediately upon release and remain within the plume for almost the entire duration of the residence time (see Section 8.7.4.1). Given fish are typically highly mobile, and no BIAs or no defined habitat critical to the survival of fish species were identified within the operational area, injury/mortality from increased toxicity to adult and juvenile pelagic fish from operational discharges is not a credible event. Highly mobile adult and juvenile pelagic fish that swim through operational discharge plumes will be exposed to temporary elevated levels of turbidity. Mobile fish passing through the plume may experience behavioural or sub-lethal effects (Johnson, 2018). Observations from numerous studies have identified that adult fish can tolerate relatively high levels of turbidity and TSS for short periods (Johnson, 2018).

Fish species may become attracted to food waste discharged from the MODU and vessels. However, discharges will be sporadic over short durations and are not predicted to result in long term habituation. The intermittent discharge of food waste to the marine environment will result in a temporary localised increase in nutrients in the water column affecting ecological receptors within the operational area.

Thirty fish species are listed as having the potential to occur within the operational area in the EPBC Act PMST (26 of which are pipefish, pipehorses, seadragons and seahorses). There are 5 threatened species within this list that may be present in the operational area including blue warehou, southern bluefin tuna, Australian grayling, white shark and eastern school shark. Migratory species include species that may be present within the operational area include white shark, shortfin mako and mackerel porbeagle. Although a variety of fish species maybe be present in the area, impacts are not predicted as fish species would be transient within the operational areas and any discharges will dilute rapidly.

Marine Reptiles

The intermittent and brief nature of in-water operational discharges will preclude chronic exposure of marine organisms. To be impacted, marine reptiles would need to pass directly through any discharge plume almost immediately upon release and remain within the plume for almost the entire duration of the residence time (see Section 8.7.4.1). Given there are no marine turtle BIAs or habitat critical to the survival of marine turtles located within the operational area, it is not expected that they would be exposed to concentrations above impact thresholds for an extended time. As a result, mortality to marine reptiles from increased toxicity is not a credible event.

Marine reptiles, specifically turtles, may adjust behaviour if exposed to temporary increases in water turbidity (Johnson, 2018). Marine turtles are dependent on vision to forage, communicate and move through the water. Increase in turbidity from operational discharges may result in minor avoidance by marine turtles when exposed to operational discharge plumes in the operational area (Johnson, 2018).

Chemical and terrestrial discharge are identified as a threat in the Recovery Plan for Marine Turtles in Australia (CoA, 2017). However, the proposed activities are located within a high energy offshore environment. There are no BIA's for marine turtles in the region. Discharges will rapidly dilute and disperse; as a result of oceanic conditions; when considered along with the transient nature of these species within the area, impacts are not predicted to occur. No population level impacts are expected.

Marine Mammals

The intermittent and brief exposure nature of in-water operational discharges will preclude chronic exposure of marine mammals, as individuals would need to pass directly through any discharge plume almost immediately upon release and remain within the plume for almost the entire duration of the residence time (see Section 8.6.4.1). Marine pollution by acute and chronic chemical discharge is identified as a threat that has minor consequences to pygmy blue whale individuals within the Blue Whale Conservation Management Plan (DoE, 2015a). Given marine mammals are highly mobile pelagic species, the minor consequence classification in the Conservation Management Plan, along with the low toxicity of discharges and expected rapid dilution, injury/mortality to marine mammals from increased toxicity from operational discharges is not considered a credible event.

Marine mammals exposed to temporary elevated levels of turbidity may experience minor behavioural effects (Johnson, 2018). Increase in turbidity from operational discharges may result in plume avoidance by marine mammals when exposed to turbid plumes (Johnson, 2018).

The operational area overlaps BIAs for the pygmy blue whale and southern right whale. The operational area is also within a region of the Bass Strait which is strongly influenced by the seasonal Bonney Upwelling system and is a known seasonal feeding aggregation area for pygmy blue whales. Pygmy blue whale aggregations may overlap the operational area and surrounds to feed from November and May (DoE, 2015a).

The Bonney Upwelling is a seasonal event that causes high natural variability of water column turbidity on the Victorian coastline. Marine mammals that regularly feed along the Victorian coastline are adapted to high natural variability of in-water turbidity. Given marine mammals in the region are adapted to temporary increases in turbidity, plumes generated by operational discharges are not expected to have a discernible effect on foraging behaviours or movement patterns of individuals, nor therefore at a population level.

Summary

The predicted level of impact, i.e. the consequence, to marine fauna as a result of operational discharges is evaluated to have a consequence of **Level 1** based on:

- The high energy oceanographic processes typical of the Otway Basin. Rapid dilution and dispersion of operational discharges plume is anticipated.
- Potential impacts to plankton are predicted to be localised and short term and are not predicted to result in discernible impacts at local or regional levels.
- Due to the intermittent and brief presence of operational discharge plumes in the operational area; discharges would be expected to disperse to below no-observed-effect-concentrations (NOEC) before marine fauna could be exposed for long enough to experience toxicity impacts.
- The operational area is subject to high natural variation in turbidity levels, therefore, marine fauna present within the operational area will be adapted to brief and high levels of turbidity.
- Potential minor behavioural impacts will be temporary and localised.

Inherent Likelihood

A range of marine fauna are known to occur within the operational area. Operational discharge plumes may result in some minor and temporary behavioural and/or physiological impacts; therefore, it is likely the risk event will occur.

The inherent likelihood of a **Level 1** consequence occurring is rated **B**.

Inherent Risk Severity

The predicted level of risk, i.e., inherent risk severity, to marine fauna as a result of injury/mortality is considered **Low**.

8.7.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-58.

Table 8-58: Operational Discharges Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Impact: Change in water quality	Consequence: Level 1
	Impact: Change in sediment quality	Consequence: Level 1
	Risk: Injury/mortality to marine fauna	Risk: Low
Principles of ESD	'A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, impacts and risks from planned discharges – operational was identified as: • Level 1 consequence for changes in water quality and sediment quality • Low risk for injury/mortality to marine fauna. The above predicted levels of impact and risk due to planned discharges – operational from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology and Cooper Energy Offshore Chemical Assessment Procedure. • The highest consequence ranking for operational discharges was Level 1 and the highest inherent risk was evaluated as Low; therefore, operational discharges from the East Coast Project will not result in serious or irreversible environmental damage. The potential impacts and risks from operational discharges are well-understood, and management measures are well established and regulated in Australian waters.	
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and	

<table>
<tr><td></td><td colspan="3">productivity of the environment is maintained or enhanced for the benefit of future generations.
The East Coast Project is consistent with the principle of ESD (c) for this aspect as:
• The highest consequence ranking for operational discharges was Level 1 and the highest inherent risk was evaluated as Low and therefore will not forego the health, diversity and productivity of the environment for future generations.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.7.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</td></tr>
<tr><td></td><td colspan="3">D) ‘Biodiversity principle’
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
The East Coast Project is consistent with the principle of ESD (d) for this aspect as:
• The relevant environmental values and sensitivities to operational discharges were evaluated in Section 8.7.4 and the highest consequence ranking for operational discharges was Level 1 and the highest inherent risk was evaluated as Low.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.7.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.</td></tr>
<tr><td>Legislative and Other requirements</td><td>Requirement</td><td>Relevant Objective / Action</td><td>Demonstration of Requirement</td></tr>
<tr><td></td><td>Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Section 26F (implements MARPOL Annex I).</td><td>All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act.
Several MOs are enacted under this Act relating to offshore petroleum activities, including:
MO Part 91: Marine Pollution Prevention – Oil
MO Part 93: Marine Pollution Prevention –</td><td>Adoption of the following control measures:
CM1: Marine Assurance Process
CM6: Cooper Energy Offshore Chemical Assessment Procedure
CM8: Emissions and Discharges Standards
CM20: Campaign Risk Review</td></tr>
</table>

		Noxious Liquid Substances MO Part 96: Marine pollution prevention – sewage	
	Industrial Chemicals (Notification and Assessment Act) 1989	Project Chemicals will be considered under the requirements of this Act prior to use as relevant.	
	Minamata Convention on Mercury	Cooper Energy will consider best available techniques and environmental practices to control releases of components containing mercury in future activity specific EPs.	
	Recovery Plan for Marine Turtles in Australia, 2017 – 2027	Recovery objective: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: Anthropogenic threats are demonstrably minimised. No relevant management actions.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures for operational discharges.		

Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to planned operational discharges are AL2, AL3, AL10 and AL11 identified in Table 8-59. These acceptable levels defined for a change in water quality, sediment quality and injury / mortality to marine fauna are defined in Table 7-6. The worst-case predicted impacts assessed in Section 8.7.4 are: • Changes to water and sediment quality are likely to be localised and temporary based upon the relatively small volumes associated with operational discharges. There are no continuous discharges over the life of the project. • Due to the intermittent and brief presence of operational discharge plumes in the operational area; discharges would be expected to disperse to below no-observed-effect-concentrations (NOEC) before marine fauna could be exposed for long enough to experience toxicity impacts. • The greatest consequence ranking for operational discharges is Level 1, and highest level of risk is Low. Any impacts caused from operational discharges will be short term and highly localised. Therefore, at its worst-case, the predicted impact from planned operational discharges would not: • Lead to a substantial change in water quality which may adversely impact biodiversity and ecological integrity. • Lead to changes to seabed quality that adversely affect biodiversity, and ecological integrity. • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Lead to loss of habitat critical to the survival of species Therefore, the predicted level of impact resulting from planned operational discharges from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to operational discharges are acceptable, based on: • Predicted levels of impact (evaluated in Section 8.7.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors. • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES. • No relevant feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPOs have been applied: **EPO2:** Impacts to water quality from drilling and operational discharges are limited to localised, temporary changes in the vicinity of the discharge location. **EPO3:** Impacts to sediment quality are limited to localised, changes in the vicinity of the discharge location.

	EPO14: Impacts to marine fauna from operational and drilling discharges will not change the viability of the population of EPBC listed threatened or migratory species. **EPO15**: Impacts to marine fauna from operational and drilling discharges will not impact the recovery or conservation status of EPBC Act listed threatened or migratory species, with no population level impacts.

8.7.6 Environmental Performance

Table 8-59 lists the acceptable level and EPOs defined for operational discharges and the adopted control measures to achieve the outcome.

Table 8-59: Environmental Performance Summary – Operational discharges

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL2: Impacts and risks to water quality from activities defined in this OPP will not lead to a substantial change in water quality which adversely impacts biodiversity and ecological integrity.	**EPO2:** Impacts to water quality from drilling and operational discharges are limited to localised, temporary changes in the vicinity of the discharge location.	CM1: Marine Assurance Process All wastewater discharges will comply with relevant MARPOL 73/78, *Navigation Act 2012*, *Protection of the Sea (Prevention of Pollution) Act 1983* and subsequent Marine Order requirements (as appropriate for vessel classification): • AMSA MO 91 - Marine Pollution Prevention (Oil) • AMSA MO 95 - Marine Pollution Prevention (Garbage) • AMSA MO 96 - Marine Pollution Prevention (Sewage).
AL3: Impacts to sediment quality from activities defined in this OPP will not lead to changes that adversely affect biodiversity, and ecological integrity.	**EPO3:** Impacts to sediment quality are limited to localised, changes in the vicinity of the discharge location.	CM6: Cooper Energy Offshore Chemical Assessment Procedure Project chemicals will meet the requirements of the Cooper Energy Offshore Chemical Assessment Procedure. This process is used to ensure the lowest toxicity, most biodegradable and least bioaccumulative chemicals are selected which meet the technical requirements, where their function necessitates discharge to sea. The process consults public chemical assessment repositories such as PLONOR list, OCNS Definitive Ranked List, OSPAR and OCNS listings for those chemicals to be discharged. Eco-toxicity is evaluated with any required control measures defined. Chemicals that are highly toxic, have high bioaccumulation potential, and have high persistence in organisms are screened out during the assessment process. Only chemicals that meet low ecotoxicity pre-screening criteria, or are further justified as ALARP can be approved for discharge. An accepted chemical list is issued to the offshore project team detailing which products may be discharged and in what circumstances.
AL10: Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species.	**EPO14**: Impacts to marine fauna from operational and drilling discharges will not change the viability of the population of EPBC listed threatened or migratory species. **EPO15**: Impacts to marine fauna from operational and drilling discharges will not impact the recovery or conservation status of EPBC Act listed threatened or migratory species, with no population level impacts.	

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
		CM8: Emissions and Discharges Standards Prior to commencing the offshore activity, the following will be verified, as relevant to vessel class: • 2017 Guidelines for the Implementation of MARPOL Annex V to assist shipowners, masters and crews in applying the Annex V discharge requirements. • Bilge water treated via a MARPOL (or equivalent) approved oily water separator and only discharge if oil content less than 15 ppm. • Sewage discharged at sea is done so only in accordance with AMSA discharge standards and treated via a MARPOL (or equivalent) approved sewage treatment system as applicable. o Food waste only discharged in accordance with AMSA, MARPOL and relevant State discharge standards. CM20: Campaign Risk Review The Cooper Energy Environmental Protocol describes how environmental impact and risk management, including risk assessments, is undertaken for activities including offshore campaigns. As part of pre-campaign planning a risk review will be undertaken to re-assess campaign environmental impacts and risks to ensure acceptability criteria are met and that impacts and risks are reduced to ALARP. The risk review will consider aspects relevant to the campaign; where there is a risk that campaign discharges to sea may contain mercury, the risk review will consider the current best available techniques and environmental practices in order to control releases of mercury.

8.8 Seabed Disturbance

8.8.1 Cause of Aspect

During each phase of the East Coast Project, there are interactions with the seabed; some disturbance is expected to the seabed and benthic assemblages.

An overview of activities that will result in seabed disturbance are defined in Table 8-60 and described in Section 8.8.2.

Table 8-60: Activities undertaken during the East Coast Project that may cause seabed disturbance

Cause of Aspect / Phase	Activity component
Survey	Geotechnical survey

Cause of Aspect / Phase	Activity component
Well Construction	MODU positioning (mooring)
	Drilling operations*
	Drilling cuttings and fluids*
	Cementing operations
Installation and commissioning	Pre-lay works
	Installation of flowline and umbilical systems
	Installation of subsea structures
	Post-lay works and commissioning*
Operations	Inspection
	Maintenance and repair
Decommissioning	Well abandonment
	Flowline and umbilical decommissioning*
	Removal of remaining subsea infrastructure
Support Operations	Vessel operations
	ROV Operations

*Note – Discharges associated with these activities are described in Section 8.6.2.1 with impact and risks evaluated in Section 8.6.4.

8.8.2 Aspect Characterisation

Apart from MODU positioning and minor geotechnical survey elements, seabed disturbance from the East Coast Project (Table 8-60) are expected to be equivalent to the following planned disturbance areas:

- 2.5 km radius for the MODU anchor spread per well location
- 100 m wide disturbance corridor for flowline and umbilical systems
- 100 m disturbance radius for well and manifold locations.

Table 8-61 summarises the total area of seabed disturbance from the East Coast Project. Further details on how each activity component interacts with the seabed is provided in the following subsections based on each phase.

Table 8-61: Seabed disturbance estimated disturbance spatial extent

Planned Disturbance Area for the Project	Activity	Parameters	Estimated Disturbance Spatial Extent (km^2)	Total Estimated Disturbance Spatial Extent for the Project (km^2)
Long-term				
Disturbance corridor of 100 m for flowline and umbilical systems	Installation of flowline and umbilical systems, including activities and infrastructure occurring along these systems, such as: • geotechnical seabed sampling • IMR activities	Total route length of: • flowlines: 65.92 km • umbilicals: 73.79 km.	Spatial extent with 100 m disturbance corridor: • flowlines: 0.659 km^2 • umbilicals: 0.738 km^2.	Total disturbance spatial extent for the project: • subsea infrastructure (flowlines and umbilicals): ~1.4 km^2.

Planned Disturbance Area for the Project	Activity	Parameters	Estimated Disturbance Spatial Extent (km^2)	Total Estimated Disturbance Spatial Extent for the Project (km^2)
	• subsea infrastructure (e.g., mattresses, transponders, spools, tie-in structures).			
Disturbance radius of 100 m for well and manifold locations	Operational activities around the wells and manifold locations. Including seabed disturbance from related activities, such as: • direct drilling of top-holes • drilling and well abandonment discharges (i.e., cement and drilling cuttings) • installation of subsea infrastructure (i.e., manifolds) • decommissioning • support operations (i.e. ROV 'wet parking').	• construction of up to 15 wells • 3 manifolds • well abandonment of up to 15 wells.	Within the disturbance area of 100 m radius (0.03 km^2) per well and manifold location.	Total disturbance spatial extent for the project: • well construction: ~0.45 km^2 • subsea infrastructure (manifolds): ~0.09 km^2 • well abandonment: 0.45 km^2.
Short-term				
Disturbance within 2.5 km radius per well for the MODU positioning – anchor spread	MODU Positioning Mooring of the MODU at each well location for activities requiring the MODU, such as: • well construction • well abandonment • well intervention (a non-routine activity that may occur during the Project when required).	Mooring at each well location will require between 8 and 12 anchors. Estimated footprint per anchor: • 60 m^2 per anchor. Typically mooring chains extend from the MODU with 1,200 m of grounded chain. A disturbance width of 5m is applied accounting for some lateral movement of the chain during deployment, use and recovery. Estimated spatial extent per chain:	Total estimated spatial extent per well: • ~0.0727 km^2:	Total estimated spatial extent for Project: • well construction - ~1.09 km^{2**} • well abandonment - ~1.09 km^2 • well intervention ~0.0727 km^2 per well***: Seabed disturbance of each well location is expected to be over the same area of seabed for each phase.

Planned Disturbance Area for the Project	Activity	Parameters	Estimated Disturbance Spatial Extent (km^2)	Total Estimated Disturbance Spatial Extent for the Project (km^2)
		• 6,000 m^2 grounded chain per line (0.006 km^2) • Total for each mooring line and anchor = 0.00606 km^2:		
Approximate total for each phase:				• subsea infrastructure: ~1.49 km^2 • well construction: ~1.54 km^2 • well abandonment: ~1.54 km^2:
Approximate total for Project:				~3.03 km^2 (subsea infrastructure and well construction)

**Note: As a conservative approach, there is some double counting of planned disturbance area where the disturbance radius for well/manifold may actually overlap with the flowline/umbilical disturbance corridor.*

***Note: The estimated footprint falls within the conservative 3 km radius allocated for the MODU positioning at individual well sites. Due to the way the anchors and chains are laid only a small portion of this 2.5 km radius area will be disturbed by mooring equipment.*

****Note: As well intervention is a non-routine activity the estimated seabed disturbance spatial extent has not been included within the final estimated seabed disturbance areas; if well intervention does occur during the operational phase, the footprint would be the same or similar to the well construction and well abandonment footprints.*

8.8.2.1 Surveys

Geotechnical survey seabed sampling is expected to result in seabed disturbance.

Each piston / push sample results in a small hole (<1m^3). Approximately ~20 – 40 sample locations are expected within the scope of the OPP subject to detailed engineering requirements. Any direct disturbance to the seabed will be equivalent to the proposed disturbance corridor or survey areas.

8.8.2.2 Well construction

MODU Positioning / Installation

Mooring for the MODU will require between 8 and 12 anchors, ranging from 15 to 30 MT each (dependent on mooring analysis). The seabed disturbance spatial extent from anchors can vary between 30 m^2 and 60 m^2 at each well location. Mooring lines are also designed to partially lay on the seabed. Typically, mooring lines extend ~2,000 m – 2,500 m from the MODU with ~1,200 m of grounded chain, with an estimated 5 m width corridor within which the grounded chain may shift on the seabed.

Up to 15 production wells may be drilled in the East Coast Project within the scope of this OPP.

The seabed disturbance from the MODU positioning at each well location is expected to be over the same or similar area of seabed for each phase utilising the MODU (i.e. well construction, well abandonment, and well intervention if required).

Based on the above parameters, the estimated total seabed disturbance spatial extent for MODU positioning of the 15 production wells is ~1.09 km^2.

Drilling Operations

The drilling of the surface hole sections for new wells will result in seabed disturbance from initial penetration of the seabed. The direct disturbance spatial extent of the top-hole at each well is approximately ~2 m^2.

Three new manifolds are proposed under the East Coast Project. The dimensions will be approximately 8 x 12 m for each manifold structure; however, this spatial extent will be within the disturbance radius of 100 m.

Top-hole drilling will discharge cement and cuttings from the wellbore and drilling fluids to the seabed which has been evaluated within Section 8.6 and 8.7. The seabed disturbance from drilling operations will be within the 100 m disturbance radius for each well locations, which has an estimated total seabed disturbance spatial extent of ~0.45 km^2.

8.8.2.3 Installation and Commissioning

Seabed disturbance during installation and commissioning may be long or short-term disturbances. Long-term disturbances will result from the installation of flowlines, umbilicals, mattresses, well and manifolds and other subsea infrastructure on the seafloor. Short-term disturbances will result from deployment of transponders on the seabed and temporary wet parking of equipment and infrastructure (e.g. during severe weather events). Both long-term and short-term disturbances are planned to occur within the planned disturbance areas (Table 8-61).

Seabed disturbance from flowlines and umbilicals will be within a footprint equivalent in area to the planned 100 m wide disturbance corridor for flowline and umbilical systems, which has a footprint of 0.738 km^2 for umbilicals and 0.659 km^2 for flowlines. Trenching or excavation is not planned for pre-lay works, due to the hard seabed and historical lack of seabed trawling (due to lack of suitable trawl grounds) in the operational area.

Mattresses will be used for stabilisation of the flowlines and umbilicals. Each mattress will have an approximate footprint of 18 m^2. The total number of concrete mattresses will not be known until the pre-lay and post-lay surveys are performed; however, at this concept stage there is confidence that the area disturbed will be equivalent to the area within the nominal disturbance corridor specified for flowline and umbilical systems.

Other subsea infrastructure, such as hot-tap tie-in structures, spools etc, are expected to have a footprint of less than 25 m^2. This spatial extent will also be within the total disturbance footprint for the flowline and umbilical systems.

Equipment to support accurate positioning of subsea structures and ROVs may include transponders. Transponders are typically placed on the seabed using gravity anchors or on a frame or ballast. Transponders are recovered when they no longer required for positioning. The placement of transponders on the seabed will result in a temporary disturbance of <2 m^2 for each transponder and associated frame within the planned disturbance areas.

During installation activities, some equipment and infrastructure may be temporarily wet parked on the seabed due to storm or emergency events. Wet parking will occur within the operational area and is accounted for in the planned disturbance areas.

8.8.2.4 Operations

Seabed disturbance during the operations phase may occur if maintenance and repair activities such as replacement of equipment on the seafloor is required. Nominally up to 25 m^2 disturbance may occur during an IMR campaign. This could increase in the case of pipeline or umbilical repair activities. However nominal seabed disturbances from an IMR campaign are expected to be within the planned disturbance areas for the project.

8.8.2.5 Decommissioning

During decommissioning, mooring of a MODU used for plug and abandonment of the wells will result in seabed disturbance. The seabed disturbance spatial extent for a moored MODU for well abandonment activities is expected to be the same as the footprint of a moored MODU used for drilling. A maximum of 15 wells will be abandoned under this OPP.

Seabed disturbance is also expected during the recovery and removal of flowlines and umbilicals and other subsea infrastructure such as spools and jumpers, subsea structures, controls structures, stabilisation equipment. Structures may need to be modified subsea to facilitate removal. The seabed around structure foundations may need to be excavated or structures may need to be toppled to break sediment suction and cutting may also be required. Structures such as trees and manifolds will be cut at or below the mudline and recovered on deck. The disturbance spatial extent is expected to be an area equivalent to the disturbance corridor for flowline and umbilical systems.

Seabed disturbance during other decommissioning activities is also expected to be within an area equivalent to the disturbance corridor for flowline and umbilical systems.

8.8.2.6 Support Operations

Seabed disturbance has the potential to occur during vessel and ROV operations during vessel anchoring or temporary ROV wet parking. Any potential seabed disturbance from these operations is expected to be within the planned disturbance areas.

Vessels may deploy anchors to manage an emergency situation (such as engine failure). Seabed disturbance from emergency anchoring is estimated at 1300 m^2 (0.0013 km^2) accounting for deployment and some drag in heavy weather. The maximum number of vessels in the operational area at a time is expected during drilling activities and is expected to be 3 x anchor handler vessels or PSVs plus the MODU.

During ROV operations, seabed disturbance may occur if it is set on seabed temporarily. The seabed disturbance from ROV wet parking is estimated to be <10 m^2.

8.8.2.7 Concurrent activities

The total area of seabed disturbance from the East Coast Project for all phases has been identified in Table 8-61, and has been used as the basis for impact assessment; therefore, concurrent activities have been considered.

8.8.3 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from seabed disturbance are:

- Change in habitat.

Potential risk are:

- Injury / mortality to marine fauna
- Change to cultural heritage.

8.8.4 Impact and Risk Evaluation

8.8.4.1 Impact: Change in Habitat

Inherent Consequence Evaluation

As described in Section 6.4.7 and 6.5.1 Ramboll (2020a) and Ramboll (2020b) both found that benthic habitats within, and in close vicinity to the East Coast Project operational area to be characteristic of a seabed comprised of hard substrate and reef with patches of sand or gravelly / rubble; these substrates are well represented in the Bass Strait, particularly across the Otway region (Ramboll, 2020b). Benthic assemblages within and proximal to the operational area have been observed during subsea habitat surveys and facility inspections; the latest in 2020 (see Figure 6-17). Inspections identified hard ground and some sand, supporting patchy areas of abundant epibiota, typically bryozoans, gorgonian, cnidarians and sponges (Ramboll, 2020b). While there is some residual uncertainty on the composition of benthic assemblages in the south-western portion of the operational area, as there is no historical survey data in that area; Ramboll (2020a) surveyed sites at a similar water depth and distance offshore in a neighbouring title area (Figure 6-17; Section 6.5.1), and which provide a reasonable proxy for the purpose of impact and risk assessment.

No ecological communities listed as threatened under the EPBC Act were observed and the operational area does not overlap AMPs.

Within the operational area, up to ~3.03 km^2 of seabed has the potential to be disturbed by temporary placement of equipment on the seabed and the installation of subsea infrastructure. Approximately ~1.09 km^2 of the ~3.03 km^2 of seabed that has the potential to be disturbed during the East Coast Project is from mooring of the MODU across up to 15 well locations (during well construction / abandonment phases). As a result, ~35% of planned seabed disturbance will be short-term. Once the MODU has completed drilling, well intervention or well abandonment activities, the anchor system would be removed from the seabed which will allow for benthic habitats to recover.

Secondary impacts from scouring may occur. Scouring is a natural feature on the Otway shelf whereby currents may erode sediments around hard calcareous sediments resulting in secondary impacts (Ramboll, 2020b). Installation of subsea infrastructure will introduce the presence of hard features on the seabed which may encourage scouring processes in areas immediately surrounding seabed infrastructure installed for the East Coast Project.

The operational area overlaps the shelf rocky reefs KEF (see Section 6.6.6): these are areas of rocky reefs and hard substrates along the continental shelf which provide unique seafloor habitat for diverse assemblages of species which align with the benthic fauna observations in the Ramboll (2020b) survey (see Section 6.5.1.3). This KEF has not been spatially delineated like other KEFs as it is considered ubiquitous in the region. Activities occurring within the operational area are likely to result in seabed disturbance to the KEF and the impact some of the associated values, such as diversity and productivity of the hard substrate which are often colonised by sponges, sessile invertebrates, soft corals. The results from the 2020 seabed survey observed hard ground and patchy epifauna throughout most video transects, consistent with the description of the KEF, though no reef-type structures of high relief were observed (Ramboll, 2020b).

Recovery of benthic habitats following the removal of MODU mooring system is expected to be within months (e.g. Morrisey et al., 2018). The placement of subsea infrastructure (i.e. flowlines and umbilicals) is anticipated to have a footprint on the seabed until the decommissioning of the infrastructure, estimated to be completed in 2049. Despite the long-term impact, the disturbance will be localised within the operational area, and the infrastructure is expected to be progressively colonised by benthic assemblages. Subsea surveys of the flowlines and umbilicals installed during Stage I & II of the CHN development demonstrated colonisation by sponges, bryozoans, and hydrozoans (Figure 6-16). Therefore, benthic habitats are expected to recolonise and recover to baseline levels following installation, and again following the removal of the infrastructure.

The predicted level of impact, i.e., the consequence, as a result of a change in benthic habitat from seabed disturbance is evaluated to have a consequence of **Level 2** based on:

- Shelf rocky reefs KEF is ubiquitous with the Otway region and occur across the south east marine region and are likely to be overlapped by the operational area based on findings of the Ramboll (2020b) survey.
- Benthic assemblages in the operational area have a scattered distribution and do not contain any threatened listed ecological communities or critical habitats.
- the operational area does not overlap AMPs.
- a geophysical seabed survey will be undertaken to inform the planning of well construction activities and subsea infrastructure installation considering seabed relief, substrate and hazards.
- the total estimated area of impact is predicted to be relatively small (~3.03 km^2 for the entire project) compared to the extent of the distribution of the benthic habitats and associated benthic marine fauna found within the operational areas and wider region.

- 35% of the planned seabed disturbance area (~3.03 km^2) is expected to be from short-term mooring of a MODU during drilling, decommissioning, and well intervention (if required).
- seabed disturbance is anticipated to be localised and recoverable following infrastructure installation, and again during removal, and not impact ecosystem functioning of benthic habitats.

8.8.4.2 Risk: Injury/Mortality to Marine Fauna

Inherent Consequence Evaluation

Benthic assemblages and invertebrates

Seabed disturbance during the East Coast Project has the potential to result in the direct loss of benthic and demersal invertebrate communities within the planned disturbance area. The operational area is in water depths ranging from 55 m to 85 m. At these water depths benthic and demersal invertebrates in the planned disturbance area may include patchy presence of epifauna such as bryozoans, gorgonian cnidarians and sponges (Ramboll, 2020b), molluscs such as the Arrow squid (Kailola et al., 1993) and crustaceans such as rock lobsters (Section 6.5.4). The presence of these invertebrate communities is representative of what is expected throughout the Otway Basin. Injury/mortality to benthic and demersal invertebrate communities from seabed disturbance is expected to be localised given benthic and demersal invertebrate communities within the planned disturbance area are highly represented throughout the region.

Mobile invertebrates, including some molluscs and crustaceans, are generally less vulnerable to seabed disturbance activities given the ability to move away (Fraser, et al., 2017). However sessile taxa including sediment-burrowing infauna and surface epifauna invertebrates (particularly filter feeders) which inhabit the seabed directly around subsea infrastructure locations are expected to be impacted by seabed disturbance activities. As a result, the direct loss of infauna and epifauna within the planned disturbance areas is expected. Dernie et al. (2003) conducted a study that showed the full recovery of soft sediment assemblages from physical disturbance could take between 64 and 208 days. Within the operational area, the seabed can be rocky, and assemblages representative of hard substrate communities; in-field inspections around existing facilities confirm recovery of benthic assemblages, with colonisation of installed equipment and surrounding seabed (Figure 6-16). Therefore, the loss of infauna and epibenthic communities is expected to be recoverable whereby surrounding infauna and epibenthic communities will recolonise impacted areas and likely colonise the surfaces of equipment installed on the seabed. Injury/mortality to benthic and demersal invertebrate communities from seabed disturbance is expected to be short term / recoverable based on observations of natural regrowth and recovery around existing facilities.

The predicted level of impact, i.e. the consequence, to benthic assemblages and invertebrate communities from seabed disturbance is evaluated to have a consequence of **Level 2** based on:

- Shelf rocky reef KEF is ubiquitous with the Otway region and occurs across the south east marine region and are likely to be overlapped by the operational area based on findings of the Ramboll (2020b) survey.
- invertebrate communities in the operational area are representative of what is expected throughout the Otway Basin.
- no threatened benthic species, assemblages or ecological communities were identified within the operational area.
- the planned seabed disturbance area is subject to localised and short-term changes to benthic habitats with no long-term effects to habitat, diversity or productivity.

Fish

Seabed disturbance during the East Coast Project has the potential to impact fish and subsequently commercial fisheries. Impacts are limited to sessile fish species that do not have the ability to avoid seabed disturbance activities, therefore resulting in injury and death.

Thirty-three fish species are listed as having the potential to occur within the operational area on the EPBC Act PMST (26 of which are pipefish, pipehorses, seadragons and seahorses). There are 5 threatened species within this list that may be present in the operational area including blue warehou, southern bluefin tuna, Australian grayling, white shark and eastern school shark. Migratory species include species that may be present within the operational area include white shark, shortfin mako and mackerel porbeagle. The operational area does not contain habitats to support aggregations or site fidelity for these listed fish species. Except for pipefish, pipehorses, seadragons and seahorses, all species are mobile and are expected to move away and avoid injury during seabed disturbance activities.

Sessile and slow-moving fish species including pipefish, pipehorses, seadragons and seahorses are found in a variety of habitats ranging from deep reefs to coastal algae, or weed or seagrass habitats (Kuiter, 2000). Certain seahorse species, such as the big-belly seahorse (*Hippocampus abdominalis*) have been identified in water depths up to 104 m; attached to sponges and colonial hydroids (DoE, 2024). The seabed proximal to the operational area does not include weed or seagrass habitats (Ramboll, 2020b). The majority of the area within and proximal to the operational area is hard substrate and patches of sand and rubble. This seabed type does support benthic fauna including sessile marine invertebrates such as sponges (Ramboll, 2020b). Impacts to seabed communities are anticipated from the East Coast Project. These impacts will be limited to the near vicinity of the activities where there is interaction with the seabed. The seabed and assemblages are expected to recover naturally, as demonstrated by surveys of existing infrastructure and adjacent seabed showing regrowth over and around equipment on the seabed (Figure 6-16).

Commercial fish species that may occur within the operational area include elephantfish, gummy shark, sawshark and lobster. These commercial fish and shark species are not known to exhibit site fidelity and are anticipated to be transient through the operational area. Therefore, impacts are predicted to be limited to temporary and localised avoidance behaviours during seabed disturbance activities. Lobster are mobile species and are generally considered less vulnerable to seabed disturbance compared to sessile taxa as they are able to move (Fraser et al. 2017).

Seabed disturbance within the operational area is not expected to result in a change in the viability of the population of commercially important fish species. Subsequently impacts to commercial fisheries are not expected to occur.

The predicted level of impact, i.e. the consequence, to fish and commercial fisheries from seabed disturbance is evaluated to have a consequence of **Level 1** based on:

- potential impacts to fish, including sessile species are expected to be localised and recoverable.
- potential impacts to commercial fish species are expected to be limited to temporary and localised avoidance behaviours.

<u>Summary</u>

The predicted level of impact, i.e. the consequence, to marine fauna from seabed disturbance is evaluated to have a consequence of **Level 2** based on:

- Shelf rocky reef KEF is ubiquitous with the Otway region and occurs across the south east marine region and are likely to be overlapped by the operational area based on findings of the Ramboll (2020b) survey.
- invertebrate communities in the operational area are representative of what is expected throughout the Otway Basin.
- no threatened benthic species, assemblages or ecological communities were identified within the operational area.
- localised and short-term loss of benthic and demersal invertebrate communities with high recovery rates and highly represented throughout the region.

Inherent Likelihood

Benthic assemblages have been observed during surveys and inspections within and proximal to the operational area. The surveys observed modified (around infrastructure) and unmodified marine environments with scattered areas of hard ground supporting patchy areas of abundant epibiota, typically bryozoans, gorgonian, cnidarians and sponges (Ramboll, 2020b). The scattered and patchy presence of benthic and demersal invertebrate communities is expected within the operational area and there will be some disturbance through the life of the project.

The inherent likelihood of a **Level 2** consequence occurring is therefore rated as Likely **B**.

Inherent Risk Severity

The inherent risk severity of Injury/mortality to benthic and demersal invertebrate communities is considered **Moderate**.

8.8.4.3 Risk: Change to Cultural Heritage

Seabed disturbance may result in changes to cultural heritage such as:

- Disturbance of underwater cultural heritage including shipwrecks, aircraft and other artefacts.

A search of the Australasian Underwater Cultural Heritage Database found one shipwreck, Alfred (<75 years old ID 11052), located near the border of the operational area. On further investigation the wreck is confirmed to be at Middle Island, Warrnambool, and is therefore not relevant to the operational area of the East Coast Project (Section 6.8.1).

No shipwrecks have been observed during survey or inspections within and proximal to the operational area to date. Most recent surveys and inspections were in 2020.

There is potential for unknown underwater cultural heritage to be disturbed from activities that may cause seabed disturbance. However, the predicted level of impact, i.e. the consequence, of change to cultural heritage from seabed disturbance is evaluated to have a consequence of **Level 1** given the absence of heritage to date, and that disturbance to cultural heritage (if it were unexpectedly found) is regulated, to avoid damage.

Inherent Likelihood

No known underwater cultural heritage including shipwrecks, aircraft, and other artefacts occur within the operational area. Changes to cultural heritage from seabed disturbance is not expected to occur during the East Coast Project. However, in exceptional circumstances there is a remote chance of change to unknown underwater cultural heritage within the planned disturbance area during non-intrusive pre-install surveys, therefore there is a remote likelihood the risk event will occur.

As a result, the inherent likelihood of a **Level 1** consequence occurring is rated **Remote (E)**.

Inherent Risk Severity

The inherent risk severity of change to cultural heritage is considered **Low**.

8.8.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-62.

Table 8-62: Seabed disturbance acceptability assessment

<table>
<tr><th>Acceptability Criteria</th><th colspan="2">Demonstration of Acceptability</th></tr>
<tr><td rowspan="3">Cooper Energy Risk Management Protocol</td><td>Impact: Change in habitat</td><td>Consequence: Level 2</td></tr>
<tr><td>Risk: Injury/mortality to marine fauna</td><td>Risk: Moderate</td></tr>
<tr><td>Risk: Change to cultural heritage</td><td>Risk: Low</td></tr>
<tr><td rowspan="4">Principles of ESD</td><td colspan="2">A) ‘Integration principle’
The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate.
The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate.
Pre-public comment, impacts and risks from seabed disturbance was identified as:
• Level 2 consequence for change in habitat
• Moderate risk for injury/mortality to marine fauna
• Low risk for change cultural heritage.
The above predicted levels of impact and risk due to seabed disturbance from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).</td></tr>
<tr><td colspan="2">B) ‘Precautionary principle’
If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
The East Coast Project is consistent with the principle of ESD (b) for this aspect as:
• Evaluation of impacts and risks were conducted in accordance with Cooper Energy’s risk assessment methodology.
• The highest consequence ranking for seabed disturbance was Level 2 and the highest inherent risk was evaluated as Low; therefore, seabed disturbance from the East Coast Project will not result in serious or irreversible environmental damage.
The potential impacts and risks from seabed disturbance are well-understood, and management measures are well established and regulated in Australian waters.</td></tr>
<tr><td colspan="2">C) ‘Intergenerational principle’
The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.
The East Coast Project is consistent with the principle of ESD (c) for this aspect as:
• The highest consequence ranking for seabed disturbance was Level 2 and the highest inherent risk was evaluated as Moderate and therefore will not forego the health, diversity and productivity of the environment for future generations through protection of environmental values.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.8.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</td></tr>
<tr><td colspan="2">D) ‘Biodiversity principle’</td></tr>
</table>

	The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant environmental values and sensitivities to seabed disturbance were evaluated in Section 1.1.1 and consequence ranking for seabed disturbance was Level 2 and the highest inherent risk was evaluated as Low. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.6.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained through protection of the values of the Commonwealth Marine Area as per the objectives of bioregional plans.		
Legislative and Other requirements	**Requirement**	**Relevant Objective / Action**	**Demonstration of Requirement**
	Offshore Petroleum Decommissioning Guideline (DISER, 2018)	Options other than complete removal may be considered, however the titleholder must demonstrate that the alternative decommissioning approach delivers equal or better environmental, safety and well integrity outcomes compared to complete removal, and that the approach complies with all other legislative and regulatory requirements.	Adoption of the following control measures: CM2: Offshore Operational Procedures CM9: Underwater Cultural Heritage Disturbance Risk Management Measures CM10: Implement Cooper Energy's Decommissioning Protocol
	Commonwealth Environment Protection (Sea Dumping) Act 1981	A Sea Dumping Permit under the Commonwealth *Environment Protection (Sea Dumping) Act 1981* may need to be sought for proposals to decommission the facilities other than by full removal.	
	Section 572 Maintenance and removal of property Policy (NOPSEMA)	All property is designed, installed and operated with the intention of being removed when it is no longer in use when a field permanently ceases production, all remaining property is removed if it is not to be used in connection with the operations a comparative assessment may be used in an EP as a method to evaluate feasible alternatives to removing property when an evaluation of impacts and risks are required by the OPGGS(E)R, they must incorporate a holistic evaluation of the	

		impacts and risks of the alternative arrangements (including those impacts and risks that may arise from removing or relocating property outside the title area) and consider community interest.	
	Section 270 Consent to surrender Title	Prior to Title surrender, the following principles and conditions apply: • Ecologically sustainable development. • Impacts and risks are reduced to ALARP and are of an acceptable level. • Wells have been plugged or closed off in accordance with section 569(1) of the OPGGS Act (Cwth). • Other international and domestic requirements. • The seabed within the Title Area is cleared of property installed, or authorised to be installed by the Titleholder, except where a deviation has been accepted by the Regulator. • EPs (to be) developed for the decommissioning phases will address these principles and conditions and outline the studies and surveys required to demonstrate compliance with Section 572 and Section 270.	
	Recovery Plan for the White Shark (*Carcharodon carcharias*)	Identifies habitat modification as a threat. No explicit relevant objectives.	
	Underwater Cultural Heritage Act 2018	The *Underwater Cultural Heritage Act 2018* (UCH Act) protects the integrity of Australia's underwater cultural heritage sites in-situ and individual artefacts	

		associated with those sites.	

Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).
External Context	No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures for seabed disturbance.
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to seabed disturbance are AL6, AL10, AL11. AL13, AL14, AL15 and AL16 identified in Table 8-63. These acceptable levels defined for a change in habitat, cultural heritage and injury/mortality to marine fauna are defined in Table 7-6. The worst-case predicted impacts assessed in Section 1.1.1 are: • The total area of impact from seabed disturbance is expected to be limited to a localised area of ~3.03 km^2, which includes ~1.49 km^2 for subsea infrastructure, and ~1.54 km^2 for well construction. • The total area of impact from seabed disturbance is expected to be limited to a localised area of ~3.03 km^2, which includes ~1.49 km^2 for subsea infrastructure, and ~1.54 km^2 for well construction. • The short-term disturbance area is approximately 35% of the total planned seabed disturbance area (1.09km^2 of the ~3.03 km^2) which is expected to be from short-term mooring of a MODU. • Recovery of benthic habitats following the removal of MODU mooring system is expected to be within months (e.g. Morrisey et al., 2018). However, Dernie et al. (2003) conducted a study that showed the full recovery of soft sediment assemblages from physical disturbance could take between 64 and 208 days. • The long-term disturbance area is based on the placement of subsea infrastructure (i.e. flowlines and umbilicals) which is anticipated to have a physical presence on the seabed until the decommissioning of the infrastructure, estimated to be completed in 2049. Despite the long-term impact, the disturbance will be localised within the operational area, and the infrastructure is expected to be progressively colonised by benthic assemblages. • Shelf rocky reef KEF is ubiquitous with the Otway region and occurs across the south east marine region (Ramboll, 2020b). • No threatened benthic species, assemblages or ecological communities were identified within the operational area. The highest consequence ranking for seabed disturbance was Level 2 and the highest inherent risk was evaluated as Moderate. • Infauna and epibenthic communities are expected to recolonise impacted areas. Injury/mortality to benthic and demersal invertebrate communities from seabed disturbance is expected to be short term and recoverable based on observations of natural regrowth and recovery around existing facilities. • Fish species are transient through the operational area, and impacts are predicted to be temporary and localised as the fauna can avoid the area during disturbance. Therefore, at its worst-case, the predicted impact from seabed disturbance would not: • Modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity. • • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Lead to loss of habitat critical to the survival of species • Exceed levels which prevent protection and conservation of underwater cultural heritage as defined under the *Underwater Cultural Heritage Act 2018*.

	• Not lead to injury or desecration of objects or areas declared for protection under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*. • Not interfere with native title rights or users as defined under section 233 of the *Native Title Act 1993* (Cth). Therefore, the predicted level of impact resulting from seabed disturbance from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to seabed disturbance are acceptable, based on: • Predicted levels of impact (evaluated in Section 1.1.1) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors. • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES. • No relevant feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPOs have been applied: **EPO6:** Impacts to benthic habitats from drilling discharges and seabed disturbance are limited to localised changes. **EPO7:** Impacts to benthic habitat from drilling discharges and seabed disturbance are limited to localised changes which will not adversely impact the ecosystem functioning or integrity of the shelf rocky reef KEF. **EPO19**: Impacts will not result in substantial adverse impacts to commercially targeted species. **EPO20:** The Activity is managed such that: • It does not prevent any cultural practice from taking place • It does not destroy any element of the environment which is a cultural feature, or which forms part of a cultural feature • There is no destruction of underwater cultural heritage

8.8.6 Environmental Performance

Table 8-63 lists the acceptable level and EPO defined for seabed disturbance and the adopted control measures to achieve the outcome.

Table 8-63: Environmental Performance Summary – Seabed disturbance

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL6: Impacts and risks to benthic habitat from activities defined in this OPP will not modify an important or substantial area of habitat which may adversely impact on	**EPO6:** Impacts to benthic habitats from drilling discharges and seabed disturbance are limited to localised changes. **EPO7:** Impacts to benthic habitat from drilling discharges and seabed	CM2: Offshore Operational Procedures Seabed surveys (geophysical, geotechnical, visual and contaminant sampling) will be undertaken for the purposes of collecting information on, and where required for managing risks related to the benthic environment, underwater heritage, debris and hazards on the seafloor. These will be undertaken prior to finalising MODU position and location of mooring

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
biodiversity and ecological integrity. **AL10:** Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species. **AL9:** Impacts and risks to other marine users associated with activities defined in this OPP will not lead to substantial adverse effects on the sustainability of commercial fisheries.	disturbance are limited to localised changes which will not adversely impact the ecosystem functioning or integrity of the shelf rocky reef KEF. **EPO19:** Impacts will not result in substantial adverse impacts to commercially targeted species.	equipment, and prior to selection of final locations of wells and subsea infrastructure. Mooring procedures for the MODU will reduce overlap/disturbance by ensuring: • Adequate tensioning of mooring for the MODU is applied and maintained. • Mooring equipment for the MODU is only installed or stored within the designed radius areas of the mooring spread. The final location of infrastructure and wells will be selected to ensure: • Seabed relief and sensitive seabed features are considered, and sensitive features (i.e., areas of high relief) are avoided, or overlap with the project footprint reduced where practicable. CM10: Implement Cooper Energy's Decommissioning Protocol The Cooper Energy decommissioning protocol acknowledges legislative requirements and illustrates the company's management system for integrating decommissioning planning and provisioning through a projects life cycle.
AL14: Impacts and risks from activities defined in this OPP will not prevent the protection and conservation of underwater cultural heritage as defined under the *Underwater Cultural Heritage Act 2018.* **AL15:** Impacts and risks from activities defined in this OPP will not lead to injury or desecration of objects or areas declared for protection under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984.* **AL16:** Impacts and risks from activities defined in this OPP will not interfere with native title rights or interests as defined under section 233 of the *Native Title Act 1993* (Cth), to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the Titleholder.	**EPO20**: The Activity is managed such that: • It does not prevent any cultural practice from taking place • It does not destroy any element of the environment which is a cultural feature, or which forms part of a cultural feature • There is no destruction of underwater cultural heritage	CM9: Underwater Cultural Heritage Disturbance Risk Management Measures Cooper Energy Cultural Heritage Disturbance Risk Management Measures acknowledge legislative requirements and establishes the methods by which potential disturbance to cultural heritage is identified including via screening, consultation, and expert advice as required. The procedure identifies management measures applicable to the different phases of the offshore project to ensure impacts and risks throughout the project life cycle remain within acceptable levels and are managed to ALARP.

8.9 Interaction with Other Marine Users

8.9.1 Cause of Aspect

The physical presence of survey vessels, the MODU and support vessels will temporarily displace any other marine users within the operational area, with exclusion areas requested via notice to mariners, issued by the Australian Hydrographic Office (AHO). Small Petroleum Safety Zones (PSZs) are typically established around wells, and sometimes other equipment; marine users will be excluded from PSZs for the life of the facility, or until the PSZ is revoked. PSZs are gazetted by NOPSEMA.

Displacement of marine users will occur as a result of East Coast Project activities, identified in Table 8-64, which are described in further detail in subsections below.

Table 8-64: Activities undertaken during the East Coast Project that may cause displacement of marine users

Cause of Aspect / Phase	Activity component
Equipment presence on the seabed / All Phases	PSZ gazetted by NOPSEMA at the request of the Titleholder (typically 500m radius exclusion zone around wells and sometimes other equipment such as manifolds)
Support operations	MODU operations – temporary exclusion zone issued by the AHO
	Vessel operations – temporary exclusion zone issued by the AHO

8.9.2 Aspect Characterisation

8.9.2.1 Hydrocarbon extraction and transport

Cooper Energy will typically apply for new PSZs to be put in place, where necessary, to protect the subsea assets and to ensure the vessels and equipment of other marine users are not put at risk (e.g. snagging fishing equipment).

PSZs are typically 500 m radius around each well site, or other equipment (as needed). Vessels or classes of vessel will be prohibited from being in these PSZs for the duration of the East Coast Project, typically until decommissioning activities are complete, or risks are otherwise managed, and PSZs revoked.

The subsea infrastructure will remain in place on the seabed for the life of the East Coast Project. There is potential for interaction of other marine users with this equipment, in the event that those marine users interact with the seabed.

8.9.2.2 Support Operations

The MODU will be present in the operational area during drilling, well intervention and for well abandonment activities (see Section 4.3 for indicative durations of these activities). The MODU will be stationary for most of the time in the operational area. During operations other marine users will typically be requested to avoid entering area surrounding the activity and a nominal exclusion area established:

- A 3 km radius cautionary zone around the MODU during well construction activities to allow for anchors, mooring chains and wire to be placed within the operational area.
- A Safety Exclusion Zone around temporary project vessels and the MODU, typically 500m radius and established via a ‘Notice to Mariners’ outlining the exclusion zone location, size and activity duration.

Project vessels will temporarily visit the operational area during all phases of the East Coast Project. ~3 anchor handler vessels or PSVs plus the MODU could be within the operational area during drilling and decommissioning activities.

The largest vessel required for the project is likely to be an Installation Support Vessel (ISV) or Reel-Lay vessel in which may be in field for ~45 days per campaign.

Interim vessel transiting to and from the operational area are managed under the Commonwealth *Navigation Act 2012* and therefore this activity is excluded from the scope of the OPP.

8.9.2.3 Concurrent activities

As described in Section 4.1.3, concurrent activities could occur. Cooper Energy assessed reasonably foreseeable concurrent activity scenarios and identified that the potential concurrent activities of drilling operations at Elanora-1 and flowline installation between Annie-2 and Casino-5 represents the activity scenario with the greatest number of vessels within the operational area, operating concurrently. This could involve 3 vessels and a MODU operating at once (further details in Section 8.2.2.4). These kinds of concurrent activities could occur over periods of ~50 days depending on the exact scope of works to be completed and availability of vessels and equipment. Drilling and related activities such as flaring would occur only from 1 well at a time.

Long term PSZs may be established around the near vicinity of each well; this is common practice offshore Victoria.

8.9.3 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from the physical presence of survey vessels, the MODU and support vessels include changes to the function, interests, and activities of other marine users, including:

- shipping
- petroleum exploration and production
- other offshore infrastructure (i.e. renewable energy)
- defence
- recreation and tourism
- commercial fisheries.

8.9.4 Impact and Risk Evaluation

8.9.4.1 Impact: Changes to the Functions, Interests and Activities of Other Marine Users

The physical presence of infrastructure, and support operations (vessel and MODU operations) has the potential to impact on the following activities by the exclusion of other marine users into the operational area.

<u>Shipping</u>

The operational area sits at the norther edge of the shipping route that runs east/west along Australia's southern coastline. Moderate levels of shipping traffic are expected in the southern sections of the operational area, with the occasional vessel traversing in the northerly sections most likely related to surrounding hydrocarbon production and exploration activities. A total of 522 vessels intersected the proposed operational area in 2022 (AMSA, 2023) which is an average of 1.4 vessels per day.

There are no designated shipping lanes in the vicinity of the operational area (Australian Hydrographic Office, 2023).

Commercial shipping will need to physically avoid the temporary exclusion zones established around the MODU and other project vessels; and long-term PSZs in place above infrastructure during operations. These zones are small (typically 500 m radius); the MODU exclusion zone temporary for the duration of drilling.

Given this small area, moderate number of vessels transiting through the operational area and with known activities published via a notice to mariners, impacts to commercial shipping are likely to minimal. Exclusion and traffic management areas not unusual off the southeast of Australia and are managed and communicated under existing protocols.

Petroleum exploration and production

Within the operational area there are a number of abandoned and production wells which were originally explored by Santos Limited, Shell Development (Australia) Proprietary Limited and Cooper Energy Pty. Ltd.

Cooper Energy's existing CHN facilities consist of the Casino, Henry and Netherby gas fields along with associated subsea infrastructure.

Beach Energy's Otway Gas Field Development and Woodside's Minerva Gas Development are ~5.2 km and 8.5 km respectively from the operational area. The Otway Gas Field is under operation; and Minerva is in the process of being decommissioned.

At the time of writing, the following EPs are under development or assessment, and propose to undertake activities in the Otway Region in the next 5-years:

- Regia MSS
- Beach Energy Otway Drilling Campaign
- Woodside Energy Minerva Facility Decommissioning
- Conoco Phillips Exploration Drilling.

CGG are planning to undertake the Regia 3D Marine Seismic Survey, which overlaps 76% of the East Coast Project operational area. The survey duration of 90 days, with an earliest start date is 1 November 2023 following regulatory approval; and latest finish date is 31 October 2028 (CGG, 2023).

Future Cooper Energy exploration drilling activities may be undertaken within the operational area, which will inform the final engineering design of the East Coast Project; and will be managed by Cooper Energy.

There is no direct overlap of infrastructure, and no crossings of third-party pipelines in the operational area. The East Coast Project operational area does overlap the operational area of the proposed Regia 3D Marine Seismic Survey. Therefore, apart from the proposed short term Regia 3D Marine Seismic Survey (90 days), it is expected that only transiting support vessels could be impacted by proposed exclusion zones for the East Coast Project.

Proposed exclusion zones (PSZ and cautionary zones) will result in the exclusion of support vessels. Given the limited size of PSZs (typically a 500 m radius) and cautionary zones (approximately 3 km), impacts to petroleum activities are expected to be minimal.

Other Offshore Infrastructure

There are currently no offshore renewable energy installations or areas 'declared to be suitable' for offshore wind by the Australian Government within the operational area. The closest area 'declared to be suitable' is the Southern Ocean Region, which is ~5 km from the operational area.

The Proposed Area designated as the Barwon Offshore Wind Farm is currently under early planning and concept phases and overlaps with the operational area (DP Energy, 2024). This initial area is yet to be 'declared to be suitable' by the Australian Government and is still undergoing stakeholder consultation. Whilst there are a few proposals for windfarms off the coast of Victoria, none has progressed further than a pre-feasibility assessment and therefore, no further assessment is required.

Defence

There is no known Australian Defence Force (ADF) training, practice or prohibited area that intersect with the operational area, therefore no impact to defence activities from the East Coast Project are predicted.

Recreation and Tourism

Key tourist and recreational activities in the area include sight-seeing, surfing and fishing however, these are generally land-based or near-shore activities and are not impacted by the proposed activities. Most recreational fishing typically occurs in nearshore coastal waters (shore or inshore vessels), and within bays and estuaries; offshore (>5 km) fishing only accounts for approximately 4% of recreational fishing activity in Australia.

Proposed exclusion zones (PSZ and cautionary zones) will result in very localised exclusion of tourist and recreational marine users. Given the limited size of PSZs (typically a 500 m radius) and cautionary zones (~3 km), impacts to tourists and recreational fishers are expected to be minimal

Commercial Fishing

Multiple fisheries from two fishing management jurisdictions (Commonwealth and Victorian) overlap the operational area, including:

- ten Commonwealth fisheries
- seven Victorian fisheries.

Table 8-65 identifies these fisheries and notes if recorded fishing activity has occurred within the operational areas within the period of 2016 to 2022 (ABARES, 2023).

Table 8-65: Presence of commercial fisheries and fishing activity within the operational area

Fishery	Recorded fishing intensity in the operational area (2016 to 2022)
Commonwealth	
Bass Strait Central Zone Scallop Fishery (BSCZSF)	X
Eastern Skipjack Tuna Fishery (ESTF)	X
Eastern Tuna and Billfish Fishery (ETBF)	X*
Small Pelagic Fishery (SPF)	X
Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)	✓
Southern and Eastern Scalefish and Shark Fishery – Gillnet Hook Trap Sector Shark Gillnet sub-sector (SESSF – CGS)	✓
Southern and Eastern Scalefish and Shark Fishery – Gillnet Hook Trap Sector Shark Hook sub-sector (SESSF – CSHS)	X*
Southern and Eastern Scalefish and Shark Fishery SESSF – Scalefish Hook Sector (SESSF – SHS)	X*
Southern Bluefin Tuna Fishery (SBTF)	X
Southern Squid Jig Fishery (SSJF)	✓
Victorian	
Abalone	X
Giant Crab Fishery	✓
Multi-species Ocean Fishery	✓
Octopus	✓
Rock Lobster Fishery	✓
Scallop Fishery	X
Wrasse Fishery	✓

**operational area is not overlapped by an area reporting intensity data but is overlapped by an area designated as maximum area fished (Commonwealth reporting grid) at a resolution of one degree (approximately 111 x 111 km)*

Commonwealth Fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA) under the *Fisheries Management Act 1991* (Cth). AFMA jurisdiction covers the area from 3 nm from the coast out to the 200 nm limit (the Australian Fishing Zone (AFZ)). Within Commonwealth fishery data sets, relative fishing intensity is an area where 5 or more fishing vessels operated and consists of the relative effort expended or the catch. The maximum area fished (Commonwealth reporting grid) is the total area where fishing occurred at a resolution of one degree (approximately 111 x 111 km). If fishing consists of <5 vessels, it is considered confidential by AFMA, and intensity data may not be reported.

Commonwealth fisheries which had a reporting grid or fishing intensity data intersecting with the operational area between 2016 and 2022 are detailed in the following sections.

Eastern Tuna and Billfish (ETBF)

No fishing intensity data between 2016 and 2022 overlaps the operational area. However, the operational area is overlapped by a single Commonwealth reporting grid. Between 2016 and 2022 fishing activity occurred within this Commonwealth reporting grid only in 2017. Little or no fishing activity from the Eastern Tuna and Billfish Fishery is expected within the operational area as fishing intensity data is shown to mostly occur in southern NSW and southern Tasmanian waters.

Therefore, activities from the East Coast Project are unlikely to have an impact to fishers within the ETBF fishery.

Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)

The Commonwealth Trawl Sector (CTS) includes both otter-board trawl fishing as wells as Danish-seine methods.

Intensity data for the SESSF – CTS (otter-board trawl) fishery is primarily active along the continental shelf spanning from South Australian offshore waters to NSW offshore waters plus the west and east coasts of Tasmania. The operational area overlaps the combined 2016 to 2022 five-year low intensity data by 0.03% and has no overlap with areas designated as moderate or high intensity fishing. Therefore, activities from the East Coast Project are unlikely to have an impact to fishers within the SESSF Commonwealth Trawl Sector fishery (otter-board trawl) fishery.

No fishing intensity data for the Danish-seine segment of the Commonwealth Trawl Sector overlaps the operational area between 2016 to 2022. However, the operational area is overlapped by one reporting grid resulting from activity occurring in the 2020 – 2021 fishing season. Fishing activity primarily occurs in the Gippsland area and to the east of Tasmania.

Therefore, activity from this fishery is not expected within the within the operational area with activities from the East Coast Project unlikely to have an impact to fishers within the SESSF Commonwealth Trawl Sector fishery (Danish-seine) fishery.

Southern and Eastern Scalefish and Shark Fishery – Gillnet Hook Trap Sector Shark Gillnet sub-sector (SESSF – CGS)

Data for the SESSF – Gillnet Hook Trap Sector Shark Gillnet sub-sector (SESSF – CGS) shows on overlap with both low and moderate intensity fishing between 2016 and 2022. However, the overlap is minimal with the operational area overlapping the low and moderate intensity areas by 0.49% and 0.21% respectively.

Therefore, activities from the East Coast Project are unlikely to have an impact to fishers within the SESSF – Gillnet Hook Trap Sector Shark Gillnet sub-sector (SESSF – CGS) fishery.

Southern and Eastern Scalefish and Shark Fishery – Gillnet Hook Trap Sector Shark Hook sub-sector (SESSF – CSHS)

No fishing intensity data for the SESSF – Gillnet Hook Trap Sector Shark Hook sub-sector (SESSF – CSHS) overlaps the operational area between 2016 and 2022. However, the operational area is overlapped by one reporting grid resulting from activity occurring in the 2020 – 2022 fishing season. The majority of fishing activity occurs in South Australia waters and north-eastern Tasmania.

Therefore, activities from the East Coast Project are unlikely to have an impact to fishers within the SESSF – Gillnet Hook Trap Sector Shark Hook sub-sector (SESSF – CSHS) fishery.

Southern and Eastern Scalefish and Shark Fishery – Scalefish Hook Sector (SESSF – SHS)

No fishing intensity data for the SESSF – Scalefish Hook Sector (SESSF – SHS) overlaps the operational area between 2016 and 2022. However, the operational area is overlapped by one reporting grid resulting from activity occurring in the 2020 – 2022 fishing season. The majority of fishing activity occurs in waters to the east and south of Tasmania.

Therefore, activities from the East Coast Project are unlikely to have an impact to fishers within the SESSF – Scalefish Hook Sector (SESSF – SHS) fishery.

Southern Squid Jig Fishery (SSJF)

Data for the Southern Squid Jig Fishery (SSJF) shows an overlap with low intensity fishing between 2016 and 2022. However, the overlap is minimal with the whole operational area overlapping the low intensity area by 4.02%. Moderate and high fishing intensity occurs to the west of the operational area and east of Tasmania.

Therefore, activities from the East Coast Project are unlikely to have an impact to fishers within the Southern Squid Jig Fishery (SSJF) fishery.

Victorian Fisheries

Victorian fisheries are managed by the Victorian Fisheries Authority (VFA) with their jurisdiction extending offshore to 3 nm. By agreement with the Commonwealth, the VFA also manages some fisheries beyond this limit.

Abalone

The operational area overlaps the central zone of the Victorian Abalone Fishery. However, catch data for the 34-licence holders within the zone is assessed as confidential. Abalone is collected by divers who use a chisel-like, iron bar to prise it from the rocks as is found on rocky reefs from the shore out into the sea to depths of 30 m (VFA, 2022b). Divers operating using hookah (light-weight surface supplied equipment), which is usually limited to a maximum of 30 m operating depth.

The shallowest section of the operational area is 49 m; therefore, based on water depths for fishing and habitat, overlap between the East Coast Project and stakeholder functions, interests, and activities is considered to be very unlikely.

Giant Crab Fishery

The Victorian giant crab fishery targets Giant Crab *(Pseudocarcinus gigas*) using baited lobster pots. The operational area is situated within the 'western zone' of this fishery defined as the area between Apollo Bay and the Victorian/South Australian border. VFA data shows that the greatest fishing intensity for the Victorian Giant Crab Fishery occurs along the continental shelf at depths between approximately 150 to 300 m which is to the south of the operational area. VFA data shows that the operational area intersects with 6 separate reporting grids. Four of these reporting grids are marked as confidential due to <5 vessels operating between 2013 and 2023. The fifth and sixth reporting block reports 8 and 9 fished between 2013 and 2023.

As the highest degree of fishing intensity is situated to the south of the operational area, stakeholder functions, interests, and activities of the giant crab fishery are unlikely to be impacted by the East Coast Project.

Multi-species Ocean Fishery

The Victorian multi-species ocean fishery is comprised of the ocean fishery, the commercial permit fishery and the octopus fishery sub-sectors. Historically the octopus (eastern zone) fishery was included in the multi-species ocean fishery but was established as a standalone fishery in 2020. VFA data shows the greatest number of days fished occurring to the west of Portland and between Cape Otway and Cape Liptrap.

As the highest degree of fishing intensity data (not deemed confidential) is situated outside of the operational area, stakeholder functions, interests, and activities of the multi-species ocean fishery are unlikely to be impacted by the East Coast Project.

Octopus

The octopus (eastern zone) fishery was historically included in the multi-species ocean fishery; but was established as a standalone fishery in 2020. The target species the pale octopus (*Octopus pallidus*), are found in bays and coastal waters. Catch data shows that only one reporting grid overlaps the operational area which is assessed as confidential as <5 fishing vessels have reported fishing in the area. The majority of the fishing effort is shown to occur to the east of the operational area.

As the highest degree of fishing intensity data (that is not deemed confidential) is situated outside of the operational area, stakeholder functions, interests, and activities of the octopus fishery are unlikely to be impacted by the East Coast Project.

Rock Lobster Fishery

The operational area lies within the 'western zone' of the Victorian rock lobster fishery management area. Intensity data shows the highest reported value near the Victorian/South Australia border as 5,005 days fished between 2013 and 2023. Intensity data (VFA, 2022b) also shows that the operational area intersects with 9 reporting grids. Of these, 4 reporting days fished between 2013 and 2023 range between 5 and 100 days. The operational area also overlaps coastal reporting grids G11 and G12 which report values of days fished as 1,811 and 2,110 respectively between 2013 and 2023. However, the whole operational area only overlaps G11 and G12 by 19.02% and 0.46% respectively.

As the highest degree of fishing intensity data (not deemed confidential) is situated outside of the operational area, stakeholder functions, interests, and activities of the Victorian southern rock lobster fishery are unlikely to be impacted by the East Coast Project.

Wrasse Fishery

The Victorian wrasse (ocean) fishery is divided into three commercial management zones and extends along the length of the Victorian coastline and out to 20 nm offshore, excluding marine reserves. Intensity data shows the highest intensity of fishing effort occurs in reporting grids adjacent to Port Fairy and Warrnambool (441 to 564 days fished) and to the south of Mornington Peninsula (968 days fished) outside of the operational area. Whilst the operational area overlaps reporting grids G11 and G12, VFA data lists low values of 43 and 37 days fished respectively between 2013 and 2023. In addition, the whole operational area only intersects with G11 and G12 by 19.02% and 0.46% respectively.

As the highest degree of fishing intensity data (not deemed confidential) is situated outside of the operational area, stakeholder functions, interests, and activities of the Victorian wrasse fishery are unlikely to be impacted by the East Coast Project.

Summary

Impacts to other marine users are likely to be localised and temporary. The predicted level of impact, i.e., the consequence, to commercial fisheries from having a substantial adverse effect on the sustainability of a commercial fishery is evaluated to have a consequence of **Level 1**, based on:

- Exclusion areas are small and are temporary (<60 days per well) are a well-established method to avoid interactions between marine users.
- Long-term PSZs (typically established around the wells) would also have a small spatial extent (500 m) and are an accepted tool for managing risks to equipment and marine users.

- The level of use of the operational area by shipping, petroleum exploration and production and recreation and tourism are expected to be low based on the current low usage.
- The level of use of the operational area by commercial fisheries is relatively low. For most of the fisheries identified, the highest degree of fishing intensity data is situated outside of the operational area, therefore stakeholder functions, interests, and activities of fisheries are unlikely to be impacted by the East Coast Project.
- The operational area covers only a small percentage of the identified Victorian and Commonwealth fishery management areas.
- The physical presence of subsea infrastructure is not expected to impact the sustainability of commercial fisheries. One commercial fishery that operates within the operational area undertakes trawling, however the combined 2016 to 2022 five-year fishing intensity data shows that it there is a 0.03% overlap of low fishing intensity, therefore impacts are unlikely.

8.9.5 Demonstration of Acceptability

To demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 8-66.

Table 8-66: Interaction with other marine users acceptability assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Impact: changes to the functions, interests and activities of other marine users	Consequence: Level 1 – commercial shipping Consequence: Level 1 – other offshore industry Consequence: Level 1 – recreation and tourism Consequence: Level 1 – commercial fisheries
Principles of ESD	'A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, impacts and risks from interaction with other marine users was identified as:	

	• Level 1 consequence for changes to the functions, interests and activities of other marine users. The above predicted levels of impact due to interaction with other marine users from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology. • The highest consequence ranking for interaction with other marine users was Level 1; therefore, interaction with other marine users from the East Coast Project will not result in serious or irreversible environmental damage. • The potential impacts and risks from interaction with other marine users are well-understood, and management measures are well established and regulated in Australian waters.
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest consequence ranking for interaction with other marine users was Level 1 and therefore will not forego the health, diversity and productivity of the environment for future generations. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.9.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations generations through ensuring the rights of other marine users or sustainability of fisheries are not compromised as per the OPGGS Act.
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant environmental values and sensitivities to interaction with other marine users were evaluated in

	Section 8.9.4 and the highest consequence ranking for seabed disturbance was evaluated as Level 1. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 8.9.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.		
Legislative and Other requirements	**Requirement**	**Relevant Objective / Action**	**Demonstration of Requirement**
	Offshore Petroleum and Greenhouse Gas Storage Act 2010 (OPGGSA) (& Regulations 2021)	Objective: Demonstrate that the activity will be undertaken in line with the principles of ecologically sustainable development and in accordance with an EP with appropriate performance objectives and standards. Management Action: Address all licensing, health, safety, environmental and royalty issues for offshore petroleum exploration and development operations in Victorian coastal waters (between the low water mark and the 3 nm limit).	Adoption of the following control measures: CM1: Marine Assurance Process CM11: Fisheries Damages Protocol CM12: Marine exclusion and caution zones CM13: Ongoing Engagement
	Navigation Act 2012	Objective: Regulates international ship and seafarer safety, shipping aspects of protecting the marine environment and the actions of seafarers in Australian waters. The Act gives effect to the relevant international conventions (MARPOL 73/78,	

		COLREGS 1972) relating to maritime issues to which Australia is a signatory. The Act also has subordinate legislation contained in Regulations and Marine Orders. Management Action: All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act. Several Marine Orders (MO) are enacted under this Act which relate to offshore petroleum activities, including: MO 21: Safety and emergency arrangements MO 30: Prevention of collisions MO 31: SOLAS and non-SOLAS certification	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11) • External Affairs & Stakeholder Management (MS05). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. Cooper Energy has participated in consultation with commercial fishers since acquiring the CHN facilities. Previous consultation (Cooper Energy, 2019) has not indicated that the proposed activities and associated exclusion zones located within the vicinity of the existing CHN development would result in further objections or claims. Impacts to commercial fisheries are predicted to be minimal due to the localised nature of exclusion and safety zones.		

		AMSA have not raised claims or objections to the Project and have not previously raised claims or objections to previous Cooper Energy exploration activities (Cooper Energy, 2019).
Predicted impact compared to Defined Acceptable Level		The defined acceptable level of impacts relevant to interactions with other marine users is AL12 and AL13 identified in Table 8-67. These acceptable levels defined for changes to the functions, interests and activities of other marine users are defined in Table 7-6. The worst-case predicted impacts assessed in Section 8.9.4 are: • The level of usage of the operational area by commercial fisheries, shipping, petroleum and tourism are expected to be low. • Areas defined for the purpose of safe operations include the exclusion areas which are small and temporary (<60 days per well); and long-term PSZs (typically established around the wells) would also have a small spatial extent (500 m). • The physical presence of subsea infrastructure is not expected to impact the sustainability of commercial fisheries. One commercial fishery that operates within the operational area undertakes trawling, however the combined 2016 to 2022 five-year fishing intensity data shows that it there is only a 0.03% overlap of low fishing intensity. • The highest consequence ranking for interaction with other marine users was Level 1. Therefore, at its worst-case, the predicted impact from interactions with other marine users would not: • Lead to substantial adverse effects on the sustainability of commercial fisheries. • Prevent the maintenance of social and commercial amenity values of the Commonwealth Marine Area within the region consistent with the rights of all marine users. Therefore, the predicted level of impact resulting from interactions with other marine users resulting from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to interactions with other marine users are acceptable, based on: • Predicted levels of impact (evaluated in 8.9.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors. • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is	Cooper Energy has determined that impacts and risks related to interactions with other marine users are acceptable, based on: • Predicted levels of impact (evaluated in 8.9.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors. • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES. • No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures.

	not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES. • No feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPO have been applied: **EPO18:** Marine users are not excluded from areas other than those defined for the purpose of safe operations, and for which agreed notifications have been issued.	To manage impacts to receptors to or below the defined acceptable levels the following EPO have been applied: **EPO18:** Marine users are not excluded from areas other than those defined for the purpose of safe operations, and for which agreed notifications have been issued.

8.9.6 Environmental Performance

Table 8-67 lists the acceptable level and EPO defined for the displacement of marine users and the adopted control measures to achieve the outcome.

Table 8-67: Environmental Performance Summary – Interaction with other marine users

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL12: Social and commercial amenity values of the Commonwealth Marine Area within the region are maintained consistent with the rights of all marine users.	**EPO18**: Marine users are not excluded from areas other than those defined for the purpose of safe operations, and for which agreed notifications have been issued.	CM1: Marine Assurance Process The vessels and MODU will adhere to navigational safety requirements under the *Navigation Act 2012* and associated Marine Orders, including but not limited to: • AMSA MO 21 – Safety and Emergency Arrangements • AMSA MO 27 - Safety of Navigation and Radio Equipment • AMSA MO 30 - Prevention of Collisions.
		CM12: Marine Exclusion and Caution Zones May include: • A temporary 3 km cautionary zone around the MODU during the drilling program. • A temporary 500 m exclusion/caution zones to be established via Notice to Mariners around vessels undertaking petroleum activities.

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
		• PSZs will be gazetted around wells and other equipment where required for equipment integrity management. Subsea infrastructure will be marked on navigational charts for awareness.
AL13: Impacts and risks to other marine users associated with activities defined in this OPP will not lead to substantial adverse effects on the sustainability of commercial fisheries.		CM11: Fisheries Damages Protocol Fisheries Damage Protocol will be in place to provide a compensation mechanism to fishers who damage fishing equipment on East Coast Project infrastructure outside of the PSZ.
		CM13: Ongoing Engagement Further engagement will take place during the development and implementation of component EPs. This will include details relating to notification of third-party stakeholders.

9 Risk Assessment

9.1 Loss of Materials or Waste Overboard

9.1.1 Cause of Aspect

The use of equipment and materials on vessels may result in the unplanned loss of materials overboard during the East Coast Project. The unplanned loss of materials overboard could occur during the phases and activities identified in Table 9-1.

Table 9-1: Activities undertaken in the East Coast Project that could result in the Loss of Materials Overboard

Cause of Aspect / Phase	Activity Component
Well Construction	Drilling operations
Installation and Commissioning	Pre-lay works
	Flowline and umbilicals
	Installation of subsea structures
	Post-lay works
	Testing, preservation and start-up
Support Operations	MODU operations
	Vessel operations
	ROV operations
Decommissioning	Well abandonment
	Flowline and umbilical decommissioning
	Removal of remaining subsea infrastructure

9.1.2 Aspect Characterisation

9.1.2.1 Well Construction

Drilling will be carried out using a semisubmersible rig referred to as a MODU for the East Coast Project. There is potential for loss of equipment to the marine environment during well construction.

9.1.2.2 Installation and Commissioning

During installation and commissioning operations, there is potential for subsea equipment including manifolds, mattresses, jumpers, spools and so on, to be accidentally dropped during lifting operations as a result of lifting equipment malfunctions, loading incidents or improper handling.

9.1.2.3 Support Operations

MODU, vessel, and ROV operations include the use and transfer of hazardous or non/hazardous materials including waste and apply throughout the life cycle of the project including drilling, IMR, survey, and decommissioning activities.

The unplanned loss of materials overboard during support operations may result from rough ocean conditions when items may be washed or blown off the deck, improper or unsuitable waste storage, human error, or failure of waste storage equipment.

The unplanned loss of materials overboard could include hazardous solid materials such as batteries, aerosol cans, empty paint cans, printer cartridges, fluorescent tubes, hydrocarbon-contaminated materials (e.g., oily rags, oil filters, oily PPE) etc. The unplanned loss of materials overboard could also include non-hazardous solid materials such as paper, cardboard, wooden pallets, scrap steel, metal, aluminium, cans, glass, plastics etc.

Solid materials that are non-buoyant are expected to sink to the seabed and remain in the operational area. Any buoyant materials, such as wood and plastic packaging or equipment components, lost overboard have the potential to be transported by wind, waves and currents outside of the operational area.

Waste generated on-board vessels will be handled in accordance with AMSA Discharge Standards, relevant State requirement, and vessel Garbage Management Plans (GMP); these require that wastes are managed so that it is not lost or discarded overboard.

9.1.2.4 Decommissioning

Full removal of all subsea infrastructure is considered as the base case for decommissioning. Parts of subsea infrastructure have the potential to be dropped during their recovery to surface within the operational area.

9.1.3 Potential Environmental Impacts and/or Risks.

Potential risks from the loss of materials or waste overboard are:

- Change in habitat
- Injury / mortality to marine fauna.

Socio-economic impacts on commercial fisheries have not been evaluated further, as there are no discernible impacts to behaviour and distribution expected at the population level given the limited nature and scale of activities associated with loss of materials or waste overboard.

9.1.4 Impact and Risk Evaluation

9.1.4.1 Risk: Change in Habitat

Inherent Consequence Evaluation

The loss of materials overboard during drilling, installation and commissioning and decommissioning phases may result in localised and temporary disturbance to benthic habitats.

The impact footprint on benthic habitats would align with the size of the object dropped overboard. The largest potential impact footprint is from the overboard loss of a manifold (8 x 12 m) and therefore considered highly localised. A dropped object has the potential to release limited quantities of chemicals or hydrocarbons. This risk of contamination from chemicals or hydrocarbons is anticipated to be localised and minor (see Section 9.2 for the evaluation of minor loss of containment). Once a dropped object has been recovered, the seabed is expected to recover naturally.

As described in Section 6.5.1 Ramboll (2020b) found that benthic assemblages within and adjacent to the East Coast Project operational area to be representative of the characteristics of the rocky reef and hard substrate KEF that are well represented in the Otway and wider Bass Strait region (see Section 6.6.6). Benthic assemblages have been observed during offshore surveys; these surveys have reported scattered areas of hard ground supporting patchy areas of abundant epibiota, typically bryozoans, gorgonian, cnidarians and sponges (Ramboll, 2020b); benthic fauna have also been observed to be colonising existing subsea infrastructure also (Figure 6-16). While there is some residual uncertainty on the exact benthic assemblage composition in the south-western portion of the operational area, as there is no historical survey data in that area; Ramboll (2020a) surveyed sites at a similar water depth and distance offshore in a neighbouring title area (Figure 6-17; Section 6.5.1) and which provide a reasonable proxy for the purpose of impact and risk assessment. No ecological communities listed as threatened under the EPBC Act were observed and the operational area does not overlap AMPs.

The predicted level of impact, i.e., the consequence, to benthic habitats is evaluated to have a consequence of **Level 2**, based on:

- benthic assemblages have a scattered distribution in the operational area and do not contain listed ecological communities
- the shelf rocky reefs KEF exists throughout the Otway region
- the potential impact footprint is highly localised (maximum footprint of 96 m^2 in the event of a loss of a manifold overboard)
- seabed disturbance would be expected to recover naturally, as described in Section 8.8.

Inherent Likelihood

A combination of factors would be required for a loss of materials or equipment overboard, such as rough ocean conditions combined with unsuitable equipment, improper deck management, human error and equipment failure. The risk event is considered conceivable and could occur during the East Coast Project.

The likelihood of disturbance to benthic habitats from loss of material overboard is considered **Unlikely (D).**

Inherent Risk Severity

The predicted level of risk, i.e., inherent risk severity, of disturbance to benthic habitats is considered **Low**.

9.1.4.2 Risk: Injury/Mortality to Marine Fauna

Inherent Consequence Evaluation

Marine fauna susceptible to injury or death from loss of materials overboard include:

- Fish
- Marine reptiles
- Seabirds
- Marine mammals.

Fish

The loss of materials overboard has the potential to cause injury/mortality to fish from entanglement and ingestion. Plastics, if lost overboard, degrade over time, forming micro (and smaller) plastic particles. Fish may ingest wastes and microplastics found floating at the surface, buoyant within the water column, or on/in the seabed. Studies show that ingestion of microplastics by fish is relatively common, with over a third of all fish examined in studies in European waters having microplastics within their gastrointestinal tract (Murphy et al. 2017). Although pelagic or demersal fish may ingest microplastics, the impact on fish is expected to be relatively small and is not expected to result in a change to the viability of populations.

Marine Reptiles

Marine reptiles, specifically turtles, may be impacted through ingestion or entanglement from materials lost overboard. Turtles are known to be indiscriminate feeders and may mistake plastic for jellyfish (Mrosovsky et al., 2009). Ingestion of debris can cause internal wounds, suffocation, prevent feeding leading to starvation and can create intestinal blockages that increase buoyance and stop a turtle from diving (DEE, 2017).

The operational area does not intersect any recognised BIAs for marine turtles and therefore low numbers are expected in the area. Furthermore, areas where marine turtle foraging, feeding or related behaviours are not known to occur within the operational area (see Table 6-7). As a result, potential injury/mortality to marine reptiles from a loss of material or waste overboard would be limited to entanglement, with ingestion of material not expected to occur. Any impacts would be expected to be limited to individual turtles transiting through the area, with no population impacts are expected.

Seabirds

Seabirds are highly susceptible to injury/mortality from the loss of materials overboard because of potential entanglements and ingestion of in-water materials. Plastic debris adrift in the ocean are covered in biofilm which attracts albatrosses and petrels, and consequently, seabirds are highly likely to mistake plastic particles for food and ingest them (DCCEEW, 2022e). Ingestion of plastics can potentially cause impacts such as gut obstruction or reduced stomach volume, resulting in a loss of fitness and starvation (Wilcox et al., 2015). However, there is currently no evidence to suggest that ingestion or entanglement of marine debris are posing a significant threat to any Australian seabird species at the population level (CoA, 2020).

No habitats critical to the survival of threatened albatross and petrel species occur within the operational area, this including no known nesting sites. Suitable albatross and petrel breeding islands in Australia are limited to remote offshore islands of which the closest is Albatross Island located 250 km southeast of the operational area (CoA, 2022b). However, the operational area intersects with 8 foraging seabird BIAs, for albatross and petrel species. Based on the absence of habitats critical to the survival of threatened albatross and petrel species, it is inferred that albatrosses and petrels will forage within the operational area but not in high numbers.

No habitats critical to the survival of threatened shearwater species occur within the operational area. However, the wedge-tailed shearwater breeding site, Muttonbird Island, is located approximately 18 km from the operational area. Based on a buffer of Muttonbird Island, the operational area overlaps the wedge-tailed shearwater breeding and foraging BIA in accordance with the National Conservation Values Atlas (CoA, 2022b). The operational area does not overlap foraging (in high numbers) BIAs for the wedge-tailed shearwater. Wedge-tailed shearwaters are expected within the operational area for offshore foraging during breeding season between August and May, however not in high numbers.

Potential injury/mortality to seabirds from entanglements and ingestion of materials overboard would be expected to be limited to individual foraging seabirds, no population impacts are expected.

Marine Mammals

The loss of materials overboard has the potential to cause injury/mortality to marine mammals from entanglement and ingestion. Entanglement can harm or kill individual marine mammals and can reduce the fitness of an individual by restricting mobility and impairing breathing, swimming or feeding ability (DCCEEW, 2022a). Entanglement causes physical damages, through cutting of skin and blubber, and exposing the animal to infection and amputation or death. The operational area overlaps BIAs for both the pygmy blue whale and southern right whale (see Table 6-9).

DAWE (2022a) reports that there have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998 (humpback whales being the main species). The Threat Abatement Plan (2018) suggests that most marine plastic debris are associated with shipping, fishing and household activities (fishing gear and plastic household items). The loss of plastic debris is also possible during vessel operations for the East Coast Project. No injury of marine fauna has been reported during Cooper Energy Offshore Operations to date. Any impacts would be expected to be limited to individuals, with no population level effects.

There is potential to harm an individual marine mammal from the loss of materials overboard. The impact is not expected to result in a change to the viability of marine mammal populations.

Inherent Consequence

The predicted level of impact, i.e. the consequence, to marine fauna is evaluated to have a consequence of **Level 2**, based on:

- the limited inventory of material which has the potential to be lost overboard
- any impacts to seabirds, marine mammals, marine reptiles and fish from materials lost overboard will be to individuals only and no population impacts are expected.

Inherent Likelihood

Waste generated on board vessels will be handled in accordance with AMSA Discharge Standards, relevant State requirements, and respective vessel Garbage Management Plans (GMP); these require that particular wastes are managed so they are not lost or discarded overboard. Given this, loss of materials overboard such as plastics to the marine environment will be an uncommon event.

This assessment considers any indirect impacts to species arising from theoretical exposure to materials lost overboard. While the impact is conceivable and could occur, from this activity, which is relatively short term, it is considered **Unlikely (D).**

Inherent Risk Severity

The inherent risk severity to marine fauna is considered **Low**.

9.1.4.3 Risk: Change to Cultural Heritage

Loss of materials or waste overboard may result in changes to cultural heritage such as:

- Disturbance of underwater cultural heritage including shipwrecks, aircraft and other artefacts.

No shipwrecks or other artefacts have been identified along existing pipeline routes or seabed proximal to the existing facilities (Section 6.7.4.1)

Inherent Consequence

The predicted level of impact, i.e. the consequence, of change to cultural heritage from seabed disturbance is evaluated to have a consequence of **Level 1** based on:

- No expected underwater cultural heritage artefacts within the operational area based on screening assessments, previous inspection and survey and stakeholder engagement.

Inherent Likelihood

Waste generated on board vessels will be handled in accordance with AMSA Discharge Standards and respective vessel Garbage Management Plans (GMP); these require that particular wastes are managed so they are not lost or discarded overboard. Given this, loss of materials overboard such as plastics to the marine environment is not expected.

This assessment considers any indirect impacts to cultural heritage arising from theoretical exposure to materials lost overboard. While the impact is conceivable and could occur, from this activity, which is has a limited footprint, it is considered **Unlikely (D).**

Inherent Risk Severity

The inherent risk severity of the change to cultural heritage is considered **Low**.

9.1.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 9-2.

Table 9-2: Loss of material or waste overboard acceptability assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Risk: Change in habitat	Risk: Low
	Risk: Injury/mortality to marine fauna	Risk: Low
	Risk: Change to cultural heritage	Risk: Low

Principles of ESD	A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, risks from loss of materials or waste overboard was identified as: • Low risk for change in habitat • Low risk for injury/mortality to marine fauna • Low risk for change to cultural heritage. The above predicted levels of risk due to loss of materials or waste overboard from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology. • The highest consequence ranking for loss of material or waste overboard was evaluated as Level 2 and the highest inherent risk for loss of material or waste overboard was evaluated as Low; therefore, loss of material overboard from the East Coast Project will not result in serious or irreversible environmental damage. • The potential impacts and risks from loss of material or waste overboard are well-understood, and management measures are well established and regulated in Australian waters.
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest inherent risk for loss of material or waste overboard was evaluated as Low and therefore will not forego the health, diversity and productivity of the environment for future generations. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.1.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant environmental values and sensitivities to loss of material or waste overboard were evaluated in Section 9.1.4 and highest inherent risk for loss of material or waste overboard was evaluated as Low. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls

	detailed below (Section 9.1.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.		
Legislative and Other requirements	**Requirement**	**Relevant Objective / Action**	**Demonstration of Requirement**
	Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Section 26F (implements MARPOL Annex I).	All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act. Several Marine Orders (MO) are enacted under this Act relating to offshore petroleum activities, including: • MO Part 95: Marine Pollution Prevention – Garbage	Adoption of the following control measures: CM1: Marine Assurance Process CM2: Offshore Operational Procedures CM8: Emissions and Discharge Standards CM9: Underwater Cultural Heritage Disturbance Risk Management Measures
	Navigation Act 2012 (Cth) – Chapter 4 (Prevention of Pollution)	Regulates international ship and seafarer safety, shipping aspects of protecting the marine environment and the actions of seafarers in Australian waters. Several MOs are enacted under this Act which relate to offshore petroleum activities, including: • MO 21: Safety and emergency arrangements • MO 91 and 94: In Commonwealth waters AMSA is the Statutory Agency for vessels and must be notified of all incidents involving a vessel.	
	Wildlife Conservation Plan for Seabirds (CoA, 2020)	Relevant objective 2: Seabirds and their habitats are identified, protected and managed in Australia. Action 2e: Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.	
	National Recovery Plan for Albatrosses and Petrels 2022 (DCCEEW, 2022e)	Relevant objective (Strategy 5): Improve understanding of generalised threats to albatrosses and petrels breeding and	

		foraging within Australia's jurisdiction. Action 5c_ Risk based response strategies for marine pollution incidents are developed.	
	Recovery plan for marine turtles in Australia 2017–2027	Relevant objective (Action Area A3): Reduce the impacts from marine debris. Actions: Describe and quantify the impact of ingestion of debris on marine turtles, particularly those life phases using the open ocean. Support the implementation of the EPBC Act Threat Abatement Plan for the impacts of marine debris on vertebrate marine life.	
	Threat Abatement Plan for the impacts of marine debris on vertebrate wildlife of Australia's coasts and oceans (CoA, 2018)	Relevant objective: Contribute to long-term prevention of the incidence of marine debris. Action 1.02: Limit the amount of single use plastic material lost to the environment in Australia.	
	Recovery Plan for the White Shark (*Carcharodon carcharias*)	Identifies habitat modification as a threat. No explicit relevant objectives.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11) Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	Cooper Energy has previously been contacted by Beach Patrol 3280-3284 during consultation for existing operations. Beach Patrol 3280-3284 are a voluntary organisation based in Warrnambool. The community-based organisation has dedicated thousands of hours to cleaning up local beaches and requested further information from Cooper Energy as to the measures in place to prevent debris and hydrocarbons (including tar balls) entering the marine environment. Cooper Energy responded with further information as to the types of activities undertaken by Cooper Energy, the regulatory requirements and arrangements in place (as described in this OPP) to prevent loss of materials and loss of hydrocarbons into the marine environment.		

	Subsequently, no further information was requested, or concerns raised. Beach Patrol 3280-3284 have been listed as a relevant person for the purposes of EP preparation which will enable their continued input into the management of activity specific impacts and risks.
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to a loss of materials or waste overboard is AL5, AL10, AL11 and AL12 identified in Table 9-3. These acceptable levels defined for a change in habitat and cultural heritage and injury / mortality to marine fauna are defined in Table 7-6. The worst-case predicted impacts assessed in Section 9.1.4 are: • The potential impact footprint is highly localised (maximum footprint of 96 m2 in the event of a loss of a manifold overboard) • Shelf rocky reef KEF is ubiquitous with the Otway region and occurs across the south east marine region (Ramboll, 2020b). • Any impacts to seabirds, marine mammals, marine reptiles and fish from materials lost overboard will be to individuals only and no population impacts are expected. • No threatened benthic species, assemblages or ecological communities were identified within the operational area. • The highest consequence ranking for loss of material or waste overboard was evaluated as Level 2 and the highest inherent risk for loss of material or waste overboard was evaluated as Low. Therefore, at its worst-case, the predicted impact from a loss of materials or waste overboard would not: • Exceed levels which prevent conservation of biodiversity, recovery and protection of threatened species, maintenance of ecosystem health and the ecological integrity and functioning of the Commonwealth Marine Area • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Lead to loss of habitat critical to the survival of species • Not exceed levels which prevent protection and conservation of underwater cultural heritage as defined under the Underwater Cultural Heritage Act 2018. • Not lead to injury or desecration of objects or areas declared for protection under the Aboriginal and Torres Strait Islander Heritage Protection Act 1984. • Not interfere with native title rights or users as defined under section 233 of the *Native Title Act 1993* (Cth). Therefore, the predicted level of impact resulting from s a loss of materials or waste overboard from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined risks relating to loss of materials or waste overboard are acceptable, based on: • Predicted levels of impact (evaluated in 9.1.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advice, and significant impact guidelines for MNES • Relevant feedback from stakeholders has been received, reviewed and assessed that informs the management of impacts and risks associated with the East Coast Project. To manage impacts to receptors to, at or below the defined acceptable levels the following EPOs have been applied: **EPO21:** No unplanned release of waste to the marine environment **EPO20**: The Activity is managed such that:

	• It does not prevent any cultural practice from taking place • It does not destroy any element of the environment which is a cultural feature, or which forms part of a cultural feature • There is no destruction of underwater cultural heritage.

9.1.6 Environmental Performance

Table 9-3 lists the acceptable levels and EPOs defined for loss of materials or waste overboard and the adopted control measures to achieve the outcome.

Table 9-3: Environmental Performance Summary – Loss of materials overboard

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL6: Impacts and risks to benthic habitat from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity. **AL6:** Impacts and risks to benthic habitat from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity. **AL10:** Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species.	**EPO21**: No unplanned release of waste to the marine environment.	CM1: Marine Assurance Process MODU and vessels will comply with relevant MARPOL Commonwealth requirements and subsequent Marine Orders for waste management practices. CM2: Offshore Operational Procedures In accordance with Marine Order 42 (Carriage, stowage and securing of cargoes and containers), where relevant, to ensure cargo is packed, loaded, stowed and secured throughout each voyage. CM8: Emissions and Discharges Standards Prior to commencing the offshore activity, the following will be verified, as relevant to vessel class: 2017 Guidelines for the Implementation of MARPOL Annex V to assist shipowners, masters and crews in applying the Annex V discharge requirements.
	•	

9.2 Minor Loss of Containment

9.2.1 Cause of Aspect

During the East Coast Project, there is a risk of minor volumes of chemicals or hydrocarbons being spilled to the marine environment, also referred to as minor Loss of Containment (LOC).

The risk of major spills of hydrocarbons is evaluated in Section 9.5 and 9.6, for MDO and condensate respectively.

Table 9-4 identifies the project activities which carry a risk of minor LOC; Table 9-5 provides a summary of the types of fluids that could be released in the event of a minor LOC.

Table 9-4: Activities undertaken in the East Coast Project that could result in a Minor LOC

Cause of Aspect / Phase	Activity Component
Installation and Commissioning	Testing, preservation and start-up
Operations	Inspection, Maintenance and Repair
Support Operations	MODU operations
	Vessel operations
	Helicopter operations
	ROV operations

9.2.2 Aspect Characterisation

9.2.2.1 Installation and Commissioning

Installation and commissioning phases will include the installation of flowlines and other subsea infrastructure plus testing activities. Refer to Section 4.1.3 for indicative activity sequences and durations.

During installation and commissioning activities, there is a potential for the accidental minor LOC from a dropped object, resulting in damage to the dropped equipment or equipment within the potential drop zone. During the installation and commissioning phase, some equipment will contain chemicals, such as hydraulic fluid, MEG or inhibited seawater; depending on the type of damage sustained, these fluids have the potential to leak from equipment into the marine environment.

9.2.2.2 Operations

During operations and IMR activities, there is a potential for the accidental minor LOC from a dropped object, resulting in damage to the dropped equipment or equipment within the potential drop zone. During the operations phase, some equipment will contain treated water and chemicals. An accident that damages the subsea infrastructure could result in a loss of chemicals, such as hydraulic fluid, MEG or inhibited seawater; depending on the type of damage sustained, these fluids have the potential to leak from equipment, into the marine environment.

Note a major release of condensate from a flowline rupture is evaluated in Section 9.5.

9.2.2.3 Support Operations

Support operations expected during the project life include MODU and vessels activities for drilling, supply runs, IMR activities including subsea inspection, survey, and decommissioning, and helicopter, ROV and diver operations. See Section 4.3.6 for further details on support activities for the East Coast Project.

An accidental minor LOC of hydrocarbons and/or chemicals may occur during these support activities due to deck spills (from handling error or failure in containment from storage error), hydraulic line failure from equipment (including ROV), dropped objects (as described in sections 9.2.2.1 and 9.2.2.2), and bulk transfer failure (i.e., hose failure/leak).

Minor LOC scenarios are identified in Table 9-5.

Table 9-5: Types of fluids that may be released during minor LOC

Minor LOC Fluids	Phase / Activity	Source of releases	Maximum expected volume of release
Mono Ethylene Glycol (MEG)	Installation, IMR	Spill to deck: Vessel equipment, bulk storage or package chemical leak may be accidentally released to marine environment. Dropped object: damaging subsea equipment and resulting in the accidental release of chemicals.	<10 m^3
Inhibited water (seawater with chemical additives including corrosion inhibitor, oxygen scavenger, biocide and dye)	Installation, IMR	Dropped object: damaging subsea equipment and resulting in the accidental release of chemicals.	<25 m^3 Based on typical large isotainer size
Methanol	Operations	Spill to deck: Vessel equipment, bulk storage or package chemical leak may be accidentally released to marine environment.	<10 m^3
Hydraulic fluids	Installation, MODU operations, vessel operations, ROV operations	Failure of hydraulic hose: from ROV, geotechnical equipment, from vessel/MODU deck. Dropped object: damaging subsea infrastructure and resulting in the accidental release of fluids from the umbilical.	1 – 10 m^3
Marine diesel oil (MDO)	MODU operations, vessel operations	Bulk transfer hose failure: hydrocarbons are transferred between a supply vessel and other vessels and MODU. Hoses could be mis-aligned. Partial or total failure of bulk transfer hoses or associated couplings could occur during refuelling.	<50 m^3 Assuming 200 m^3/h transfer rate, released for 15 minutes.
Aviation jet fuel (Jet A1)	Helicopter operations	Unplanned release: Equipment malfunction leading to helicopter ditching into ocean. Spill to deck: Fuel tank compromised during landing resulting in a release of fuel to sea.	3 m^3 (entire fuel tank volume)
Drilling muds or fluids	MODU activities	Unplanned surface release during drilling operations.	<25 m^3
Cement	MODU activities	Unplanned surface release during drilling operations. Bulk transfer: cement is transferred between a supply vessel and MODU. Hoses could be mis-aligned and hoses or couplings could break during transfers.	<50 m^3

Minor LOC Fluids	Phase / Activity	Source of releases	Maximum expected volume of release
Other various chemicals stored on vessels / MODU	MODU operations, vessel operations	Spill to deck: Vessel equipment, bulk storage or package chemical leak may be accidentally released to marine environment.	Other chemicals are anticipated to be of small volume <5 m^3.

9.2.3 Predicted Environmental Impacts and/or Risks (Consequence)

The presence of hydrocarbons and chemicals in the marine environment following an unplanned minor LOC has the potential to result in these impacts:

- Change in water quality.

Hydrocarbons or chemicals from a minor LOC are unlikely to result in a change to sediment quality due to the small volumes released which would quickly dilute and disperse into the water column.

If marine fauna passes directly through a release, any impacts are expected to be highly localised, and any minor release of LOC is not expected to result in a change in the viability of the population of any species. Given the small volumes, short potential exposure time due to rapid dilution through wave and current action, impacts to marine fauna are not expected and therefore have not been assessed further.

9.2.4 Impact and Risk Evaluation

9.2.4.1 Risk: Change in Water Quality

Inherent Consequence Evaluation

A minor LOC of hydrocarbons or chemicals has the potential to result in a change in water quality in both surface waters and the pelagic environment, through the introduction of anthropogenic materials that have the potential to be toxic depending on the presence of sensitivities, and the level and duration of exposure.

Potential volumes of chemicals and hydrocarbons that could be lost to the environment during the East Coast Project are summarized in Table 9-5; with the largest being a <50 m^3 MDO spill during refuelling. The potential impact of these different chemicals is evaluated below.

All project chemicals are selected in accordance with the Cooper Energy Offshore Chemical Procedure to ensure ecotoxicity profiles are of an acceptable level. Fluids that may be used for IMR campaigns, such as MEG or inhibited water, are generally of limited efficacy outside of their specified application, readily degradable or dispersible. Subsea discharges will rapidly dissipate into the water column with any minor toxic constituents (e.g., biocide) being diluted rapidly to no effect levels.

<u>MEG</u>

MEG is classified internationally as posing little or no risk to the (marine) environment (PLONOR); it is effectively non-toxic in the marine environment, is readily biodegradable and has a low/no potential for bioaccumulation. MEG is readily dispersible in water and would only have a short-term, localised effect on water quality. The volume of MEG from an LOC scenario is estimated as in the order of up to 10 m^3.

<u>Inhibited Water</u>

It is sometimes necessary to inhibit water used within the subsea system with chemical additives including corrosion inhibitor, oxygen scavenger, biocide and dye. Biocide is toxic by design but is diluted rapidly to below no effect levels if released to the offshore marine environment.

Larger planned releases of inhibited water during hydrotesting and commissioning are evaluated in Section 8.7. The volume that may be accidentally released during a minor LOC (a maximum of ~25 m^3) is comparatively much smaller than that evaluated in Section 8.7 (3,232 m^3).

Hydraulic fluids

Hydraulic fluids are required to operate tools and manipulators on subsea ROV units and may be used for other vessel equipment. Hydraulic fluids are likely to be relatively low toxicity and water based. Releases are expected to be in the order of up to 10 m^3 and would rapidly dilute and dissipate once in the offshore marine environment.

MDO

The fate of oil such as MDO in the marine environment depends on a number of factors including the physical and chemical properties of the hydrocarbon, the volume released, the prevailing environmental conditions and whether the oil remains at sea or accumulates on a shoreline (ITOPF 2011a).

MDO is classified as a light persistent oil, has a low specific gravity (and therefore will tend to remain afloat) and has a high proportion (~97.3%) of volatile components and only a small (10%) residual component. Due to the nature of MDO. Most would be expected to evaporate from the water surface or become entrained. Both processes are accelerated by wind / wave energy. In a study completed by RPS which investigated the weathering and fate of a hypothetical MDO spill, approximately 24 hours after the spill of 250 m^3, 36% of the MDO has been shown to have evaporated and a further 54% is shown to have evaporated after several days, leaving only a small proportion of the oil floating on the water surface (1.3%) (RPS, 2023a).

The actual area of exposure for an individual spill event of the maximum 50m^3 would be relatively small, with exposure shown to be transient and temporary due to the influence of waves, currents and weathering processes.

A major release of MDO (i.e. from a vessel collision) is evaluated in Section 9.5.

Aviation jet fuel

In the unlikely event of a failure during helicopter operations, ~3 m^3 Jet A-1 fuel could be lost to sea. Jet A-1 is classified as a light persistent oil. It is lighter than MDO and would weather more rapidly in the active marine environment.

Drilling fluids

The main constituents of water-based drilling fluids are typically regarded as PLONOR. Discharge could increase turbidity within the water column, and some of the minor constituents within drilling fluids have the potential to be toxic. Within 100 m of the discharge point, drilling fluids released at the surface with have diluted by a factor of at least 10,000 (Hinwood et al., 1994). Unplanned discharges from the surface are anticipated to impact a larger area than subsea discharges, but discharges are expected to be dispersed rapidly within the offshore marine environment, resulting in a relatively localised and fleeting change in water quality.

Planned drilling discharges are assessed in Section 8.6.

Cement

An unplanned release of ~50 m^3 of cement could be released to the marine environment during bulk transfer. Cement is typically regarded as PLONOR. Discharges of cement may impact the localised water quality at the sea surface and within the water column, with an increase in turbidity. These cement particles will disperse under action of waves and currents, and eventually settle out of the water column. The initial discharge will generate a downwards plume, increasing the initial mixing of receiving waters.

Modelling of surface cement discharges (approximately 78 m^3 over a one-hour period) was undertaken by BP (2013). It showed that within two hours, suspended solid concentrations ranged between 0.005-0.05 mg/m^3 within the extent of the plume, which was ~150 m horizontal and 10 m vertical. By four hours post-discharge, concentrations were <0.005 mg/m^3. These volumes are greater than the expected cement wash volumes during IMR, and results are considered conservative.

Summary

Impacts to ambient water quality are likely to be localised and temporary based upon the volumes associated with minor spill scenarios (nominally <0.2 m³ but up to ~50 m³). Due to the relatively small volumes which have the potential to be spilled in a minor LOC any hydrocarbons or chemicals would become well mixed and diluted within the water column due to wave action and local ocean currents, with a smaller proportion potentially evaporating.

The predicted level of impact, i.e. the consequence, to water quality from a minor LOC is evaluated to have a consequence of **Level 1**, based on:

- the limited frequency of minor LOC events
- nominal scenario volume in the order of 50 m³
- the dispersive offshore environment in and surrounding the operational area.

Inherent Likelihood

This assessment considers any indirect impacts to species arising from theoretical exposure would also be negligible given the limited exposure duration and extent due to rapid dispersion and return to ambient conditions post event. While the impact is conceivable and could occur, it would require a rare combination of factors and is therefore considered **Unlikely (D).**

Inherent Risk Severity

The inherent risk severity of water quality is considered **Low**.

9.2.5 Demonstration of Acceptability

To demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 9-6.

Table 9-6: Minor LOC Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Risk: Change in water quality	Risk: Low
Principles of ESD	‘A) ‘Integration principle’ The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, risks from minor loss of containment was identified as: • Low risk for change in water quality. The above predicted level of risk due to minor loss of containment from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	

<table>
<tr><th>Acceptability Criteria</th><th colspan="3">Demonstration of Acceptability</th></tr>
<tr><td></td><td colspan="3">B) ‘Precautionary principle’
If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
The East Coast Project is consistent with the principle of ESD (b) for this aspect as:
• Evaluation of impacts and risks were conducted in accordance with Cooper Energy’s risk assessment methodology.
• The highest consequence ranking was evaluated as Level 1 and the highest inherent risk for a minor LOC was evaluated as Low; therefore, minor LOC from the East Coast Project will not result in serious or irreversible environmental damage.
The potential impacts and risks from a minor LOC are well-understood, and management measures are well established and regulated in Australian waters.</td></tr>
<tr><td></td><td colspan="3">C) ‘Intergenerational principle’
The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.
The East Coast Project is consistent with the principle of ESD (c) for this aspect as:
• The highest inherent risk for a minor LOC was evaluated as Low and therefore will not forego the health, diversity and productivity of the environment for future generations.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.2.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</td></tr>
<tr><td></td><td colspan="3">D) ‘Biodiversity principle’
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
The East Coast Project is consistent with the principle of ESD (d) for this aspect as:
• The relevant environmental values and sensitivities to a minor LOC were evaluated in Section 9.2.4 and highest inherent risk for a minor LOC was evaluated as Low.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.2.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.</td></tr>
<tr><td rowspan="3">Legislative and Other requirements</td><td>Requirement</td><td>Relevant Objective / Action</td><td>Demonstration of Requirement</td></tr>
<tr><td>Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Section 26F (implements MARPOL Annex I).</td><td>All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act.
Several MOs are enacted under this Act relating to offshore petroleum activities, including:
MO Part 91: Marine Pollution Prevention – Oil
MO Part 93: Marine Pollution Prevention – Noxious Liquid Substances</td><td rowspan="2">Adoption of the following control measures:
CM1: Marine Assurance Process
CM2: Offshore Operational Procedures
CM6: Cooper Energy Offshore Chemical Assessment Procedure
CM8: Emissions and Discharge Standards
CM12: Marine Exclusion and Caution Zones</td></tr>
<tr><td>Navigation Act 2012 – Chapter 4</td><td>All ships involved in petroleum activities in Australian waters are</td></tr>
</table>

Acceptability Criteria	Demonstration of Acceptability		
	(Prevention of Pollution).	required to abide to the requirements under this Act. Several Marine Orders (MO) are enacted under this Act which relate to offshore petroleum activities, including: MO 21: Safety and emergency arrangements	CM13: Ongoing Engagement CM14: Facility Safety and Integrity Management Plans
	AMSA Marine Orders 91 and 94	In Commonwealth waters AMSA is the Statutory Agency for vessels and must be notified of all incidents involving a vessel.	
	Industrial Chemicals (Notification and Assessment Act) 1989	Project Chemicals will be considered under the requirements of this Act prior to use.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	Cooper Energy has previously communicated with Beach Patrol 3280-3284 during consultation activities for existing operations. Beach Patrol 3280-3284 are a voluntary organisation based in Warrnambool. The community-based organisation has dedicated thousands of hours to cleaning up local beaches and requested further information from Cooper Energy as to the measures in place to prevent debris and hydrocarbons (including tar balls) entering the marine environment. Cooper Energy responded with further information as to the types of activities undertaken by Cooper Energy, the regulatory requirements and arrangements in place (as described in this OPP) to prevent loss of materials and loss of containment into the marine environment. Subsequently, no further information was requested, or concerns raised. Beach Patrol 3280-3284 have been listed as a relevant person for the purposes of EP preparation which will enable their continued input into the management of activity specific impacts and risks.		
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to a minor LOC is AL2 identified in Table 9-7. These acceptable levels defined for a change in water quality are defined in Table 7-6. The worst-case predicted impacts assessed in Section 9.2.4 are: • Changes to water quality are likely to be localised and temporary based upon the relatively small volumes associated with a minor LOC (<50 m^3). • The highest consequence ranking was evaluated as Level 1 and the highest inherent risk for a minor LOC was evaluated as Low. Therefore, at its worst-case, the predicted impact from a minor LOC would not: • Exceed levels which prevent conservation of biodiversity, recovery and protection of threatened species, maintenance of ecosystem health and the ecological integrity and functioning of the Commonwealth Marine Area. • Lead to a change in biodiversity beyond natural variability. Therefore, the predicted level of impact resulting from a minor LOC resulting from the East Coast Project is at or below the defined acceptable levels.		
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to a minor LOC are acceptable, based on: • Predicted levels of impact (evaluated in Section 9.3.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors.		

Acceptability Criteria	Demonstration of Acceptability
	• The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes. • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD. • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advice, and significant impact guidelines for MNES. Relevant feedback from stakeholders has been received, reviewed and assessed that informs the management of impacts and risks associated with the East Coast Project. To manage impacts to receptors to or below the defined acceptable levels the following EPOs have been applied: **EPO22**: No accidental releases of chemicals or hydrocarbons to the marine environment

9.2.6 Environmental Performance

Table 9-7 lists the acceptable level and EPOs defined for minor LOC and the adopted control measures to achieve the outcome.

Table 9-7: Environmental Performance Summary – Minor LOC

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL2: Impacts to water quality from activities defined in this OPP will not lead to a substantial change in water quality which adversely impacts biodiversity and ecological integrity.	**EPO22:** No accidental releases of chemicals or hydrocarbons to the marine environment	CM1: Marine Assurance Process Vessels shall meet the AMSA Marine Order (MO) requirements, including: • AMSA MO 30 - Prevention of collisions requires that onboard navigation, radar equipment, and lighting meets the International Rules for Preventing Collisions at Sea (COLREGs) and industry standards.
		CM2: Offshore Operational Procedures In accordance with MARPOL Annex I and AMSA MO 91 [Marine Pollution Prevention – oil], a Shipboard Marine Pollution Emergency Plan (SMPEP) or Shipboard Oil Pollution Emergency Plan (SOPEP) (according to class) is required to be developed. To prepare for a spill event, the SMPEP/SOPEP details: • response equipment available to control a spill event. • review cycle to ensure that the SMPEP/SOPEP is kept up to date and • testing requirements, including the frequency and nature of these tests. In the event of a spill, the SMPEP/SOPEP details: • reporting requirements and a list of authorities to be contacted. • activities to be undertaken to control the discharge of hydrocarbon. Bunkering / bulk liquids will be transferred in accordance with operational procedure(s) to

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
		reduce the risk of an unintentional release to sea during transfer.
		CM6: Cooper Energy Offshore Chemical Assessment Procedure Project chemicals will meet the requirements of the Cooper Energy Offshore Chemical Assessment Procedure. This process is used to ensure the lowest toxicity, most biodegradable and least bioaccumulative chemicals are selected which meet the technical requirements, where their function necessitates discharge to sea. The process consults public chemical assessment repositories such as PLONOR list, OCNS Definitive Ranked List, OSPAR and OCNS listings for those chemicals to be discharged. Eco-toxicity is evaluated with any required control measures defined. Chemicals that are highly toxic, have high bioaccumulation potential, and have high persistence in organisms are screened out during the assessment process. Only chemicals that meet low ecotoxicity pre-screening criteria, or are further justified as ALARP can be approved for discharge. An accepted chemical list is issued to the offshore project team detailing which products may be discharged and in what circumstances.
		CM8: Emissions and Discharges Standards Prior to commencing the offshore activity, the following will be verified, as relevant to vessel class: • 2017 Guidelines for the Implementation of MARPOL Annex V to assist shipowners, masters and crews in applying the Annex V discharge requirements.
		CM12: Marine Exclusion and Caution Zones May Include: • a temporary 3 km exclusion/cautionary zone around the MODU during the drilling program • a temporary 500 m exclusion/caution zones to be established via Notice to Mariners around vessels undertaking petroleum activities • PSZs will be gazetted around wells and other equipment where required for integrity management. Subsea infrastructure will be marked on navigational charts for awareness.
		CM13: Ongoing Engagement

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
		Further engagement will take place during the development and implementation of component EPs. This will include details relating to notification of third-party stakeholders.
		CM14: Facility Safety and Integrity Management Plans A NOPSEMA accepted safety case is required before any development activities can be undertaken. All activities will be managed in accordance with accepted safety cases.

9.3 Interaction with Marine Fauna

9.3.1 Cause of Aspect

Unplanned interactions with fauna could occur because of MODU, vessel and helicopter movements within the operational area. These interactions could include vessel/ MODU strike (collision between marine fauna and a moving vessel/ MODU) and bird strike (collision between a bird and a helicopter).

The activities within each phase that have potential for unplanned interactions with marine fauna are identified in Table 9-8 and described in the subsections below.

Table 9-8: Activities undertaken in the East Coast Project that could cause unplanned interaction with marine fauna

Cause of Aspect / Phase	Activity Component
Installation and Commissioning	Testing, preservation and start-up
Support Operations	MODU operations
	Vessel operations
	Helicopter operations

9.3.2 Aspect Characterisation

9.3.2.1 Installation and Commissioning

Seawater is typically used for commissioning operations. Water intake during flooding or dewatering operations has the potential to entrain or entrap small marine fauna, either against the intake screen or within the intake itself if small enough (e.g., zooplankton).

Commissioning is only expected to be undertaken once for each flowline and is a short-term activity as the East Coast Project flowlines are not long, and volumes required are small (Section 4.3.3.5).

9.3.2.2 Support Operations

Vessel and helicopter movements will occur within the operational area throughout the life of the East Coast Project.

Multiple vessels are expected during offshore construction and decommissioning activities. Installation and commissioning activities are included in the pre-operation phase, which is expected to last up to 6 years for all gas development opportunities and confirmed fields. The post-operations phase is predicted to last between 3 to 5 years.

The largest vessel is which may be used for the project, is likely to be an Installation Support Vessel (ISV) or Reel-Lay vessel and would be expected to be in field for ~45 days per campaign. Vessels undertaking project activities could collide with large marine fauna that swim at or near the water surface. Vessels undertaking petroleum activities described in this project will typically be holding station or travelling at speeds slower than typical shipping traffic (Figure 6-100), and therefore exhibit a lower risk of interactions with marine fauna.

The MODU will be present in the operational area during drilling, well intervention and for well abandonment activities. Up to 15 production wells may be drilled for the East Coast Project within the scope of this OPP, each well taking up to 60 days. The MODU will be stationary for most of the time in the operational area, with little travel between fields. When required, movement will be assisted by up to 3 vessels (anchor handler vessels or PSV). When under tow, the MODU speed is limited (below 10 knots).

Helicopters will be used when needed, throughout the life of the project, primarily for crew change and medical evacuation, with occasional equipment and material transfers when a MODU or ISV is working offshore for the project. Helicopters may complete 5-8 round trips per week during these activities. There is potential for bird strikes, though this is limited, and would be unusual; there have been no reports of bird strikes during Cooper Energy's offshore operations in the Otway to date, including MODU campaigns in 2018 and 2019.

9.3.3 Predicted Environmental Impacts and/or Risks (Consequence)

Potential risks from interaction with marine fauna are:

- Injury/mortality to large marine fauna from vessel strike, and to birds from collision with helicopter.

9.3.4 Impact and Risk Evaluation

9.3.4.1 Risk: Injury/Mortality to Marine fauna

Inherent Consequence Evaluation

Fish

Vessels transiting within the operational area have the potential to collide with large fish species that may occur within the Otway Basin. The EPBC Act listed 33 species of fish and sharks occurring in the operational area. Large, slow-moving fish species that bask or feed at the surface are the most vulnerable to vessel collisions.

From this list, only the white shark (*Carcharodon carcharias*) has a distribution BIA that overlaps the operational area. The Recovery plan for white sharks lists the principal threats and likely contributors to the lack of white shark recovery in Australia. Some of the reasons are linked to accidental or illegal capture by commercial and recreational fishers and illegal trade in white shark products, however, there is no mention of vessel collision. No collisions between vessels and white sharks associated with Cooper Energy's activities in the Otway region have occurred to date. There are also no examples of a vessel collision with a white shark from other operators within Australia. Therefore, vessel collisions with white sharks are not expected to occur during the East Coast Project.

Seabirds

Helicopters arriving to, or departing from, the MODU or installation vessel have the potential to collide with birds and potentially result in injury/mortality. Helicopter transfers could occur 5 – 8 times a week during drilling, installation and commissioning and decommissioning phases.

The operational area does not host roosting or nesting habitat. The absence of these features decreases the chances of high numbers of birds at potentially vulnerable life stages within the operational area, reducing the chances of a bird strike event. It is expected that any birds within the operational area would be foraging, rafting, or travelling through. There are 34 EPBC listed marine bird species that may occur within the operational area, of which 9 species have foraging BIAs overlapping the operational area (7 albatross, one petrel and one shearwater).

The Wildlife Conservation Plan for Seabirds does not identify aircraft collisions as a specific threat to any species; the plan identifies that transport, such as aircraft, flying low over breeding colonies may cause excessive disturbance to breeding individuals. There are no breeding/nesting sites within the operational areas, within the vicinity of where helicopters may land and take off from a MODU or vessels used for the project. The plan also identifies a threat of bird mortality due to collisions with oil and gas platforms, particularly as the night lighting from offshore oil and gas platforms could attract higher than average seabird numbers; with seabirds potentially habituating to the structures (CoA, 2020). There are no permanent structures associated with the project which are above water, such as an oil and gas platform; the vessels and MODUs which may be used for project activities are temporary which limits the potential for habituation. Albatross and petrel are covered under the National Recovery Plan for Albatross and Petrel; this plan does not list aircraft as a threat to these species (DCCEEW, 2023e). The wedge-tailed shearwater has a foraging BIA overlapping the operational area. Foraging individuals could be impacted by a collision with the East Coast Project, though considered unlikely as offshore foraging occurs close to the water's surface, whereas helicopters fly well above it. Though there is some potential for interaction between birds and helicopters, it would be unusual; there have been no reports of bird strikes during Cooper Energy's offshore operations in the Otway to date, including MODU campaigns in 2018 and 2019. Given the temporary nature and limited scale of offshore activities and associated helicopter use, any interactions would be expected to be with individuals only.

Marine reptiles

Moving vessels have the potential to collide with marine reptile species when they surface to breathe. Vessels movements will occur within the operational area throughout the entire project life, but less frequently during the operations phase.

The Recovery Plan for Marine Turtles in Australia 2017-2027 identifies vessel disturbance as a threat to the species, however the threat is focused on shallow coastal foraging habitats and internesting areas (CoA, 2017). There are 3 species of marine turtles that may occur within the operational area; however, this occurrence is expected to only be of a transient nature due to the absence of suitable coastal habitat in the south-east marine region. No BIAs or habitat critical to the survival of marine turtles occurs within the operational area or wider south-east marine region. Individual turtles may be transiting through the region,

The risk of collisions between turtles and vessels increases with vessel speed (Hazel et al., 2007). For the majority of time, vessels working on the project and within the operational area will be stationary or moving slowly between operational locations; this reduces the potential severity and likelihood of collision.

Marine mammals

There are multiple species of marine mammal that may or do occur within the operational area (Section 6.5.8). Of these species, two have BIAs that overlap the operational area:

- Pygmy blue whale (foraging and distribution)
- Southern right whale (migration).

Vessel strikes are a known threat, particularly for some whale species (e.g., DoE, 2015a). Marine mammals that are within surface waters and breach often are most at risk from interactions with vessels operating for the project. Marine mammals must surface to breathe periodically and may spend much of their time at or near the surface. This behaviour makes marine mammals, particularly large mammals such as baleen whales, vulnerable to vessel strikes. A response of baleen whales to the presence of a vessel may be to avoid the vessel, either by moving away (e.g. increasing swimming speed) or by diving (Corkeron 1995; Scheidat et al., 2004), though marine mammals often do not display avoidance behaviour and may approach vessels, as observed during recent offshore activities (Figure 6-48 and Figure 6-49).

The International Whaling Commission (IWC) (2022) report around 900 cases of vessel strikes with cetaceans across the globe inclusive of all historical records; 35 of those strikes were identified as within Australian jurisdictions. Most collisions involved fin whales, humpback whales and sperm whales; Peel et al. (2016) indicates the number of strikes in Australian waters may be more like 109 and includes strikes with southern right whales and pygmy blue whales. Fin, humpback, pygmy blue and southern right whales are known to occur in off the southeast Australian coast and are likely to occur in the project operational area (Table 6-9). Collisions between larger vessels with reduced manoeuvrability and large, slow-moving cetaceans occur more frequently where there is high vessel traffic and cetacean habitat (Whale and Dolphin Conservation Society, 2003). Laist et al. (2001) identified that larger vessels with reduced manoeuvrability moving more than 10 knots may cause fatal or severe injuries to cetaceans, with the most severe injuries caused by vessels such as tankers travelling faster than 14 knots and with limited manoeuvrability. Vessels used to support the East Coast Project activities do not have the same limitations on manoeuvrability. Vessel speed influences the probability and severity of strikes between a cetacean and a vessel. Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale because of a vessel strike increases from about 20% at 8.6 knots to 80% at 15 knots. The IWC (2022) reports that of the historical vessel strikes reported globally, the highest number of identified vessels involved were ferries, including fast ferries and high-speed ferries, followed by sailing yachts, passenger vessels including cruise ships, and motor yachts. Less frequent were interactions between cetaceans and whale watching vessels, then navy and container ships, followed by general cargo vessels.

For most of the time, vessels working on the project and within the operational area will be stationary or moving slowly between operational locations; this reduces the potential severity and likelihood of collision. The occurrence of reported vessel strikes is low within the Australian offshore energy industry; there have been no incidents of vessel strikes during Cooper Energy's offshore activities in the Otway region.

<u>Summary</u>

The occurrence of physical interactions with marine fauna is very low. In the event that an individual animal suffers injury or death as the result of helicopter or vessel strike during the East Coast Project, it would not be expected to manifest in population level impacts. The consequence of the potential impact is assessed as **Level 2**, as short-term impacts to species or habitats of recognized conservation value, not affecting local ecosystem function.

Inherent Likelihood

Cooper Energy have had no incidents of physical interactions with marine fauna that have resulted in injury/mortality to marine fauna over the course of their offshore operations off the coast of southeast Australia.

Recorded marine fauna interactions during Cooper's operations across the Bass Strait are limited to those indicative of passive coexistence, such as:

- frequent sightings of Humpback Whales during their migrations.
- observations of seabirds temporarily perched on vessel handrails.
- observations of an owl seeking refuge on a MODU.

Given the nature of the proposed activity, the impact is conceivable and could occur, however, it would require a rare combination of factors for physical interactions to result in injury/mortality. Therefore, the inherent likelihood is considered **Unlikely (D).**

Inherent Risk Severity

The inherent risk severity of support operations activities interacting negatively with marine fauna within East Coast Project operational area is considered **Low**.

9.3.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table

7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 9-9.

Table 9-9: Interaction with Marine Fauna Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Risk: Injury/mortality to marine fauna	Risk: Low
Principles of ESD	‘A) ‘Integration principle’ The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, risks from interaction with marine fauna was identified as: • Low risk for injury/mortality to marine fauna. The above predicted level of risk due to interaction with marine fauna from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	
	B) ‘Precautionary principle’ If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy’s risk assessment methodology and the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA, 2024). • The highest consequence ranking for interaction with marine fauna was evaluated as Level 2 and the highest inherent risk for interaction with marine fauna was evaluated as Low; therefore, interaction with marine fauna from the East Coast Project will not result in serious or irreversible environmental damage. The potential impacts and risks from interaction with marine fauna are well-understood, and management measures are well established and regulated in Australian waters.	
	C) ‘Intergenerational principle’ The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest inherent risk for interaction with marine fauna was evaluated as Low and therefore will not forego the health, diversity and productivity of the environment for future generations. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.3.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	

<table>
<tr><td></td><td colspan="3">D) ‘Biodiversity principle’
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
The East Coast Project is consistent with the principle of ESD (d) for this aspect as:
• The relevant environmental values and sensitivities to interaction with marine fauna were evaluated in Section 9.3.4 and highest inherent risk for interaction with marine fauna was evaluated as Low.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.3.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.</td></tr>
<tr><td rowspan="4">Legislative and Other requirements</td><td>Requirement</td><td>Relevant Objective / Action</td><td>Demonstration of Requirement</td></tr>
<tr><td>National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna</td><td>Objective 3: Mitigation – reduce the likelihood and severity of megafauna vessel collision.
Management action:
• ensure all vessel strike incidents are reported in the National Vessel Strike Database (AMMC)
• identify mitigation measures and a set of criteria.</td><td rowspan="3">Adoption of the following control measures:
CM2: Offshore Operational Procedures
CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process.
Reporting of vessel strike incidents in the National Vessel Strike Database is required in Section 12.12.</td></tr>
<tr><td>Blue Whale Conservation Management Plan 2015 - 2025 (2015)</td><td>Recovery objective: Minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list.
Interim objective 4: Anthropogenic threats are demonstrably minimised.
Management action A.4.2: Ensure all vessel strike incidents are reported in the National Ship Strike Database (AMMC)
Management action A.4.3: Ensure the risk of vessel strikes on Blue Whales is considered when assessing actions that increase vessel traffic in areas where Blue Whales occur and, if required, implement appropriate mitigation measures</td></tr>
<tr><td>National Recovery Plan for the Southern Right Whale (DCCEEW, 2024l)</td><td>Long term recovery objective is that the population has increased in size to a level that the conservation status has improved, and the species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria.
Interim Objective 2: Anthropogenic threats are managed consistent with ecologically sustainable development principles to</td></tr>
</table>

		facilitate recovery of southern right whales. Management action A.6: Manage, minimise, and mitigate the threat of vessel strike.	

Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).
External Context	GMTOAC has previously communicated values and sensitivities relevant to the risk of vessel strike. GMTOAC highlighted Gunditjmara's strong connection to whales and responsibility for their care. Cooper Energy briefed GMTOAC on the kinds of activities undertaken by Cooper Energy which carry a risk of interaction with whales and discussed with members the measures taken by Cooper Energy to avoid interactions. GMTOAC are listed as a relevant person for the purposes of EP preparation which will enable their continued input into the management of activity specific impacts and risks.
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to interactions with marine fauna is AL6 and AL7 identified in Table 9-10. These acceptable levels defined for injury / mortality to marine fauna are defined in Table 7-6. The worst-case predicted impacts assessed in Section 9.3.4 are: • The occurrence of physical interactions with marine fauna is very low. In the event that an individual animal suffers injury or death as the result of helicopter or vessel strike during the East Coast Project, it would not be expected to manifest in population level impacts. • The highest consequence ranking for interaction with marine fauna was evaluated as Level 2 and the highest inherent risk for interaction with marine fauna was evaluated as Low. Therefore, at its worst-case, the predicted impact from interactions with marine fauna would not: • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species • Lead to loss of habitat critical to the survival of species. Therefore, the predicted level of impact resulting from interactions with marine fauna resulting from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to interactions with marine fauna are acceptable, based on: • Predicted levels of impact (evaluated in Section 9.3.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD • The proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • Feedback has been received from stakeholders that has informed the values and sensitivities / existing environment description, impacts and risks, performance outcomes and / or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPO have been applied:

	EPO24: No physical interactions by support operations within the operational area with EPBC Act listed threatened or migratory species.

9.3.6 Environmental Performance

Table 9-10 lists the acceptable level and EPO defined for interaction with marine fauna and the adopted control measures to achieve the outcome.

Table 9-10: Environmental Performance Summary – Interaction with marine fauna

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL10: Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species.	**EPO24:** No physical interactions by support operations within the operational area with EPBC Act listed threatened or migratory species.	CM2: Offshore Operational Procedures All helicopters and vessels will adhere to the distances and vessel management practices of EPBC Regulations (Part 8 Division 8.1 interacting with cetaceans).
		CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process The Whale Disturbance Risk Management Process communicates how whale interaction and disturbance risks are to be managed by offshore project teams, and crews on offshore vessels involved in offshore projects. The procedure provides details on the level of whale observation effort, triggers for actions and the actions to be taken to manage potential impacts to whales. This includes caution and no approach zones which meet or exceed regulatory standards under the EPBC Act.

9.4 Introduction, Establishment and Spread of IMS

9.4.1 Cause of Aspect

Invasive Marine Species (IMS) are marine plants or animals which have been introduced into a region beyond their natural range and have the potential to survive, reproduce and establish founder populations. Species of concern are those that are not native, are likely to survive and establish in the region, and are able to spread by human mediated or natural means. Factors that dictate their survival and invasive capabilities depend on environmental factors such as water temperature, depth, salinity, nutrient levels, habitat type and competition.

The main pathways for IMS introduction into Australian waters are through ballast water and biofouling (DAWR, 2018), both of which are described below. Table 9-12 provides an overview of the related project activities that could cause introduction, establishment and spread of IMS.

9.4.1.1 Ballast water

Ballast water can contain aquatic microbes, plants and animals from all life stages, which can be transferred globally as a vessel releases ballast water. Vessel ballast and seawater systems provide suitable habitats and conditions for IMS to survive and have the potential of spreading between ports and other facilities via vessels acting as a vector. Some vessels and MODUs are required to adjust their ballast water during operations to maintain stability, balance, and trim.

If IMS are present in ballast water and released within the operational area, they could settle on the seafloor or subsea structures where they could establish. An estimated 25% of Australia's established IMS was the result of ballast water exchange (DAWR, 2019). All vessels that are designed to carry ballast water are required to carry and implement a Ballast Water Management Plan and follow the Australian Ballast Water Management Requirements (DAWE, 2018).

9.4.1.2 Biofouling

The submerged parts of a vessel, such as propeller, anchors, hull and other areas, are subject to biofouling when attachment and establishment of organisms occur. Internal seawater systems can also become fouled. IMS could be present as biofouling on vessels/MODUs, be translocated to the operational area; and transferred directly to the seafloor or seabed structures via dislodgement or reproduction.

Equipment that is submerged in water, particularly equipment that is stationary for days or longer can start to become bio-fouled. Installed infrastructure including flowlines, manifolds and other subsea equipment can provide marine organisms, including IMS, with a substrate to attach to.

IMS on MODU or vessels can be dislodged to the seabed. IMS can then become established if conditions and habitat are suitable. Once established IMS may spread by itself. Other anthropogenic influences (e.g., vessel transit, fishing) could spread IMS within and outside of the field.

Vessels entering Australia from International waters are required to comply with Australian biofouling management requirements (DAWE, 2022).

Details of the pathways for potential introduction, establishment and spread of IMS are shown in Table 9-11.

Table 9-11: Pathways for potential introduction, establishment and spread of IMS

Risk Event	Pathway to introduction	Means of establishment	Mechanisms of spreading
IMS are transferred into the field, becomes established and spreads	IMS within biofouling on vessels dislodged to the seabed IMS within biofouling on equipment that is routinely submerged in water, and which is dislodged to the seabed	Suitable habitat and conditions available for IMS in field.	Once established, IMS may spread by itself if conditions are suitable. In field equipment may provide connectivity allowing spread across infrastructure. Other anthropogenic influence (e.g., fishing) could spread established IMS within and outside of the field.
IMS are transferred between vessels, establishes on vessels and is spread to other areas (e.g., ports)	Discharge of ballast water containing IMS.	Suitable habitat and conditions available for IMS on vessels and within ballast and seawater systems.	IMS spreads between ports and other facilities via vessels acting as a vector.
IMS are transferred out of the field, becomes established at locations inside or outside the region and spreads.	Already established populations of IMS within the offshore field via natural or anthropogenic influences are recovered with equipment and dislodged whilst being transferred to shore.	Suitable habitat and conditions available for IMS at shoreside facilities.	Once established, IMS may spread by itself if conditions are suitable. May become established on structures at ports, and from there spread to vessels which then become a vector for the spread of IMS.

The transfer of IMS can occur within the operational area through natural or anthropogenic influences. For example, IMS may be dislodged, established and spread when subsea equipment and infrastructure is recovered or removed during decommissioning or operational activities, or during marine growth removal which may be required during IMR activities.

If IMS are translocated to the operational area, they could, theoretically, be subsequently transferred between the project vessels / MODUs, and by extension to marine environments beyond the operational area.

Activities associated with the East Coast Project that could result in the introduction, establishment and spread of IMS are identified in Table 9-12 and described in further detail in the subsections below.

Table 9-12: Activities undertaken in the East Coast Project that could cause unplanned introduction, establishment and spread of IMS

Cause of Aspect / Phase	Activity Component
Operations	Maintenance and repair
Decommissioning	Flowline and umbilical decommissioning
	Removal of remaining subsea infrastructure
Support Operations	MODU operations
	Vessel operations
	ROV operations

9.4.2 Aspect Characterisation

IMS already established in the region

A variety of IMS has established within ports around Australia. Even within the same region, different ports typically host a different mix of established IMS (Australian Government, 2019; Parks Victoria, 2019). Ports are often suitable for establishment of IMS because they are regularly exposed to IMS from many different vessels that may lay-up for long periods of time. Ports also typically have shallow areas and hard structures which provide suitable substrate for establishment. IMS can be translocated from a port in either vessel ballast or as biofouling.

Table 9-13 provides a consolidated list of high-risk marine species that are of concern to Victoria and other Australian jurisdictions that were identified following advice from the State Government Biosecurity Department (pers comms, 3rd May 2023) as well as IMS listings on the Australian Government Marine Pest website, and IMS listed as of most concern on the Victorian Parks website (Australian Government, 2019; Parks Victoria, 2019).

Table 9-13: High-risk marine species of concern to Australia

Scientific name	Common Name	Key Ports in the Region (✓ = confirmed IMS w = keep watch for)	
Invasive Marine Species		Portland (Otway)	Melbourne (Gippsland)
Balanus improvises	Barnacle	-	-
Caprella mutica	Japanese skeleton shrimp	-	-
Caulerpa taxifolia (exotic strains only)	Green macroalga	-	-
Charybdis japonica	Lady crab, Asian paddle crab	-	-
Corbula (Potamocorbula) amurensis	Asian clam, brackish-water corbula	w	w

Scientific name	Common Name	Key Ports in the Region (✓ = confirmed IMS w = keep watch for)	
Invasive Marine Species		Portland (Otway)	Melbourne (Gippsland)
Crepidula fornicate	American slipper limpet	w	w
Ensis directus	Jack-knife clam	-	-
Eriocheir sinensis	Chinese mitten crab	w	w
Hemigrapsus takanoi/penicillatus	Brush-clawed shore crab	-	-
Marenzelleria spp. (invasive species, marine/estuarine incursions)	Red gilled mudworm	-	-
Mnemiopsis leidyi	Comb jelly	-	-
Mya arenaria and japonica	Soft shell clam	w	w
Mytella strigata	Charru mussel	w	w
Mytilopsis sallei	Black striped false mussel	w	w
Neogobius melanostomus (marine/estuarine incursions)	Round goby	-	-
Perna canaliculus	New Zealand green-lipped mussel	-	-
Perna perna	Brown mussel	-	-
Perna viridis	Asian green mussel	w	w
Rapana venosa (syn. Rapana thomasiana)	Rapa whelk	w	w
Rhithropanopeus harisii	Harris' mud crab	-	-
Sargassum muticum	Asian seaweed	-	-
Siganus rivulatus	Marbled spinefoot, rabbit fish	-	-
Urosalpinx cinerea	Atlantic oyster drill	-	-
Established in Australia			
Asterias amurensis	Northern Pacific sea star	-	✓
Arcuatula senhousia	Asian bag mussel, Asian date mussel	✓	✓
Carcinus maenas	European green crab	-	✓
Codium fragile spp. Tomentosodies	Green macroalga	-	-
Didemnum perlucidum	White colonial sea	-	-
Didemnum vexillum	Carpet sea squirt	-	-
Grateloupia turuturu	Red macroalga	-	-
Hemigrapsus sanguineus	Asian shore crab	w	✓
Maoricolpus roseus	New Zealand screwshell	-	✓
Sabella spallanzanii	European fan worm	✓	✓
Undaria pinnatifida	Wakame	-	-
Varicorbula gibba	European clam	-	-
Holoplankton high-risk species			

Scientific name	Common Name	Key Ports in the Region (✓ = confirmed IMS w = keep watch for)	
Invasive Marine Species		Portland (Otway)	Melbourne (Gippsland)
Alexandrium monilatum, Dinophysis norvegica and Pfiesteria piscicda	Toxic dinoflagellate species	-	-
Chaetoceros concavicornis and Chaetoceros convolutes	Centric diatom species	-	-
Pseudo-nitzschia seriata	Pennate diatom	-	-

<u>IMS associated with the East Coast Project</u>

Prior to and during operations, the Cooper Energy IMS Risk Management Protocol will be implemented for all vessels and submersible equipment and will consider all regions of operation prior to the campaign (international and domestic).

9.4.2.1 Operations

Marine growth removal may be required during maintenance and repair, in order to provide access to subsea infrastructure.

Marine growth and deposits may be removed by water jetting or manual cleaning from an ROV or by divers to access equipment. Water jetting may use potable or sea water.

Chemicals, typically sulfamic acid (or equivalent such as citric acid), may be used to assist accumulations of carbonate on infrastructure, such as tooling interfaces.

9.4.2.2 Decommissioning

Marine growth removal may be required during decommissioning to access lifting points for equipment.

Marine growth may also become dislodged when flowlines, umbilicals or other structures are retrieved to deck, subsequently falling onto the seabed.

9.4.2.3 Support Operations

Support operations have the potential to introduce IMS to the operational area from the discharge of ballast water or biofouling. Support operations that are at risk of introduction of IMS during the project life include MODU operations during drilling, well intervention and well abandonment, and vessel operations.

For any support activities, vessels, MODU and equipment may be sourced internationally or domestically. During the activity, vessels will transit between the operational area and domestic ports. Any vessel has the potential to host IMS.

Support operations expected during the project life include MODU activity and vessels for drilling, supply runs, IMR including subsea inspection, survey, and decommissioning (see Section 4.3.6 for further details)

Prior to and during support operations, the Cooper Energy IMS Risk Management Protocol will be implemented for all vessels, MODU and submersible equipment, and will consider all regions of operation prior to the campaign (international and domestic).

9.4.3 Predicted Environmental Impacts and/or Risks (Consequence)

The risk events associated with of IMS introduction (assuming their survival, colonisation and spread) include:

- Displacement of native marine species
- Change to the functions, interests and activities of other marine users.

9.4.4 Impact and Risk Evaluation

9.4.4.1 Risk: Displacement of Native Marine Species

Inherent Consequence Evaluation

The introduction of an IMS can have a range of impacts on the receiving environment and can potentially alter the ecosystem dynamics of an area. Due to the complexity of ecosystems and level of interactions between and amongst biotic and abiotic receptors; there is no sure way to predict how an individual species may interact with a new environment.

Once an IMS is established, it's level of invasiveness and ecosystem damage is determined by a range of factors described above. IMS have the potential to change ecosystem dynamics by competing for natural resources, reducing the availability of natural resources, predation, change natural cycling processes, segregation of habitat, spread of viruses, change in water quality, producing toxic chemicals, disturb, injure or kill vital ecosystem organisms (ecosystem engineers and keystone species), change surrounding ecosystems, change conservation values of protected areas and create new habitats.

IMS have proven economically damaging to areas where they have been introduced and established, particularly as IMS are difficult to eradicate from areas once established (Hewitt, et al., 2002). If the introduction is captured early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life. It has been found that highly disturbed nearshore environments (such as marinas) are more susceptible to colonisation than open-water environments, where the number of dilutions and the degree of dispersal are high (Paulay, et al., 2002).

Marine pests have not been identified within the operational area to date, though the potential exists for marine pests to establish through natural and anthropogenic influences.

Impacts from IMS if introduced to the operational area could affect marine fauna and benthic habitats that may utilise the operational area and protected marine areas present in the wider region. The operational area contains hard substrate, that is typical of the broader Otway at this water depth.

<u>Benthic Habitats</u>

As described in Section 6.4.7 and 6.5.1 Ramboll (2020a) and Ramboll (2020b) both found that benthic habitats within and adjacent to the operational area are characterised by sand or gravelly / rubble and hard platform substrates. Invertebrate species located in the vicinity of the Otway offshore pipeline alignment include sponges, annelids, ascidians, hydrozoans, bryozoans, molluscs and crustaceans.

The benthic habitat of the operational area is typical of the broader area at this water depth and does not intersect any Australian Marine Parks. The operational area overlaps the shelf rocky reefs KEF (see Section 6.6.6); areas of rocky reefs and hard substrates along the continental shelf which provide habitat for diverse assemblages of species and aligns with the benthic fauna observations in the Ramboll (2020b) survey (see Section 6.5.1.3). This KEF does not have a delineated shape / boundary within the southeast marine region, as it is common with some large areas of hard substrate, and some small, isolated sections. Any IMS that is introduced into the operational area has the potential to establish itself on the seabed, including seabed which may be characteristic of the shelf rocky reef KEF. Organisms at risk of displacement by IMS include sponges, sessile invertebrates and soft corals.

<u>Marine Fauna</u>

Fur seals are known to occur within the region and may occur within the operational area. Fur seals are known to forage offshore benthic habitats and have been observed foraging along subsea pipelines associated with oil and gas facilities (Arnould et al., 2015). Changes to benthic communities, structure, diversity and abundance because of IMS, may have the potential to affect foraging success of fur seals in localised areas; with individuals or groups potentially modifying foraging ranges according to food availability. This kind of adaptation has been observed in Australian Fur Seals in response to climatic changes, to regional, large and local-scale environmental variability (Kliska et al., 2022).

Fish

Ecological impacts associated with IMS introduction may have an impact to socio-economic receptors through reduction in ecological values. Marine pest species can deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion. For example, the introduction of the Northern Pacific Seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries (Dommisse and Hough, 2004).

Once introduced, and if it did colonise an area, IMS may prey on local species (which had previously not been subject to this kind of predation and therefore not have evolved protective measures against the attack), they could outcompete indigenous species for food, space or light and could also interbreed with local species, creating hybrids such that the endemic species is lost. These changes to the local marine environment result in changes to the natural ecosystem.

The risk of an IMS being able to successfully establish itself would depend on depth, distance from the coast, water movement and latitude. The probability of successful IMS settlement and recruitment decreases in well-mixed, deep ocean waters away from coastal habitats.

If IMS were transferred between support vessels whilst working within the operational area and IMS is spread, there is the potential for local impacts to receptors where IMS has become established, including benthic communities and listed marine fish species.

The risk scenario of IMS introduction and establishment is evaluated to have a consequence of **Level 4**, based on:

- Species present in operational area of conservation value.
- Ability of IMS impacts to extend beyond the operational area.
- Difficulty to eradicate IMS once established and potential long-term effects.

Inherent Likelihood

Any IMS introduced to the operational area would be expected to remain fragmented and isolated, and only within the vicinity of its point of introduction. The chances of successful colonisation inside the operational area are considered small given:

- The operational areas distance from shore of greater than 8 km: Establishment of IMS is dependent on distance to shore where highly disturbed shallow-water marine environments are more susceptible to IMS colonisation (Dafforn et al., 2009). Modelling by the Bureau of Rural Sciences (BRS) has shown that the risk of IMS colonisation decreases with distance to shore with estimates as follows (BRS, 2007):
  - 33% chance of colonisation at 3 nm (5.6 km)
  - 8% chance at 12 nm (22 km)
  - 2% chance at 24 nm (44.5 km).
- Based on these risk estimates and the operational areas distance to shore (8 km or 4.3 nm) there is a very low likelihood that IMS would colonise.
- New subsea infrastructure brought into the project area originates from onshore fabrication and storage facilities and would therefore be biofouling free.
- The activities which have the potential to introduce IMS (vessel or MODU activities) are infrequent and relatively short in duration.

- Subsea equipment such as ROVs and baskets deployed to seabed during IMR activities are maintained cleaned to reduce the potential for IMS transfer.
- The operational area will not have any long-term platforms, FPSO or moored vessels, with the MODU and vessels being in the operational area temporarily; as vessels and MODUs will be moving relatively frequently, the risk of attachment of IMS and colonisation of the facilities is reduced compared to a permanent or semi-permanent vessel presence.
- Practices for minimising the risk of IMS spread are well established within the marine industry and there are clear requirements set by the DAFF.

The likelihood of IMS becoming established within the operational area as a result of the activities is considered **Remote (E).**

The transfer of IMS between vessels within the operational area, and which may then become established elsewhere is also considered here. A number of factors reduce the chance of IMS translocating between vessels:

- The offshore environment within the Otway region is highly dispersive, and vessels will be frequently moving; these conditions are not typically conducive to the establishment of marine organisms onto a new surface.
- There are a number of international and national management measures which already manage the potential introduction of IMS.

The likelihood of the transfer of IMS between vessels within the operational area, and which may then become established elsewhere, as a result of the activities is considered **Remote (E).**

Inherent Risk Severity

The inherent risk severity of IMS causing displacement or reduction in native marine species diversity and abundance is considered **Moderate**.

9.4.4.2 Risk: Changes to the Functions, Interests and Activities of Other Marine Users

Inherent Consequence Evaluation

The establishment of IMS has the potential to cause changes to the functions, interests or activities of other marine users such as:

- Commercial fisheries
- Marine industry (shipping, petroleum, renewables)
- Tourism.

IMS have proven economically damaging to areas where they have been introduced and established, particularly as IMS are difficult to eradicate from areas once established (Hewitt, et al., 2002). If the introduction is captured early, eradication may be effective but is likely to be expensive, disruptive and, depending on the method of eradication, harmful to other local marine life. It has been found that highly disturbed nearshore environments (such as marinas) are more susceptible to colonisation than open-water environments, where the number of dilutions and the degree of dispersal are high (Paulay et al., 2002).

IMS can have a primary and/or secondary impact on socio economic receptors. Primary impacts include direct damage to vessels, equipment and infrastructure which may then cause flow on affects and lead to a reduction in efficiency, productivity and profit. The presence of fouling organisms within a marine environment is likely to have the same or similar impacts to socio-economic receptors.

Secondarily, ecological impacts associated with IMS introduction may have an impact to socio-economic receptors through reduction in ecological values which are previously discussed in Displacement of native marine species. Marine pest species can deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia’s fishing industry being potentially vulnerable to marine pest incursion. For example, the introduction of the Northern Pacific Seastar

(*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries (Dommisse and Hough, 2004).

Predicted impacts from IMS if introduced to the operational area could affect marine fauna, benthic habitats, as described above, and commercial fisheries and tourism operators that may utilise the operational area and protected marine areas present in the wider region. Eleven managed fisheries have previously been identified in the operational area, of which three have recorded fishing efforts. Species include elephant fish, gummy shark, sawshark and lobster and abalone species. Further, tourism operators may utilise the operational area for a number of activities such as fishing charters which commonly target bluefin tuna, gummy, school and mako sharks and reef species such as snapper. Habitats for these resources exist across the greater region, any colonisation of IMS in the area around the Otway offshore facilities are unlikely to represent a limited resource for native species.

The establishment of IMS has a potential to disrupt the activities of other marine users, including the oil and gas industry or shipping by increasing the risk of further translocation of IMS within and beyond the region.

In the unlikely event of IMS being transferred between vessels/MODU whilst working within the operational area, IMS may be translocated and introduced to other local areas beyond the operational area. Ports and other offshore industry could potentially be exposed through both ballast and biofouling on vessels. If an IMS is spread, there is the potential for local impacts to receptors where IMS has become established, including fisheries and offshore industry.

The predicted level of impact, i.e., the consequence, to changes to the functions, interests or activities of other users as a result of the introduction of IMS is evaluated to have a consequence of **Level 4**, based on:

- potential impacts to commercial fisheries and tourism operators due to species displacement
- potential to translocated IMS out of operational area on project vessels or MODU, and
- multiple industries and operators are active in the region.

Inherent Likelihood

Any IMS introduced to the operational area would be expected to remain fragmented and isolated, and only within the vicinity of the infrastructure. The chances of successful colonisation inside the operational are considered small given:

- the Australian Government Bureau of Resource Sciences (BRS) established that the relative risk of IMS incursion decreases with distance from the coast. The operational area ranges from approximately 8 to 35 km from shore and 55 to 85 m water depth; decreasing the probability of IMS colonising and impacting the values of other marine users
- the activity is not typically conducive to the establishment of marine organisms onto a new surface with vessels frequently moving and the absence of long-term platforms, FPSO or moored vessels remaining within the field
- there are several international and national management measures which already manage the potential introduction of IMS
- there have been no IMS introductions recorded from Cooper Energy’s activities offshore in the southeast.

The likelihood of IMS becoming established within the operational area as a result of the activities is considered **Remote (E).**

Inherent Risk Severity

The inherent risk severity of IMS causing a change to the functions, interests and activities of other marine users is considered **Moderate**.

9.4.5 Demonstration of Acceptability

In order to demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 9-14.

Table 9-14: Introduction, Establishment and Spread of IMS Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Process	Risk: Displacement of native marine species	Risk: Moderate
	Risk: Changes to the functions, interests or activities of other users	Risk: Moderate
Principles of ESD	A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, risks from introduction, establishment and spread of IMS was identified as: • Moderate risk for displacement of native marine species • Moderate risk for changes to the functions, interests or activities of other users. The above predicted levels of risk due to introduction, establishment and spread of IMS from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology, Cooper Energy's Invasive Marine Species Risk Management Process, and Australian IMS prevention guidelines. • The highest consequence ranking for the successful introduction, establishment and spread of IMS was evaluated as Level 4, however the likelihood of IMS being established was considered Remote, therefore the inherent risk for introduction, establishment and spread of IMS was evaluated as Moderate. Therefore, introduction, establishment and spread of IMS from the East Coast Project will not result in serious or irreversible environmental damage. • There is little scientific uncertainty associated with predicted environmental impact (should be risk be realised prior to establishment) and the anticipated effectiveness of management measures. • The potential impacts and risks from introduction, establishment and spread of IMS are well-understood, and management measures are well established and regulated in Australian waters.	

	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest inherent risk for introduction, establishment and spread of IMS was evaluated as Moderate and therefore will not forego the health, diversity and productivity of the environment for future generations. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.4.6). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.		
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant environmental values and sensitivities to introduction, establishment and spread of IMS were evaluated in Section 9.4.4 and highest inherent risk for introduction, establishment and spread of IMS was evaluated as Moderate. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.4.6). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.		
Legislative and Other requirements	**Requirement**	**Relevant Objective / Action**	**Demonstration of Requirement**
	Biosecurity Act 2015 (Cth)	Vessels entering into the Australian territorial seas from outside Australian territory must complete pre-arrival reporting.	Adoption of the following control measures: CM15: Cooper Energy IMS Risk Management Process
	Biosecurity Amendment (Biofouling Management) Regulations 2021	Vessels entering into Australia must complete pre-arrival reporting requirements on biofouling practices.	
	Protection of the Sea (Harmful Anti-fouling Systems) Act 2006 (Cth)	All ships involved in offshore petroleum activities in Australian waters are required to abide to the requirements under this Act.	
	Australian Ballast Water Management Requirements	Details Australia's commitment to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) (IMO 2017). International marine vessels must comply with these key requirements: • non-discharge of 'high-risk' ballast water in Australian ports or waters • full ballast exchange outside Australian territorial seas • documentation of all ballast exchange activities.	

	Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (Biofouling Guidelines) 2011	Internationally agreed guidance for vessel operators to develop vessel-specific biofouling management plans.	
	Australian biofouling management requirements (DAFF, 2023)	Describes requirements that operators of all vessels need to provide on biofouling practices prior to arriving in Australia	
	Marine Pest Plan 2018-2023: National Strategic Plan for Marine Pest Biosecurity (2018-2023) (CoA, 2018)	Provides Australia's national strategic plan for marine pest biosecurity. It outlines a coordinated approach to building Australia's capacity to manage the threat of marine pests over five years. The key relevant objective is to minimise the risk of marine pest introduction, establishment and spread.	
N/a	**Guideline**	**Relevant Considerations**	**Where Guideline is Considered**
	National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (CoA, 2009)	Guides operators on: • evaluating biofouling risk of types of structure/facilities • biofouling management and decommissioning. Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species.	Adoption of the following control measures: CM17: Cooper Energy IMS Risk Management Process
	National biofouling management guidelines for commercial vessels (CoA, 2009b)	Guidance for evaluation of biofouling risk of types of vessels; and on biofouling. Used as guidance for Cooper Energy's Invasive Marine Species Risk Management Process.	
	Reducing marine pest biosecurity risks through good practice biofouling management	Provides guidance that is consistent with the expectations of all jurisdictions responsible for regulating biofouling management within the Australian marine environment. Used as guidance for Cooper Energy's Invasive Marine Species Risk Management Process.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11) • Operations Management (MS07) • External Affairs & Stakeholder Management (MS05).		

	Activities will be undertaken in accordance with the Implementation Strategy (Section 12).
External Context	Through ongoing communications with the Victorian Government Biosecurity Section Cooper Energy has received information relating to IMS which may be relevant to particular activities and circumstances. This information is included in the OPP where applicable and is revisited during the detailed planning phase of an activity to inform the assessment of risk and management of vessels accounting for their operational history.
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to the introduction, establishment and spread of IMS is AL8 and AL9 identified in Table 9-15. These acceptable levels defined for the displacement of native marine species and changes to the functions, interests and activities of other marine users are defined in Table 7-6. The worst-case predicted impacts assessed in Section 9.4.4 are: • Potentially long-term impacts to native marine species and other marine users if IMS are able to successfully establish in the operational area, due to difficulty to eradicate and potential to translocate beyond the operational area. • Likelihood of success establishment is remote due to distance from shore, water depth, no long-term presence of topsides infrastructure or vessels, and relatively infrequent vessel and MODU movements. • The highest consequence ranking for the successful introduction, establishment and spread of IMS was evaluated as Level 4, however, the likelihood of IMS being established was considered Remote, therefore the inherent risk for introduction, establishment and spread of IMS was evaluated as Moderate. Therefore, at its worst-case, the predicted impact from the introduction, establishment and spread of IMS would not: • Lead to substantial adverse effects on the sustainability of commercial fisheries; and that • Social and commercial amenity values of the Commonwealth Marine Area within the region are maintained consistent with the rights of all marine users. Therefore, the predicted level of impact resulting from the introduction, establishment and spread of IMS resulting from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to the introduction, establishment and spread of IMS are acceptable, based on: • predicted levels of impact (evaluated in Section 9.4.4) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors • the planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • the activities will be managed in a way that is not inconsistent with the relevant principles of ESD • the proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • no feedback from stakeholders has been received that would inform the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPO have been applied: **EPO25:** No introduction, establishment or spread of invasive marine species

9.4.6 Environmental Performance

Table 9-15 lists the acceptable level and EPO defined for the introduction, establishment and spread of IMS and the adopted control measures to achieve the outcome.

Table 9-15: Environmental Performance Summary – Introduction of IMS

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL8: Social and commercial amenity values of the Commonwealth Marine Area within the region are maintained consistent with the rights of all marine users. **AL9:** Impacts and risks to other marine users associated with activities defined in this OPP will not lead to substantial adverse effects on the sustainability of commercial fisheries.	**EPO25**: No introduction, establishment or spread of invasive marine species	CM17: Cooper Energy IMS Risk Management Process • The Cooper Energy IMS Risk Management Process acknowledges legislative requirements and the different sources of IMS risk for different types of project activity. The Process details the regulatory and any additional company requirements to manage biofouling and ballast water risks to levels that are acceptable and ALARP.

9.5 Accidental Release – MDO

9.5.1 Cause of Aspect

Loss of containment (LOC) of hydrocarbons (MDO) into the marine environment could occur because of the East Coast Project activities, identified in Table 9-16, which are described in further detail in subsections below.

Table 9-16: Activities undertaken in the East Coast Project that could result in an accidental release of MDO

Cause of Aspect / Phase	Activity Component
Support Operations	Vessel operations
	MODU operations

9.5.2 Aspect Characterisation

There is the possibility of an unplanned collision between the project vessels, a project vessel and the MODU, or a project vessel and a third-party passing vessel within the operational area. Vessel grounding is not a risk because there are no shallow areas or emergent features in the operational area.

Diesel spill modelling is included in the OPP as one of a number of indicative spill scenarios. It is not the worst-case spill scenario for the East Coast Project and does not drive the EMBA for the purposes of the assessment of impacts and risks under the OPP. The LOWC scenario is the worst-case scenario for the OPP. Depending on the delineation of activities for EP preparation, LOWC may not be applicable to each EP for the ECSP, for example a site survey EP may carry a vessel diesel spill as its worst case. Modelling will be revisited and re-vised for the purposes of the development of individual EPs and associated OPEPs to ensure worst case discharges for the activities within the scope of the EP are provided for.

9.5.2.1 Support Operations

Support operations expected during the project life include vessel operations for drilling, supply runs, and IMR including subsea inspection, survey, and decommissioning.

To support the risk evaluation, Cooper Energy assessed the worst-case credible spill scenario that could result from a vessel collision. For the risk evaluation the vessel largest fuel tank volume was used as recommended by AMSA's guideline for indicative maximum credible spill volumes for other, non-oil tanker, vessel collision (AMSA, 2023).

The worst-case scenario vessel LOC (MDO) scenario used for the assessment was:

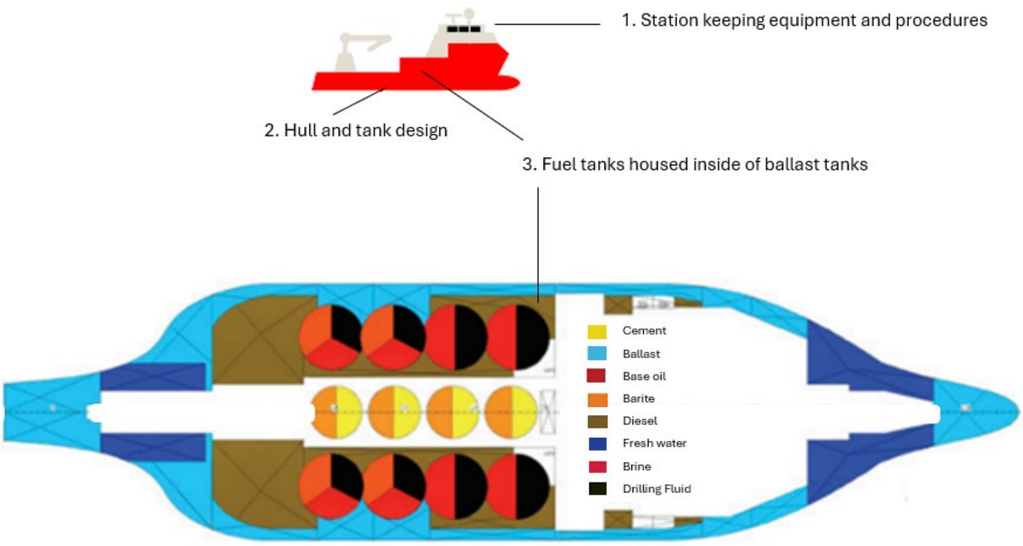
- An instantaneous release of MDO because of a vessel collision rupturing a vessel fuel tank (~250 m^{3*} of MDO over 6 hours).

**Additional context as to the vessel fuel spill scenario presented in the OPP: To identify an indicative vessel fuel spill scenario for the OPP, Cooper Energy refers to the AMSA 2023 Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities. The guideline states 'Generally, the WCS assumes a failure of one or two levels of spill prevention or control'. For a typical vessel operating offshore, the loss of full inventory from a vessel fuel tank as a result of the failure of two control measures could result from:*

1. Failure of Procedural Control: Loss of station keeping and / or monitoring on the bridge, leading to a collision with another vessel, and then

2. Failure of Engineering Control: Collision impact breaches the skin of the vessel hull into a fuel tank leading to loss of inventory.

Cooper Energy reviewed applicable vessel safety cases and/or tank plans of vessels indicative of those that could be used for the ECSP. Vessel tank sizes range from 168m^3 (anchor handling vessel) to (150m^3 for the CSV), and 604m^3 for the ISV (Section 4.3.6.2). The vessels reviewed have an additional level of control engineered into their design; vessel fuel tanks are not housed directly inside of the hull but are housed in the centre of the hull (example diagram below). This positioning of fuel tanks provides additional protection against a collision leading to the breach of a fuel tank, and third layer of control that would need to fail for a breach to eventuate. Following the AMSA 2023 guidance, a full breach of a vessel fuel tank which is within the centre of the vessel hull would not meet criteria for a WCS. Cooper Energy has modelled a 250m^3 fuel spill for the purpose of providing an indicative scenario for the OPP; whilst aware there are myriad vessel tank sizes and tank arrangements that could eventuate over the life of the East Coast Project (~25 years), though none of these would be orders of magnitude greater than the current modelled scenario, and none would result in an EMBA greater than the overall WCD for the project, which is a LOWC scenario. Nonetheless there is additional conservatism built into the vessel fuel spill scenario selected for the OPP, being an instantaneous release of 250m^3, which is considered less likely than a lower release rate (leak-type) scenario given there are also a range of reactive controls to manage the source of a fuel release. These measures typically include ballast transfer to change the pitch and depth of the hull, and fuel tank transfer to move fuel out of the tank which may have been breached and are described in the SOPEP (or SMPEP) for each individual vessel.



9.5.3 Quantitative Hydrocarbon Spill Modelling

Cooper Energy commissioned RPS Group to conduct stochastic modelling and deterministic analysis (RPS, 2023a) on the scenario of a surface spill of 250 m^3 of MDO following a vessel collision at the Annie-2 location (Table 9-17).

The modelling was undertaken in 2023 using NOPSEMA's contemporary modelling thresholds (NOPSEMA, 2019); provided in Table 9-3.

The Annie-2 field was considered an appropriate location for the modelling as it is the closest Cooper Energy gas field to the shore. A spill from this location is anticipated to potentially result in the largest shoreline accumulation with shortest time to shoreline contact. Subsequently, providing a conservative modelling output for vessel LOC incidents that may occur at other locations covered within the East Coast Project.

The model used during the assessment was SIMAP (Spill Impact Mapping and Analysis Program), which is a three-dimensional hydrocarbon spill trajectory and weathering model. It is designed to simulate the transport, spreading and weathering of specific hydrocarbon types under the influence of variable meteorological and oceanographic conditions in the Otway.

Stochastic oil spill modelling is created by overlaying ≥100 individual, computer-simulated hypothetical spills (NOPSEMA, 2018), and is a common means of assessing the potential risks from oil spills related to new projects and facilities. In other words, only a fraction of the area within the EMBAs have the potential to be impacted from a given spill.

Stochastic modelling utilises hydrodynamic data for the location in combination with historic wind data. 100 or more iterations of the model are run utilising the data that is most relevant to the season or timing of the project, or in the case of the East Coast Project, all seasons were accounted for. The outcomes are used for risk assessment purposes in view to understand the range of environments that may be affected or impacted by a spill, as well as to understand and plan for the resources required to respond effectively to a wide range of spill. Detailed response planning occurs during the development of activity specific EPs, and which include a comprehensive oil spill pollution emergency response plan (OPEP).

Modelling inputs are provided in Table 9-17.

Table 9-17: MDO Spill Modelling Parameters

Parameter	Scenario
Scenario	Vessel LOC
Location	Annie-2 well Lat: 38.68375° S Long: 142.82456° E
Maximum credible spill volume (total)	250 m^3
Number of randomly selected spill start times	100 per season (200 per scenario)
Model period	Summer (November to April) Winter (May to October)
Hydrocarbon type	MDO
Release type (depth (m))	Surface
Release duration (hours)	6
Simulation length (days)	30

Parameter	Scenario
Surface oil concentration thresholds (g/m^2)*	1 (low); 10 (moderate); 50 (high)
Shoreline oil accumulation thresholds (g/m^2)*	10 (low); 100 (moderate); 1,000 (high)
Dissolved hydrocarbon concentrations (ppb)*	10 (low); 50 (moderate); 400 (high)
Entrained hydrocarbon concentrations (ppb)*	10 (low); 100 (high)

**Thresholds based on NOPSEMA (2019); Table 9-18*

9.5.3.1 Hydrocarbon Impact Thresholds

Table 9-18 describes the concentration thresholds used in the impact assessment for the different exposure types (surface, shoreline, and in-water (dissolved and entrained)). These impact thresholds and exposure pathways are then applied at a receptor level with the consequence evaluations. The thresholds used align with the NOPSEMA environmental bulletin 'Oil spill modelling' (NOPSEMA, 2019).

Table 9-18: Justification for Hydrocarbon Impact Thresholds

Exposure Level	Impact Threshold	Description
Surface Oil		
Low	1 g/m^2	Approximates range of socioeconomic effects and establishes planning area for scientific monitoring.
Moderate	10 g/m^2	Approximates lower limit for harmful exposures to birds and marine mammals.
High	50 g/m^2	Approximates surface oil slick and informs response planning.
Shoreline		
Low	10 g/m^2	Predicts potential for some socio-economic impact.
Moderate	100 g/m^2	Loading predicts area likely to require clean-up effort.
High	>1000 g/m^2	Loading predicts area likely to require intensive clean-up effort.
In-water - Dissolved		
Low	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers.
Moderate	50 ppb	Approximates potential toxic effects, particularly sublethal effects to sensitive species.
High	400 ppb	Approximates toxic effects including lethal effects to sensitive species.
In-water - Entrained		
Low	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
High	100 ppb	As appropriate given oil characteristics for informing risk evaluation

9.5.3.2 Hydrocarbon Characteristics

The MDO selected for modelling is a light persistent hydrocarbon (classified as Group II by the International Tankers Owners Pollution Federation (ITOPF, 2011b), with a low dynamic viscosity and low pour point (Table 9-19). The hydrocarbon has low (10%) residual component (i.e., the component that tends not to evaporate and that may persist in the marine environment) (Table 9-19).

Table 9-19: Physical Characteristics of the MDO

Type	API	Pour Point (°C)	Density kg/m³ (at 25 °C)	Viscosity cP (at 25°C)	Non-Persistent			Persistent
					Volatiles (BP < 180°C)	Semi-volatiles (180°C < BP < 265°C)	Low Volatiles (265°C < BP < 380°C)	Residuals (BP > 380)
MDO	24	-9	890	14.0	4%	32%	54%	10%

9.5.3.3 Weathering and Fate

The modelling included a series of weather tests to illustrate the potential behaviour of the MDO when exposed to idealised and representative environmental conditions (RPS, 2023a). The two tests included a model under calm wind conditions (5 knots) and under variable weather conditions (1-23 knots), both assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.

The mass balance forecast for the constant-wind case (Figure 9-1) for MDO shows that approximately 34.3% of the hydrocarbon is predicted to evaporate within 24 hours (RPS, 2023a). Under these calm conditions, most of the remaining hydrocarbon on the water surface will weather at a slower rate due to being comprised of the low volatile, longer-chain compounds. Evaporation of the residual compounds will cease when the residual compounds remain, and they will be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 9-2) where the winds are of greater strength on average, entrainment of MDO into the water column is shown to increase. Approximately 24 hours after the spill, 83.1% of the hydrocarbon mass is shown to have entrained and a further 11.4% is shown to have evaporated, leaving only a small proportion of the hydrocarbon floating on the water surface (1.3%).

The increased level of entrainment in the variable-wind case result in a higher percentage decaying at an approximate rate of 3% per day with 22% after 7 days, compared to 0.4% per day and a total of 2.6% after 7 days for the constant-wind case (RPS, 2023a). Given the proportion of entrained hydrocarbon and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

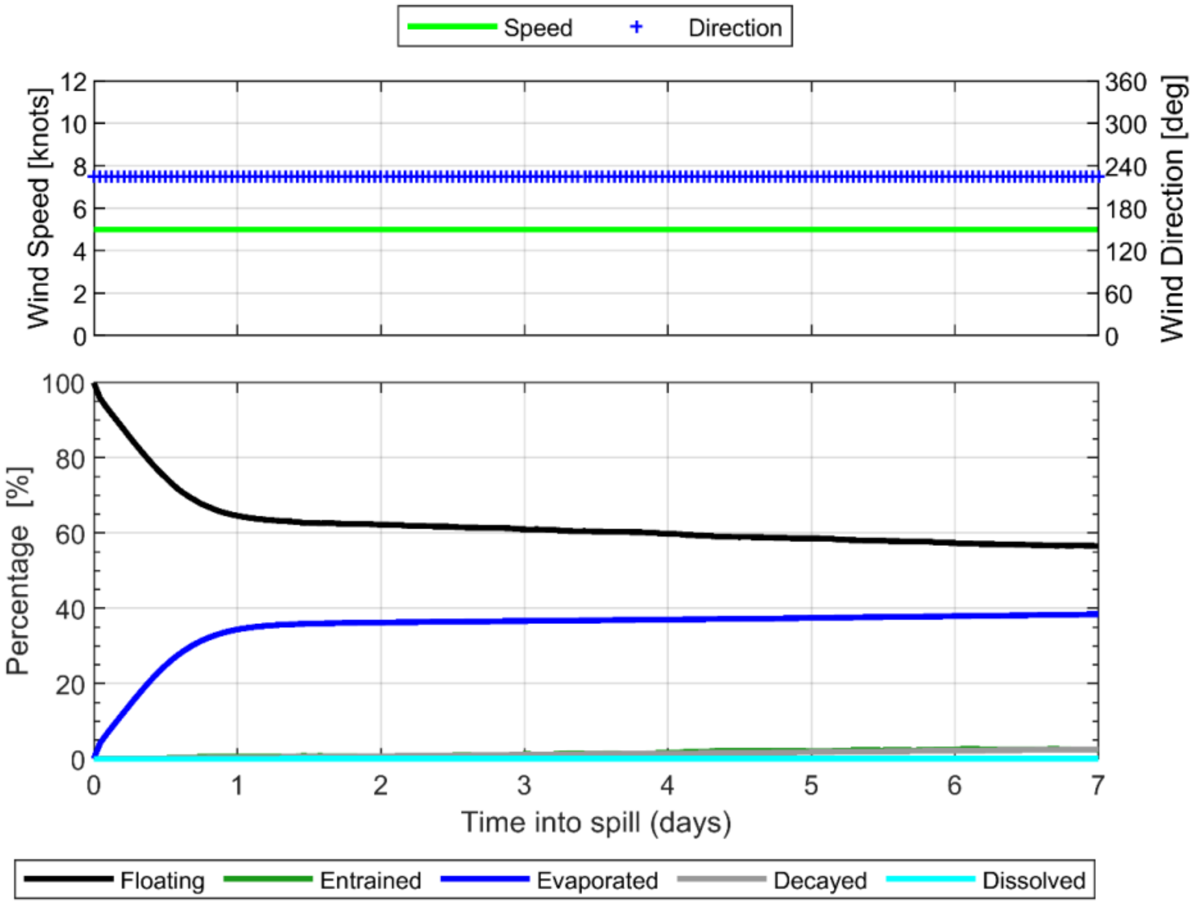


Figure 9-1: Proportional mass balance plot representing the weathering of MDO spilled onto the water surface over 1 hour and subject to a constant 5 knots wind speed at 15°C water temperature (RPS, 2023a).

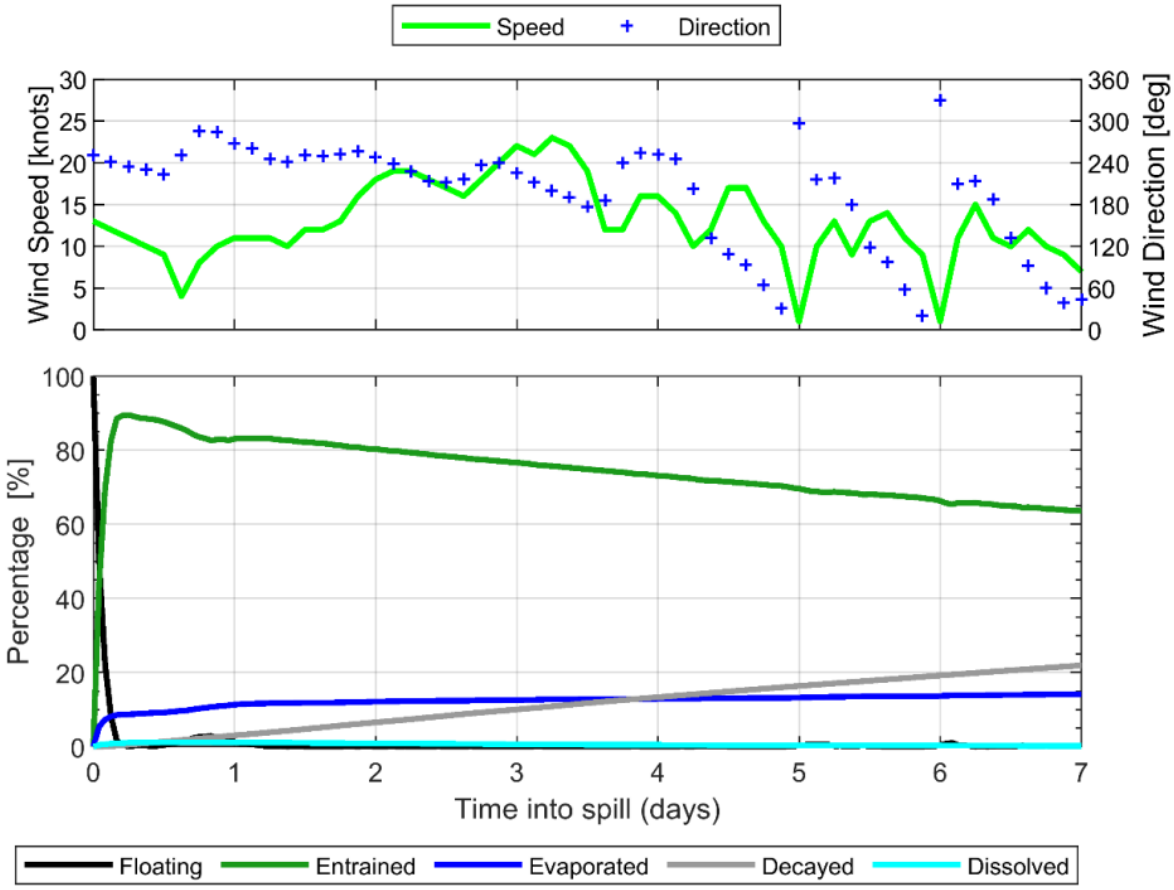


Figure 9-2: Proportional mass balance plot representing the weathering of MDO spilled onto the water over 1 hour and subject to variable wind speeds (1-23 knots) at 15°C water temperature (RPS, 2023a).

9.5.3.4 Modelling Outputs

Table 9-20 provides a summary of the results from the stochastic modelling report (RPS, 2023a). Figure 9-3 displays the MDO EMBAs (Ecological, Social, and Monitoring) obtained from the stochastic modelling results (RPS, 2023a). See Table 6-1 for further details on the EMBA descriptions ad specific thresholds.

Table 9-20: Modelling Output Summary for MDO

Exposure Values	Summary of worst-case predicted exposure
Floating	
Low **(1 g/m^2)**	Floating hydrocarbon at this level is expected to be visually detectable but not have ecological impacts. • The maximum distance for floating hydrocarbon exposure from the source was predicted to be 32.5 km. • Would intersect with BIAs for seabird and cetacean species. • Would intersect with the Twelve Apostles Marine Park.
Moderate **(10 g/m^2)**	Floating hydrocarbon at this level has the potential to cause ecological impacts. • The maximum distance for floating hydrocarbon exposure from the source was predicted to be 10.3 km. • Would intersect with BIAs for seabird and cetacean species.

Exposure Values	Summary of worst-case predicted exposure
Shoreline	
Low **(10 g/m^2)**	Shoreline hydrocarbon at this level is expected to be visually detectable but not have ecological impacts. • The probability of hydrocarbon accumulation on any shoreline at or above the low threshold was 60%. • The minimum time to shore at or above the low threshold was 22 hours. • The maximum total volume of hydrocarbon ashore for a single spill trajectory was 43.2 m^3 • The maximum length of hydrocarbon ashore above the low threshold was 32 km.
Moderate **(100 g/m^2)**	Shoreline hydrocarbon at this level has the potential to cause ecological impacts. • The minimum time to shore at or above the moderate threshold was 1 day. • The highest maximum probability of shoreline accumulation is 28% at Corangamite. • The maximum length of hydrocarbon ashore above the moderate threshold was 11 km.
In-Water- Dissolved	
Low **(10 ppb)**	Dissolved hydrocarbon at this level is not expected to have ecological impacts. • The minimum time to dissolved hydrocarbon exposure at any given receptor(s) was 2 hours. • The probability of intersect with the Twelve Apostles Marine Park is 1%. • Would intersect with BIAs for cetacean and shark species.
Moderate **(50 ppb)**	Dissolved hydrocarbon at this level has the potential to cause ecological impacts. • The minimum time to dissolved hydrocarbon exposure at any given receptor(s) was 5 hours • Would intersect with BIAs for cetacean and shark species.
In-Water- Entrained	
Low **(10 ppb)**	Entrained hydrocarbon at this level is not expected to have ecological impacts. • The minimum time to entrained hydrocarbon exposure at any given receptor(s) was 1 day • Would intersect with BIAs for cetacean and shark species.
High **(100 ppb)**	Entrained hydrocarbon at this level has the potential to cause ecological impacts. • The minimum time to entrained hydrocarbon exposure at any given receptor(s) was 1 day • Would intersect with BIAs for cetacean and shark species.

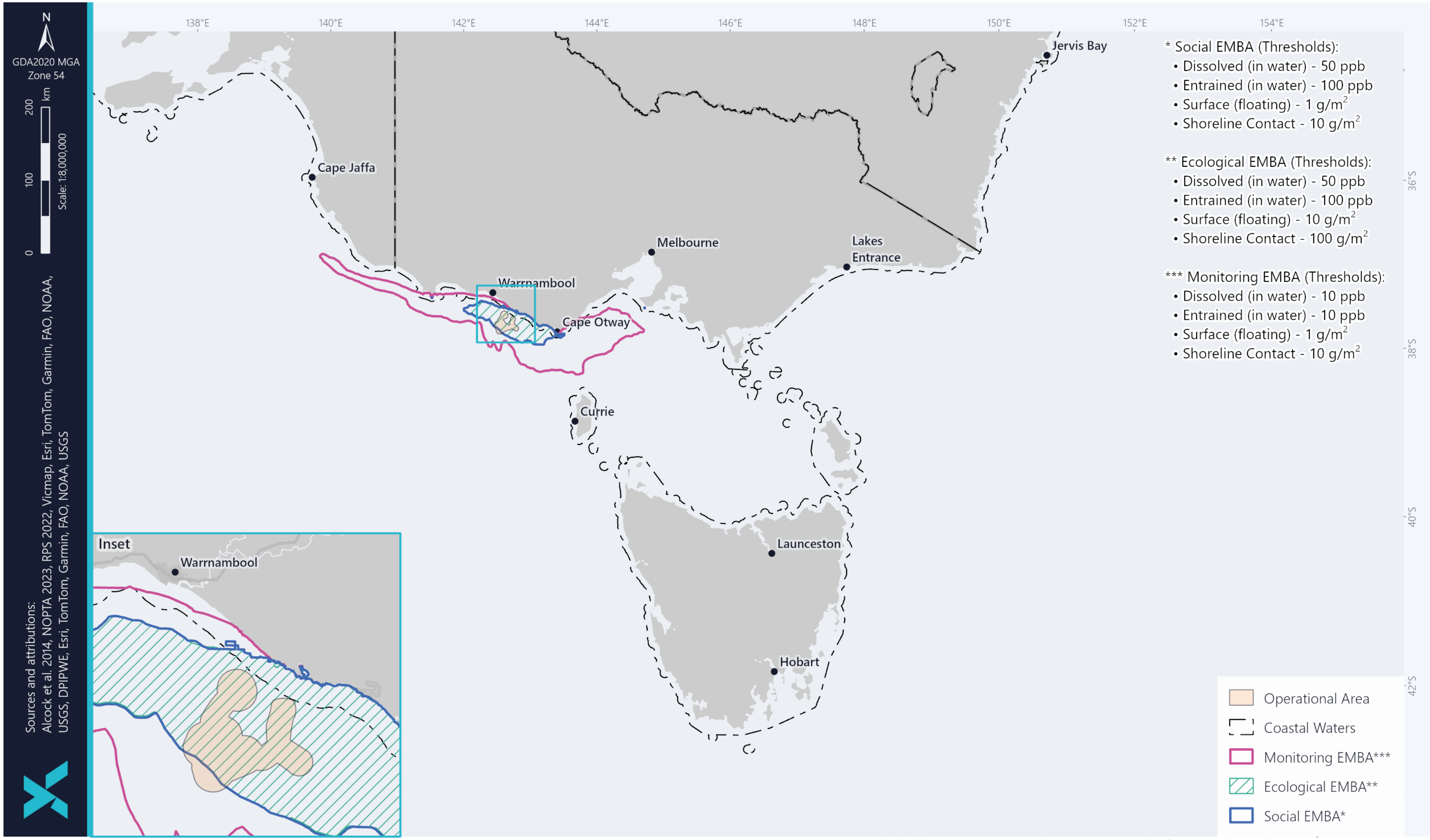


Figure 9-3 East Coast Project operational area and MDO EMBAs (Ecological, Social and Monitoring) for a surface release of 250m^3 of MDO over 6 hours. Results calculated from 100 spill simulations (RPS, 2023a)

9.5.4 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from an accidental release of MDO are:

- Change in water quality.

Potential risk:

- Change in habitat
- Change in fauna behaviour
- Injury / mortality to fauna
- Change to the functions, interests, or activities of other users.

9.5.5 Impact and Risk Evaluation

The potential impacts on environmental receptors from general hydrocarbon spills are summarised in Table 9-21. The below sections evaluate the potential impact from a specific accidental release of MDO for the East Coast Project in more detail.

The Social EMBA and Ecological EMBA for MDO spill modelling represent the area where hydrocarbons could occur above social or ecological impact thresholds (Figure 9-3). Only a fraction of the area within the EMBAs have the potential to be impacted from a given spill.

Table 9-21: Potential impacts of Hydrocarbon Exposure on receptors

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
Ecological environment			
Benthic assemblages	No exposure pathway.	Marine invertebrate species, such as crustaceans, molluscs, cnidarians, and porifera, including commercially important species, may be impacted by in-water exposure of hydrocarbon expected to occur within the upper 0 – 10 m of the water column and shallow coastal areas. Water quality in benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within weeks to months of contact. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (National Academies Press, 2003).	No exposure pathway.
Coastal habitats – Rocky shorelines	No exposure pathway.	No exposure pathway.	The sensitivity of a rocky shoreline to oiling is dependent on a number of factors including its topography and composition, position, and exposure to oceanic waves and currents. Exposed rocky shorelines have been shown to be less sensitive than sheltered rocky shorelines. Rocky shorelines provide habitats for invertebrates (e.g., sea anemones, sponges, sea-squirts, molluscs), and can also be utilised by some pinniped (haul-out sites) and bird species. Foraging and breeding/nesting by birds typically occurs above high tide line (see Section 6.5.7 for further details). The impact of oil on any organism depends on the toxicity, viscosity and amount of oil, on the sensitivity of the organism and the length of time it is in contact with the oil. Even where the immediate damage to rocky shores from oil spills has been considerable, it is unusual for this to result in long-term damage and the communities have often recovered within 2 or 3 years (IPIECA, 1995).

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
			Due to the tidal action and constant wave washing on this type of shoreline, rapid weathering of any hydrocarbons in the intertidal area is expected and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline.
Coastal habitats – Sandy shorelines	No exposure pathway.	No exposure pathway.	Sandy beaches are considered to have a low sensitivity to hydrocarbon exposure. The tides and constant wave washing are expected to lead to rapid weathering of any hydrocarbons in the intertidal area and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline. A sandy beach may also allow oil to percolate through the sand, thus increasing its ability to hold more oil ashore over tidal cycles and various wave actions than an equivalent area of water; hence oil can increase in thickness onshore over time.
Coastal habitats - Mangroves	No exposure pathway.	Mangroves are considered to have a high sensitivity to hydrocarbon exposure. Mangroves can be killed by heavy or viscous oil, or emulsification, that covers the trees' breathing pores thereby asphyxiating the subsurface roots, which depend on the pores for oxygen. Mangroves can also take up in-water hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death (Wardrop et al., 1987). The change in toxicity levels within the marine environment can penetrate the root surfaces, via the respiratory capabilities of the roots, poisoning the plant. Acute impacts to mangroves can be observed within weeks of exposure, whereas chronic impacts may take months to years to detect.	Oil can enter mangrove forests when the tide is high and be deposited on the aerial roots and sediment surface as the tide recedes. This process commonly leads to a patchy distribution of the oil and its effects because different places within the forests are at different tidal heights (IPIECA, 1993; NOAA, 2014). The exposed aerial roots can be smothered by hydrocarbons.
Coastal habitats - Saltmarsh	No exposure pathway.	No exposure pathway.	Saltmarsh is considered to have a high sensitivity to hydrocarbon exposure. Hydrocarbon (in liquid form) will readily adhere

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
			to the marshes, coating the stems from tidal height to sediment surface. Oil can enter saltmarsh systems during the tidal cycles if the estuary/inlet is open to the ocean. Saltmarsh vegetation offers a large surface area for oil absorption and tends to trap oil. Similar to mangroves, this can lead to a patchy distribution of the oil and its effects, because different places within the inlets are at different tidal heights. Evidence from case histories and experiments shows that the damage resulting from oiling, and recovery times of oiled marsh vegetation, are highly variable. In areas of light to moderate oiling where oil is mainly on perennial vegetation with little penetration of sediment, the shoots of the plants may be damaged, but recovery can be relatively rapid, occurring the following growing season or earlier. However, when oil penetrates the soil and the initial mortality of the vegetation is extensive, recovery to reference conditions may take 3–4 years (Hester and Mendelssohn, 2000).
Coastal habitats - Macroalgae	No exposure pathway.	The effect of hydrocarbons, however, is largely dependent on the degree of direct exposure and how much of the hydrocarbon adheres to algae, which will vary depending on the oils physical state and relative 'stickiness'. The morphological features of macroalgae, such as the presence of a mucilage layer or the presence of fine 'hairs' will influence the amount of hydrocarbon that will adhere to the algae. A review of field studies conducted after spill events by Connell and Miller (1981) indicated a high degree of variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. The rapid recovery of algae was attributed to the fact that for most algae, new growth is produced from near the base of the plant while the distal parts (which would be exposed to the oil contamination) are continually lost. Other studies have indicated that kelp beds oiled by crude oil had a 90% recovery within 3-4 years of impact, however full	No exposure pathway.

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
		recovery to pre-spill diversity may not occur for long periods after the spill (French- McCay, 2004). Intertidal macroalgal beds are more prone to oil spills than subtidal beds because, although the mucous coating prevents oil adherence, oil that is trapped in the upper canopy may be more persistent, which impacts site-attached species. Additionally, when oil sticks to dry fronds on the shore, they can become heavy and break as a result of wave action (IPIECA, 2002). The toxicity of hydrocarbons to macroalgae varies for the different macroalgal life stages, with water-soluble hydrocarbons more toxic (Van Overbeek and Blondeau 1954; Kauss et al., 1973; cited in O'Brien and Dixon, 1976). Gametes, larvae and zygote stages are more sensitive to petroleum oil exposure than adult growth stages (Thursby and Steele, 2004; Lewis and Pryor, 2013). Entrained hydrocarbon within the water column can affect light qualities and the ability of macrophytes, including macroalgae, to photosynthesise.	
Coastal habitats - Seagrass	No exposure pathway.	Intertidal and subtidal seagrass ecosystems can be damaged in several ways. In addition to direct mortality from smothering, petroleum fractions may be absorbed into the seagrass tissues, which can then lower the organism’s tolerance to other stressors and reduce growth rates (Zieman et al., 1984) (Runcie et al. 2010). Sub-lethal impacts from physical contact, are more likely to occur than lethal impacts because much of seagrasses’ biomass is underground in their rhizomes and less likely to be exposed to hydrocarbons (Zieman et al., 1984). However, exposure can also take place via uptake of hydrocarbons through plant membranes and seeds may be affected by contact with oil contained within sediments (NRDA, 2012). Studies of offshore benthic seaweeds in the northwest Gulf of Mexico prior to and after the Macondo well blowout at Sackett and Ewing banks (in water depths of 55–75 m) found a dramatic die-off of seaweeds after the spill (60 species pre-spill compared with 10	No exposure pathway.

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
		species post-spill) (Felder et al., 2014). However, these banks are exposed to influences from Mississippi River discharges that vary year to year, so definitive links to the oil spill were not possible. Petroleum residues were observed on Ewing Bank, and it is possible that this may have caused localised mortalities (Felder et al., 2014). Entrained hydrocarbon within the water column can affect light qualities and the ability of macrophytes, including seagrasses, to photosynthesise. In-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 – 10 m of the water column; therefore, benthic habitat, such as seagrass, within intertidal or shallow nearshore waters has the potential to be exposed.	
Plankton	Phytoplankton can bloom rapidly, due to their small size and high surface area to volume ratio, therefore populations are typically not sensitive to the impacts of oil (Hook et al., 2016). However, if phytoplankton are exposed to hydrocarbons at the sea surface, their ability to photosynthesise may be directly affected and could have implications for the next trophic level in the food chain (e.g., small fish) (Hook et al., 2016) depending on the extent and duration of effects on phytoplankton. A reduction in the rate of photosynthesis may inhibit growth, depending on the concentration range. For example, photosynthesis is stimulated by low concentrations of oil in the water column (10-30 ppb) but becomes progressively inhibited above 50 ppb. Conversely, photosynthesis can be stimulated below 100 ppb for exposure to weathered oil (Volkman et al., 1994).	Plankton are generally abundant in the upper layers of the water column and form the basis of the marine food web. Zooplankton, such as rotifers, copepods and krill, are vulnerable to hydrocarbons due to their small size and high surface area to volume ratio. Some zooplankton also have high lipid content, which facilitates hydrocarbon uptake and bioaccumulation (Hook et al., 2016). Water column organisms that come into contact with oil risk exposure through ingestion, inhalation and dermal contact (NRDA, 2012), which can cause immediate mortality or declines in egg production and hatching rates along with a decline in swimming speeds (Hook et al., 2016). The distribution of zooplankton, such as krill, is closely linked to spatial and temporal patterns in primary production by phytoplankton, which in turn is closely linked to the supply of nutrients and oceanographic processes (see Section 6.5.3). Variations in the temporal scale of oceanographic processes have a greater influence on plankton communities than the direct effect of spilled hydrocarbons. This is because reproduction by survivors or migration from unaffected areas is likely to rapidly replenish any losses from permanent zooplankton (Volkman et al., 1994). The Otway is characterised by strong currents which transfer large	No exposure pathway.

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
		volumes of water into and out of the region (Section 6.4.5.1), Studies have shown minimal or transient effects on marine plankton (Volkman et al., 1994). Once background water quality conditions have re-established, the plankton community may take weeks to months to recover due to short generation times (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics	
Invertebrates	No exposure pathway.	The primary modes of exposure for marine invertebrate communities include: Direct exposure to dispersed oil (e.g., physical smothering) from a subsea release of hydrocarbon which remains at the sea floor. Direct exposure to dispersed and non-dispersed oil (e.g., physical smothering) where oil sinks down from higher depths of the ocean Direct exposure to dispersed and non-dispersed oil dissolved in sea water and/or partitioned onto sediment particles. Indirect exposure to dispersed and non-dispersed oil through the food web (e.g., uptake of oiled plankton, detritus, prey, etc.) (NRDA, 2012) Acute or chronic exposure through surface contact and/or ingestion can result in toxicological risks. Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms. Impacts to some adult species (e.g. crustaceans) is reduced as a result of the presence of an exoskeleton, while others with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact population recruitment. If invertebrates are contaminated by hydrocarbons, tissue taint can remain for several months, although taint may eventually be lost. For example, it has been demonstrated that it took 2-5 months for lobsters to lose their taint when exposed to a light hydrocarbon (NOAA, 2002).	No exposure pathway.

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
		Exposure to microscopic oil droplets may also impact aquatic biota either mechanically (especially filter feeders) or act as a conduit for exposure to semi-soluble hydrocarbons (that might be taken up by the gills or digestive tract) (French-McCay, 2009). Toxicity is primarily attributed to water soluble polycyclic aromatic hydrocarbons (PAHs), specifically the substituted naphthalene (C2 and C3) as the higher C-ring compounds become insoluble and are not bioavailable. Other possible impacts from the presence of dispersed and non-dispersed oil include effects of oxygen depletion in bottom waters due to bacterial metabolism of oil (and/or dispersants), and light deprivation under surface oil (NRDA, 2012).	
Fish	No exposure pathway. Since fish and sharks do not generally break the sea surface, the impacts of surface hydrocarbons to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Volkman et al., 1994).	Any pelagic fish and shark species that occupy the water column, specifically within the upper 0 – 10 m of the water column the surface layers of the water column (where in-water hydrocarbon exposure is predicted), are more susceptible to entrained and dissolved hydrocarbons. Fish and sharks can be exposed to in-water hydrocarbon droplets through a variety of pathways, including: Direct dermal contact (e.g. whilst swimming through oil or waters with elevated dissolved hydrocarbon concentrations and other constituents, with diffusion across their gills (Hook et al., 2016)), Ingestion (e.g. directly or via food base, fish that have recently ingested contaminated prey may themselves be a source of contamination for their predators), and Inhalation (e.g. elevated dissolved contaminant concentrations in water passing over the gills). Exposure to hydrocarbons entrained or dissolved in the water column can be toxic to fish. Studies have shown a range of impacts including changes in abundance, decreased size, inhibited swimming ability, changes to oxygen consumption and respiration, changes to reproduction, immune system responses, DNA damage, visible skin and organ lesions and increased parasitism. However, many fish	No exposure pathway.

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
		species can metabolise toxic hydrocarbons, which reduces the risk of bioaccumulation of contaminants in the food web (NRDA, 2012). Sub-lethal impacts in adult fish include altered heart and respiratory rates, gill hyperplasia, enlarged liver, reduced growth, fin erosion, impaired endocrine systems, behavioural modifications and alterations in feeding, migration, reproduction, swimming, schooling, and burrowing behaviour (Kennish, 1996). Fish exposed to aromatics in the water have been shown to have a reduced aerobic capacity, which may be a result of the process to eliminate ingested oil from the fish (Cohen et al., 2005). However, generally these species are highly mobile, and their patterns of movement make it unlikely they will remain in an area long enough to experience sub-lethal impacts (ITOPF, 2010). The exception would be in areas such as reefs and other seabed features where species are less likely to move away into open waters (i.e., site-attached species). Fish are most vulnerable to hydrocarbons during their embryonic, larval and juvenile life stages. Embryos and larvae may sustain mechanical damage to feeding and breathing apparatus from contact with oil droplets, and genetic damage, physical deformities and altered developmental timing from hydrocarbons in water (Fodrie and Heck, 2011). There may also be chronic effects to fish exposed to hydrocarbons in early life stages, such as disruption of predator avoidance behaviour (Hjermann et al., 2007). Eggs and larvae exposed to weathered concentrations of hydrocarbons in water for a prolonged period of time have been shown to be immunosuppressed (Hjermann et al., 2007). Hydrocarbons in the water column can physically affect fish with high site fidelity. When exposed for an extended duration (weeks to months) coating of gills may lead to lethal and sub-lethal effects from reduced oxygen exchange and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or	

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
		contaminated food, leading to reduced growth (Volkman et al., 1994). Studies of impacts on bony fishes report that light, volatile oils are likely to be more toxic to fish. Many studies conclude that exposure to PAHs and soluble compounds are responsible for the majority of toxic impacts observed in fish (e.g., Carls et al., 2008; Ramachandran et al. 2004). Toxicity in adult fish has been reported in response to crude oils, HFO and diesel (Holdway, 2002; Shigenaka, 2011). Uptake of hydrocarbons has been demonstrated in bony fish after exposure to the water-soluble fraction of between 24 and 48 hours. However, large scale fish kills have rarely been observed as a result of hydrocarbon spills (ITOPF, 2011a) (though mortality in aquaculture pens has been reported), which is likely to be because vertebrates can rapidly metabolise and excrete hydrocarbons (Hook et al., 2016). The majority of studies, either from laboratory trials or of fish collected after spill events (including the Hebei Spirit, Macondo, and Sea Empress spills), found evidence of elimination of PAHs in fish tissues returning to reference levels within two months of exposure when subsequently exposed to clean water (Challenger and Mauseth, 2011; Davis et al. 2002; Gagnon and Rawson, 2011; Gohlke et al., 2011; Jung, 2011; Law 1997; Rawson et al., 2011). Recovery of fish assemblages depends on the intensity and duration of an unplanned discharge, the composition of the discharge and whether dispersants are used, as each of these factors influences the level of exposure to potential toxicants. Recovery would also depend on the life cycle attributes of fishes. Species that are abundant, short-lived and highly fecund may recover rapidly. However less abundant, long-lived species may take longer to recover. The range of movement of fishes will also influence recovery. The nature of the receiving environment would influence the level of impact on fishes.	

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
Marine reptiles	Sea turtles are vulnerable to the effects of oil at all life stages—eggs, post-hatchlings, juveniles, and adults in nearshore waters. Several aspects of sea turtle biology and behaviour place them at particular risk (NOAA, 2010a), including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large pre-dive inhalations. Oil exposure affects different turtle life stages in different ways. Turtles may be exposed to chemicals in oil in two ways: Internally – eating or swallowing oil, consuming prey containing oil-based chemicals, or inhaling of volatile oil related compounds Externally – swimming in oil or dispersants, or oil or dispersants on skin and body.		
	Marine turtles make large, rapid inhalations before they dive which may result in inhalation of toxic vapours from hydrocarbons in surface waters (Milton and Lutz, 2003). This can lead to respiratory irritation, inflammation, emphysema or pneumonia (NOAA, 2010a). Ingested oil may cause harm to the internal organs of turtles. Visibly oiled turtles showed higher indicators of polycyclic aromatic hydrocarbons (PAH) in tissues, stomach content, colon content and faeces compared to non-visibly oiled turtles (Ylitalo et al., 2017). This exposure pathway may cause an increase in the production of white blood cells and may affect the functioning of their salt gland (Lutcavage et al., 1995). Oiling has the potential to cause mortality depending on the size of the individual and the extent of oiling (DWH Natural Resource Damage Assessment Trustees, 2016).	Some individual marine reptiles could encounter low, moderate and high in-water hydrocarbon exposure while swimming or feeding. Entrained hydrocarbons can adhere to body surfaces (Gagnon and Rawson 2010) and can enter cavities such as the eyes, nostrils, or mouth. This can cause an elevated susceptibility to infections (NOAA 2010a). Records of oiled wildlife during spills rarely include marine turtles, even from areas where they are known to be relatively abundant (Wallace et al., 2020). An exception to this was the large number of marine turtles collected during the Macondo spill in the Gulf of Mexico, although many of these animals did not show any sign of oil exposure (Stacy, 2012). Of the captured animals, most were later released, suggesting that oiling does not inevitably lead to mortality.	No exposure pathway (no nesting occurs within the EMBA).
Seabirds and shorebirds	Seabirds rafting, resting, diving or feeding within surface hydrocarbons at moderate exposure levels (>10 g/m^2) could experience damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs (ITOPF, 2011a). Birds foraging at sea have the potential to directly interact with oil on the sea surface some considerable distance from breeding sites in the course of normal foraging activities. Species most at risk include those that readily rest on the sea surface (such as shearwaters) and surface plunging species such as terns and boobies. Toxic effects could result where oil is ingested as the bird attempts to preen its feathers (ITOPF, 2011a). The preening process may also	Seabirds could potentially be impacted by in-water hydrocarbon exposure from direct contact whilst diving through the water column foraging, or indirectly, by consuming hydrocarbon-tainted fish, resulting in sub-lethal or toxic impacts. Penguins may be especially vulnerable to oil because they spend a high portion of their time in the water and readily lose insulation and buoyancy if their feathers are oiled. The Iron Baron vessel spill, of 325 tonnes of bunker fuel in Tasmania in 1995, is estimated to have resulted in the death of up to 20,000 penguins (Hook et al., 2016). As seabirds are top order predators, any impact on other marine life (e.g., pelagic fish) from hydrocarbon exposure may disrupt and limit food supply both for	Shorebird species foraging for invertebrates within the intertidal foraging areas, such as exposed sand and mud flats at lower tides, will be at potential risk of both direct impacts through contamination of individual birds (ingestion or soiling of feathers) and indirect impacts through the contamination of foraging areas that may result in a reduction in available prey items (Clarke, 2010). Any direct impact of oil on terrestrial habitats has the potential to contaminate seabirds present at the breeding sites (Clarke, 2010). Bird eggs may also be damaged if an oiled adult sits on the nest. Fresh crude was shown to be more toxic than weathered crude, which had a medial lethal dose of 21.3 mg/egg (Clarke, 2010). Studies of contamination of duck eggs by small quantities

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
	spread oil over otherwise clean areas of the body (ITOPF, 2011a). Whether this toxicity ultimately results in mortality will depend on the amount consumed and other factors relating to the health and sensitivity of the bird. Birds that are coated in oil also suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs. In the case of seabirds, direct contact with hydrocarbons is likely to foul plumage, which may result in hypothermia due to a reduction in the ability of the bird to thermo-regulate and impaired waterproofing (ITOPF, 2011a). A bird suffering from cold, exhaustion and a loss of buoyancy (resulting from fouling of plumage) may dehydrate, drown or starve (ITOPF, 2011; DSEWPaC, 2011a; AMSA, 2013). It may also result in impaired navigation and flight performance (Hook et al., 2016). Increased heat loss as a result of a loss of water-proofing results in an increased metabolism of food reserves in the body, which is not countered by a corresponding increase in food intake, and may lead to emaciation (DSEWPaC, 2011a). The greatest vulnerability in this case occurs when birds are feeding or resting at the sea surface (Peakall et al., 1987). In a review of 45 marine hydrocarbon spills, there was no correlation between the numbers of bird deaths and the volume of the spill (Burger, 1993).	the maintenance of adults and the provisioning of young.	of crude oil, mimicking the effect of oil transfer by parent birds, have been shown to result in mortality of developing embryos (French-McCay, 2009). Shoreline accumulation would be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA, 1995). As breeding activities of shorebirds and seabirds generally occurs above the high tide mark, exposure to hydrocarbons is considered unlikely to occur. However, oiled bird species could track oil into their nests, which may then have subsequent impacts on any eggs present. The little penguin, is the species where this would be the highest risk, as they have to move through the intertidal area to reach nesting sites.
Marine mammals - Cetaceans	Cetaceans may come into contact with surface hydrocarbons when surfacing. However, direct surface oil contact with hydrocarbons is considered to have little deleterious effect on whales, and any effect is likely to be minor and temporary. This may be due to the skin's effectiveness as a barrier to toxicity (Geraci and St Aubin, 1988). Cetaceans have mostly smooth skins with limited areas of pelage (hair covered skin) or rough surfaces such as barnacled skin. Oil tends to adhere to rough surfaces, hair or	Cetaceans exposed to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988). Such impacts are associated with 'fresh' hydrocarbon, the risk of impact declines rapidly as the condensate weathers. Physical impacts from ingested hydrocarbon with subsequent lethal or sub-lethal impacts are possible with entrained oil, however, the susceptibility varies with feeding habits. Baleen whales (such as blue, southern right and humpback whales) are not particularly susceptible to ingestion of oil in the water	No exposure pathway.

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
	calluses of animals, so contact with hydrocarbons by cetaceans is expected to cause only minor hydrocarbon adherence. The inhalation of oil droplets, vapours and fumes may occur if whales' surface in slicks to breathe. Exposure to hydrocarbons in this way could damage mucous membranes, damage airways, or even cause death. Geraci and St Aubin (1988) found little evidence of cetacean mortality from hydrocarbon spills; however, some behaviour disturbance (including avoidance of the area) may occur. While this reduces the potential for physiological impacts from contact with hydrocarbons, active avoidance of an area may disrupt behaviours such as migration, or displace individuals from habitat, such as foraging, resting or breeding areas.	column but are susceptible to oil at the sea surface as they feed by skimming the surface. Oil may stick to the baleen while they 'filter feed' near slicks. Sticky, tar-like residues are particularly likely to foul the baleen plates. Specifically, toothed whales and dolphins may be susceptible to ingestion of dissolved and entrained oil as they gulp feed at depth. There are reports of declines in the health of individual pods of killer whales (a toothed whale species), though not the population as a whole, in Prince William Sound after the Exxon Valdez vessel spill (heavy oil) (Hook et al., 2016). It has been stated that pelagic species will avoid hydrocarbon, mainly because of its noxious odours, but this has not been proven. The strong attraction to specific areas for breeding or feeding (e.g., use of the Warrnambool coastline as a nursery area for southern right whales) may override any tendency for cetaceans to avoid the noxious presence of hydrocarbons. Dolphin populations from Barataria Bay, Louisiana, USA, which were exposed to prolonged and continuous oiling from the Macondo oil spill in 2010, had higher incidences of lung and kidney disease than those in the other urbanised environments (Hook et al. 2016). The spill may have also contributed to unusually high perinatal mortality in bottlenose dolphins (Hook et al., 2016). As highly mobile species, in general it is very unlikely that cetaceans will be exposed to concentrations of hydrocarbons in the water column for continuous durations that would lead to chronic toxicity effects.	
Marine mammals - Pinnipeds	Pinnipeds are vulnerable to sea surface exposures given they spend much of their time on or near the surface of the water. They need to surface every few minutes to breathe and regularly haul out on to beaches. Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. As a result of exposure to surface	Pinnipeds are sensitive to in-water hydrocarbon exposure as they will stay near established colonies and haul-out areas, meaning they are less likely to practice avoidance behaviours. This is corroborated by Geraci and St. Aubin (1988) who suggest seals, sea- lions and fur-seals have been observed swimming in oil slicks during a number of documented spills.	Pinniped breeding colonies may be sensitive to hydrocarbon spills. Following the Iron Baron oil spill (in Tasmania 1995) nearby seal colonies were monitored. The report concluded that reduced pup production was evident on islands close to the spill, but not evident on islands more distant (Pemberton, 1999).

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
	oils, pinnipeds, with their relatively large, protruding eyes are particularly vulnerable to effects such as irritation to mucous membranes that surround the eyes. Irritation may also occur to mucous membranes that line the oral cavity, respiratory surfaces, and anal and urogenital orifices. Hook et al. (2016) reports that seals appear not to be very sensitive to contact with oil, but instead to the toxic impacts from the inhalation of volatile components. For some pinnipeds, fur is an effective thermal barrier because it traps air and repels water. Petroleum stuck to fur reduces its insulative value by removing natural oils that waterproof the pelage. Consequently, the rate of heat transfer through fur-seal pelts can double after oiling (Geraci and St. Aubin, 1988), adding an energetic burden to the animal. Kooyman et al. (1976) suggest that fouling of approximately one-third of the body surface resulted in 50% greater heat loss in fur-seals immersed in water at various temperatures. Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water. However, pinnipeds other than fur-seals are less threatened by thermal effects of fouling, if at all. Oil has no effect on the relatively poor insulative capacity of sea-lion and bearded and ringed seal pelts, and oiled Weddell seal samples show some increase in conductance (Oritsland 1975; Kooyman et al., 1976; 1977). ITOPF (2011a) demonstrates that species that rely on fur to regulate their body temperature (such as fur-seals) are most vulnerable to oil, as the animals may die from hypothermia or overheating, depending on the season, if the fur becomes matted with oil. It is reported that most pinnipeds scratch themselves vigorously with their flippers and do not lick or groom themselves, so are less likely to ingest oil from skin surfaces (Geraci and St.	Hydrocarbons within the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds.	

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
	Aubin 1988). However, mothers trying to clean an oiled pup may ingest oil. Ingested hydrocarbons can irritate or destroy epithelial cells that line the stomach and intestine, thereby affecting motility, digestion and absorption. However, pinnipeds have been found to have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt, 1982; Addison and Brodie 1984; Addison et al. 1986). Geraci and St. Aubin (1988) suggest that a small phocid weighing 50 kg might have to ingest approximately 1 L of oil to be at risk. Volkman et al. (1994) report that benzene and naphthalene ingested by seals is quickly absorbed into the blood through the gut, causing acute stress, with damage to the liver considered likely. If ingested in large volumes, hydrocarbons may not be completely metabolised, which may result in death. Poisoning from ingestion of hydrocarbons may lead to reduced foraging and reproductive fitness or mortality (DSEWPAC, 2013d).		
Conservation values and sensitivities			
Protected areas	Impacts to coastal habitats, marine fauna and protected areas as discussed in rows above. Injury / mortality or behavioural disruption to marine fauna. Death or impairment of habitats within protected areas. Reduction in the quality of the marine environment within protected areas. Environmental value of protected areas is degraded.	Impacts to benthic habitats, marine fauna and protected areas as discussed in rows above. Injury / mortality or behavioural disruption to marine fauna. Death or impairment of habitats within protected areas. Reduction in the quality of the marine environment within protected areas. Environmental value of protected areas is degraded.	Impacts to benthic and coastal habitats, marine fauna and protected areas as discussed in rows above. Injury / mortality or behavioural disruption to marine fauna. Death or impairment of habitats within protected areas. Reduction in the quality of the marine environment within protected areas. Environmental value of protected areas is degraded.
Socio-economic environment			
Coastal settlements, commercial	Impacts to coastal habitats, marine fauna and protected areas as discussed in rows above.	Impacts to benthic habitats, marine fauna and protected areas as discussed in rows above.	Impacts to benthic and coastal habitats, marine fauna and protected areas as discussed in rows above.

Receptors	Surface	In-water (Dissolved & Entrained)	Shoreline
fisheries, other offshore industry, recreation and tourism	Possible disruption to tourism, recreation, coastal settlements or other offshore industries. Possible reduction in resource available for commercial and recreational fisheries.	Possible disruption to tourism, recreation, coastal settlements or other offshore industries. Possible reduction in resource available for commercial and recreational fisheries.	Possible disruption to tourism, recreation, coastal settlements or other offshore industries. Possible reduction in resource available for commercial and recreational fisheries.
Cultural environment			
Underwater cultural heritage, indigenous heritage	Impacts to coastal habitats, marine fauna and protected areas as discussed in rows above. Possible degradation of underwater cultural heritage or indigenous heritage sites and values. Possible disruption to ability to continue conducting traditional cultural practices.	Impacts to benthic habitats, marine fauna and protected areas as discussed in rows above. Possible degradation of underwater cultural heritage or indigenous heritage sites and values. Possible disruption to ability to continue conducting traditional cultural practices.	Impacts to benthic and coastal habitats, marine fauna and protected areas as discussed in rows above. Possible degradation of underwater cultural heritage or indigenous heritage sites and values. Possible disruption to ability to continue conducting traditional cultural practices.

9.5.5.1 Impact: Change in Water Quality

Inherent Consequence Evaluation

An accidental release of MDO into the marine environment will result in a change in water quality. MDO is classified as a light persistent hydrocarbon (Group II hydrocarbon), containing a high proportion of volatile components and only a small proportion of non-volatile (persistent) components.

Under favourable evaporation conditions, approximately 36% of the released MDO is anticipated to evaporate from the water surface within the first 24 hours, with a further 54% evaporating over several days, leaving approximately 10% remaining as persistent (see Section 9.5.3.3). Whereas in the presence of moderate to strong winds (>12 knots) and breaking waves, MDO has a strong tendency to entrain within the upper water column, leaving a small proportion remaining on the water surface (see Section 9.5.3.3). High proportions of entrained hydrocarbons reduce the proportion being evaporated; however, it also increases the rates of hydrocarbon decay when mixed in the water column. Entrained hydrocarbon will often remain in the upper water column until conditions are calm then will float to the surface and reform as a slick.

Given the nature of the hydrocarbon, the forecasted weathering processes, and the offshore metocean conditions, the area of exposure following a spill event is anticipated to be localised and short-term. The water quality of the area exposed to hydrocarbons is expected to return to pre-spill conditions relatively rapidly. Long-term adverse impacts to the water quality are not anticipated. Matters relating to potentially impacted receptors from a change in water quality within the exposed area are discussed for the specific receptors below.

Therefore, the predicted level of impact, i.e., the consequence of a change in water quality from an accidental release of MDO is evaluated as **Level 2**.

9.5.5.2 Risk: Change in Habitat

Inherent Consequence Evaluation

A release of hydrocarbons into the marine environment has the potential to impact shoreline habitats, from shoreline accumulation resulting in toxins accumulating within the shoreline habitat or intertidal area, and adversely impacting receptors. A surface release of MDO following a vessel collision is not anticipated to impact the seabed environment, as any in-water hydrocarbon exposure (dissolved and entrained) will remain with the 0–10 m water depths of the water column, therefore only coastal habitats have been assessed.

A moderate shoreline accumulation threshold has been identified as the threshold that would potentially harm the fauna which inhabit these habitats (i.e. shorebirds, marine invertebrates, and marine reptiles) based on studies for sub-lethal and lethal impacts (French et al., 1996 and French-McCay, 2009). However, certain habitat types can be important socio-economically, therefore, risk assessment often use the conservative low threshold of shoreline accumulation (10 g/m^2) to assess impacts to shoreline habitats.

The probability of shoreline accumulation at or above the low exposure was approximately 60%, with shoreline contact at this threshold anticipated within 22 hours for the worst-case credible modelled scenario (RPS, 2023a). The maximum total volume ashore for a single spill trajectory was 43.2 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 32 km, 11 km and 1 km, respectively. The shoreline at Corangamite recorded the highest maximum probability of shoreline loading (47% at the low threshold) and the highest potential volume onshore (43.1 m^3).

Habitats that may be impacted by an accidental release of MDO following a vessel collision include:

- Rocky shorelines
- Sandy beaches
- Mangroves
- Saltmarshes

- Macroalgae
- Seagrass.

Table 9-22 provides details on the presence of habitats within the area exposed to MDO at the Ecological EMBA for MDO, the potential impact and the resulting inherent consequence level for each type.

Table 9-22: Inherent Consequence Levels – Accidental release of MDO – Change in Habitat

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
Shorelines - Rocky	The modelling predicted the maximum probability of shoreline loading at or above the moderate exposure was approximately 28% with shoreline contact at this threshold anticipated within 1 day for the worst-case credible modelled scenario (RPS, 2023a). The modelling also predicted rapid evaporation during the first 24 hours following the release of MDO, and depending on the weather conditions (i.e. wind speeds) the remainder of the MDO is predicted to readily entrain into the water column (more entrainment under higher wind speeds) (Section 9.5.3.3).	Rocky shorelines provide habitat for marine invertebrates (e.g., sea anemones, sponges, sea-squirts, molluscs) (Section 6.5.2.1). The impact of hydrocarbon on any organism depends on the toxicity, viscosity and amount of hydrocarbon, the sensitivity of the organism and the length of time it is exposed to the hydrocarbon. In general, MDO is not a sticky or viscous hydrocarbon, and therefore, will often wash off surfaces if exposed to tidal action. Marine invertebrate communities exposed to hydrocarbon are less likely to result in long-term damage, with communities shown to recover within 2 or 3 years (IPIECA, 1995). Due to the highly volatile nature of MDO, the actual area of exposure for an individual spill event will be relatively small, and exposure is expected to be temporary with only a very small residual component. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function.	Level 3

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
Shorelines - Sandy	Sandy shorelines are the dominant shoreline type along the Victoria coastline where hydrocarbons will come into contact in the unlikely event that they are released into the marine environment. The maximum length of shoreline impacted at the moderate threshold was 10 km, with a maximum peak volume ashore of 43.1 m^3 – both at the Corangamite LGA (RPS, 2023a). Therefore, sandy beaches have the potential to be exposed to hydrocarbons at, or above the low, moderate, and high threshold (RPS, 2023a).	Sandy beaches may provide habitat for a diverse assemblage of infauna including nematodes, copepods, polychaetes, and macroinvertebrates (e.g., crustaceans) (see Section 6.5.2.1). In the event of shoreline accumulation, MDO may penetrate the porous sediments and become buried. Due to proximity to shore (~8 km) from the Annie-2 release location, a release of MDO may reach the shoreline prior to it completely weathering and consequently impacts to shorelines may occur. However, NOAA (2014) note that as MDO is readily and completely degraded by naturally occurring microbes, it could be expected to disappear from shorelines within one to two months. The actual area of exposure for an individual spill event will be relatively small, with only a very small residual component having the potential to impact shorelines, due to the highly volatile nature of the MDO. Furthermore, due to the hydrocarbon characteristics of MDO being a light non-persistent hydrocarbon, MDO on certain shorelines, such as sandy shorelines, may easily by washed off in the presence of tidal and/or wave action. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to habitats of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Mangroves	Mangroves are not a dominant habitat found within the area potentially exposed to hydrocarbons. However, a few isolated patches of mangroves can be found along the Victorian coastline, predominantly with inlets or bay (Section 6.5.2.2). These mangroves have the potential to be exposed to hydrocarbons within the Ecological EMBA (MDO) (RPS, 2023a).	Mangroves are considered to have a high sensitivity to hydrocarbon exposure. Hydrocarbons can be deposited on the aerial roots and sediment surface by tidal action (IPIECA, 1993; NOAA, 2014). Physical smothering of aerial roots by hydrocarbons can block the trees' breathing pores used for oxygen intake and result in the asphyxiation of sub-surface roots (IPIECA, 1993). Heavy or viscous oil, or emulsification, can kill mangroves via this process. Mangroves can also take up hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death (Wardrop et al., 1987). Acute impacts to mangroves can be observed within weeks of exposure, whereas chronic impacts may take months to years to detect. Given the non-viscous nature of MDO, impacts are expected to be limited to the volatile component of the hydrocarbon, however given their sensitivity to hydrocarbons, the potential consequence to mangroves is assessed to conservatively based on the potential for localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.	Localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function.	Level 3

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
Saltmarsh	Saltmarshes may potentially be exposed to hydrocarbons in the event of shoreline accumulation following a loss of containment from a vessel collision. Saltmarsh habitats are present within estuaries, inlets, and riverine systems in many parts along the Victorian coast (Section 6.5.2.3). The saltmarsh habitats identified by the modelling to be exposed to shoreline accumulated include subtropical and temperate saltmarsh TECs.	Saltmarshes are generally considered to be highly sensitive to hydrocarbon exposure due to the low tidal and wave action restricting hydrocarbon degradation. Hydrocarbon can enter saltmarsh systems during the tidal cycles if the estuary/inlet is open to the ocean, and will readily adhere to the marshes, coating the stems from tidal height to sediment surface. Oil (in liquid form) will readily adhere to the marshes, coating the stems from tidal height to sediment surface. Heavy oil coating is unlikely due to the highly volatile nature of the hydrocarbon. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function.	Level 3
Macroalgae	Macroalgae may be present within areas predicted to be exposed to in-water hydrocarbons. In-water hydrocarbon exposure in nearshore, intertidal, and subtidal areas is predicted to occur at moderate thresholds for dissolved hydrocarbons, with some sites of macroalgae (RPS, 2023a). However, it is not a dominant habitat feature within the Ecological EMBA (MDO) (Section 6.5.2.4)	Macroalgal systems are an important source of food and shelter for many ocean species; including in their unattached drift or wrack forms (McClatchie et al., 2006). The physical effects of smothering, fouling and asphyxiation has been documented from oil contamination in marine plants (Blumer 1971; Cintron et al., 1981). Reported toxic responses to hydrocarbons have included a variety of physiological changes to enzyme systems, photosynthesis, respiration, and nucleic acid synthesis (Lewis and Pryor, 2013). In macroalgae, oil can act as a physical barrier for the diffusion of CO_2 across cell walls (O'Brien and Dixon, 1976). Given the restricted range of exposure (shallow nearshore and intertidal waters only) and the predicted lower concentrations of hydrocarbons that could reach these waters, any impact to macroalgae is not expected to result in long-term or irreversible damage. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to habitats of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Seagrass	Seagrasses may be present within the Ecological EMBA (MDO) (Section 6.5.2.5).	Seagrass meadows are important in stabilising seabed sediments, and providing nursery grounds for fish and crustaceans, and a protective habitat for the juvenile fish and invertebrates species (Huisman, 2000; Kirkman, 1997). There is the potential that exposure could result in sub-lethal impacts, more so than lethal impacts, possibly because much of seagrasses' biomass is underground in their rhizomes (Zieman et al., 1984). Given the restricted range of exposure (shallow nearshore and intertidal waters only) and the predicted low concentrations of	Localised short-term impacts to habitats of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
		hydrocarbons expected to be in these waters, any impact to seagrass is not expected to result in long-term or irreversible damage. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		

Summary

The potential consequence to habitats from an accidental release of MDO is assessed to be Level 3 based on the potential for localised medium-term impacts to species or habitats of recognised conservation value or to local ecosystem function.

Inherent Likelihood

A LOC from a petroleum industry vessel following a collision is uncommon. AMSA's Annual Report 2021-22 of serious pollution incidents within the marine environment (Level 2 or higher) identified only two shipping incidents which had been reported within the last four years from marine operations (AMSA, 2022), with neither related to the petroleum industry.

Cooper Energy has been operating facilities in the Otway for ~10 years and has utilised a variety of vessels and MODU in the region during that time with no vessel collisions or associated LOCs. The risks associated with vessel collision are considered well understood. In addition, control measures, such as navigational aids and exclusion zones, will be adopted by the East Coast Project, further reducing the likelihood of a vessel collision resulting in a LOC of MDO.

Due to the nature of this activity, the control measures that will be implemented, and based on previous occurrences, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of a vessel collision (MDO) causing a change to water quality is considered **Unlikely (D).**

Inherent Risk Severity

The inherent risk severity of an accidental release of MDO causing impacts to habitat is considered **Moderate**.

9.5.5.3 Risk: Change in Fauna Behaviour

Inherent Consequence Evaluation

An accidental release of MDO into the marine environment has the potential to impact the behaviour of certain marine fauna within the environment. Marine fauna that has been shown to exhibit changes to behaviour include:

- Fish and Sharks
- Seabirds and Shorebirds
- Marine Reptiles
- Marine Mammals (including pinnipeds and cetaceans).

Table 9-23 describes the presence of marine fauna within the Ecological EMBA (MDO), the potential impact and the resulting inherent consequence level for each type.

Table 9-23: Inherent Consequence Levels - Accidental release of MDO - Change in Fauna Behaviour

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
Fish	Several fish species may be present within the Ecological EMBA (MDO) (see Section 6.5.5 for all EPBC-listed fish species). BIAs identified within the Ecological EMBA (MDO) are: • Distribution BIA for the white shark; and foraging BIA for entrained exposure only.	Multiple fish species are listed on the EPBC Act PMST were identified to occur within the Ecological EMBA (MDO) (Section 6.5.5). Since fish and sharks do not generally break the sea surface, the risk from hydrocarbon spills is more likely to occur from entrained and dissolved hydrocarbon components. A release of hydrocarbon within the marine environment may cause behavioural modifications and alterations in feeding and/or migration patterns as fish and shark species attempt to avoid an area impacted by a spill (Kennish, 1996). However, generally these species are highly mobile species, and their patterns of movements makes it unlikely for them to remain within the area long enough to be exposed to hydrocarbons to experience sub-lethal impacts (ITOPF, 2010). Furthermore, the modelling predicted that majority of the MDO would evaporate within a few days following a release (see Section 9.5.3.3); therefore, reducing the potential of exposure to fish species that may be present within the EMBA. White sharks have been shown to routinely move between surface and to depths or >30 m, and in offshore regions can spend most of their time near the seafloor (DSEWPaC, 2012), thus decreasing the chance of exposure. Pelagic species, such as white sharks, and other fish species identified within the EMBA, are generally highly mobile, with wide-spread distribution ranges. Therefore, these species are not likely to be severely impacted from the temporary avoidance that may occur following a spill event. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Seabirds and shorebirds	Several threatened, migratory and/or listed marine species have the potential to be rafting, resting, diving and feeding within the area predicted to be contacted by surface hydrocarbons. The area potentially at risk from floating and/or shoreline exposure includes known foraging habitats for shoreline and migratory	The presence of birds within surface hydrocarbons at moderate exposure levels is expected to be limited to foraging individuals of a transitory nature, given the absence of offshore aggregation areas in the area. Furthermore, the actual area of exposure for an individual spill event being relatively small compared to the typically large foraging area, with exposure shown to be transient and temporary due to the influence of waves, currents and weathering processes.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
	bird species, such as albatross, petrels and shearwater species (some with associated BIAs) (Section 6.5.7). Several threatened, migratory and/or listed marine seabirds or shorebirds species may be present within the Ecological EMBA (Section 6.5.7). Several foraging BIAs for several albatross, shearwater and petrel species was identified within the Ecological EMBA (MDO). • Antipodean albatross • Wandering albatross • Buller's albatross • Indian yellow-nosed albatross • Shy albatross • Campbell albatross • Black-browed albatross • Common diving-petrel • White-faced storm-petrel • White-tailed shearwater • Short-tailed shearwater • Australasian gannet. Breeding BIAs were also identified within the Ecological EMBA: • Short-tailed shearwater • Wedge-tailed shearwater.	Seabirds exposed to surface hydrocarbons at moderate exposure levels may experience acute or chronic toxicity impacts, however the area of contact is localised (i.e., areas of concentrations >10 g/m^2 out to 10.3 km) and temporary (~18 hrs) due to the rapid weathering of the MDO. Therefore, impacts to these species are not anticipated to be long-term, or affect population functioning. Shoreline accumulation following a spill event from a vessel collision, or the associated spill response activities, may cause disruption to foraging habitats for shorebirds and migratory birds (see Section 6.5.7), which predominantly occur along the shoreline. Shoreline impacts are not anticipated to impacts areas above the high tide mark, therefore, will not impact breeding areas identified within the Ecological EMBA (MDO). See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		
Marine reptiles	There may be marine turtles in the area predicted to be exposed to surface hydrocarbons at moderate exposure levels. However, there are no BIAs or habitat critical to the survival of the species within this area. Four EPBC listed marine turtle species were identified to be present within the Ecological EMBA (MDO);	Marine turtles which are within the area could be displaced by a release of MDO into the marine environment. The area exposed by moderate levels of surface hydrocarbons from a vessel collision event is limited to offshore open waters (10.3 km from the release site) over a maximum period of 18 hours. However, there are no BIAs or habitat critical to the survival of species within the shoreline or environment potentially affected (Section 6.5.6).	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
	these include: loggerhead, green, leather back and hawksbill turtle (Section 6.5.6). Marine turtles may be exposed to hydrocarbon when transiting through the in-water hydrocarbons, surfacing to breathe within the surface slick, or nesting on oiled shorelines.	See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		
Marine mammals - Pinnipeds	There may be pinnipeds in the area predicted to affected by surface hydrocarbons at moderate exposure levels (Section 6.5.8). Pinnipeds that are present within the ecological EMBA (MDO) have the potential to be impacted by surface hydrocarbons when surfacing to breathe, in-water hydrocarbons when transiting through the area, and shoreline accumulated hydrocarbons that occur at haul-out sites along the coastline. No BIAs for pinnipeds were identified within the Ecological EMBA (MDO).	Pinnipeds, such as the Australian sea lion, and the New Zealand and Australian fur-seals, which occur within Victoria and Tasmania may be impacted by shoreline accumulation resulting in a displacement from haul-out sites or entrained and dissolved hydrocarbons affecting movement through the affected area. Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water. Breeding colonies may be sensitive to hydrocarbon spills in the event of shoreline accumulation. Individual adults may also be impacted by oil whilst transiting through the nearshore environments at haul-out sites that may be impacted from the spill event. However, impacts to pinnipeds at a population level are considered very unlikely given the localised and temporary presence of hydrocarbons at relevant thresholds, the absence of haul out sites within or near the operational area, the transient, highly mobile nature of pinnipeds, over typically extensive foraging grounds. There are no BIAs or habitat critical to survival of species within the EMBAs. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised medium-term impacts to species of recognised conservation value but not affecting local ecosystem functioning.	Level 3

Receptor	Presence within Ecological EMBA (MDO)	Potential impact	Description of consequence	Inherent consequence
Marine mammals - Cetaceans	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the Ecological EMBA (Section 6.5.8). The following BIAs are within the area exposed to hydrocarbons at moderate exposure levels (Ecological EMBA): • Pygmy blue whale known foraging and distribution BIA • Southern right whale migration and reproduction BIAs.	A MDO spill could disrupt natural behaviours and displace animals. Geraci (1988) found little evidence of cetacean mortality from hydrocarbon spills; however, some behaviour disturbance (including avoidance of the area) may occur. Active avoidance of an area may disrupt behaviours such as migration, or displace individuals from areas where they are foraging, resting or breeding. Certain whales, particularly those with coastal migration and reproduction, can display strong site fidelity to specific resting, breeding and feeding habitats, as well as to their migratory paths, subsequently these species may be affected more. However, the potential extent of hydrocarbon exposure is significantly smaller than the extent of the BIAs for each species and their much broader range. Cetaceans are highly mobile, pelagic species, with wide-spread distribution ranges, therefore, it is unlikely that individuals will be severely impacted from the temporary displacement that may occur following a spill event. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

<u>Summary</u>

The potential consequence to marine fauna from an accidental release of MDO event is assessed as Level 3 based on the potential for localised medium-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.

Inherent Likelihood

Due to the nature of this activity, the adopted control measures, and limited previous occurrences, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of a vessel collision (MDO) causing **Level 3** consequences to marine fauna behaviour is considered **Unlikely (D)**.

Inherent Risk Severity

The inherent risk severity of a vessel collision (MDO) causing impacts to fauna behaviour is considered **Moderate**.

9.5.5.4 Risk: Injury/Mortality to Fauna

An accidental release of MDO into the marine environment has the potential to result in injury and/or mortality to marine fauna within the vicinity. In general, moderate thresholds of surface and moderate to high of in-water hydrocarbons (dissolved and entrained) have been shown to cause sub-lethal and lethal ecological impact (French et al., 1996 and French-McCay, 2009). The marine fauna that may be present within the Ecological EMBA and impacted by an unplanned release of MDO include:

- Plankton
- Invertebrates
- Fish
- Seabirds and Shorebirds
- Marine reptiles
- Marine mammals

Table 9-24 provides details on the presence of receptors within the Ecological EMBA (MDO), the potential impact and the resulting inherent consequence level for each type.

Table 9-24: Inherent Consequence Levels – accidental release of MDO – Injury/mortality Fauna

Receptor	Presence within moderate threshold	Potential impact	Description of consequence	Inherent consequence
Plankton	Plankton is found in nearshore and open waters in the water column. Plankton population distributions are expected to be highly variable both spatially and temporally and are likely to comprise characteristics of tropical, southern Australian, central Bass Strait and Tasman Sea populations (Section 6.5.3). Therefore, plankton populations may be present within the area potentially exposed to hydrocarbons in the Ecological EMBA (MDO).	Injury/mortality to planktonic species may occur due to a change in water quality following an unplanned hydrocarbon release (see Section 9.5.5.1 for further details on a change to water quality). Plankton are widely dispersed throughout the water column, although exposure is predicted to occur within the 0-10 m water depth, where plankton are most abundant. Effects will be greatest in the area close to the spill source where hydrocarbon concentrations are likely to be highest. These organisms migrate vertically through the water column to feed in surface waters at night (NRDA, 2012). As they move close to the sea surface it is possible that they may be exposed to surface hydrocarbons, however, the potential impacts from in-water exposure (dissolved or entrained) will be greater. Entrained MDO could intersect the Bonney Upwelling KEF, however, only at the low threshold (8% probability of exposure) (RPS, 2023a). While a spill would not affect the upwelling itself, if the spill occurs at the time of an upwelling event, it may result in higher levels of krill being exposed to low (effects) level entrained phase MDO. Species which feed on the krill, such as the pygmy blue whales, may suffer from reduced prey. However, these impacts would be expected to be localised and temporary. MDO has higher toxicity levels when initially release due to the presence of the volatile components (Di Toro et al., 2007), however, with rapid weathering expected, this toxicity decreases. Furthermore, the actual area of exposure is expected to be extremely localised and temporary due to the influence of waves, currents and weathering processes. Once background water quality is re-established, plankton has been shown to take weeks to months to recover (ITOPF, 2011b), therefore long-term impacts are not anticipated. Due to the hydrocarbon characteristics, expected weathering and fate of MDO, the relatively quick recovery times of plankton, unplanned releases of MDO are not expected to have a substantial adverse effect on plankton life cycle and spatial distribution and therefore unlikely to affect populations at the regional scale or affect local ecosystem functioning. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2

Receptor	Presence within moderate threshold	Potential impact	Description of consequence	Inherent consequence
Invertebrates	Marine invertebrate species, such as crustaceans, molluscs, cnidarians, and porifera, including commercially important species, may be present within the area exposed to hydrocarbons. Impacts by direct contact with hydrocarbon is only expected to potentially occur within the 0-10 m section of the water column and shallow coastal areas of the EMBA, where the highest diversity of invertebrate species is found, given the surface nature of the spill and the water depths throughout much of the Ecological EMBA (MDO). Sediment sampling by Parry et al. (1990) in shallow in-shore water also demonstrated high diversity, although patchy distribution, within shallow waters, with crustaceans, polychaetes and molluscs being the dominant species (Section 6.5.4).	Exposure in nearshore and intertidal areas is predicted to occur at low thresholds of dissolved and entrained, moderate thresholds of dissolved, with some sites predicted to be exposed to high thresholds of entrained for the worst-case scenario modelled. No exposure at high thresholds was predicted for dissolved in-water hydrocarbons from either scenario (RPS, 2023a). Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms. Impacts to some adult species (e.g., crustaceans) is reduced as a result of the presence of an exoskeleton, while others with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact population recruitment. Filter-feeding benthic invertebrates such as sponges, bryozoans, abalone and hydroids may be exposed to sub-lethal impacts, however, population level impacts are considered unlikely. Tissue taint may occur and remain for several months in some species (e.g., lobster, abalone) however, this will be localised and low level with recovery expected. In-water invertebrates of value have been identified to include squid, crustaceans (rock lobster, crabs) and molluscs (scallops, abalone). Several commercial fisheries for marine invertebrates are within the area predicted to be exposed (Section 6.5.4). See Section 9.5.5.5 for the consequence evaluation to commercial fisheries. Water quality in benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within weeks to months of contact. Due to the hydrocarbon characteristics of the MDO and the well-mixed nature of the waters, coating of benthic assemblages and prolonged exposure to hydrocarbons is considered highly unlikely. At this threshold, there may be ecological impacts to benthic assemblages stranded on the shoreline. However, wave action at the shoreline will rapidly disperse and weather the hydrocarbons naturally. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within moderate threshold	Potential impact	Description of consequence	Inherent consequence
Fish	Several fish species may be present within the Ecological EMBA (MDO) (Section 6.5.5). BIAs identified within the Ecological EMBA (MDO) are: • Distribution BIA for the white shark; and foraging BIA for entrained exposure only.	Pelagic fish and shark species that occupy the water column, specifically the surface layers of the water column (where in-water hydrocarbon exposure is predicted to be highest), are more susceptible to entrained and dissolved hydrocarbons. Pelagic free-swimming fish and sharks are unlikely to suffer long-term damage from hydrocarbon spill exposure because dissolved/entrained hydrocarbons in water are not expected to be sufficient to cause harm (ITOPF, 2010). Impacts on fish eggs and larvae entrained in the upper water column are not expected to be significant given the temporary period of water quality impairment, and the limited areal extent of the spill. As egg/larvae dispersal is widely distributed in the upper layers of the water column it is expected that current induced drift will rapidly replace any hydrocarbon affected populations. Since fish and sharks do not generally break the sea surface, the impacts of surface hydrocarbons to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Volkman et al., 2004). See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Seabirds and shorebirds	Several threatened, migratory and/or listed marine seabirds or shorebirds species may be present within the area exposed to MDO (Section 6.5.7). There are several seabird BIAs identified within the Ecological EMBA (MDO), however, these species are oceanic, not shoreline foragers. No habitat critical to the survival of the species have been identified (Section 6.5.7). Several foraging BIAs for several albatross, shearwater and petrel species was identified within the Ecological EMBA (MDO). • Antipodean albatross • Wandering albatross	Birds have the potential to be rafting, resting, diving and feeding within the area predicted to be contacted by surface hydrocarbons; diving or foraging within in-water hydrocarbons; and foraging and nesting within shoreline exposure. The presence of birds within in-water hydrocarbons at moderate exposure levels is expected to be limited, due to the transitory nature of foraging individuals, and given the absence of offshore aggregation areas in the area. Breeding birds may be impacted via contamination of breeding sites, including contamination of eggs by contaminated adults (Clarke, 2010). Direct hydrocarbon contamination of nesting sites is considered unlikely as hydrocarbons would typically accrue within the upper swash zone, and nests would occur above this level on a beach. However, exposed fauna may track hydrocarbon into their nests, which may then have subsequent impacts on any eggs present.	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.	Level 2

Receptor	Presence within moderate threshold	Potential impact	Description of consequence	Inherent consequence
	• Buller's albatross • Indian yellow-nosed albatross • Shy albatross • Campbell albatross • Black-browed albatross • Common diving-petrel • White-faced storm-petrel • White-tailed shearwater • Short-tailed shearwater • Australasian gannet. Breeding BIAs were also identified within the Ecological EMBA: • Short-tailed shearwater • Wedge-tailed shearwater.	This would be more of a risk for fauna, such as the Little Penguin, that must traverse the intertidal area to reach nesting sites. There are no known breeding locations for penguins along the Otway mainland coast at risk of shoreline hydrocarbon accumulation. In addition, shoreline accumulation will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA, 1995). As breeding activities of shorebirds and seabirds generally occurs above the high tide mark, exposure to hydrocarbons is considered unlikely to occur. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		
Marine reptiles	There may be marine turtles in the area predicted to be exposed to hydrocarbons. Injury/mortality to species may occur due to a change in water quality following an unplanned hydrocarbon release relevant exposure levels. However, there are no BIAs or habitat critical to the survival of the species within this area. Four of the five EPBC listed species which have the potential to be present within the area were identified to be present within the Ecological EMBA (MDO), these include: loggerhead, green, leather back and hawksbill turtle (Section 6.5.6).	Marine turtles may be exposed to hydrocarbon when transiting through the in-water hydrocarbons, surfacing to breathe within the surface slick, or nesting on oiled shorelines. The area exposed by moderate levels of surface hydrocarbons from a vessel collision event is limited to offshore open waters (10.3 km from the release site) over a maximum period of 18 hours. The number of marine turtles that may be exposed to hydrocarbons during a LOWC event is expected to be low due to the localised and temporary presence of hydrocarbons at moderate exposure levels, the low number of turtles foraging or migrating through Bass Strait in general, and the absence of BIAs or habitat critical to the survival of the species within this area. The potential impact would be limited to individual transiting marine turtles, with population impacts not anticipated. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within moderate threshold	Potential impact	Description of consequence	Inherent consequence
Marine mammals - Pinnipeds	There may be pinnipeds, such as the Australian sea lion, and the New Zealand and Australian fur-seals, within the spatial extent of moderate threshold. No BIAs or habitat critical to survival of species for pinnipeds were identified within the environment potentially affected (Section 6.5.8).	Pinnipeds that are present within the area exposed to hydrocarbons have the potential to be impact by surface hydrocarbons when surfacing to breathe, in-water hydrocarbons when transiting through the area, and shoreline accumulated hydrocarbons that occur at haul-out sites along the coastline. Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. Oiling of pinnipeds can lead to hypothermia if the fur is affected, or poisoning if oil is ingested, resulting in reduced foraging and reproductive fitness or death (DSEWPaC, 2013). The area exposed by moderate levels of surface hydrocarbons from a vessel collision event is limited to offshore open waters (10.3 km from the release site within the operational area) over a maximum period of 18 hours. Hydrocarbons within the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds. Given condensate is considered a light hydrocarbon that rapidly evaporates, the absence of BIAs within the impacted area and the transient, highly mobile nature of the species, over typically extensive foraging grounds; impacts to pinnipeds at a population level are considered very unlikely. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.	Level 3
Marine mammals - Cetaceans	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the EMBA. The following BIAs are within the Ecological EMBA (MDO) exposed to surface hydrocarbons: • Pygmy blue whale known foraging and distribution BIA • Southern right whale migration and reproduction BIAs.	Cetacean exposure to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin 1988). Such impacts are associated with 'fresh' hydrocarbon; the risk of impact declines rapidly as the MDO weathers. Geraci (1988) found little evidence of cetacean mortality from hydrocarbon spills. The area exposed by moderate levels of surface hydrocarbons from a vessel collision event is limited to offshore open waters (10.3 km from the release site within the operational area) over a maximum period of 18 hours. No surface exposure at the high threshold was modelled for any scenario (RPS, 2023a). Inhalation of surface hydrocarbons could damage mucous membranes, damage airways, or even cause death. Furthermore, ingestion of contaminated prey could cause toxic impacts. Cetaceans exposed to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988).	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.	Level 2

Receptor	Presence within moderate threshold	Potential impact	Description of consequence	Inherent consequence
		Physical impacts from ingested hydrocarbon with subsequent lethal or sub-lethal impacts are possible with entrained oil. As highly mobile species, in general it is very unlikely that cetaceans will be constantly exposed to concentrations of hydrocarbons in the water column for continuous durations (e.g., >96 hours) that would lead to chronic toxicity effects. Physical contact by individual whales of MDO is unlikely to lead to any long-term impacts. Given the mobility of whales, only a small proportion of the population would surface in the affected areas, resulting in short-term and localised consequences, with no long-term population viability effect. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		

Summary

The potential consequence to marine fauna from an accidental release of MDO event is assessed as Level 3 based on the potential for localised and medium-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.

Inherent Likelihood

Due to the nature of this activity, the adopted control measures, and limited previous occurrences, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of a vessel collision (MDO) causing **Level 3** consequences of injury / mortality to marine fauna is considered **Unlikely (D)**.

Inherent Risk Severity

The inherent risk severity of an accidental release of MDO resulting from a vessel collision causing impacts to receptors is considered **Moderate**.

9.5.5.5 Risk: Changes to the Functions, Interests, or Activities of Other Users

Inherent Consequence Evaluation

The unplanned release of MDO into the marine environment has the potential to affect the functions, interests, or activities of other users of the sea. Risk assessments often use the conservative low threshold levels of hydrocarbon exposure, specifically floating hydrocarbon threshold (1 g/m^2), shoreline accumulation threshold (10 g/m^2), and entrained/dissolved thresholds (10 ppm) to assess socio-economic impacts. These thresholds are considered the levels which could trigger temporary closures of areas (i.e., fishing grounds, shorelines) as a precautionary measure due to the visibility of the hydrocarbon on the sea surface or shoreline. These thresholds may also trigger the need for shoreline clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.) depending on the socio-economic value of the shoreline (French-McCay et al., 2005a; 2005b).

The probability of shoreline accumulation at or above the low exposure (10 g/m^2) was approximately 60%, with shoreline contact at this threshold anticipated within 22 hours for the worst-case credible modelled scenario (RPS, 2023a). The shoreline at Corangamite recorded the highest maximum probability of shoreline loading (47% at the low threshold) and the highest potential volume onshore (43.1 m^3).

Functions, interests, or activities of other users that may be present within EMBA include:

- Conservation values and sensitivities:
  - World and National Heritage Areas
  - Australian Marine Parks
  - Wetlands
  - State Parks and Reserve
  - Key Ecological Features
  - TECs
- Socio-economic environment:
  - Coastal settlements.
  - Commercial fisheries
  - Other offshore industry
  - Recreation and tourism.

Table 9-24 provides details on the presence of receptors within the Social EMBA (MDO), the potential impact and the resulting inherent consequence level for each type.

Table 9-25: Inherent Consequence Levels - accidental release of MDO - Changes to functions, interests and activities of other users

Receptor	Presence within Social EMBA (MDO	Potential impact	Description of consequence	Inherent consequence
Conservation values and sensitivities				
World and National heritage areas	Modelling predicted that one National heritage area could be contacted by hydrocarbon exposure within the Social EMBA (MDO); and no World heritage areas (RPS, 2023a): • Great Ocean Road and its Scenic Environs.	The values identified of these World and National heritage areas have the potential to be exposed to shoreline hydrocarbons at, or above, the low threshold. Visible shoreline hydrocarbons may have the potential to reduce the visual, social and cultural amenity of the area temporarily. Given the non-persistent nature of the hydrocarbon, waves and tidal action are anticipated to continue the weathering process if shoreline contact occurs. Refer also to potential impact to habitats (Section 9.5.5.2) and coastal settlements (below).	Localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2
AMPs	Modelling predicted one AMP could be contacted by hydrocarbon exposure within the Social EMBA (MDO): • Apollo AMP (Multiple Use Zone (IUCN VI)). The major conservation values for this AMP have been identified within Section 6.6.3 of the EP and include foraging areas for some EPBC listed species of birds (e.g., petrels, shearwaters, albatross), and cetaceans (e.g., pygmy blue and southern right whales). The AMP is associated with unique seafloor features, which influence the formation of large eddies mixing warm waters with cool nutrient-rich waters increasing marine biodiversity; these features would not be expected to be affected (see Section 6.6.3).	The values identified within the Apollo AMP have the potential to be exposed to surface hydrocarbons at, or above, the low threshold, in the event of a release of MDO following a vessel collision. Seabirds are the value which has been identified for this AMP that may be impacted by surface hydrocarbons by rafting, resting, diving or feeding within the surface slick. Impact to seabirds from direct or indirect exposure to surface hydrocarbons may cause a subsequent negative impact to the value of the AMP, however any impact is expected to be limited to a small number of individuals, with no impacts to regional populations. However, the exposure of entrained hydrocarbons will be greatest within the upper 0-10 m of the water column and areas close to the spill source. The Apollo AMP is located within waters 80-120 m; therefore, conservation values within this AMP, such as ecosystems, habitats and sea-floor features are not predicted to be impacted. Furthermore, the modelling predicted no entrained hydrocarbon exposure at the high threshold; and only 25% at low (RPS, 2023a). The Apollo AMP is important foraging areas for seabirds. There is a low probability that seabirds would forage only within the area exposed to hydrocarbons given their extensive foraging grounds. Therefore, there is a chance that foraging seabirds will experience sub-lethal impacts from consuming contaminated prey, however,	Localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning.	Level 3

Receptor	Presence within Social EMBA (MDO	Potential impact	Description of consequence	Inherent consequence
		impacts will be limited to individuals and are not expected to cause impacts at a population-level. The Apollo AMP also overlaps areas where cetaceans could be moving through (i.e. humpback, blue, fin, and sei whales) (see Section 6.6.3). As cetaceans are highly mobile pelagic animals, they are unlikely to be within the exposure area 0-10 m of the water column for prolonged periods of time. Refer to potential impact to marine fauna (Sections 9.5.5.3 and 9.5.5.4) and to habitats (Section 9.5.5.2).		
Wetlands	Wetlands could be exposed to hydrocarbons in the event of shoreline accumulation following a vessel collision. There are no wetlands of International Importance (RAMSAR) identified within the Ecological EMBA (MDO) (Section 6.6.4.1). Three wetland communities with TEC status are present within the area predicted to be exposed to hydrocarbons ashore: • Karst springs and associated alkaline fens of the Naracoorte Coastal Plain Bioregion • assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community • natural Damp Grassland of the Victorian Coastal Plains. The major values for these wetlands have been identified within Section 6.6.4 of the EP. Furthermore, a number of these wetlands are associated with First Nations cultural values (see Section 6.6.4).	Wetlands are saline marsh areas and estuarine environments that are a continuation from the marine environment. Therefore, depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands, potentially impacting the aesthetic and ecological value of the wetland. Shoreline hydrocarbon exposure at, or above, the low threshold may impact the key receptors of wetlands (e.g. waterbirds, fish and invertebrates) which may cause a subsequent negative impact to the value of the wetland, however, is expected to be limited to a small number of individuals, with no impacts to regional populations. Refer to potential impact to marine fauna (Sections 9.5.5.3 and 9.5.5.4) and to habitats (Section 9.5.5.2) and cultural heritage (Section 6.8.3.7).	Localized and medium-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 3
State parks and reserves	The modelling identified one State Park and reserve present within the Social EMBA (MDO): • Twelve Apostle Marine National Park. Conservation values for this protected area are detailed within Section 6.6.5 and include high levels of marine fauna and flora diversity,	The values identified within the identified State Park and reserve that has the potential to be exposed to surface hydrocarbons at, or above, the low threshold. Visible surface hydrocarbons (i.e. a rainbow sheen) may have the potential to reduce the visual amenity of the area, also impacting the value.	Localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning.	Level 3

Receptor	Presence within Social EMBA (MDO	Potential impact	Description of consequence	Inherent consequence
	including fish and invertebrate assemblages and benthic coverage (sponges, soft corals, macroalgae).	The values identified within this marine park have the potential to be exposed to entrained hydrocarbons at, or above, the low threshold (RPS, 2023a). The modelling predicted 29% probability of hydrocarbon exposure for entrained (high threshold); and no dissolved hydrocarbons above the low threshold (RPS, 2023a). However, the exposure of entrained hydrocarbons will be greatest within the upper 0-10 m of the water column and areas close to the spill source. Therefore, conservation values within Twelve Apostles Marine National Park, such as benthic and pelagic species, ecosystems, habitats and sea-floor features are not predicted to be impacted. Given the light, non-persistent nature of MDO , impacts from entrained exposure are likely be localised and short-term, and not affect fish at a population level, or affect local ecosystem functioning. Also refer to potential impact to marine fauna (Sections 9.5.5.3 and 9.5.5.4) and to habitats (Section 9.5.5.2).		
KEFs	Modelling predicted exposure from in-water hydrocarbons at, or above low exposure levels, was shown to overlap two KEFs (RPS, 2023a): • Bonney Coast upwelling • shelf rock reefs. Values associated with the Bonney Coast Upwelling include the upwelling of cold nutrient rich water to the sea surface which supports regionally high productivity and high species diversity. Whales and other endangered and listed species frequent the area, possibly relying on the abundance of krill that provide a food source to many seabirds and fish. Higher predator species such as little penguins and Australian fur-seals also feed on baitfish within the area (Section 6.6.6). The KEF is associated with unique sea-floor features of ecological significance, and habitat forming species, such as sponges, attached megafauna, and hard substrate formations	The values identified within the Bonney Coast Upwelling KEF and shelf rocky reef KEFs have the potential to be exposed to entrained hydrocarbons at, or above, the low threshold. There is no exposure to surface hydrocarbons at any threshold. However, the exposure of entrained hydrocarbons will be greatest within the upper 0-10 m of the water column and areas close to the spill source. Therefore, the spill is unlikely to intersect with majority of the values of the KEFs which are concentrated within the water column >10 m deep or along the seafloor at varying water depths. The Bonney Coast Upwelling is also an area of high abundance of plankton, such as krill which acts as a food source to many seabirds, fish and cetacean species. Plankton populations may be impacted by hydrocarbon exposure, however, would be expected to be limited to a small proportion of the productivity driven by the Bonney upwelling, with no impacts to the overall system and productivity across the region. The modelling predicted only a small portion of the Bonney Coast Upwelling could be exposed (low probability of 8%) of entrained hydrocarbon exposure at or above low thresholds of MDO (RPS, 2023a). Therefore, any impacts are anticipated to localised and not impact the overall value of the KEF.	Localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning.	Level 3

Receptor	Presence within Social EMBA (MDO	Potential impact	Description of consequence	Inherent consequence
	and canyons which create a habitat for diverse species. Shelf rocky reefs KEF supports a variety of benthic communities, such as coral, sponges and benthic communities, along the continental shelf within the temperate east marine region (see Section 6.6.6).	Given the nature of the hydrocarbon, the relatively short duration of the spill, and the small area of exposure, any impacts are anticipated to be localised and short-term. Refer to potential impact to marine fauna (Sections 9.5.5.3 and 9.5.5.4) and to habitats (Section 9.5.5.2).		
TECs	Modelling predicted exposure from shoreline hydrocarbons at, or above low exposure levels, to overlap several TECs within the Social EMBA (MDO). Three wetland communities with TEC status are present within the area predicted to be exposed to hydrocarbons ashore: • Karst springs and associated alkaline fens of the Naracoorte Coastal Plain Bioregion • assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community • natural Damp Grassland of the Victorian Coastal Plains. Values associated with these TECs (see Section 6.6.7) are listed as critically endangered, endangered or vulnerable, and can be sensitive to hydrocarbon exposure.	TECs have the potential to be exposed to shoreline hydrocarbons at, or above, the low threshold. Any hydrocarbon exposure to the key receptors of the TECs may cause a subsequent negative impact to the value of the TECs, However, potential impacts to socio-economic receptors (tourism, cultural and/or other social values associated with the TECs) are more likely to occur because of a reduction in the visual amenity, rather than ecological impacts of hydrocarbon exposure at low threshold. Shoreline hydrocarbons can become concentrated as they strand ashore. However, most of the oil is concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA, 1995). The majority of the TECs are located above the high tide mark, therefore, impacts are not anticipated to occur. Shoreline hydrocarbon exposure at, or above, the low threshold may impact the key receptors of wetlands (e.g. waterbirds, fish and invertebrates) which may cause a subsequent negative impact to the value of the wetland, however, is expected to be limited, with no long term impacts local populations or regional occurrences. Refer to potential impact to marine fauna (Sections 9.5.5.3 and 9.5.5.4) and to habitats (Section 9.5.5.2), cultural heritage (Section 6.8.3.7); and Wetlands (above).	Localised and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2
Socio-economic environment				
Coastal settlements	There are several local government areas identified as potentially being overlapped by the spatial extent of shoreline hydrocarbon exposure at the low threshold. Stochastic modelling undertaken for the surface release of MDO indicated that there was a 60% probability of shoreline accumulation of hydrocarbon at or above the low threshold. The contact was predicted to occur within 22 hours, with the average total	Coastal settlements may be vulnerable to shoreline accumulation from a hydrocarbon spill of MDO as visible hydrocarbons have the potential to reduce the visual amenity of the area. Closure of these shorelines may impact public use and public activities. The shoreline segments exposed, with Corangamite having the highest probability of accumulation above all three thresholds (47% at the low threshold), are not densely populated stretches of coast. Furthermore, most of the hydrocarbon will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA, 1995) and expected to be visible, therefore	Localised, short-term impacts.	Level 2

Receptor	Presence within Social EMBA (MDO	Potential impact	Description of consequence	Inherent consequence
	volume of hydrocarbons ashore being 7.5 m^3 (RPS 2023a). Corangamite was the shoreline segment predicted to have the highest probability of shoreline exposure at the low threshold level (47%) (RPS, 2023a). No exposure at any threshold was predicted for Tasmanian state waters.	the impact to coastal settlements is expected to be relatively low or not occur. Given the hydrocarbon characteristics of MDO as a light-persistent hydrocarbon, expected rapid weathering, relatively small volumes predicted ashore, and the potential for tidal flushing, any impact is anticipated to be localised short-term. Refer to potential impact to habitats (Section 9.5.5.2).		
Commercial fisheries	In-water exposure to entrained MDO may result in a reduction in commercially targeted marine species or marketability of catch, resulting in impacts to commercial fishing and aquaculture. Several commercial fisheries operate in the Social EMBA (MDO) and overlap the spatial extent of the water column hydrocarbon predictions (Section 6.7.2.1).	In-water hydrocarbon exposure could result in a reduction in commercially targeted marine species (i.e. fish and invertebrate species). Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk to seafood from a spill has subsided (NOAA, 2002) which can have economic impacts to the industry. Physical displacement of commercial fishers may occur due to the establishment of exclusion zones during the spill response. However, the maximum distance from the release location at the low threshold (10 g/m^2) was 32.5 km from the release site, therefore, any exclusion zones required are not anticipated to be required for a large area. The low dissolved/entrained threshold (10 ppb) represents the lowest concentration where impacts could potentially occur. However, these thresholds require a relatively long exposure time (>24 hours) for the exposure to be significant to fish species (RPS, 2023a). Therefore, any acute impacts are expected to be limited to small numbers of juvenile fish, larvae, and planktonic organisms, which are not expected to affect population viability or recruitment. Impacts from entrained exposure would likely be localised and short-term, and not affect fish at a population level, or affect local ecosystem functioning. Visible surface hydrocarbons (i.e. a rainbow sheen) could impact public perception of the industry products, potentially causing a negative economic impact. Due to the nature of the MDO, being a light non-persistent hydrocarbon, with high anticipated evaporation and entrainment rates, exclusion zones are not expected to be long-term, or encompass entire fisheries. Refer to potential impact to habitats (Section 9.5.5.2); specifically, Fish and Invertebrates.	Localised, short-term impacts.	Level 2

Receptor	Presence within Social EMBA (MDO	Potential impact	Description of consequence	Inherent consequence
Other offshore industry	Other offshore industry, such as shipping, petroleum exploration and production, other offshore infrastructure and defence activities, may occur within the Social EMBA (MDO) (Section 6.7.3).	Physical displacement of other offshore industry may occur due to the establishment of exclusion zones during the spill response. This has the potential to cause negative economic impact. However, due to the nature of the MDO, being a light non-persistent hydrocarbon, and the relatively short duration of surface exposure (i.e. 34% evaporated within 24 hours in calm conditions, and 81% entrained under variable wind conditions) impacts are expected to be localised and short term.	Localised, short-term impacts.	Level 2
Recreation and tourism	The Victorian coast and marine region provide a diverse range of land-based and near-shore tourism opportunities, including scuba diving, fishing, whale and wildlife watching, sailing, snorkelling and kayaking (Section 6.7.4). Modelling predicted low exposure thresholds of surface hydrocarbons are predicted up to 32.5 km (west) of the release location. Areas where low threshold surface hydrocarbon is predicted include Twelve Apostle MNP, Corangamite, and Moonlight Head. No exposure at any threshold was predicted for Tasmanian state waters. In general, recreational and tourism activities are restricted to shallower coastal waters and shorelines.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. MDO is known to rapidly spread and thin out on release and consequently, a large area may be exposed to surface hydrocarbons. Precautionary exclusion from shorelines may be implemented by local governments until water quality monitoring verifies the absence of residual hydrocarbons. This could cause disruption to some recreational and tourism activities within that area. Any impact to receptors that provide nature-based tourism features (e.g. whales) may cause a subsequent negative impact to recreation and tourism activities. Given the nature of the hydrocarbon type, the relatively short duration of the spill, and the small area of exposure, any impacts to recreation and tourism are anticipated to be localised and short-term. Refer to potential impact to marine fauna (Sections 9.5.5.3 and 9.5.5.4)	Localised, short-term impacts.	Level 2

<u>Summary</u>

The potential consequence to the functions, interests or activities of other users is assessed as **Level 3** based on the potential for localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning.

Inherent Likelihood

Due to the nature of this activity, the adopted control measures, and limited previous occurrences, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of a vessel collision (MDO) causing **Level 3** consequences to the functions, interests and activities of other users is considered **Unlikely (D)**.

Inherent Risk Severity

The inherent risk severity of an accidental release of MDO resulting from a vessel collision causing impacts to socio-economic receptors is considered **Moderate**.

9.5.6 Demonstration of Acceptability

To demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 9-26.

Table 9-26: Accidental release - MDO Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Potential impact: Change in water quality	Consequence: Level 2
	Risk: Change in habitat	Risk: Moderate
	Risk: Change in fauna behaviour	Risk: Moderate
	Risk: Injury/mortality to fauna	Risk: Moderate
	Risk: Change to the functions, interests, or activities of other users.	Risk: Moderate
Principles of ESD	A) 'Integration principle' A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, p-otential impact and risks from accidental release – MDO was identified as: • Level 2 consequence for change in water quality • Moderate risk for change in habitat • Moderate risk for change in fauna behaviour • Moderate risk for injury/mortality to fauna • Moderate risk for change to the functions, interests or activities of other users. The above predicted levels of impact and risk due to accidental release – MDO from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	
	B) 'Precautionary principle' If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology. • The consequence ranking for an accidental release of MDO was Level 3, and the highest inherent risk was evaluated as Moderate; therefore, an accidental release of MDO from the East Coast Project will not result in serious or irreversible environmental damage.	

	• The potential impacts and risks from an accidental release of MDO are well-understood, and management measures are well established and regulated in Australian waters.		
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest inherent risks for an accidental release of MDO was evaluated as Moderate and therefore will not forego the health, diversity and productivity of the environment for future generations. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.5.7). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.		
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant environmental values and sensitivities to an accidental release of MDO were evaluated in Section 9.5.5 and the highest inherent risk for an accidental release of MDO was evaluated as Moderate. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.5.7). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.		
Legislative and Other requirements	Requirement	Relevant Objective / Action	Demonstration of Requirement
	OPPGS(E)R	An EP, including an OPEP and emergency response arrangements, must be place for any petroleum activity prior to activities commencing, and must be implemented.	Adoption or the following control measures: CM1: Marine Assurance Process CM12: Marine Exclusion and Caution Zones CM13: Ongoing Engagement CM16: OSMP CM17: OPEP CM18: Regulatory Safety and Integrity Management Plans
	Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Section 26F (implements MARPOL Annex I).	All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act. Several MOs are enacted under this Act relating to offshore petroleum activities, including: MO Part 91: Marine Pollution Prevention – Oil MO Part 93: Marine Pollution Prevention – Noxious Liquid Substances	
	Navigation Act 2012 – Chapter 4 (Prevention of Pollution).	All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act. Several Marine Orders (MO) are enacted under this Act which relate to offshore petroleum activities, including: MO 21: Safety and emergency arrangements	

	AMSA Marine Orders 91 and 94	In Commonwealth waters AMSA is the Statutory Agency for vessels and must be notified of all incidents involving a vessel.	
	Recovery plan for marine turtles in Australia 2017–2027	Recovery objective: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: Anthropogenic threats are demonstrably minimised. No relevant management actions.	
	National Recovery Plan for Albatrosses and Petrels 2022 (DCCEEW 2022e)	Recovery objective: To improve the conservation status of albatrosses and petrels so that these species are on a trajectory towards no longer being threatened in Australia's jurisdiction. No relevant management actions.	
	Wildlife Conservation Plan for Seabirds (CoA 2020)	Objective 2: Seabirds and their habitats are identified, protected and managed in Australia. Objective 3. The long-term survival of seabirds and their habitats is achieved through supporting priority research programs, coordinated monitoring, on-ground management and conservation. No relevant management actions.	
	Blue Whale Conservation Management Plan 2015 - 2025 (2015)	Recovery objective: Minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 4: Anthropogenic threats are demonstrably minimised. Management action A.4.2: Ensure all vessel strike incidents are reported in the National Ship Strike Database (AMMC). Management action A.4.3: Ensure the risk of vessel strikes on Blue Whales is considered when assessing actions that increase vessel traffic in areas where Blue Whales occur and, if required, implement appropriate mitigation measures.	
	National Recovery Plan for the Southern Right Whale (DCCEEW, 2024l)	Long term recovery objective: is that the population has increased in size to a level that the conservation status has improved, and the species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria. Interim Objective 2: Anthropogenic threats are managed consistent with ecologically sustainable development principles to facilitate recovery of southern right whales.	

	Approved Conservation Advice for *Balaenoptera borealis* (Sei Whale)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program in Australian waters. No relevant management actions.	
	Approved Conservation Advice for *Balaenoptera physalus* (Fin Whale)	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program in Australian waters. No relevant management actions.	
	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (2013a) Conservation Advice for the *Neophoca cinerea* (Australian sea lion)	Overarching objective: to halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: Improving the population status leading to the future removal of the Australian sea lion from the threatened species list of the EPBC Act Ensuring that anthropogenic activities do not hinder recovery in the near future or impact on the conservation status of the species in the future. No relevant management actions.	
	Recovery Plan for the White Shark (*Carcharodon carcharias*)	Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas. No relevant management actions.	
	Conservation Advice for Subtropical and Temperate Coastal Saltmarsh (DSEWPAC, 2013)	No relevant objectives. Management action: Identify Coastal Saltmarsh as important habitat in all oil spill contingency planning at national and State levels and monitor the application of protocols on the management of spills involving saltmarshes.	
	Approved Conservation Advice for *Botaurus poiciloptilus* (Australasian bittern)	Provide guidance for actions that will expand the range and the number of Australasian Bitterns in Australia. No relevant management actions.	
	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper)	Australian Objective: Reduce disturbance at key roosting and feeding sites. No relevant management actions.	
	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew)	Australian objectives: Achieve a stable or increasing population. Maintain and enhance important habitat.	

		Reduce disturbance at key roosting and feeding sites. No relevant management actions.	
	National Recovery Plan for (*Sternula nereis nereis*) (Australian Fairy Tern) Approved Conservation Advice for *Sternula nereis* (Australian Fairy Tern)	Long-term Vision: The Australian Fairy Tern population has increased in size to such an extent that the species no longer qualifies for listing as threatened under any of the Environment Protection and Biodiversity Conservation Act 1999 listing criteria. No relevant management actions.	
	Approved Conservation Advice for *Thinornis rubricollis* (Hooded Plover, Eastern)	Primary Conservation Objectives: Achieve stable numbers of adults in the population and maintain a stable number of occupied and active breeding territories. Maintain, enhance and restore habitat, and integrate the subspecies' needs into coastal planning. No relevant management actions.	
	Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan	Specific recovery objective: To identify and manage the threats operating at sites where the subspecies occurs. No relevant management actions.	
	National Recovery Plan for the *Lathamus discolour* (swift parrot) Conservation Advice *Lathamus discolor* Swift Parrot	Overall objectives: To prevent further decline of the Swift Parrot population. To achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat to increase carrying capacity. No relevant management actions.	
	National Recovery Plan for the Orange-bellied Parrot (*Neophema chrysogaster*)	Objective 1. To achieve a stable or increasing population in the wild within five years. Objective 2. To increase the capacity of the captive population, both to support future releases of captive-bred birds to the wild and to provide a secure long term insurance population. Objective 3. To protect and enhance habitat to maintain, and support growth of, the wild population. Objective 4. To ensure effective adaptive implementation of the plan. No relevant management actions.	
	Commonwealth Conservation Advice on *Dermochelys coriacea* (2008)	These EPBC management plans identify habitat degradation / modification or pollution / contamination as a threat; but do not include any relevant objectives or relevant management actions.	
	Approved Conservation Advice for *Calidris canutus* (Red Knot)		

	Approved Conservation Advice for *Charadrius leschenaultia* (Greater Sand Plover)		
	Approved Conservation Advice for *Halobaena caerulea* (Blue Petrel)		
	Approved Conservation Advice for *Limosa lapponica bauera* (Bar-tailed Godwit (western Alaskan)		
	Approved Conservation Advice for *Pachyptila subantarctica* (Fairy Prion (southern))		
	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe)		
	Approved Conservation Advice for *Thalassarche Chrysostoma*, Greyheaded Albatross)		
	Conservation Advice *Thalassarche cauta* Shy Albatross		
	Conservation Advice *Falco hypoleucos* Grey Falcon		
	Conservation Advice *Hirundapus caudacutus* White-throated Needletail		
	Conservation Advice for Dendronephthya australis Cauliflower Soft Coral (TSSC, 2020)		
	Approved Conservation Advice for Giant Kelp Marine Forests of Southeast Australia (TEC) (DSEWPAC, 2012)		
	Approved Conservation Advice for the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia		

	ecological community (DoE, 2015)		

Internal Context	Relevant management system processes adopted include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11) • External Affairs & Stakeholder Management (MS05). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).
External Context	Stakeholder feedback received. GMTOAC has previously communicated values and sensitivities relevant to the risk. GMTOAC highlighted Gunditjmara' strong connection to Sea Country and responsibility for its care. Cooper Energy briefed GMTOAC on the kinds of activities undertaken by Cooper Energy which carry a risk of spills, and the plans in place to prevent and respond to spills. During the briefing, members queried whether Cooper Energy had ever had a large hydrocarbon spill (February 2024). Cooper Energy clarified that no hydrocarbon spills have occurred during Cooper Energy's time operating within the Otway. GMTOAC indicated Gunditjmara's responsibility for Country extended to a spill response along the coast and would expect to be contacted in the event of a spill which threatens Gunditjmara Country. GMTOAC are listed as a relevant person for the purposes of EP preparation which will enable their continued input into the management of activity specific impacts and risks.
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to an accidental release of MDO is AL1 and AL2 identified in Table 9-27. These acceptable levels defined for a change in water quality are defined in Table 7.6. The worst-case predicted impacts assessed in Section 9.5.5 are: • Given the nature of the activity, implementation of control measures and based on previous occurrences, the inherent likelihood of a vessel collision (MDO) causing a change to habitat, injury/ mortality to fauna, change in fauna behaviour or change to the functions, interests and activities of other users is considered Unlikely (D). • Highest consequence for change in habitat from accidental release MDO is Level 3, for shorelines – rocky, saltmarsh and mangroves. These are localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function. • Highest consequence to marine fauna is Level 3, for pinnipeds. Breeding colonies may be sensitive to hydrocarbon spills in the event of shoreline accumulation and individuals have the potential to be impact by surface hydrocarbons when surfacing to breathe, in-water hydrocarbons when transiting through the area. Impacts to pinnipeds at a population level are considered very unlikely given the localised and temporary presence of hydrocarbons at relevant thresholds, the absence of haul out sites within or near the operational area, the transient, highly mobile nature of pinnipeds, over typically extensive foraging grounds. • Impacts to plankton, invertebrates, cetaceans, fish, marine reptiles, seabirds and shorebirds are localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning. • The highest consequence to the functions, interests or activities of other users is assessed as Level 3 based on the potential for localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning. • The highest consequence ranking for an accidental release of MDO was Level 3, and the highest inherent risk was evaluated as Moderate. Therefore, at its worst-case, the predicted impact from accidental release of MDO would not: • Exceed levels which prevent conservation of biodiversity, recovery and protection of threatened species, maintenance of ecosystem health and the ecological integrity and functioning of the Commonwealth Marine Area.

	• Lead to a change in biodiversity beyond natural variability. Therefore, the predicted level of impact resulting from an accidental release of MDO from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to an accidental release of MDO are acceptable, based on: • predicted levels of impact (evaluated in Section 9.5) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors • the planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • the activities will be managed in a way that is not inconsistent with the relevant principles of ESD • the proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • feedback has been received from stakeholders that has informed the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPOs have been applied: **EPO22**: No unplanned release of chemicals or hydrocarbons to the marine environment.

9.5.7 Environmental Performance

Table 9-27 lists the acceptable level and EPOs defined for the introduction, establishment and spread of IMS and the adopted control measures to achieve the outcome.

Table 9-27: Environmental Performance Summary – Accidental release of MDO

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL2: Impacts and risks to water quality from activities defined in this OPP will not lead to a substantial change in water quality which adversely impacts biodiversity and ecological integrity. **AL6:** Impacts and risks to benthic habitat from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity. **AL10:** Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed	**EPO22:** No unplanned release of chemicals or hydrocarbons to the marine environment.	CM1: Marine Assurance Process The vessels and MODU will adhere to navigational safety requirements under the *Navigation Act 2012* and associated Marine Orders, including but not limited to: • AMSA MO 21 – Safety and Emergency Arrangements • AMSA MO 27 - Safety of Navigation and Radio Equipment • AMSA MO 30 - Prevention of Collisions. • In accordance with MARPOL Annex I and AMSA MO 91 [Marine Pollution Prevention – oil], a SMPEP or SOPEP (according to class) is required for each vessel and MODU. Response equipment will be available in accordance with the SMPEP / SOPEP. Training and testing will be undertaken in accordance with the SMPEP/SOPEP exercise schedule. In the event of a spill, the SMPEP/SOPEP details: • Reporting requirements and a list of authorities to be contacted. • Activities to be undertaken to control the discharge of hydrocarbon; and Vessels shall meet the AMSA Marine Order (MO) requirements, including: o AMSA MO 21 – Safety and emergency arrangements gives effect to SOLAS regulations dealing with life-saving appliances and

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in this OPP will not lead to loss of habitat critical to the survival of species. **AL12:** Social and commercial amenity values of the Commonwealth Marine Area within the region are maintained consistent with the rights of all marine users. **AL13:** Impacts and risks to other marine users associated with activities defined in this OPP will not lead to substantial adverse effects on the sustainability of commercial fisheries.		arrangements, safety of navigation and special measures to enhance maritime safety. ○ AMSA MO 27 - Safety of navigation and radio equipment gives effect to SOLAS regulations regarding radiocommunication and safety of navigation and provides for navigation safety measures and equipment and radio equipment requirements. ○ AMSA MO 30 - Prevention of collisions requires that onboard navigation, radar equipment, and lighting meets the International Rules for Preventing Collisions at Sea (COLREGs) and industry standards. ○ AMSA MO 31 - vessels contracted will meet survey, maintenance and certification of regulated Australian vessels
		CM12: Marine Exclusion and Caution Zones May include: • A temporary 3 km exclusion/cautionary zone around the MODU during the drilling program • A temporary 500 m exclusion/caution zones to be established via Notice to Mariners around vessels undertaking petroleum activities • PSZs may be gazetted around wells and other equipment where required for integrity management. Subsea infrastructure will be marked on navigational charts for awareness.
		CM13: Ongoing Engagement Further engagement will take place during the development and implementation of component EPs. This will include details relating to notification of third-party stakeholders.
		CM16: OSMP Cooper Energy's OSMP details the arrangements and capability in place for: • Operational monitoring of a hydrocarbon spill to inform response activities • Scientific monitoring of environmental impacts of the spill and response activities.
		CM17: OPEP Under the Regulations, the petroleum activity must have an accepted OPEP in place before the activity commences. In the event of a surface release of MDO following a vessel collision, the OPEP will be implemented. Cooper Energy acknowledges that any response will be implemented in accordance with the requirements described within the OPEP.
		CM18: Regulatory Safety and Integrity Management Plans A NOPSEMA accepted safety case is required before applicable activities can be undertaken. Applicable activities will be managed in accordance with the accepted safety case revisions.

9.6 Accidental Release – LOWC

9.6.1 Cause of Aspect

An accidental release of condensate into the marine environment has the potential to occur during the East Coast Project activities (Table 9-28).

Table 9-28: Activities undertaken in the East Coast Project that may result in an accidental release of condensate

Cause of Aspect / Phase	Activity Component
Well Construction	Drilling operations
Operations	Hydrocarbon extraction and transport Well intervention
Decommissioning	Well abandonment

9.6.2 Aspect Characterisation

Guidance on the identification of worst-case credible spill scenarios is given in AMSA's Technical guidelines for preparing contingency plans for Marine and Coastal Facilities (AMSA, 2015) and Technical Report on Calculation of Worst-Case Discharge (SPE, 2016).

An accidental release of condensate could occur from the East Coast Project as a result of:

- Accidental release of condensate from a subsea flowline, and/or
- Accidental release of condensate from a well; from a leak or a LOWC.

Credible scenarios are presented in Table 9-29.

Table 9-29: Causes and estimated volumes of accidental release of condensate

Activity Component	Accidental Hydrocarbon Release	Cause of Aspect	Fluid Type and Volume	Release location
Drilling, well intervention and well abandonment	Loss of well control (LOWC)	There are multiple controls in place to prevent a LOWC. For a LOWC to occur requires the failure of multiple different controls at each level in the control hierarchy. These are described in detail, and managed under a Well Operations Management Plan, and facility specific Safety Case. Both documents must be accepted by NOPSEMA before an activity can occur, and these plans must be implemented.	Gas / condensate mix. Total maximum credible spill volume: 10,562 m^3 to 16,740 m^3, depending on the well. Refer to Table 9-30.	Wells
Hydrocarbon extraction and transport	Subsea well LOC (leak from SST)	There are multiple controls in place to prevent a leak. For a leak to occur requires the failure of multiple different controls at each level in the control hierarchy. These are described in detail, and managed under the Well Operations Management Plan, and facility specific Safety Case. Both documents must be accepted by NOPSEMA before an activity can occur, and these plans must be implemented.	Gas / condensate mix. The worst-case discharge rate of release from the wells with all barriers removed is 41 MMscf/d. There are no situations in which all well barriers would be removed during the operational period. Any release from the well would be a low leak rate via tortuous leak path	Wells

Activity Component	Accidental Hydrocarbon Release	Cause of Aspect	Fluid Type and Volume	Release location
			through subsurface and surface equipment. Nominal rate ~100 L/day.	
Hydrocarbon extraction and transport	Subsea flowline LOC (subsea leak from flowline)	There are multiple controls in place to prevent a leak. For a leak to occur requires the failure of multiple different controls at each level in the control hierarchy. These are described in detail and managed under the facility specific Safety Case. The Safety Case must be accepted by NOPSEMA before an activity can occur, and these plans must be implemented. Pipeline rupture (external impact, or through corrosion of the pipeline) could result in a release over several minutes as system shuts in and pipeline pressure falls to ambient. Flowline contains primarily gas. A nominal volume of condensate would also be distributed along the length of the flowline system. With a single rupture point in the pipeline system, a nominal conservative estimate 50 m^3 condensate release as the system shuts in.	Gas / condensate. Estimated 50 m^3 condensate.	Anywhere along the length of the flowlines.

9.6.2.1 *Drilling Operations*

Fifteen production wells are within the scope of this OPP. A MODU will be used to drill the wells; each well may require ~60 days to construct.

The project is in offshore waters adjacent the Otway coastline. The Annie gas field is the closest to shore, situated ~9 km from the Otway Coastline and in ~55 m water depth. The identified prospect, Heera, is the furthest offshore, ~35 km from the coastline and in ~85 m water depth.

Potential causes of a LOWC, and hypothetical worse-case release volumes are presented in Table 9-29.

9.6.2.2 *Operations*

The East Coast Project wells have an indicative productive duration of 5 -12 years (see Section 4.1.3). During this phase, in which hydrocarbons are moving through the well, there is potential for a loss of containment to occur from the subsea well equipment and subsea flowline system, which could result from a loss of integrity, such as from inadvertent 3rd party interaction, or corrosion defects. Whilst these aspects are managed through a hierarchy of control measures, there remains a risk. During the operations phase, wells may require maintenance, also called a workover, or downhole intervention. These maintenance activities involve re-entering the well bore, and also carry the risk of LOWC scenario described in Section 9.6.2.1.

Table 9-29 identifies causes of an LOC, and hypothetical worst-case release volumes.

9.6.2.3 *Decommissioning*

Well plug and abandonment activities will be undertaken from a MODU and are expected to take ~25 days per well, for up to 15 wells. Abandonment operations involve setting a series of mechanical and cement plugs within the wellbore, to isolate the reservoir and prevent any further flow from the well.

Abandonment activities have a similar potential for LOWC as drilling operations (Section 9.6.2.1), albeit generally lower pressures and volumes as at the time of decommissioning, the gas reservoirs would likely have been depleted over time by production.

9.6.3 Quantitative Hydrocarbon Spill Modelling

Of the potential scenarios identified in Table 9-29, LOWC is the worst-case credible volume for an unplanned release of condensate. Therefore, this scenario has been used as the basis for the impact assessment.

Cooper Energy commissioned RPS Group to conduct stochastic modelling and deterministic analysis (RPS, 2024) of three separate worst-case credible scenarios of a subsea release of 16,740 m^3, 13,239 m^3 and 10,562 m^3 of condensate during a LOWC at Elanora-ST1, Pecten East-2 and Annie-2 locations (Table 9-30).

Like the modelling undertaken for MDO in Section 9.5, SIMAP was used to simulate the transport, spreading and weathering of specific hydrocarbon types under the influence of changing meteorological and oceanographic forces.

Modelling inputs are presented in Table 9-30.

Table 9-30: Condensate Spill Modelling Parameters

Parameter	Scenario 1	Scenario 2	Scenario 3
Scenario	LOWC at Elanora-ST1	LOWC at Pecten East-2	LOWC at Annie-2
Location	Lat: 38° 47' 41.5" S Long: 142° 37' 56.5" E	Lat: 38° 37' 59.7" S Long: 142° 40' 9.7" E	Lat: 38° 41' 1.68" S Long: 142° 49' 28.56" E
Maximum credible spill volume (total)	105,289 bbl (16,740 m^3)	83,273 bbl (13,239 m^3)	66,430 bbl (10,562 m^3)
Number of randomly selected spill start times	100 per season (200 per scenario)		
Model period	Summer (November to April) Winter (May to October)		
Hydrocarbon type	Annie-2 condensate		
Release type (depth (m))	Subsurface 54 m	Subsurface 34 m	Subsurface 36 m
Release duration (days) **	102	102	104
Simulation length (days)	116		118
Surface oil concentration thresholds (g/m²)*	1 (low); 10 (moderate); 50 (high)		
Shoreline oil accumulation thresholds (g/m²)*	10 (low); 100 (moderate); 1,000 (high)		
Dissolved hydrocarbon concentrations (ppb)*	10 (low); 50 (moderate); 400 (high)		
Entrained hydrocarbon concentrations (ppb)*	10 (low); 100 (high)		

**Thresholds based on NOPSEMA (2019); Table 9-3*

***Note: A conservative release duration has been selected, which accounts for the estimated time which would be required to drill a relief well and control the source of the release, if a secondary MODU were required to be mobilised from outside of the region. There are multiple different source control options which would be* *implemented prior to finally 'killing' the well via a relief well. These options could include subsea intervention and capping depending on the circumstances. The 104-day release duration assumes for conservatism, that each option fails to control the source and the release continues until the relief well is drilled.*

9.6.3.1 Hydrocarbon Characteristics

The condensate modelled for all scenarios was Annie condensate; a light persistent hydrocarbon (Group II according to International Tankers Owners Pollution Federation (ITOPF, 2020) classification), with a low dynamic viscosity and low pour point (Table 9-30).

Annie condensate has been modelled as it is a conservative proxy for all fields. Based on the most recent analysis from the drilling of Annie-1 well; Annie condensate is the only condensate within the offshore East Coast Project which has been classified as a Group II (light persistent) oil, with all of the others classified as Group I (non-persistent) oil. Therefore, it is expected that Annie-2 condensate will have a higher proportion of residual (heavier / persistent) hydrocarbons compared to the other prospect fields within the scope of the OPP, based on most appropriate geological analogues.

A few physical characteristics were not available for Annie-1 condensate (see Table 9-31). Therefore, this information was supplemented from the Minerva condensate assay, found in a nearby reservoir and considered an appropriate analogue for this information. The condensate comprises a significant portion of volatiles and semi- to low volatiles (82.5% total) with 17.5% residual components. This means the condensate will evaporate readily when on the water surface, with the persistent components to remain on the water surface or become entrained over time (Table 9-31).

Table 9-31: Physical Characteristics of Annie Condensate

Type	API	Pour Point (°C)	Density kg/m³ (at 16 °C)	Viscosity cP (at 20°C)	Non-Persistent			Persistent
					Volatiles (BP < 180°C)	Semi-volatiles (180°C < BP < 265°C)	Low Volatiles (265°C < BP < 380°C)	Residuals (BP > 380)
Annie-1 condensate	41	-30*	820	1.063*	8%	46.5%	28%	17.5%

** data extracted from Minerva condensate assay.*

9.6.3.2 Weathering and Fate

The modelling included a series of weather tests to illustrate the potential behaviour of the condensate when exposed to idealised and representative environmental conditions (RPS, 2024). The two tests included a surface release model under calm wind conditions (5 knots) and under variable weather conditions (1-23 knots), both assuming low seasonal water temperature (15°C) and ambient tidal and drift currents. Note, a surface release is used in the weathering test to solely focus on the weathering and fates of the hydrocarbons when exposed to atmospheric conditions.

The mass balance forecast for the constant-wind case (Figure 9-4) shows that 52.4% of the condensate is expected to evaporate within 24 hours (RPS, 2024). Under these calm conditions, most of the remaining hydrocarbon on the water surface will weather at a slower rate due to being comprised of the low volatile, longer-chain compounds. Evaporation of the residual compounds will cease when the residual compounds remain, and they will be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 9-5), where the winds are of greater strength on average, entrainment of condensate into the water column is shown to increase. Approximately 24 hours after the spill, 70.1% of the mass is shown to have entrained and a further 23.8% has evaporated, leaving only a small proportion floating on the water surface (<1%) (RPS, 2024).

The increased level of entrainment in the variable-wind case result in a higher percentage decaying at an approximate rate of ~2.5% per day with 17.8% after 7 days, compared to <0.7% per day and a total of 0.1% after 7 days for the constant-wind case (RPS, 2024). Given the proportion of entrained condensate and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

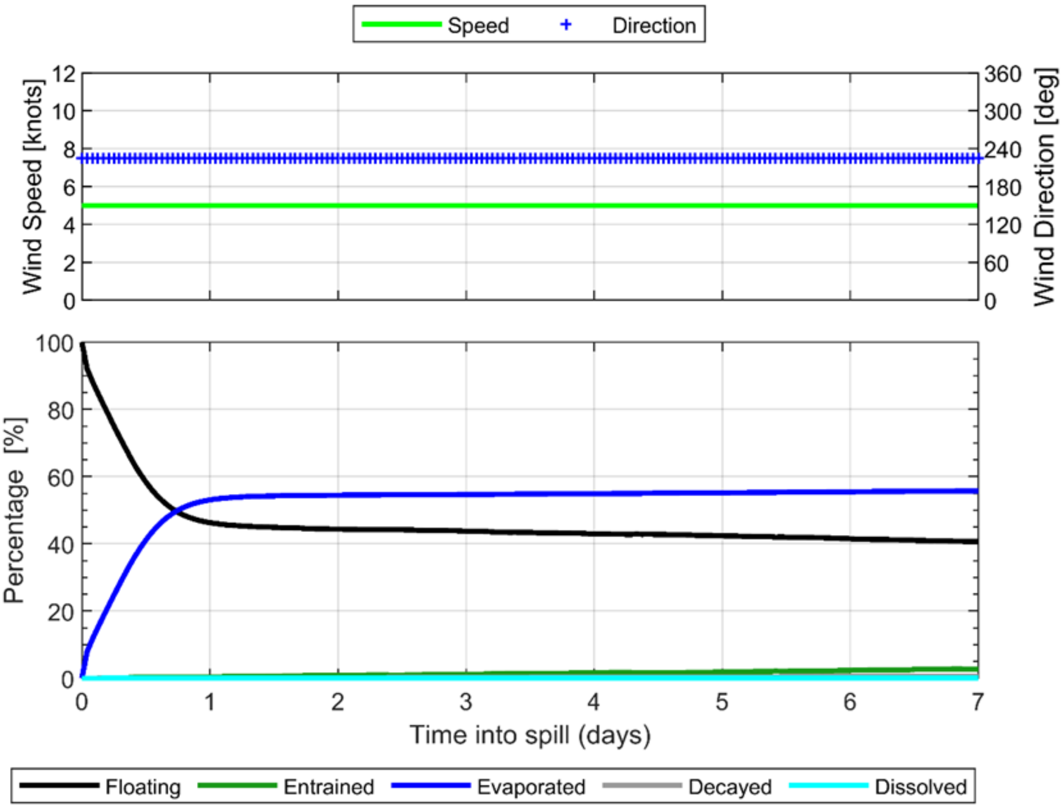


Figure 9-4: Proportional mass balance plot representing the weathering of Annie-2 condensate spilled onto the water surface over 1-hour and subject to a constant 5 knots wind speed at 15°C water temperature (RPS, 2024).

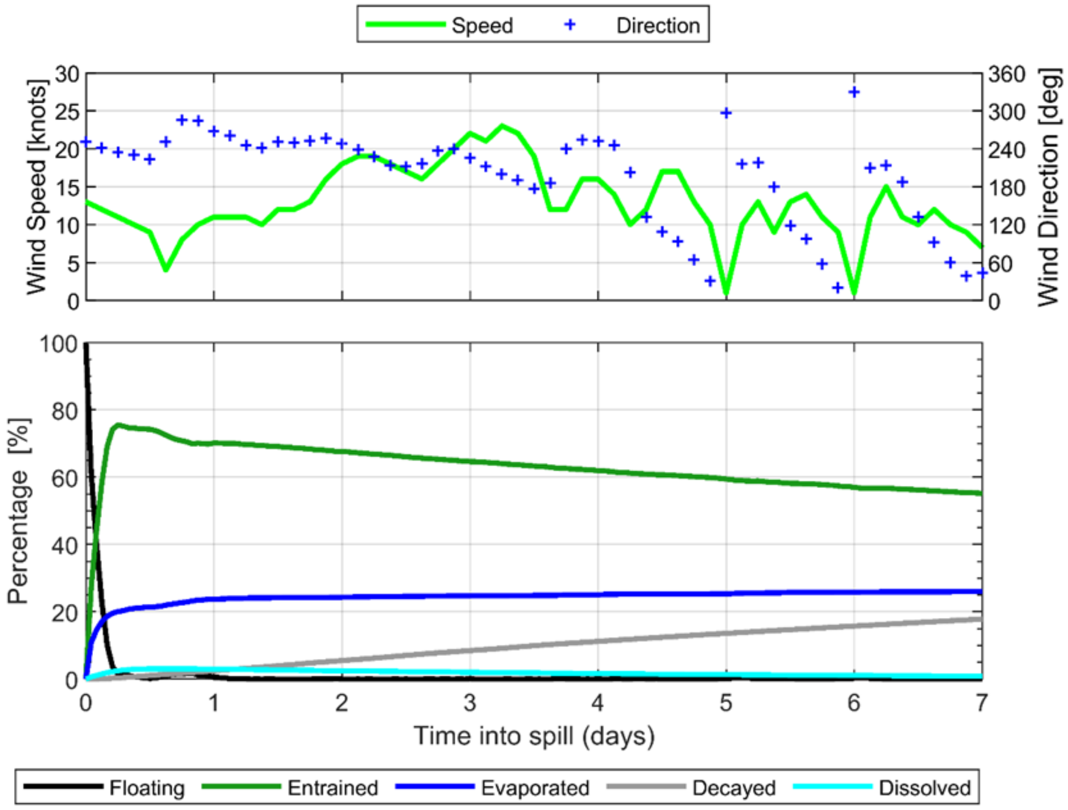


Figure 9-5: Proportional mass balance plot representing the weathering of Annie-2 condensate spilled onto the water over 1-hour and subject to variable wind speeds (1-23 knots) at 15°C water temperature (RPS, 2024).

9.6.3.3 Modelling Outputs

Table 9-32 provides a summary of the results from the stochastic modelling report provided in (RPS, 2024) for the maximum credible scenarios identified for the East Coast Project (see Table 9-29).

Figure 9-6 displays the LOWC EMBAs (Ecological, Social, and Monitoring) obtained from the stochastic modelling results (RPS, 2024). See Table 6-1 for further details on the EMBA descriptions and specific thresholds.

Table 9-32: Modelling Output Summary for LOWC

Exposure Values	Summary of worst-case predicted exposure
Floating	
Low **(1 g/m^2)**	Floating hydrocarbon at this level is expected to be visually detectable but not have ecological impacts. • Worst-case maximum distance from the source was predicted at Elanora-ST1 as 75.7 km. • Worst-case scenario could intersect with the Bonney Coast Upwelling KEF and the Twelve Apostles Marine Park (from Pecten East-2). • Would intersect with BIAs for seabird and cetacean species.
Moderate **(10 g/m^2)**	Floating hydrocarbon at this level has the potential to cause ecological impacts. • Worst-case maximum distance from the source was predicted at Pecten East-2 as 15.2 km. • Would intersect with BIAs for seabird and cetacean species. • Floating oil above this threshold is not predicted to reach Victorian State waters. • Floating oil above this threshold is not predicted to contact the Twelve Apostles Marine Park or the Bonney Coast Upwelling KEF.
Shoreline	

Low (10 g/m²)	Shoreline hydrocarbon at this level is expected to be visually detectable but not have ecological impacts. • The probability of shoreline accumulation is 100% at the following LGAs: ○ Apollo Bay, Colac Otway, Corangamite, Moyne and Bay of Islands • The worst-case minimum time to shore at or above the low threshold was predicted 0.96 day (from Annie-2). • The worst-case maximum total volume of hydrocarbon ashore was predicted from Pecten East-2 of 406.6 m^3. • The worst-case maximum length of hydrocarbon ashore was predicted as 295 km (from Elanora-ST1).
Moderate (100 g/m²)	Shoreline hydrocarbon at this level has the potential to cause ecological impacts. • The probability of shoreline accumulation is 100% at the following LGAs: ○ Corangamite. • The worst-case minimum time to shore at or above the moderate threshold was predicted in 1.25 days (from Annie-2). • The worst-case maximum length of hydrocarbon ashore at the moderate threshold 76 km (Pecten East-2).
In-Water – Dissolved	

Low (10 ppb)	Dissolved hydrocarbon at this level is not expected to have ecological impacts.
	• The worst-case minimum time to dissolved hydrocarbon exposure at any given receptor(s) was 0.42 days from Elanora-ST1.
	• Worst case scenario probabilities of intersect with the following conservation values and sensitivities:
	  ○ Bonney Coast Upwelling KEF (2%) at Pecten East-2
	  ○ West Tasmanian Canyons KEF (1%) at Elanora-ST1
	  ○ Apollo AMP (10%) at Elanora-ST1
	  ○ Twelve Apostles Marine Park (69%) at Pecten East-2
	  ○ Would intersect with BIAs for cetacean and shark species.

Moderate (50 ppb)	Dissolved hydrocarbon at this level has the potential to cause ecological impacts. • The worst-case minimum time to dissolved hydrocarbon exposure at any given receptor(s) was 5.79 days from Elanora-ST1. • Would intersect with BIAs for cetacean and shark species. • Low probabilities (1%) would intersect Victorian State Waters.
In-Water – Entrained	

Low (10 ppb)	Entrained hydrocarbon at this level is not expected to have ecological impacts.
	• The worst-case minimum time to entrained hydrocarbon exposure at any given receptor(s) was 0.04 day across all locations.
	• Worst case scenario probabilities of intersect with the following conservation values and sensitivities:
	  ○ Big Horseshoe Canyon (2%) at Pecten East-2
	  ○ Bonney Coast Upwelling KEF (73%) at Pecten East-2
	  ○ Canyons on the eastern Continental Slope (2%) at Pecten East-2
	  ○ Shelf rocky reefs (6%) at Pecten East-2
	  ○ Upwelling East of Eden (21%) at Pecten East-2
	  ○ West Tasmanian Canyons KEF (23%) at Pecten East-2
	  ○ Apollo (93%), Beagle (59%), East Gippsland (3%), Franklin (3%), Nelson (6%), and Zeehan (15%) at Pecten-East-2.
	• Would intersect with BIAs for cetacean and shark species.
	• Would intersect with New South Whales, South Australian, Tasmanian and Victorian State Waters.

High (100) ppb	Entrained hydrocarbon at this level has the potential to cause ecological impacts. • The worst-case minimum time to entrained hydrocarbon exposure at any given receptor(s) was 0.04 day from Elanora-ST1 and Pecten East-2.

	• Worst case scenario probabilities of intersect with the following conservation values and sensitivities: ○ Bonney Coast Upwelling KEF (19%) at Pecten East-2 ○ Apollo AMP (31%) at Pecten-East-2 ○ Twelve Apostles Marine Park (100%) at Pecten East-2. • Would intersect with BIAs for cetacean and shark species. • Would intersect with Victorian State Waters.

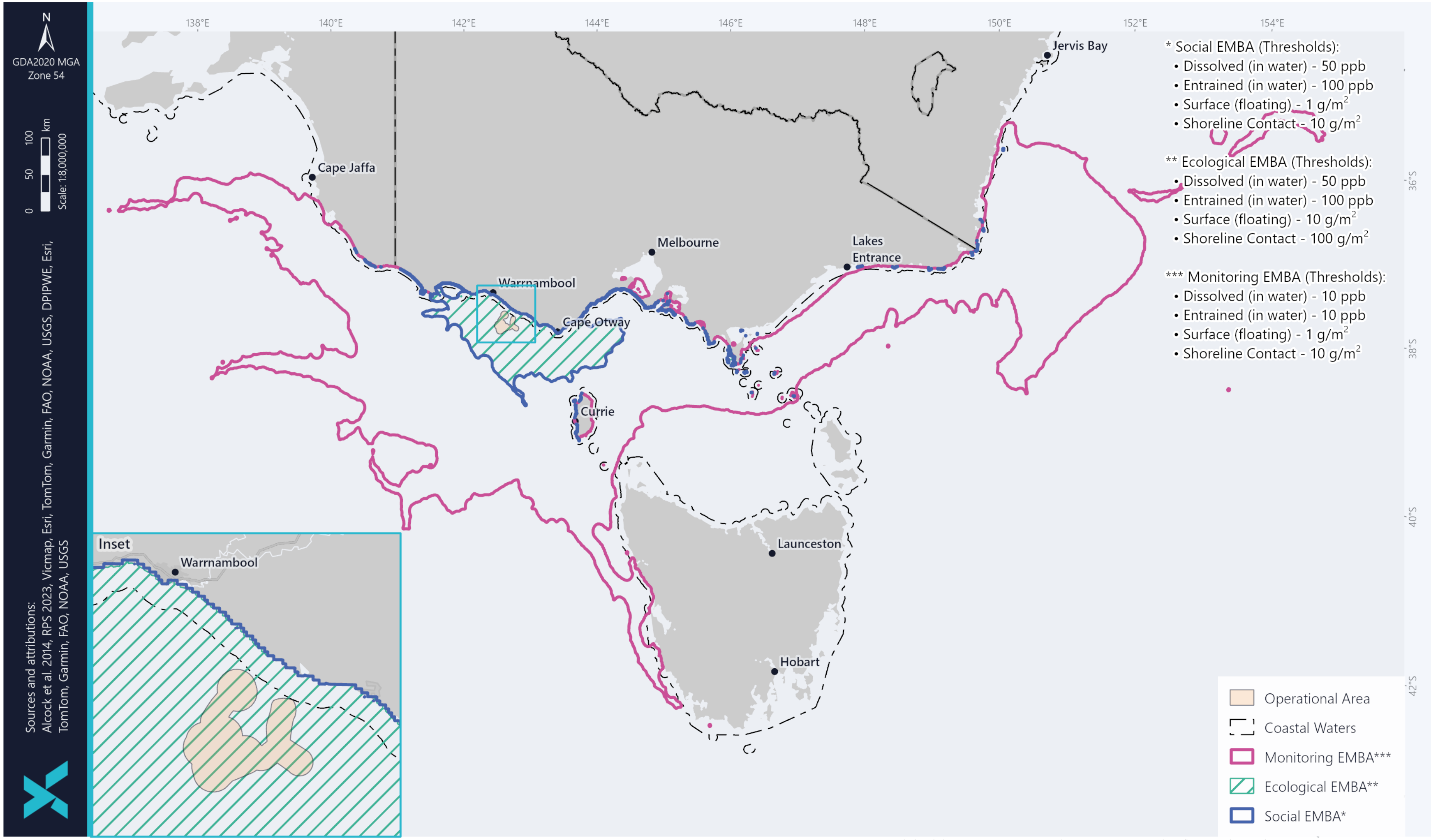


Figure 9-6: East Coast Project operational area and LOWC EMBAs (Ecological, Social and Monitoring) from the combined results of a subsea Loss of Well Control (LOWC) release of Annie-2 Condensate at Annie-2 (10,562 m3), Pecten-East-2 (13,239 m3), and Elanora-1 (16,

9.6.4 Predicted Environmental Impacts and/or Risks (Consequence)

Potential impacts from an accidental release of condensate are:

- Change in water quality.

Potential risk:

- Change in habitat
- Change in fauna behaviour
- Injury / mortality to fauna
- Change to the functions, interests, or activities of other users.

9.6.5 Impact and Risk Evaluation

The potential impacts on environmental receptors from hydrocarbon spills are summarised in Table 9-21 (in the MDO section). The below sections evaluate the potential impact from an accidental release of condensate for the East Coast Project in more detail. The Social EMBA and Ecological EMBA for Condensate spill modelling represents the area where hydrocarbons could occur above social or ecological impact thresholds (Figure 9-6). Only a fraction of the area within the EMBAs have the potential to be impacted from a given spill.

9.6.5.1 Impact: Change in Water Quality

Inherent Consequence Evaluation

An accidental release of condensate into the marine environment will result in a change in water quality. Annie condensate is classified as a light persistent hydrocarbon (Group II hydrocarbon), containing a high proportion of volatile components and only a small proportion of non-volatile (persistent) components.

Under constant wind, 52.4% of the condensate is expected to evaporate within 24 hours (Section 9.6.3.2).

Under the variable-wind case, where the winds are of greater strength on average, entrainment of condensate into the water column is shown to increase. Approximately 24 hours after the spill, 70.1% of the mass is shown to have entrained and a further 23.8% has evaporated, leaving only a small proportion floating on the water surface (<1%). Given the proportion of entrained condensate and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

A change in water quality is expected to be short-term based on the weathering behaviour described above. At the moderate threshold for floating hydrocarbons, the maximum spatial extent for any scenario is 12.7 km.

Given the nature of the hydrocarbon, the forecasted weathering processes, and the offshore metocean conditions, the area of exposure following a spill event is anticipated to be localised and short-term. The water quality of the area exposed to hydrocarbons is expected to return to pre-spill conditions relatively quickly following evaporation and dispersion into the water quality. Long-term adverse impacts to the water quality are not anticipated. Matters relating to potentially impacted receptors from a change in water quality are discussed for the specific receptors below.

Therefore, the predicted level of potential impact, i.e., the consequence of a change in water quality from an accidental release of condensate is evaluated as **Level 2**.

9.6.5.2 Risk: Change in Habitat

Inherent Consequence Evaluation

An accidental release of condensate into the marine environment has the potential to impact shoreline habitats if hydrocarbons accumulate within them. A moderate shoreline accumulation threshold has been identified as the concentration of hydrocarbons that could harm the fauna which inhabit the shoreline (i.e., shorebirds, marine invertebrates, and marine reptiles) based on studies for sub-lethal and lethal impacts (French et al. 1996 and French-McCay 2009).

The probability of accumulation on any shoreline at, or above, the low threshold was 100% throughout the year. The minimum time before oil accumulation at, or above, the low threshold was 1.17 days. The maximum total volume ashore for a single spill trajectory was 406.6 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 269.0 km (summer), 75.0 km (summer) and 6.0 km (winter), respectively.

Habitats that could be impacted by an unplanned release of condensate following a LOWC include:

- Rocky shorelines
- Sandy beaches
- Mangroves
- Saltmarshes
- Macroalgae
- Seagrass.

Table 9-33 describes the habitats that occur within the Ecological EMBA, the potential impact from a spill, and the resulting inherent consequence level for each type of habitat.

Table 9-33: Inherent Consequence Levels – Accidental release of condensate – Change in habitat

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
Shorelines - Rocky	The modelling predicted shoreline accumulation to occur at, or above, the low, moderate, and high thresholds at 100%, 100%, and 27% probabilities, respectively, for various shoreline locations (RPS, 2024). Shoreline contact at this threshold anticipated within 1.25 days for the worst-case credible modelled scenario. The worst-case maximum total volume of hydrocarbon ashore was predicted as 406.6 m^3. The modelling also predicted rapid evaporation during the first 24 hours following the release of condensate and depending on the weather conditions (i.e. wind speeds) the remainder of the condensate is predicted to readily entrain into the water column (more entrainment under higher wind speeds) (see Section 9.6.3.2).	The sensitivity of a rocky shoreline to oiling is dependent on a number of factors including its topography and composition, position, exposure to oceanic waves and currents etc. Exposed rocky shorelines have been shown to be less sensitive than sheltered rocky shorelines. Rocky shorelines provide habitats for invertebrates (e.g., sea anemones, sponges, sea-squirts, molluscs), and can also be utilised by some pinniped (haul-out sites) and bird species; noting that foraging and breeding/nesting typically occurs above high tide line (Section 6.5.8). Due to the tidal action and constant wave washing on this type of shoreline rapid weathering of any hydrocarbons in the intertidal area is expected and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline. Hydrocarbons can become concentrated as it strands ashore. However, most of the oil is concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA, 1995). See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function.	Level 3

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
Shorelines - Sandy	Sandy beaches are the predominant habitat type within the stretch of coast where shoreline contact could be expected from a LOWC event (i.e. between Port Fairy and east of Cape Otway). Therefore, sandy beaches have the potential to be exposed to hydrocarbons at, or above the low, moderate, and high threshold (RPS, 2024).	Sandy beaches are considered to have a low sensitivity to hydrocarbon exposure. Sandy beaches provide habitat for a diverse assemblage (although not always abundant) of infauna (including nematodes, copepods and polychaetes); and macroinvertebrates (e.g. crustaceans). The stretch of shoreline located at Corangamite was the area predicted to have the highest probability of shoreline accumulation from the worst-case scenario modelled, with 100% probability predicted for low, and moderate thresholds, and 27% for high threshold. The minimum time before shoreline accumulation ranged from 2 days to 42 days for the low to high thresholds, with a maximum volume of 238 m^2 predicted ashore (RPS, 2024). This stretch of shoreline is dominated by sandy habitats. The modelling predicted rapid evaporation during the first 24 hours following the release of condensate and depending on the weather conditions (i.e. wind speeds) the remainder of the condensate is predicted to readily entrain into the water column (more entrainment under higher wind speeds) (see Section 9.6.3.2). Therefore, as the volatile components of the hydrocarbon weathers, the risk of exposure decreases. Given the low viscosity of this residue it is likely to permeate into sand areas in a similar way to MDO. The tides and constant wave washing are expected to lead to rapid weathering of any hydrocarbons in the intertidal area and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline. A sandy beach may also allow oil to percolate through the sand, thus increasing its ability to hold more oil ashore over tidal cycles and various wave actions than an equivalent area of water; hence oil can increase in thickness onshore over time. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to habitats of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Mangroves	Mangroves are not a dominant habitat found within the area potentially exposed to hydrocarbons. However, a few isolated patches of mangroves can be found along the Victorian coastline, predominantly with inlets or bay (Section 6.5.2). These mangroves have the potential to be	Mangroves are considered to have a high sensitivity to hydrocarbon exposure. Hydrocarbon can enter mangrove forests when the tide is high and be deposited on the aerial roots and sediment surface as the tide recedes. Physical covering of the trees' breathing pores, thus asphyxiating the subsurface roots, which depend on the pores for oxygen.	Localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function.	Level 3

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
	exposed to hydrocarbons within the ecological EMBA (RPS, 2024).	The change in toxicity levels within the marine environment can penetrate the root surfaces, via the respiratory capabilities of the roots, poisoning the plant. Mangroves can also take up in-water hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death (Wardrop et al., 1987). However, heavy oil coating is unlikely due to the highly volatile nature of the condensate hydrocarbon. As the volatile components evaporate and the minimal remaining oil weathers, the oil will resolidify, and the risk of exposure decreases. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		
Saltmarsh	Saltmarsh is within some estuaries and inlet/riverine systems along the Victorian coastline, and which occur within the EMBAs. Modelling predicted hydrocarbon exposure at, or above the low, moderate, and high threshold predominantly between Port Fairy and east of Cape Otway along the Victorian coastline, a shoreline accumulation at the low threshold along the west coast of King Island (RPS, 2024). Some of the saltmarsh habitat along this coast will be representative of the Subtropical and Temperate Saltmarsh TEC (see Section 6.6.7 for further details).	Saltmarsh is considered to have a high sensitivity to hydrocarbon exposure. Hydrocarbon (in liquid form) will readily adhere to the marshes, coating the stems from tidal height to sediment surface. However, heavy oil coating is unlikely due to the highly volatile nature of the condensate hydrocarbon. As the volatile components evaporate and the minimal remaining oil weathers, the oil will resolidify, and the risk of exposure decreases. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function.	Level 3
Macroalgae	Macroalgae could be exposed to in-water hydrocarbons according to modelling results. In-water hydrocarbon exposure in nearshore, intertidal, and subtidal areas is predicted to occur at moderate thresholds for dissolved hydrocarbons, with some sites (such as Colac Otway, Corangamite and Cape Otway) predicted to be exposed to high thresholds of entrained (RPS, 2024).	In-water exposure (entrained and dissolved) is only predicted to occur within the upper 0–10 m of the water column; therefore, benthic habitats, such as macroalgae, within intertidal or shallow nearshore waters has the potential to be exposed. The physical effects of smothering, fouling and asphyxiation has been documented from oil contamination in marine plants such as macroalgae (Lewis and Pryor, 2013). A review of field studies conducted after spill events by Connell et al. (1981) indicated a high degree of variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy hydrocarbon exposure.	Localised short-term impacts to habitats of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
	Exposure to entrained hydrocarbons at the high threshold level are only predicted within Victorian State Waters, not within Tasmanian State waters.	As a light, non-persistent hydrocarbon, the impacts of condensate are expected to be less since the toxicity of light hydrocarbons declines as the volatile components weather. The highest level of toxicity is anticipated to be at the site of the release; any exposure of macroalgae to hydrocarbons is anticipated to have been weathered. Intertidal macroalgal beds are more prone to effects from oil spills than subtidal beds because, although the mucous coating prevents oil adherence, oil that is trapped in the upper canopy may be more persistent, which can impact site-attached species. (IPIECA 2002). Given the restricted range of exposure (shallow nearshore and intertidal waters only) and the predicted lower concentrations of hydrocarbons expected to be in these waters, any impact to macroalgae is not expected to result in long-term or irreversible damage. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		
Seagrass	Seagrass meadows may be present within the Ecological EMBA (condensate). Hydrocarbon exposure in nearshore and intertidal areas is predicted to occur mostly at moderate thresholds for dissolved hydrocarbons, with some sites (such as Colac Otway, Corangamite and Cape Otway) predicted to be exposed to high thresholds of entrained for the worst-case scenario modelled (RPS, 2024). Exposure to entrained hydrocarbons at the high threshold level are only predicted within Victorian State Waters, not within Tasmanian State waters.	Benthic habitats, such as seagrass meadows, within intertidal or shallow nearshore waters has the potential to be exposed to in-water exposure (entrained and dissolved) is only predicted to occur within the upper 0–10 m of the water column. Seagrass ecosystems exposed to hydrocarbons can result in direct mortality from smothering. Also, petroleum fractions may be absorbed into the seagrass tissues, which can then lower the organism's tolerance to other stressors and reduce growth rates (Zieman et al., 1984). Given the restricted range of exposure (shallow nearshore and intertidal waters only) and the predicted lower concentrations of hydrocarbons expected to be in these waters, any impact to seagrass is not expected to result in long-term or irreversible damage. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to habitats of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Summary

The potential consequence to habitats from an accidental release of condensate is assessed as **Level 3** based on the potential for localised medium-term impacts to species or habitats of recognised conservation value or to local ecosystem function.

Inherent Likelihood

An assessment of historical LOWC incidents was undertaken using the IOGP Risk Assessment Data Directory (2019). Blowout events during development drilling has been reported at a frequency for a gas well of 4.2 x 10^{-5} per drilled well: for development drilling operations of North Sea standard (IOGP, 2019). This frequency is based on two blowout incidents occurring in the UK between 1980 and 2014 during development drilling (IOGP, 2019); and represents the frequency of the cause (i.e., LOWC); additional environmental factors would be necessary for the worst-case consequences to habitats to eventuate.

Cooper Energy implements industry standard practice in well design and construction. In the context of the Australian regulatory regime, well operations management plans describe the design, construction, operation and decommissioning of each offshore well; through the development of this plan industry lessons and improvements in practice are adopted as appropriate. In the company's history operating within Australia, it has not experienced any LOWC events or LOC incidents from its subsea wells.

There are multiple levels of control measures to prevent a Subsea LOWC. These controls are checked and tested via various assurance activities; it would require multiple failures at each level of the control hierarchy for an LOWC to eventuate. Consequently, it is considered **Unlikely (D)** that a LOWC would occur that as a rare combination of factors would be required for an occurrence; the event is conceivable and could occur at some time; and could occur during the activity.

There are a number of potential failure modes which have the potential to result in a LOC from a flowline; these include external impact and corrosion. Each potential failure mode, and preventative measures is described within the facility integrity management plan. The facility integrity management plan also assigns a likelihood to each potential failure mode, termed frequency / probability of failure. Therefore, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of a subsea LOC causing a change in habitat is considered **Unlikely (D).**

Inherent Risk Severity

The inherent risk severity of an accidental release of condensate causing impacts to habitat is considered **Moderate**.

9.6.5.3 Risk: Change in Fauna Behaviour

Inherent Consequence Evaluation

An accidental release of condensate into the marine environment has the potential to impact the behaviour of certain marine fauna within the environment. Marine fauna that has been shown to exhibit changes to behaviour include:

- Fish
- Seabirds and shorebirds
- Marine reptiles
- Marine mammals.

Table 9-34 describes the presence of marine fauna within the Ecological EMBA, the potential impact and the resulting inherent consequence level for each type.

Table 9-34: Inherent Consequence Levels – Accidental release of condensate – Change in fauna behaviour

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
Fish	Several fish species may be present within the ecological EMBA (see Section 6.5.5 for all EPBC-listed fish species). BIAs overlapped are: • distribution and foraging BIA for the white shark.	Multiple fish species are listed on the EPBC Act PMST were identified to occur within the Ecological EMBA (LOWC) (Section 6.5.5). Sub-lethal behavioural impacts in adult fish have been shown to include behavioural modifications, including alterations in feeding, migration, reproduction, swimming, schooling, and burrowing behaviour (Kennish, 1996). However, generally these species are highly mobile species, and their patterns of movements makes it unlikely for them to remain within the area long enough to be exposed to hydrocarbons to experience sub-lethal impacts (ITOPF, 2010). Furthermore, the modelling predicted that majority of the condensate would evaporate within a few days following a release (see Section 9.6.3.2); therefore, reducing the potential of exposure to fish species that may be present within the EMBA. There is a known distribution and foraging BIA for the white shark in the area exposed to in-water hydrocarbons (RPS, 2024), however, given their range of movement throughout the water column and between coastal and offshore waters, it is not expected that individuals would be exposed for long periods to the higher concentrations predicted in surface water layers (within the 0-10 m water depth) within the slick extent. Pelagic species are generally highly mobile, with wide-spread distribution ranges. Therefore, these species are not likely to be severely impacted from the temporary avoidance that may occur following a spill event. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Seabirds and shorebirds	Several threatened, migratory and/or listed marine seabirds or shorebirds species may be present within the Ecological EMBA (LOWC) (Section 6.5.7). Several foraging BIAs for several albatross, shearwater and petrel species was identified within ecological EMBA.	Shoreline accumulation following a spill event from a LOWC, may cause disruption to foraging habitats identified for shorebirds and migratory birds (see Section 6.5.7). Shoreline impacts are not anticipated above the high tide mark, therefore, will not impact breeding areas available. Impacts to these species are not anticipated to be long-term or affect population functioning due to the widespread areas available for foraging and breeding, the transitory nature of	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
	• Antipodean albatross • Wandering albatross • Buller's albatross • Indian yellow-nosed albatross • Shy albatross • Campbell albatross • Black-browed albatross • Common diving-petrel • White-faced storm-petrel • White-tailed shearwater • Short-tailed shearwater • Australasian gannet. Breeding BIAs were also identified within the Ecological EMBA: • Short-tailed shearwater • Wedge-tailed shearwater. see Section 6.5.7 for further details.	foraging birds, , and the weathering properties of the condensate. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.		
Marine reptiles	There may be marine turtles in the area predicted to be exposed to surface hydrocarbons at moderate exposure levels. However, there are no BIAs or habitat critical to the survival of the species within this area. Four of the five EPBC listed species which have the potential to be present within the area were identified to be present within the Ecological EMBA, these include: loggerhead, green, leather back and hawksbill turtle (see Section 6.5.6 for further details). Marine turtles may be exposed to hydrocarbon when transiting through the in-water hydrocarbons, surfacing to breathe within the surface slick.	Marine turtles which are within the area could be displaced by a release of condensate into the marine environment. However, there are no BIAs or habitat critical to the survival of species within the shoreline or environment potentially affected. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
Marine mammals - Pinnipeds	There may be pinnipeds in the area predicted to affected by surface hydrocarbons at moderate exposure levels (Section 6.5.8). Pinnipeds that are present within the Ecological EMBA (LOWC) have the potential to be impact by surface hydrocarbons when surfacing to breathe, in-water hydrocarbons when transiting through the area, and shoreline accumulated hydrocarbons that occur at haul-out sites along the coastline. No BIAs or habitat critical to the survival of species for pinnipeds were identified within the Ecological EMBA (LOWC).	Pinnipeds present within the area exposed to shoreline accumulation may be displaced from haul-out sites or have movement affected to avoid areas exposed to entrained and dissolved hydrocarbons. Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water. However, impacts to pinnipeds at a population level are considered very unlikely given the localized and temporary presence of hydrocarbons at relevant thresholds, the absence of haul out sites within or near the operational area, the transient, highly mobile nature of pinnipeds, over typically extensive foraging grounds. There are no BIAs or habitat critical to survival of species within the EMBAs. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised medium-term impacts to species of recognised conservation value but not affecting local ecosystem functioning.	Level 3
Marine mammals - Cetaceans	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the Ecological EMBA (Section 6.5.8). The following BIAs are within the area exposed to hydrocarbons at moderate exposure levels (Ecological EMBA): • Pygmy blue whale known foraging and distribution BIA • Southern right whale migration and reproduction BIAs.	A condensate spill could disrupt natural behaviours and displace animals. It has been stated that pelagic species, such as cetaceans, will avoid hydrocarbon (Geraci 1988), mainly because of its noxious odours, but this has not been proven. Certain whales, particularly those with coastal migration and reproduction, can display strong site fidelity to specific resting, breeding and feeding habitats, as well as to their migratory paths, subsequently these species may be affected more. However, the strong attraction to specific areas for breeding or feeding (e.g., use of the Warrnambool coastline as a nursery area for southern right whales) may override any tendency for cetaceans to avoid the noxious presence of hydrocarbons. However, the potential extent of hydrocarbon exposure is significantly smaller than the extent of the BIAs for each species and their much broader range. Cetaceans are highly mobile, pelagic species, with wide-spread distribution ranges, therefore, it is unlikely that individuals will be severely impacted from the temporary displacement that may occur following a LOWC. See Table 9-21 for further details on the potential impacts of hydrocarbon exposure on this receptor.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Summary

The potential consequence to marine fauna from an accidental release of condensate event is assessed as **Level 3** based on the potential for localised and short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.

Inherent Likelihood

Blowout events during development drilling has been reported at a frequency for a gas well of 4.2 x 10^{-5} per drilled well (IOGP, 2019). This represents the frequency of the cause (i.e., a LOWC); additional environmental factors would be necessary for the worst-case consequences to species of recognised conservation value to eventuate.

Due to the nature of this activity, and based on previous occurrences, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of an accidental release of condensate causing **Level 3** consequences to fauna behaviour is considered **Unlikely (D)**.

Inherent Risk Severity

The inherent risk severity of an accidental release of condensate causing impacts to fauna behaviour is considered **Moderate**.

9.6.5.4 Risk: Injury/Mortality to Fauna

Inherent Consequence Evaluation

An accidental release of condensate into the marine environment has the potential to result in injury and/or mortality to marine fauna within the vicinity. In general, moderate thresholds of surface and moderate to high of in-water hydrocarbons (dissolved and entrained) have been shown to cause sub-lethal and lethal ecological impact (French et al. 1996 and French-McCay 2009). The marine fauna that may be present within the Ecological EMBA and impacted by an accidental release of condensate include:

- Plankton
- Invertebrates
- Fish
- Seabirds and shorebirds
- Marine reptiles
- Marine mammals.

Table 9-35 provides details on the presence of marine fauna within the Ecological EMBA, the potential impact and the resulting inherent consequence level for each type.

Table 9-35: Inherent Consequence Levels – Accidental release of condensate – Injury / mortality to fauna

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
Plankton	Plankton is found in nearshore and open waters in the water column. Plankton population distributions are expected to be highly variable both spatially and temporally and are likely to comprise characteristics of tropical, southern Australian, central Bass Strait and Tasman Sea populations (see Section 6.5.3). Therefore, plankton populations may be present within the area potentially exposed to hydrocarbons in the Ecological EMBA (LOWC).	Injury/mortality to planktonic species may occur due to a change in water quality following an unplanned hydrocarbon release Plankton are likely to be exposed to in-water hydrocarbons within the upper 0 – 10 m of the water column. Effects will be greatest in the area close to the spill source where hydrocarbon concentrations are likely to be highest. These organisms migrate vertically through the water column to feed in surface waters at night (NRDA, 2012). As they move close to the sea surface it is possible that they may be exposed to surface hydrocarbons, however, the potential impacts from in-water exposure (dissolved or entrained) will be greater.	Localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2
Benthic assemblages	Benthic assemblages are made up of the seabed substrates and biological communities which inhabit the seabed. The assemblages within the shallow depth close to shore consisted of kelp reef, red and brown algae; offshore there are areas of hard substrates which is home to a range of epifauna including sponges, ascidians, crustaceans, polychaetes and bivalve molluscs.	The few benthic organisms that colonise the well equipment post installation could be exposed to in-water hydrocarbons as the subsea plume rises from the opening of the well, through the water column. However, the benthic assemblages which are identified to occur within the shallow water environment (0-8 m) are the main species which may be impacted by exposure to hydrocarbons, as in-water exposure of hydrocarbon is only expected to occur within the upper 0–10 m of the water column (see Section 6.5.1). Exposure in nearshore, intertidal and subtidal areas is predicted to occur mostly in low for dissolved and entrained hydrocarbons, moderate thresholds for dissolved, with some sites predicted to be exposed to high thresholds of entrained for the worst-case scenario modelled (RPS, 2024). No exposure at high thresholds was predicted for dissolved in-water hydrocarbons from either scenario (RPS, 2024). Benthic assemblages within the intertidal area may be exposed moderate, and greater threshold in the event of a condensate spill scenario. Water quality in benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within weeks to months of contact. Furthermore, due to the physical properties of the hydrocarbons and the well-mixed nature of the waters of the EMBA, coating of	Localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
		benthic assemblages and prolonged exposure to hydrocarbons is considered unlikely.		
Invertebrates	Marine invertebrates identified within the region, including commercially important species, could be impacted by in-water exposure of hydrocarbons within the upper 0–10 m of the water column. The highest diversity of marine invertebrate species is generally found within water depths deeper than 10m. However, shallower inshore sediment sampling by Parry et al. (1990) also demonstrated high diversity, although patchy distribution, within shallow waters, with crustaceans, polychaetes and molluscs being the dominant species (Section 6.5.4).	Exposure in nearshore and intertidal areas is predicted to occur at low thresholds of dissolved and entrained, moderate thresholds of dissolved, with some sites predicted to be exposed to high thresholds of entrained for the worst-case scenario modelled. No exposure at high thresholds was predicted for dissolved in-water hydrocarbons from either scenario (RPS, 2024). Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms. Impacts to some adult species (e.g. crustaceans) is reduced because of the presence of an exoskeleton, while others with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact recruitment. Water quality in benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within weeks to months of contact.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Fish	Several fish species may be present within the Ecological EMBA (LOWC) (Section 6.5.5). BIAs identified within the Ecological EMBA are: • Distribution and foraging BIA for the white shark	Any pelagic fish and shark species that occupy the water column, specifically within the upper 0–10 m of the water column the surface layers of the water column (where in-water hydrocarbon exposure is predicted), are more susceptible to entrained and dissolved hydrocarbons. Since fish and sharks do not generally break the sea surface, the impacts of surface hydrocarbons to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Volkman et al. 2004).	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2
Seabirds and shorebirds	Several threatened, migratory and/or listed marine seabirds or shorebirds species may be present within the Ecological EMBA (LOWC) (Section 6.5.7). Several foraging BIAs for several albatross, shearwater, petrel and gannet species were identified within Ecological EMBA:	Birds have the potential to be rafting, resting, diving and feeding within the area predicted to be contacted by surface hydrocarbons; diving or foraging within in-water hydrocarbons; and foraging and nesting within shoreline exposure. The presence of birds within in-water hydrocarbons at moderate exposure levels is expected to be limited due to the transitory nature of foraging individuals limited extent of oil at levels which could have ecological effects. Shoreline accumulation would be expected to concentrate along the high tide mark while the lower/upper parts are often untouched	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.	Level 3

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
	• Antipodean albatross • Wandering albatross • Buller's albatross • Indian yellow-nosed albatross • Shy albatross • Campbell albatross • Black-browed albatross • Common diving-petrel • White-faced storm-petrel • White-tailed shearwater • Short-tailed shearwater • Australasian gannet. Breeding BIAs were also identified within the Ecological EMBA: • Short-tailed shearwater • Wedge-tailed shearwater.	(IPIECA, 1995). As breeding activities of shorebirds and seabirds generally occurs above the high tide mark, exposure of breeding and nesting birds to hydrocarbons is considered unlikely to occur.		
Marine reptiles	There may be marine turtles in the area predicted to be exposed to hydrocarbons at relevant exposure levels. However, there are no BIAs or habitat critical to the survival of the species within this area. Four of the five EPBC listed species which have the potential to be present within the area were identified to be present within the ecological EMBA, these include: loggerhead, green, leather back and hawksbill turtle (Section 6.5.6). Marine turtles may be exposed to hydrocarbon when transiting through the in-water hydrocarbons, surfacing to breathe within the surface slick.	Hydrocarbons can be ingested via the inhalation of toxic vapours at the surface waters which may cause harm to the internal organs of turtles. The area exposed by moderate levels of surface hydrocarbons from a LOWC event is limited to offshore open waters (15 km from release location) over a maximum period of 104 days at the worst-case scenario (RPS, 2024). Oiling has the potential to cause mortality depending on the size of the individual and the extent of oiling (DWH Natural Resource Damage Assessment Trustees, 2016). The number of marine turtles that may be exposed to hydrocarbons during a LOWC event is expected to be low due to the localised and temporary presence of hydrocarbons at moderate exposure levels, the low number of turtles moving through Bass Strait in general, and the absence of BIAs or habitat critical to the survival of the species within this area. The potential impact would be limited to individual transiting marine turtles, with no population level impacts anticipated.	Localised short-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.	Level 2

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
Marine mammals - Pinnipeds	There may be pinnipeds in the area predicted to affected by surface hydrocarbons at moderate exposure levels (Section 6.5.8). Pinnipeds that are present within the Ecological EMBA (LOWC) have the potential to be impacted by surface hydrocarbons when surfacing to breathe, in-water hydrocarbons when transiting through the area, and shoreline accumulated hydrocarbons that occur at haul-out sites along the coastline. No BIAs or habitat critical to survival of species for pinnipeds were identified within the EMBA (Section 6.5.8).	Exposure to surface hydrocarbons at, or above the moderate threshold can cause skin and eye irritations and disruptions to thermal regulation due to covering of insulating fur. The area exposed by moderate levels of surface hydrocarbons from a LOWC event is limited to offshore open waters (~15 km from the release site) over a maximum period of 104 days. Hydrocarbons within the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds. Given condensate is considered a light hydrocarbon that rapidly evaporates, the absence of BIAs within the impacted area and the transient, highly mobile nature of the species, over typically extensive foraging grounds; impacts to pinnipeds at a population level are considered very unlikely.	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.	Level 3
Marine mammals - Cetaceans	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the Ecological EMBA (LOWC) (Section 6.5.8). The following BIAs are within the area exposed to hydrocarbons at moderate exposure levels (Ecological EMBA): • Pygmy blue whale known foraging and distribution BIA • Southern right whale migration and reproduction BIAs. .	Surface hydrocarbons are anticipated to extend for a maximum of ~75 km and 15 km at the low and moderate thresholds in the worst-case scenario modelled. No surface exposure at the high threshold was modelled for any scenario (RPS, 2024). Inhalation of surface hydrocarbons could damage mucous membranes, damage airways, or even cause death. Furthermore, ingestion of contaminated prey could cause toxic impacts. If whales are foraging at the time of the spill, potential exposure to moderate levels of surface hydrocarbons is expected to be limited to transient individuals given the localised moderate exposure area (<15 km from the release site). In-water hydrocarbons are mostly predicted to occur at low thresholds of dissolved and entrained (100%), with low probabilities of moderate thresholds of dissolved, and a few sites with high thresholds of entrained for the worst-case scenario modelled. No exposure at high) thresholds was predicted for dissolved in-water hydrocarbons from either scenario (RPS, 2024). Cetaceans exposed to entrained hydrocarbons be physically coated, as well as inject oil (Geraci and St Aubin, 1988). Physical impacts from ingested hydrocarbon with subsequent lethal or sub-lethal impacts are possible with entrained oil.	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function.	Level 3

Receptor	Presence within Ecological EMBA	Potential impact	Description of consequence	Inherent consequence
		As highly mobile animals, in general it is very unlikely that cetaceans will be constantly exposed to concentrations of hydrocarbons in the water column for continuous durations (e.g., >96 hours) that would lead to chronic toxicity effects. Low levels of surface hydrocarbons could occur within the southern right whale aggregation BIA from Port Fairy/Warrnambool.		

Summary

In the unlikely event of a LOWC, the volume of hydrocarbons released would result in a reduction in water quality with the potential to impact marine fauna. Marine fauna present in the area may be potentially impacted by a spill through exposure to surface and in-water (entrained and dissolved) hydrocarbons.

Impacts from a LOWC release would be greatest within several kilometres from the spill when the toxic aromatic components of the condensate will be at their highest concentration and when the hydrocarbon is at its thickest on the surface of the receiving waters. Upon release to the marine environment, the condensate will lose toxicity with time and will spread thinner at the surface as evaporation continues or will become entrained within the water column. The potential sensitive receptors in the surrounding areas of the spill will include plankton, invertebrates, benthic assemblages, fish, marine mammals, marine reptiles and seabirds at the sea surface (Table 9-35).

The worst-case consequence to marine fauna from an accidental release of condensate event is assessed as **Level 3** based on the potential for localised and medium-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning.

Inherent Likelihood

Blowout events during development drilling has been reported at a frequency for a gas well of 4.2 x 10^{-5} per drilled well (IOGP, 2019). This represents the frequency of the cause (i.e. a LOWC); additional environmental factors would be necessary for the worst-case consequences to marine fauna to eventuate.

Due to the nature of this activity, and based on previous occurrences, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of an accidental release of condensate causing **Level 3** consequences to marine fauna is considered **Unlikely (D)**.

Inherent Risk Severity

The inherent risk severity of an accidental release of condensate causing a Level 3 impact to marine fauna is considered **Moderate**.

9.6.5.5 Risk: Changes to the Functions, Interests, or Activities of Other Users

Inherent Consequence Evaluation

The accidental release of condensate into the marine environment has the potential to affect the functions, interests, or activities of other users of the sea. Risk assessments often use the conservative low threshold levels of hydrocarbon exposure, specifically floating hydrocarbon threshold (1 g/m^2), shoreline accumulation threshold (10 g/m^2), and entrained/dissolved thresholds (10 ppm) to assess socio-economic impacts. These thresholds are considered the levels which could trigger temporary closures of areas (i.e., fishing grounds, shorelines) as a precautionary measure due to the visibility of the hydrocarbon on the sea surface or shoreline. These thresholds may also trigger the need for shoreline clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.) depending on the socio-economic value of the shoreline (French-McCay et al. 2005a; 2005b).

Functions, interests, or activities of other users that may be present within the Social EMBA include:

- Conservation values and sensitivities:
  - World and National Heritage Areas
  - Australian Marine Parks
  - Wetlands
  - State Parks and Reserves
  - Key Ecological Features
  - TECs.

- Socio-economic environment:
  - Coastal settlements
  - Commercial fisheries
  - Other offshore industry
  - Recreation and tourism.

Table 9-36 provides details on the presence of receptors within the Social EMBA, the potential impact and the resulting inherent consequence level for each type.

Table 9-36: Inherent Consequence Levels – Accidental release of condensate – Changes to the functions, interests and activities of other users

Receptor	Presence within Ecological or Social EMBA	Potential impact	Description of consequence	Inherent consequence
Conservation values and sensitivities				
World and National heritage areas	Modelling predicted World and National heritage areas could be contacted by hydrocarbon exposure within the Social EMBA: • Great Ocean and Scenic its Environs • Point Nepean Defence Sites and Quarantine Station Area • Commonwealth Heritage Places: HMAS Cerberus Marine and Coastal Area. • Deen Maar - Tyrendarra Area, Yambuk, VIC, Australia.	The values identified of these World and National heritage areas have the potential to be exposed to shoreline hydrocarbons at, or above, the low threshold. Visible shoreline hydrocarbons may have the potential to reduce the visual social and cultural amenity of the area temporarily. Given the non-persistent nature of the hydrocarbon, waves and tidal action are anticipated to continue the weathering process if shoreline contact occurs. Refer to potential impact to habitats (Section 9.6.5.2) and coastal settlements (below).	Localized and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2
AMPs	Modelling predicted one AMP could be contacted by hydrocarbon exposure within the Social EMBA (LOWC): • Apollo AMP (Multiple Use Zone (IUCN VI)). The major conservation values for this AMP have been identified within Section 6.6.3 of the OPP and include foraging areas for some EPBC listed species of birds (e.g. petrels, shearwaters, albatross), and cetaceans (e.g. Pygmy Blue and Southern Right Whales). Furthermore, this marine park is associated with unique seafloor features, which influence the formation of large eddies mixing warm waters with cool nutrient-rich waters increasing marine biodiversity (see Section 6.6.3).	The modelling did not predict contact by surface hydrocarbons for Apollo AMP, at or above the low threshold, in the event of a LOWC. However, values identified with the AMP may have the potential to be impacted by surface hydrocarbons at the relevant thresholds outside of the AMP. Seabirds are a value which has been identified for this AMP that may be impacted by surface hydrocarbons by rafting, resting, diving or feeding within the surface slick. Impact to seabirds from direct or indirect exposure to surface hydrocarbons may cause a subsequent negative impact to the value of the AMP, however any impact is expected to be limited to a small number of individuals, with no impacts to regional populations. The values identified within this AMP have the potential to be exposed to entrained hydrocarbons at, or above, the moderate threshold in the event of a LOWC (RPS, 2024). However, the exposure of entrained hydrocarbons will be greatest within the upper 0-10 m of the water column and areas close to the spill source. The Apollo AMP is located within waters 80-120 m; therefore, conservation values within this AMP, such as ecosystems, habitats and sea-floor features are not predicted to be impacted. The Apollo AMP includes important foraging areas for seabirds. There is a low probability that seabirds would forage only within the area exposed to hydrocarbons given their extensive foraging	Localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning.	Level 3

Receptor	Presence within Ecological or Social EMBA	Potential impact	Description of consequence	Inherent consequence
		grounds. Therefore, there is a chance that foraging seabirds will experience sub-lethal impacts from consuming contaminated prey, however, impacts will be limited to individuals and are not expected to cause impacts at a population-level. The Apollo AMP also overlaps areas where cetaceans could be moving through (i.e. humpback, blue, fin, and sei whales) (see Section 6.6.3). As cetaceans are highly mobile pelagic animals, they are unlikely to be within the exposure area 0-10 m of the water column for prolonged periods of time. Refer to potential impact to marine fauna (Sections 9.6.5.3 and 9.6.5.4) and to habitats (Section 9.6.5.2).		
Wetlands	Modelling predicted 5 internationally important Ramsar wetlands could be contacted by hydrocarbon exposure within the Social EMBA (LOWC), including: • Port Phillip Bay (Western Shoreline) and Bellarine Peninsula • Corner Inlet • Western Port • Glenelg Estuary and Discovery Bay Wetlands • Lavinia. Additional wetlands of national importance are also identified within the Social EMBA. The major values for these wetlands have been identified within Section 6.6.4 of the EP. Furthermore, a number of these wetlands are associated with First Nations cultural values (see Section 6.6.4).	Wetlands, including internationally important Ramsar wetlands, are saline marsh areas and estuarine environments that are a continuation from the marine environment. Therefore, depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands, potentially impacting the aesthetic and ecological value of the wetland. Wetlands have the potential to be exposed to shoreline hydrocarbons. Shoreline hydrocarbon exposure at, or above, the low threshold may impact the key receptors of wetlands (e.g. waterbirds, fish and invertebrates) which may cause a subsequent negative impact to the value of the wetland, however, is expected to be limited to a small number of individuals, with no impacts to regional populations. Refer to potential impact to marine fauna (Sections 9.6.5.3 and 9.6.5.4) and to habitats (Section 9.6.5.2) and First Nations heritage (Section 6.8.3.7).	Localised and medium-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 3
State parks and reserves	The modelling identified 21 State Protected Areas present within the Social EMBA being exposed to, at or above, low thresholds of shoreline hydrocarbon accumulation, which include marine parks, marine sanctuaries, marine and coastal parks, marine reserves and national parks. The Twelve Apostles Marine National Park, Marengo Reefs, Merri and The Arches Marine	The values identified within the identified State Protected Areas that have the potential to be exposed to surface hydrocarbons at, or above, the low threshold. Visible surface hydrocarbons (i.e. a rainbow sheen) may have the potential to reduce the visual amenity of the area, also impacting the value. However, given the nature of the condensate, being light non-persistent hydrocarbon, it is expected to remain in waxy flake-like	Localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning.	Level 3

Receptor	Presence within Ecological or Social EMBA	Potential impact	Description of consequence	Inherent consequence
	Sanctuary are the State Protected Areas identified to also be exposed to in-water (moderate threshold) and surface (low threshold) hydrocarbons as well as shoreline hydrocarbons within the Social EMBA. Values associated with these State Protected Areas Park include habitats (i.e. reefs, limestone formation, and kelp beds) for a diverse range of invertebrates, fish, mammals and seabirds (see Section 6.6.5 for further details).	state; and in most cases surface oiling is not expected to the visible from shore. The values identified within this marine park have the potential to be exposed to entrained hydrocarbons at, or above, the moderate threshold (RPS, 2024). However, the exposure of entrained hydrocarbons will be greatest within the upper 0-10 m of the water column and areas close to the spill source. Therefore, conservation values within these AMPs, such as benthic and pelagic species, ecosystems, habitats and sea-floor features are not predicted to be impacted. Visible shoreline hydrocarbons have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within the identified protected areas. The modelling predicted rapid evaporation during the first 24 hours following the release of condensate, depending on the weather conditions (i.e. wind speeds). Given the non-persistent nature of the hydrocarbon, waves and tidal action are anticipated to continue the weathering process if shoreline contact occurs. Majority of the coastlines that may be exposed to shoreline hydrocarbon accumulation are relatively unpopulated. Therefore, given the nature of the hydrocarbon and action of weathering processes, impacts are not anticipated to be long-term. Also refer to potential impact to marine fauna (Sections 9.6.5.3 and 9.6.5.4) and to habitats (Section 9.6.5.2).		
KEFs	Modelling predicted exposure from in-water hydrocarbons at, or above low exposure levels, to overlap three KEFs within the Social EMBA: • Bonney Coast Upwelling • West Tasmania Canyons • Shelf rocky reef. These KEFs are all associated with unique sea-floor features of ecological significance (and habitat forming species, such as sponges, attached megafauna, and hard substrate formations and canyons which create a habitat for diverse species.	The values identified within these KEFs have the potential to be exposed to entrained hydrocarbons at, or above, the low threshold. However, the exposure of entrained hydrocarbons will be greatest within the upper 0-10 m of the water column and areas close to the spill source. Therefore, the spill is unlikely to intersect with majority of the values of the KEFs which are concentrated within the water column >10 m deep or along the seafloor at varying water depths. Hydrocarbon exposure to the key receptors of the KEFs (e.g. seabirds, pinnipeds and cetaceans) may cause a subsequent negative impact to the value of the KEFs, however is expected to be limited to a small number of individuals, with no impacts to regional populations. The Bonney Coast Upwelling is also an area of high abundance of plankton, such as krill which acts as a food source to many seabirds, fish and cetacean species. Plankton populations may be	Localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning.	Level 3

Receptor	Presence within Ecological or Social EMBA	Potential impact	Description of consequence	Inherent consequence
	The shelf rocky reefs KEF in particular supports a variety of benthic communities, such as coral, sponges and benthic communities, along the continental shelf within the temperate east marine region (see Section 6.6.6). The Bonney Coast Upwelling is an area of high abundance of plankton, such as krill which acts as a food source to many seabirds, fish and cetacean species. Both the Bonney Coast Upwelling and West Tasmanian Canyon KEFs are associated with high productivity and aggregations of cetaceans, pinnipeds, fish and sharks and seabirds Furthermore, seasonal upwelling events which brings cold nutrient rich waters to the sea surface within these KEFs contribute to the high productivity and biodiversity associated within these areas.	impacted by hydrocarbon exposure, however, would be expected to be limited to a small proportion of the productivity driven by the Bonney upwelling, with no impacts to the overall system and productivity across the region. The modelling predicted only a small portion in the south-east corner of the Bonney Coast Upwelling (approximately 10%) and an even smaller portion of the north-east corner of the West Tasmania Canyons KEF (approximately 5%) to be overlapped by the Social EMBA. Therefore, any impacts are anticipated to localised and not impact the overall value of the KEF. Refer to potential impact to marine fauna (Sections 9.6.5.3 and 9.6.5.4) and to habitats (Section 9.6.5.2).		
TECs	Modelling predicted exposure from shoreline hydrocarbons at, or above low exposure levels, to overlap 18 TECs within the Social EMBA, those with marine or shoreline features include: • Giant Kelp Marine Forests of South East Australia • Subtropical and Temperate Coastal Saltmarsh • Littoral Rainforest and Coastal Vine Thickets of Eastern Australia • Assemblages of Species Associated with Open-coast Salt-wedge Estuaries of western and central Victoria • River-flat Eucalypt Forest on Coastal Floodplains of southern NSW and eastern Victoria. Values associated with these TECs (see Section 6.6.7) are listed as critically	TECs have the potential to be exposed to shoreline hydrocarbons at, or above, the low threshold. Any hydrocarbon exposure to the key receptors of the TECs may cause a subsequent negative impact to the value of the TECs, However, potential impacts to socio-economic receptors (tourism, cultural and/or other social values associated with the TECs) are more likely to occur because of a reduction in the visual amenity, rather than ecological impacts of hydrocarbon exposure at low threshold. Shoreline hydrocarbons can become concentrated as they strand ashore. However, most of the oil is concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA, 1995). The majority of the TECs are located above the high tide mark, therefore, impacts are not anticipated to occur. Given the nature of the condensate, being light non-persistent hydrocarbon, any impacts to TECs are expected to be localised and short-term.	Localised and short-term impacts to species of recognized conservation value not affecting local ecosystem function.	Level 2

Receptor	Presence within Ecological or Social EMBA	Potential impact	Description of consequence	Inherent consequence
	endangered, endangered or vulnerable, and can be sensitive to hydrocarbon exposure.			
Socio-economic environment				
Coastal settlements	There are several local government areas identified as potentially being overlapped by the Social EMBA from shoreline hydrocarbon exposure at the low threshold; predominantly between Port Fairy and east of Cape Otway along the Victorian coastline, a shoreline accumulation at the low threshold along the west coast of King Island (RPS, 2024). The scenarios modelled predicted shoreline exposure at the low threshold at 8 local government areas (Section 6.7.1).	Visible hydrocarbons along the shorelines can change the aesthetic value. Furthermore, closure of these shorelines could impact public use and public activities. However, given the nature of the condensate, being light non-persistent hydrocarbon, any impacts to coastal settlements are expected to be localised and short-term. The wave and tidal action, together with predicted weathering, indicates that hydrocarbons along shorelines will continually wash off the substrates, and be readily flushed into the water, with further weathering and dispersal.	Localised, short-term impacts.	Level 2
Commercial fisheries	Several commercial fisheries operate in the Social EMBA (LOWC) and overlap the spatial extent of the water column hydrocarbon predictions (Section 6.7.2), these include: • 6 Commercial Fisheries • 9 Victorian State Fisheries • 1 Tasmanian State Fisheries. For the Tasmanian jurisdiction, the shoreline of King Island was predicted to be exposed to levels of shoreline hydrocarbons at relevant thresholds. No exposure to in-water hydrocarbons were predicted for this location or elsewhere in Tasmanian State waters (RPS, 2024). However, the shallow waters of King Island are where seaweed collectors harvest bull kelp. Therefore, this fishery has been considered within the assessment.	In-water hydrocarbon exposure may result in a reduction in commercially targeted marine species (i.e. fish and invertebrate species), subsequently resulting in impacts to commercial fishing productivity or the marketability of the catch. Contamination of target species can cause economic impacts to the industry. Physical displacement of commercial fishers could occur due to the establishment of exclusion zones during the spill response. However, due to the nature of the condensate, being a light non-persistent hydrocarbon, with high anticipated evaporation and entrainment rates, exclusion zones are not expected to be long-term and are unlikely to result in extensive impacts. Visible surface hydrocarbons (i.e. a rainbow sheen) may have the potential to cause impact public perception of the industry, potentially causing a negative economic impact. Due to the sensitivity, a small number of juvenile fish, larvae, and planktonic organisms, may be impacted, however impacts are not expected to affect population viability or recruitment. Hydrocarbon smothering has the potential to cause fouling and asphyxiation (Blumer 1971; Cintron et al. 1981) and act as a physical barrier for the diffusion of CO_2 across cell walls of macroalgae (O'Brien and Dixon 1976). Any impacts to commercially valuable seaweed has the potential to results in a negative economic impacts to the industry. Shoreline harvesters could be affected by short-term closures but would be expected to recover relatively rapidly, with no long-term or irreversible damage.	Localised, short-term impacts.	Level 2

Receptor	Presence within Ecological or Social EMBA	Potential impact	Description of consequence	Inherent consequence
		Refer to potential impact to marine fauna (Sections 9.6.5.3 and 9.6.5.4) and potential impact to habitats (Sections 9.6.5.2).		
Other offshore industry	Other offshore industry, such as shipping, petroleum exploration and production, other offshore infrastructure and defence activities, may occur within the Social EMBA (Section 6.7.3).	Physical displacement of other offshore industry may occur due to the establishment of exclusion zones during the spill response. This has the potential to cause negative economic impact. However, due to the nature of the condensate, being a light non-persistent hydrocarbon, with high anticipated evaporation and entrainment rates, exclusion zones are not expected to be long-term and are unlikely to result in significant impacts.	Localised, short-term impacts.	Level 2
Recreation and tourism	The Victorian coast and marine region provide a diverse range of land-based and near-shore tourism opportunities, including scuba diving, fishing, whale and wildlife watching, sailing, snorkelling and kayaking (Section 6.7.4). Modelling predicted shoreline hydrocarbon exposure at, or above the low (10 g/m^2) threshold predominantly between Port Fairy and east of Cape Otway along the Victorian coastline, and shoreline accumulation at the low threshold along the West coast of King Island (RPS, 2024). Floating hydrocarbon exposure at, or above the low threshold was only predicted for nearshore waters within Victorian State waters, along the Colac Otway to Warrnambool coast sections. In general, recreational and tourism activities are restricted to shallower coastal waters and shorelines.	Visible surface hydrocarbons (i.e. a rainbow sheen) on the surface or stranded ashore have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. Precautionary exclusion from shorelines may be implemented by local governments until water quality monitoring verifies the absence of residual hydrocarbons. This could cause disruption to some recreational and tourism activities within that area. Furthermore, visible hydrocarbons along shorelines may impact the aesthetic value for tourism and discourage recreational activities that may be operating within the area. Given the nature of the condensate, being light non-persistent hydrocarbon, it is expected to evaporate, weather and disperse quickly. . Wave and tidal action along shorelines, together with predicted weathering, would continually wash off the substrates, and be readily flushed into the water, with further weathering and dispersal. Any impact to receptors that are depended on for nature-based tourism features (e.g. whales) may cause a subsequent negative impact to recreation and tourism businesses in the locally affected area. Refer to potential impact to marine fauna (Sections 9.6.5.3 and 9.6.5.4)	Localised, short-term impacts.	Level 2

Summary

The highest potential consequence to the functions, interests or activities of other users is assessed as **Level 3** based on the potential for localised and medium-term impacts to species of recognised conservation value, but not affecting local ecosystem functioning. This was based on the worst-case consequence evaluated for AMPs, KEFs, wetlands and State parks and reserves.

Inherent Likelihood

Blowout events during development drilling has been reported at a frequency for a gas well of 4.2 x 10^{-5} per drilled well (IOGP, 2019). This represents the frequency of the cause (i.e. a LOWC); additional environmental factors would be necessary for the worst-case consequences (to conservation values and socioeconomic interests) to eventuate.

Due to the nature of this activity, and based on previous occurrences, the impact is considered conceivable and could occur, however, it would require a rare combination of factors. Therefore, the inherent likelihood of an accidental release of condensate causing **Level 3** consequences to other users is considered **Unlikely (D)**.

Inherent Risk Severity

The inherent risk severity of an accidental release of condensate causing impacts to receptors is considered **Moderate**.

9.6.6 Demonstration of Acceptability

To demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 9-37.

Table 9-37: Accidental Release – LOWC Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Potential Impact: Change in water quality	Consequence: Level 2
	Risk: Change in habitat	Risk: Moderate
	Risk: Change in fauna behaviour	Risk: Moderate
	Risk: Injury/mortality to fauna	Risk: Moderate
	Risk: Changes to the functions, interests, or activities of other users.	Risk: Moderate
Principles of ESD	A) 'Integration principle' The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, potential impact and risks from accidental release – LOWC was identified as: • Level 2 consequence for change in water quality • Moderate risk for change in habitat	

<table>
<tr><td rowspan="4"></td><td colspan="3">

- Moderate risk for change in fauna behaviour
- Moderate risk for injury/mortality to fauna
- Moderate risk for changes to the functions, interests or activities of other users.

The above predicted levels of impact and risk due to accidental release – LOWC from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).</td></tr>
<tr><td colspan="3">B) 'Precautionary principle'
If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
The East Coast Project is consistent with the principle of ESD (b) for this aspect as:
• Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology.
• The consequence ranking for an accidental release from a LOWC was Level 3, and the highest inherent risk was evaluated as Moderate; therefore, an accidental release from a LOWC from the East Coast Project will not result in serious or irreversible environmental damage.
• The potential impacts and risks from an accidental release from a LOWC are well-understood, and management measures are well established and regulated in Australian waters.</td></tr>
<tr><td colspan="3">C) 'Intergenerational principle'
The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations.
The East Coast Project is consistent with the principle of ESD (c) for this aspect as:
• The highest inherent risks for an accidental release from a LOWC was evaluated as Moderate and therefore will not forego the health, diversity and productivity of the environment for future generations.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.6.7). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.</td></tr>
<tr><td colspan="3">D) 'Biodiversity principle'
The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.
The East Coast Project is consistent with the principle of ESD (d) for this aspect as:
• The relevant environmental values and sensitivities to an accidental release from a LOWC were evaluated in Section 9.6.5 and the highest inherent risk for an accidental release from a LOWC was evaluated as Moderate.
• The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 9.6.7). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.</td></tr>
<tr><td rowspan="3">Legislative and Other requirements</td><td>Requirement</td><td>Relevant Objective / Action</td><td>Demonstration of Requirement</td></tr>
<tr><td>OPPGS(E)R</td><td>An EP, including an OPEP and emergency response arrangements, must be place for any petroleum activity prior to activities commencing, and must be implemented.</td><td rowspan="2">Adoption or the following control measures:
CM1: Marine Assurance Process
CM12: Marine Exclusion and Caution Zones</td></tr>
<tr><td>Protection of the Sea (Prevention of Pollution from Ships) Act 1983 – Section 26F (implements MARPOL Annex I).</td><td>Several MOs are enacted under this Act relating to offshore petroleum activities, including:
MO Part 91: Marine Pollution Prevention – Oil</td></tr>
</table>

		MO Part 93: Marine Pollution Prevention – Noxious Liquid Substances	CM13: Ongoing Engagement CM14: Facility Safety and Integrity Management Plans CM16: OSMP CM17: OPEP CM19: Source Control Emergency Response Plan
	Navigation Act 2012 – Chapter 4 (Prevention of Pollution).	Several Marine Orders (MO) are enacted under this Act which relate to offshore petroleum activities, including: MO 21: Safety and emergency arrangements	
	AMSA Marine Orders 91 and 94	In Commonwealth waters AMSA is the Statutory Agency for vessels and must be notified of all incidents involving a vessel.	
	Recovery plan for marine turtles in Australia 2017–2027	Recovery objective: Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list. Interim objective 3: Anthropogenic threats are demonstrably minimised. No relevant management actions.	
	National Recovery Plan for Albatrosses and Petrels 2022 (DCCEEW, 2022e)	Recovery objective: To improve the conservation status of albatrosses and petrels so that these species are on a trajectory towards no longer being threatened in Australia's jurisdiction. No relevant management actions.	
	Wildlife Conservation Plan for Seabirds (CoA, 2020)	Objective 2: Seabirds and their habitats are protected and managed in Australia. Objective 3. The long-term survival of seabirds and their habitats is achieved through supporting priority research programs, coordinated monitoring, on-ground management and conservation. No relevant management actions.	
	Wildlife Conservation Plan for Migratory Shorebirds – 2015 (CoA, 2015b)	Objective 3: Anthropogenic threats to migratory shorebirds in Australia are minimised or, where possible, eliminated. No relevant management actions.	
	Blue Whale Conservation Management Plan 2015 - 2025 (2015)	Interim objective 4: Anthropogenic threats are demonstrably minimised. Management action A.4.2: Ensure all vessel strike incidents are reported in the National Ship Strike Database (AMMC). Management action A.4.3: Ensure the risk of vessel strikes on Blue Whales is considered when assessing actions that increase vessel traffic in areas where Blue Whales occur and, if required, implement appropriate mitigation measures.	

	National Recovery Plan for the Southern Right Whale (DCCEEW, 2024l)	Long term recovery objective is that the population has increased in size to a level that the conservation status has improved, and the species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria. Interim Objective 2: Anthropogenic threats are managed consistent with ecologically sustainable development principles to facilitate recovery of southern right whales.	
	Approved Conservation Advice for *Balaenoptera borealis* (Sei Whale)	Determine population abundance, trends and population structure for sei whales, and establish a long-term monitoring program in Australian waters. No relevant management actions.	
	Approved Conservation Advice for *Balaenoptera physalus* (Fin Whale)	Determine population abundance, trends and population structure for fin whales, and establish a long-term monitoring program in Australian waters. No relevant management actions.	
	Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (2013) Conservation Advice for the *Neophoca cinerea* (Australian sea lion)	Overarching objective: to halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: Improving the population status leading to the future removal of the Australian sea lion from the threatened species list of the EPBC Act Ensuring that anthropogenic activities do not hinder recovery in the near future or impact on the conservation status of the species in the future. No relevant management actions.	
	Recovery Plan for the White Shark (*Carcharodon carcharias*)	Objective 7: Continue to identify and protect habitat critical to the survival of the white shark and minimise the impact of threatening processes within these areas. No relevant management actions.	
	Conservation Advice for Subtropical and Temperate Coastal Saltmarsh (DSEWPAC, 2013)	No relevant objectives. Management action: Identify Coastal Saltmarsh as important habitat in all oil spill contingency planning at national and State levels and monitor the application of protocols on the management of spills involving saltmarshes.	
	Approved Conservation Advice for *Botaurus*	provide guidance for actions that will expand the range and the number of Australasian Bitterns in Australia.	

	poiciloptilus (Australasian bittern)	No relevant management actions.	
	Approved Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper)	Australian Objective: Reduce disturbance at key roosting and feeding sites. No relevant management actions.	
	Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew)	Australian objectives: Achieve a stable or increasing population. Maintain and enhance important habitat. Reduce disturbance at key roosting and feeding sites. No relevant management actions.	
	National Recovery Plan for (*Sternula nereis nereis*) (Australian Fairy Tern) Approved Conservation Advice for *Sternula nereis* (Australian Fairy Tern)	Long-term Vision: The Australian Fairy Tern population has increased in size to such an extent that the species no longer qualifies for listing as threatened under any of the Environment Protection and Biodiversity Conservation Act 1999 listing criteria. No relevant management actions.	
	Approved Conservation Advice for *Thinornis rubricollis* (Hooded Plover, Eastern)	Primary Conservation Objectives: Achieve stable numbers of adults in the population, and maintain a stable number of occupied and active breeding territories Maintain, enhance and restore habitat, and integrate the subspecies' needs into coastal planning. No relevant management actions.	
	Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan	Specific recovery objective: To identify and manage the threats operating at sites where the subspecies occurs. No relevant management actions.	
	National Recovery Plan for the *Lathamus discolour* (swift parrot) Conservation Advice *Lathamus discolor* Swift Parrot	Overall objectives: To prevent further decline of the Swift Parrot population. To achieve a demonstrable sustained improvement in the quality and quantity of Swift Parrot habitat to increase carrying capacity. No relevant management actions.	
	National Recovery Plan for the Orange-bellied Parrot (*Neophema chrysogaster*)	Objective 1. To achieve a stable or increasing population in the wild within five years. Objective 2. To increase the capacity of the captive population, both to support future releases of captive-bred birds to the wild and to provide a secure long term insurance population. Objective 3. To protect and enhance habitat to maintain, and support growth of, the wild population.	

		Objective 4. To ensure effective adaptive implementation of the plan. No relevant management actions.	
	Commonwealth Conservation Advice on *Dermochelys coriacea* (2008)	These EPBC management plans identify habitat degradation/modification or pollution/contamination as a threat; but do not include any relevant objectives or relevant management actions.	
	Approved Conservation Advice for *Calidris canutus* (Red Knot)		
	Approved Conservation Advice for *Charadrius leschenaultia* (Greater Sand Plover)		
	Approved Conservation Advice for *Halobaena caerulea* (Blue Petrel)		
	Approved Conservation Advice for *Limosa lapponica bauera* (Bar-tailed Godwit (western Alaskan)		
	Approved Conservation Advice for *Pachyptila subantarctica* (Fairy Prion (southern))		
	Approved Conservation Advice for *Rostratula australis* (Australian painted snipe)		
	Approved Conservation Advice for *Thalassarche Chrysostoma*, Greyheaded Albatross)		
	Conservation Advice *Thalassarche cauta* Shy Albatross		
	Conservation Advice *Falco hypoleucos* Grey Falcon		
	Conservation Advice *Hirundapus caudacutus* White-throated Needletail		
	Conservation Advice for Dendronephthya australis Cauliflower Soft Coral (TSSC, 2020)		
	Approved Conservation Advice for Giant Kelp Marine Forests of Southeast Australia (TEC) (DSEWPAC, 2012)		
	Approved Conservation Advice for the Littoral Rainforest and Coastal Vine Thickets of Eastern		

	Australia ecological community (DoE, 2015b)		
Internal Context	Relevant management system processes adopted include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11) • External Affairs & Stakeholder Management (MS05). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).		
External Context	Stakeholder feedback received. GMTOAC has previously communicated values and sensitivities relevant to the risk. GMTOAC highlighted Gunditjmara's strong connection to Sea Country and responsibility for its care Cooper Energy briefed GMTOAC (February 2024) on the kinds of activities undertaken by Cooper Energy which carry a risk of spills, and the plans in place to prevent and respond to spills. During the briefing, members queried whether Cooper Energy had ever had a large hydrocarbon spill. Cooper Energy clarified that no hydrocarbon spills have occurred during Cooper Energy's time operating within the Otway. GMTOAC indicated Gunditjmara's responsibility for Country extended to a spill response along the coast and would expect to be contacted in the event of a spill which threatens Gunditjmara Country. GMTOAC are listed as a relevant person for the purposes of EP preparation which will enable their continued input into the management of activity specific impacts and risks.		
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to an accidental release of condensate is AL2, AL6, AL10, AL11, AL12, and AL13 identified in Table 9-38. These acceptable levels defined for a change in water quality are defined in Table 7.6. The worst-case predicted impacts assessed in Section 9.6.5 are: • Given the nature of the activity, implementation of control measures and based on previous occurrences, the inherent likelihood of an accidental release of condensate causing a change to water quality, habitat, injury/ mortality to fauna, change in fauna behaviour or change to the functions, interests and activities of other users is considered Unlikely (D). • Highest consequence for change in habitat from accidental release of condensate is Level 3, for shorelines (rocky), saltmarsh and mangroves. These are localised medium-term impacts to habitats of recognized conservation value or to local ecosystem function. • Highest consequence to marine fauna behaviour is Level 3 for pinnipeds. In the event of an accidental release of condensate pinnipeds may be displaced from haul-out sites, have movement affected, reduced mobility or sub lethal injury. The highest consequence is localised medium-term impacts, with population level impacts considered very unlikely. • The highest consequence to injury/mortality to fauna is assessed as Level 3 for seabird and shorebirds, pinnipeds and cetaceans based on the potential for localised medium-term impacts to species or habitats of recognised conservation value, or to local ecosystem functioning. • The highest consequence to the functions, interests or activities of other users is assessed as Level 3 for AMPs, wetlands, state parks and reserves and KEFs based on the potential for localised medium-term impacts to habitats or species of recognised conservation value or to local ecosystem functioning. • The consequence ranking for an accidental release of condensate was Level 3, and the highest inherent risk was evaluated as Moderate. Therefore, at its worst-case, the predicted impact from an accidental release of condensate would not: • Lead to a substantial change in water quality which may adversely impact biodiversity and ecological integrity. • Modify an important or substantial area of habitat which may adversely impact on biodiversity and ecological integrity. • Disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species.		

	• Lead to loss of habitat critical to the survival of species. • Prevent maintenance of social and commercial amenity values of the Commonwealth marine area within the region consistent with the rights of all marine users. • Lead to substantial adverse effects on the sustainability of commercial fisheries. Therefore, the predicted level of impact resulting from an accidental release of condensate from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to an accidental release from a LOWC are acceptable, based on: • predicted levels of impact (evaluated in Section 9.6.5) are at or below the defined acceptable levels of impact (Table 7-6) for all receptors • the planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • the activities will be managed in a way that is not inconsistent with the relevant principles of ESD • the proposed controls and impact and risk levels are not inconsistent with national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • feedback has been received from stakeholders that has informed the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures. To manage impacts to receptors to or below the defined acceptable levels the following EPOs have been applied: **EPO22**: No unplanned release of chemicals or hydrocarbons to the marine environment.

9.6.7 Environmental Performance

Table 9-38 lists the acceptable level and EPO defined for an accidental release of condensate and the adopted measures to achieve the outcome.

Table 9-38: Environmental Performance Summary – Accidental release of condensate

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL2: Impacts and risks to water quality from activities defined in this OPP will not lead to a substantial change in water quality which adversely impacts biodiversity and ecological integrity. **AL6:** Impacts and risks to benthic habitat from activities defined in this OPP will not modify an important or substantial area of habitat which adversely impacts on biodiversity and ecological integrity. **AL10:** Impacts and risks to fauna from activities defined in this OPP will not disrupt the recovery of, or impact conservation status of EPBC Act listed threatened or migratory species. **AL11:** Impacts and risks to fauna from activities defined in	**EPO22:** No unplanned release of chemicals or hydrocarbons to the marine environment.	CM1: Marine Assurance Process All vessels contracted will meet survey, maintenance and certification of regulated Australian vessels as per AMSA MO 31.
		CM12: Marine Exclusion and Caution Zones Including: • a temporary 3 km exclusion/cautionary zone around the MODU during the drilling program • a temporary 500 m exclusion/caution zones to be established via Notice to Mariners around vessels undertaking petroleum activities • PSZs may be gazetted around wells and other equipment where required for integrity management. Subsea infrastructure will be marked on navigational charts for awareness.
		CM13: Ongoing Engagement Further engagement will take place during the development and implementation of component

this OPP will not lead to loss of habitat critical to the survival of species. **AL12:** Social and commercial amenity values of the Commonwealth Marine Area within the region are maintained consistent with the rights of all marine users. **AL13:** Impacts and risks to other marine users associated with activities defined in this OPP will not lead to substantial adverse effects on the sustainability of commercial fisheries.		EPs. This will include details relating to notification of third-party stakeholders.
		CM14: Facility Safety and Integrity Management Plans Under Part 5 of the OPGGS (Resource Management and Administration) Regulations 2011, a NOPSEMA accepted WOMP (including Cooper Energy Well Management System) and a Safety Case is required before well activities can be undertaken. The WOMP details well barriers and the integrity testing that will be in place for the activity.
		CM16: OSMP Cooper Energy's OSMP details the arrangements and capability in place for: • operational monitoring of a hydrocarbon spill to inform response activities • scientific monitoring of environmental impacts of the spill and response activities.
		CM17: OPEP Under the Regulations, the petroleum activity must have an accepted Oil Pollution Emergency Plan (OPEP) in place before the activity commences. In the event of a subsea LOWC, the OPEP will be implemented. Cooper Energy acknowledges that any response will be implemented in accordance with the requirements described within the OPEP.
		CM19: Source Control Emergency Response Plan The Cooper Energy source control emergency response plan (SCERP) acknowledges legislative requirements and provides in detail the company's plans, equipment and personnel provisions to enable a source control response, commensurate to the risk at each stage of a wells life cycle from initial drilling to closing off the reservoir.

10 Risk and Impact Evaluation - First Nations Cultural Heritage Values and Sensitivities

This section evaluates the potential for the East Coast Project to affect cultural heritage and the continuation of cultural practices. In doing so, this section:

- Identifies the potential impacts to environment receptors that are, or are linked to, cultural features of the environment within the monitoring EMBA from East Coast Project aspects (Section 10.1).
- Summarises the outcomes of the impact and risk assessments (from Section 8 and 9) for environment receptors that are also cultural features, or are linked to cultural features of the environment, to characterise the relevant project aspects (Section 10.2).
- Evaluates to what degree the cultural features of the environment, and their value to first nations cultural practices and heritage, could be degraded considering the nature and scale of impacts / risk to relevant environment receptors (Section 10.3):

Environmental Performance Outcomes (EPO's) have been developed for this project that are specific to First Nations Peoples cultural heritage. These EPO's are designed to be equal to or better than the acceptable levels of impact and risk:

- Cultural features are not destroyed by the activity, and
- Cultural Practices are not prevented from taking place.

Further, there are measures evaluated and adopted following research, training and consultation, to ensure that the predicted environment impact can be managed at levels equal to or better than the defined acceptable level of impact or risk.

The section has been written with consideration to N-04750-GN1344 A339814; NOPSEMA, 2024 and APSC, 2022, First Nations people's Country Plans[15], Consultation with First Nations peoples, participation in cultural experiences and training led by Gunditjmara people on Gunditjmara Country.

[15] Sources:
- Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023
- Wadawurrung Traditional Owners Aboriginal Corporation, 2020
- Eastern Maar Aboriginal Corporation, 2014
- Gunaikurnai Land and Waters Aboriginal Corporation, 2015

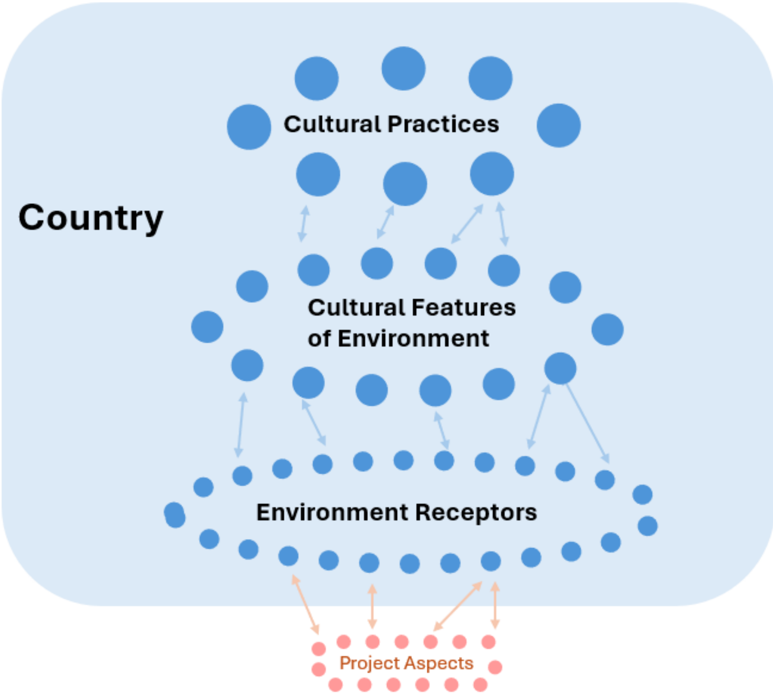


Figure 10-1: Conceptual Illustration – Interaction between Project Aspects and Environment Receptors, and links to Cultural Features and Practices

10.1 Summary of Potential Impacts to Cultural Features

Table 10-1 describes how relevant aspects of the project have the potential to affect the link between cultural features of the environment and First Nations people's heritage sites and values. Importantly, this is not a description of predicted impacts, but of the mechanisms by which a project aspect could affect a cultural feature and its value for First Nations People.

Table 10-1: Potential to affect the link between cultural features of the environment and First Nations people's sites and values

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
Tangible cultural heritage			
Coastal/island places and objects	• Deen Maar Island • Convincing Ground • Discovery Bay Coastal Park • Wilsons Promontory and Associated Land Bridge	• Accidental Hydrocarbon Release • Spill Response	Shoreline hydrocarbon exposure has the potential to change the cultural heritage value of the site (Section 9.6) if sites are not accessible to First Nations People to be able to practice culture, or if sites are perceived to have been degraded by tainting with hydrocarbons. Table 10-2 identifies there is a moderate risk to coastal/islands places and objects from hydrocarbon exposure in the event of unplanned discharge and accidental hydrocarbon release events. Section 10.3.1.1 considers the level of impact and risk to environment receptors

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
			that are also, or that are linked to, cultural features and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Submerged sites	• Benthic habitats	• Multiple Aspects	Aspects resulting in seabed disturbance have the potential to change the cultural heritage value of submerged landscapes if that disturbance is widespread and within those landscapes that feature within cultural practices. There are no potential impacts to the seabed from the activity which have more than a localised footprint (within the operational area), and therefore there will be no landscape scale impacts, or effects on the submerged elements such as the Tyrendarra lava flow which is >50 km from the operational area. Table 10-2 identifies there is moderate risk of impact to submerged sites from hydrocarbon exposure (in the event of unplanned discharge and accidental hydrocarbon release events). Section 10.3.1.2 considers the level of impact and risk to environment receptors that are also, or that are linked to cultural features, and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Intangible cultural heritage			
Sea Country	• State and Cwth Waters, including the Commonwealth Marine Environment, and habitats and species therein.	• All Aspects	First Nations cultural heritage values associated with Sea Country including ecosystems and species are considered based on their ecological values, food sources, and/or culturally significant totemic values. The First Nations people's values associated with marine ecosystems and species have the potential to be disrupted if there are impacts to ecosystem functioning and integrity or species population. Table 10-2 summarises potential impacts and risks to Sea Country are mostly limited to localised and short-term impacts (Level 1 or 2 consequences), with no

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
			impacts at the population level. However the introduction, establishment and spread of IMS, and accidental hydrocarbon release is a risk of up to Moderate severity. Section 10.3.2.1 considers the level of impact and risk to environment receptors that are also, or that are linked to cultural features, and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Creation/ Dreaming sites, Songlines, sacred sites and Ancestral beings	• Deen Maar Island • Convincing Ground • Discovery Bay Coastal Park • Wilsons Promontory and Associated Land Bridge • Tyrendarra lava flow (Julia reef)	• Accidental Hydrocarbon Release • Spill Response	Impacts and risks to seabed habitats, The Convincing Ground, and Deen Maar has the potential to change First Nations cultural heritage values of Creation/Dreaming, Songlines, sacred sites and Ancestral Beings at these sites. Shoreline hydrocarbon exposure (Section 9.6) to The Convincing Ground and Deen Maar has the potential to change the cultural heritage values (Creation/ Dreaming sites, sacred sites and Ancestral beings) of these sites. Aspects resulting in seabed disturbance, if occurring at a widespread level has the potential to weaken, fragment or break of songlines associated with submerged landscapes. Karntubul (whales) are Ancestors of Gunditj Mirring and have featured in Dreaming stories, ceremony, song and dance of Gunditjmara for thousands of years. Whale Dreaming stories connect Aboriginal people along the coastlines of Australia and strengthen the connection between neighbouring Aboriginal groups in Victoria. Protection of whales is essential to Gunditjmara spiritual and physical well-being. Table 10-2 summarises potential impacts and risks to Creation/ Dreaming sites, songlines, sacred sites and Ancestral beings are mostly limited to localised, short-term and recoverable impacts (Level 1 or 2 consequences). The introduction, establishment and spread of IMS and
	• Whales	• Multiple Aspects	

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
			accidental hydrocarbon release carries a risk of up to Moderate severity for some environmental receptors that are also cultural features, including culturally significant species and places (Deen Maar). Section 10.3.2.2 considers the level of impact and risk to environment receptors that are also, or that are linked to, cultural features and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Connection to Country Cultural obligations to care for Country Knowledge Systems	• State and Cwth Waters, including the Commonwealth Marine Environment, and habitats and species therein.	• All Aspects	The potential disruption to the cultural obligations to care for Country is linked by potential impacts to the environment and the exclusion of First Nations people from Country or decision-making processes. Potential change to knowledge on cultural heritage values will occur when the value is displaced, depleted or there is significant reduction in population of the value. If the value doesn't exist within the local area of Country, knowledge systems of that value will be disrupted or lost. Limitation on access, for safety reasons, can also affect the ability of First Nations Peoples to practice their cultural obligations, foster knowledge systems, and maintain connection to particular elements of country. Table 10-1 summarises potential impacts and risks to environment receptors that are linked to cultural features. These impacts and risks are mostly limited to localised and short-term impacts (Level 1 or 2 consequences), with no impacts at the population level. The introduction, establishment and spread of IMS and accidental hydrocarbon release carries a risk of up to Moderate severity for some environmental receptors that are also cultural features, including culturally significant species and places (Deen Maar). Section 10.3.2.3 to 10.3.2.5 considers the level of impact and risk to environment

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
			receptors that are also, or that are linked to, cultural features and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Ecosystems and species			
Culturally significant species	Food resources (current and historical): • Fish, sharks, rays, eels (Kooyang), shellfish, crustaceans, whales, seals, Seabirds - collection from coastal and riverine environments. • Plankton (basis of the food chain that provides for culturally significant species) Connection to ancestors: • Whales	• Multiple Aspects	**Food resources:** The potential change to food resources can occur when the resource is depleted (such as a reduction in population of a species) or displaced. The ability for First Nations people to continue to collect marine species (as a food resource) has the potential to change if impacts and risks to the resource species results in a reduction in population or change movements and distribution that lowers their occurrence within Sea Country of a group of First Nations Peoples. **Connection to Ancestors** Impacts to culturally significant species at a population level has the potential to erode the ability for First Nations people ability to care for culturally significant species, and to continue cultural practices that involve those species. Table 10-2 summarises potential impacts and risks to environment receptors, that include culturally significant species linked to resources, and those linked to ancestors. The levels of impact are mostly limited to localised and short-term impacts (Level 1 or 2 consequences), with no impacts at the population level. The (unplanned) introduction, establishment and spread of IMS and accidental hydrocarbon release have a risk of up to Moderate severity (consequence Level 4 and 3 (respectively)). Section 10.3.3 considers the level of impact and risk to environment receptors that are also, or that are linked to cultural features, and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
Key Ecological Feature - Bonney Coast Upwelling (productivity of)	• Bonney Upwelling (Key Ecological Feature)	• Multiple Aspects	In relation to the physical occurrence and characteristics of the Bonney Upwelling, Butler et al. (2004) identifies climate change as a possible influence on its strength or frequency, though was not of serious concern. The levels of impact are mostly limited to localised and short-term impacts to plankton (Level 1 or 2 consequences low or moderate inherent risk severity), with no impacts at the population level (Table 10-2). Section 10.3.3.5 considers the level of impact and risk to environment receptors that are also, or that are linked to cultural features, and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Water quality	• State and Cwth Waters, including the Commonwealth Marine Environment, and habitats and species therein.	• Multiple Aspects	Impacts to water quality from hydrocarbon exposure (Section 9.6), and discharges (Section 8.6 and 8.7) resulting in potential physical/tangible change to cultural heritage value of oceans and waterways. Table 10-2 summarises potential impacts and risks to water quality are mostly limited to localised, short-term and recoverable impacts (Level 1 consequences or low inherent risk severity). Section 10.3.3.6 considers the level of impact and risk to environment receptors that are also, or that are linked to, cultural features and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Nearshore benthic habitats	• Seabed in State Waters, including the habitats and species therein.	• Accidental Hydrocarbon Release • Introduction and establishment of IMS	Change to benthic habitats occurring at a widespread level, such as the introduction, establishment and spread of IMS (Section 9.4), has the potential to change the cultural heritage values of benthic ecosystems in coastal environment that provide habitat for culturally significant species, and resources for First Nations people.

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
			Table 10-2 summarises potential impacts and risks to benthic habitats are mostly limited to localised and short-term impacts (Level 1 consequence). However the introduction, establishment and spread of IMS and accidental hydrocarbon release is a risk of up to Moderate severity. Section 10.3.3.7 considers the level of impact and risk to environment receptors that are also, or that are linked to, cultural features and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices..
Intertidal communities and shorelines	• Victorian State waters and shorelines: Macroalgae, coastal saltmarsh, rocky and sandy shorelines.	• Accidental Hydrocarbon Release • Introduction and establishment of IMS	Shoreline hydrocarbon exposure (Section 9.6) resulting in potential physical/tangible change to cultural heritage value of intertidal communities and shorelines. Table 10-2 summarises potential impacts and risks to intertidal communities and shorelines are mostly limited to localised and short-term impacts (Level 1 consequence). However the introduction, establishment and spread of IMS and accidental hydrocarbon release is a risk of up to Moderate severity. Section 10.3.3.8 considers the level of impact and risk to environment receptors that are also, or that are linked to, cultural features and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.
Marine Park/ coastal reserves / wetlands	• Marengo Reef (State waters)	• Accidental Hydrocarbon Release	Hydrocarbon exposure (Section 9.6) resulting in potential physical/tangible change to cultural heritage value of Marine Parks, coastal reserves and wetland habitats that sustain culturally significant species. Table 10-2 summarises potential impacts and risks to marine parks/coastal reserves/wetlands are mostly limited to localised and short-term impacts (Level 1 consequence). However the introduction, establishment and spread of IMS and accidental hydrocarbon release is a risk of up to Moderate severity.

First Nations people's heritage sites and values	Receptors relevant to the Activity	What Activity Aspects could interact with these receptors	Potential risk to intrinsic link to cultural features of the environment
			Section 10.3.3.9 considers the level of impact and risk to environment receptors that are also, or that are linked to, cultural features and evaluates the potential for degradation of those cultural features, and to their value in relation to continuation of cultural practices.

10.2 Project Aspect Potential Interactions with Cultural Heritage Values and Sensitivities

Offshore development within or adjacent to Sea Country has the potential to impact cultural features of the environment. Table 10-1 above identifies the potential interactions between the particular aspects of this project and relevant Cultural Features of the environment identified through consultation for this or comparable activities in the region, review of County Plans, on Country Training, listening, and desktop research. Within Table 10-1, for each interaction the level of impact or risk is identified for the environment component that is intrinsically linked to, is part of, or is also a cultural feature.

The evaluation for each relevant environment component is detailed within Sections 8 and 9; the predicted impacts to these components are low-level, localised and / or generally short-term. There are risk events associated with the activity; consequences of these risk events could be more extensive, and longer term. The most severe risk events being a major loss of hydrocarbon containment, and establishment and spread of IMS; these events are Unlikely, or Remote, and there are established effective measures in place to prevent their occurrence.

Considering the level of impact or risk from activity aspects assists determining the spatial and temporal extent of the potential disturbance to, or degradation of, the associated cultural feature.

For further details on the intrinsic link between cultural features of the environment and First Nations people's heritage site and values refer to Section 6.8.3.

Table 10-2: Identification of potential interactions between East Coast Project Aspects and First Nations cultural values

Cultural feature of the environment relating to First Nations People's heritage sites and values	Environmental receptor where the cultural feature may exist	Project planned and unplanned aspects													
		Emissions – light	Emissions – atmospheric	Interaction with Marine Fauna	Seabed disturbance	Planned Discharges - Drilling	GHG Emissions	Underwater sound emissions - Continuous	Underwater sound emissions - Impulsive	Planned Discharges – Operational	Loss of materials or waste overboard	Minor LOC	Accidental Release MDO	Accidental release - LOWC	Introduction, establishment and spread of IMS
Tangible Heritage Sites															
Coastal/ island places and objects	Heritage places: • Victorian coastline • The Convincing Ground • Deen Maar • Discovery Bay Coastal Park • Wilsons Promontory • Tyrendarra lava flow												✓ Moderate inherent risk severity to shoreline habitats Section 9.5.5	✓ Moderate inherent risk severity to shoreline habitat 9.6.5	
Submerged sites	• Benthic habitats				✓ Consequence Level 2 – localised and short-term impacts to benthic habitats and Low inherent risk severity to cultural heritage Section 1.1.1	✓ Consequence Level 2 – localised and short-term impacts to benthic habitats Section 8.6.4					✓ Low inherent risk severity to cultural heritage and benthic habitats Section 9.1.4		✓ Moderate inherent risk severity to benthic habitats Section 9.5.5	✓ Moderate inherent risk severity to benthic habitats Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4
Intangible Cultural Heritage															
Sea Country	• All physical and ecological receptors • (Section 6.4 and 6.5)	✓ Consequence Level 1 - temporary and localised change in marine fauna behaviour Section 8.3.4	✓ Consequence Level 1 – temporary and localised change in air quality Section 8.4.4	✓ Low inherent risk severity to marine fauna Section 9.3.4	✓ Consequence Level 2 – localised and short-term impacts to benthic habitats Section 1.1.1	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 2 – localised and short-term impacts to cetaceans and Moderate inherent risk severity Section 8.2.5	✓ Consequence Level 2 – localised and short term impacts to cetaceans and Low inherent risk severity Section 8.1.5	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.7.4	✓ Low inherent risk severity to benthic habitats Section 9.1.4	✓ Low inherent risk severity to water quality Section 9.2.4.1	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.5.5	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4
Creation/ dreaming sites, Songlines, sacred sites and Ancestral beings	• Culturally significant species • The Convincing Ground • Deen Maar			✓ Low inherent risk severity to marine fauna Section 9.3.4	✓ Consequence Level 2 – localised and short-term impacts to benthic habitats Section 1.1.1	✓ Consequence Level 1 – localised and temporary change to water and sediment quality	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 2 localised and short-term impacts to cetaceans and Moderate inherent risk severity Section 8.2.5	✓ Consequence Level 2 – localised and short term impacts to cetaceans and Low inherent risk severity Section 8.1.5	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.7.4	✓ Low inherent risk to benthic habitats Section 9.1.4	✓ Low inherent risk severity to water quality Section 9.2.4.1	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.5.5	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4

Cultural feature of the environment relating to First Nations People's heritage sites and values	Environmental receptor where the cultural feature may exist	Project planned and unplanned aspects													
		Emissions – light	Emissions – atmospheric	Interaction with Marine Fauna	Seabed disturbance	Planned Discharges - Drilling	GHG Emissions	Underwater sound emissions - Continuous	Underwater sound emissions - Impulsive	Planned Discharges – Operational	Loss of materials or waste overboard	Minor LOC	Accidental Release MDO	Accidental release - LOWC	Introduction, establishment and spread of IMS
Cultural obligations to care for Country	• All physical and ecological receptors • (Section 6.4 and 6.5)	✓ Consequence Level 1 - temporary and localised change in marine fauna behaviour Section 8.3.4	✓ Consequence Level 1 - temporary and localised change in air quality Section 8.4.4	✓ Low inherent risk severity to marine fauna Section 9.3.4	✓ Consequence Level 2 – localised and short-term impacts to benthic habitats Section 1.1.1	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 2 localised and short-term impacts to cetaceans and Moderate inherent risk severity Section 8.2.5	✓ Consequence Level 2 – localised and short term impacts to cetaceans and Low inherent risk severity Section 8.1.5	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.7.4	✓ Low inherent risk to benthic habitats Section 9.1.4	✓ Low inherent risk severity to water quality Section 9.2.4.1	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.5.5	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4
Knowledge systems	• Culturally significant species • The Convincing Ground • Deen Maar • Discovery Bay Coastal Park • Wilsons Promontory • Tyrendarra lava flow.			✓ Low inherent risk severity to marine fauna Section 9.3.4		✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 2 localised and short-term impacts to cetaceans and Moderate inherent risk severity Section 8.2.5	✓ Consequence Level 2 – localised and short term impacts to cetaceans and Low inherent risk severity Section 8.1.5	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.7.4		✓ Low inherent risk severity to water quality Section 9.2.4.1	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.5.5	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4
Connection to Country	• All physical and ecological receptors • (Section 6.4 and 6.5)	✓ Consequence Level 1 - temporary and localised change in marine fauna behaviour Section 8.3.4	✓ Consequence Level 1 - temporary and localised change in air quality Section 8.4.4	✓ Low inherent risk severity to marine fauna Section 9.3.4	✓ Consequence Level 2 – localised and short-term impacts to benthic habitats Section 1.1.1	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 2 localised and short-term impacts to cetaceans and Moderate inherent risk severity Section 8.2.5	✓ Consequence Level 2 – localised and short term impacts to cetaceans and Low inherent risk severity Section 8.1.5	✓ Consequence Level 1 – localised and temporary change to water and sediment quality Section 8.7.4	✓ Low inherent risk to benthic habitats Section 9.1.4	✓ Low inherent risk severity to water quality Section 9.2.4.1	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.5.5	✓ Moderate inherent risk to shoreline habitats, avifauna, pinnipeds and cetaceans Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4
Habitats and species															
Coastal reserves and wetlands							✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4						✓ Moderate inherent risk severity to shoreline habitats Section 9.5.5	✓ Moderate inherent risk to shoreline habitat Section 9.6.5	
Culturally significant species and food resources:	• Fish, sharks, rays, eels, shellfish and crustaceans	✓ Consequence Level 1 - temporary and localised change in fish behaviour Section 8.3.4			✓ Moderate inherent risk severity to marine invertebrates and fish Section 1.1.1	✓ Low inherent risk severity to marine fauna Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 1 – minor impact on fish and Low inherent risk severity Section 8.2.5	✓ Consequence Level 1 – minor impact on fish and Low inherent risk severity Section 8.1.5	✓ Low inherent risk severity to marine fauna Section 8.7.4	✓ Low inherent risk severity to marine fauna Section 9.1.4		✓ Low inherent risk severity to invertebrates, fish and sharks Section 9.5.5	✓ Moderate inherent risk severity to invertebrates, fish and sharks Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4

Cultural feature of the environment relating to First Nations People's heritage sites and values	Environmental receptor where the cultural feature may exist	Project planned and unplanned aspects													
		Emissions – light	Emissions – atmospheric	Interaction with Marine Fauna	Seabed disturbance	Planned Discharges - Drilling	GHG Emissions	Underwater sound emissions - Continuous	Underwater sound emissions - Impulsive	Planned Discharges – Operational	Loss of materials or waste overboard	Minor LOC	Accidental Release MDO	Accidental release - LOWC	Introduction, establishment and spread of IMS
Culturally significant species	• Whales			✓ Low inherent risk severity to marine fauna Section 9.3.4		✓ Low inherent risk severity to marine fauna Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 2 – localised and short-term impacts to whales and Moderate inherent risk severity Section 8.2.5	✓ Consequence Level 2 – localised and short term impacts to whales and Low inherent risk severity Section 8.1.5	✓ Low inherent risk severity to marine fauna Section 8.7.4	✓ Low inherent risk severity to marine fauna Section 9.1.4		✓ Moderate inherent risk severity to cetaceans Section 9.5.5	✓ Moderate inherent risk severity to cetaceans Section 9.6.5	
Culturally significant species	• Pinnipeds			✓ Low inherent risk severity to marine fauna Section 9.3.4		✓ Low inherent risk severity to marine fauna Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4	✓ Consequence Level 1 – minor impact on pinnipeds and Low inherent risk severity Section 8.2.5		✓ Low inherent risk severity to marine fauna Section 8.7.4	✓ Low inherent risk severity to marine fauna Section 9.1.4		✓ Moderate inherent risk severity to pinnipeds Section 9.5.5	✓ Moderate inherent risk severity to pinnipeds Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4
Culturally significant species	• Seabirds and shorebirds	✓ Consequence Level 1 - temporary and localised change in avifauna behaviour Section 8.3.4		✓ Low inherent risk severity to marine fauna Section 9.3.4			✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4				✓ Low inherent risk severity to marine fauna Section 9.1.4		✓ Moderate inherent risk severity to avifauna Section 9.5.5	✓ Moderate inherent risk severity to avifauna Section 9.6.5	
Key Ecological Feature	• Bonney Coast Upwelling (productivity of)					✓ Low inherent risk severity to plankton Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4			✓ Low inherent risk severity to plankton Section 8.7.4			✓ Low inherent risk severity to plankton	✓ Moderate inherent risk severity to plankton Section 9.6.5	
Water quality						✓ Consequence Level 1 – localised and temporary change to water quality Section 8.6.4				✓ Consequence Level 1 – localised and temporary change to water quality Section 8.7.4		✓ Low inherent risk severity to water quality Section 9.2.4.1	✓ Low inherent risk severity to water quality Section 9.5.5	✓ Low inherent risk severity to water quality Section 9.6.5	
Nearshore benthic habitats	• Benthic habitats				✓ Consequence Level 2 – localised and short-term impacts to benthic habitats Section 1.1.1	✓ Consequence Level 2 – localised and short-term impacts to benthic habitats Section 8.6.4	✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4				✓ Low inherent risk severity to benthic habitats Section 9.1.4		✓ Moderate inherent risk severity to benthic habitats Section 9.5.5	✓ Moderate inherent risk severity to benthic habitats Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4

Cultural feature of the environment relating to First Nations People's heritage sites and values	Environmental receptor where the cultural feature may exist	Project planned and unplanned aspects													
		Emissions – light	Emissions – atmospheric	Interaction with Marine Fauna	Seabed disturbance	Planned Discharges - Drilling	GHG Emissions	Underwater sound emissions - Continuous	Underwater sound emissions - Impulsive	Planned Discharges – Operational	Loss of materials or waste overboard	Minor LOC	Accidental Release MDO	Accidental release - LOWC	Introduction, establishment and spread of IMS
Intertidal communities and shorelines	• Mangroves, macroalgae, seagrass, coastal saltmarsh, rocky and sandy shorelines.						✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4						✓ Moderate inherent risk severity to shoreline habitats Section 9.5.5	✓ Moderate inherent risk severity to shoreline habitat Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4
Marine Park, coastal reserve, and wetlands	• Wilsons Promontory, Ninety Mile Beach, Marengo Reef						✓ Consequence Level 1 – minor contribution to the carbon budget Section 8.5.4						✓ Moderate inherent risk severity to marine parks Section 9.5.5	✓ Moderate inherent risk severity to marine parks Section 9.6.5	✓ Moderate inherent risk severity from IMS Section 9.4.4

10.3 Evaluation

This section evaluates the potential disruption to the links between environment receptors and cultural features described in Section 10.1 and 10.2. In doing so, this section considers the nature and scale of the planned activities and impacts and risks to relevant environment receptors outlined in Table 10-1.

10.3.1 Tangible and Heritage Sites

10.3.1.1 Coastal/Island Objects and Places

Cultural heritage objects found along the coast and islands of the monitoring EMBA include shell middens, artefact scatters, and LDADs (the occurrence of stone artefacts at low densities) (Table 10-1). Shell middens and artefact scatters are located close to the shoreline, whereas LDADs are typically found further inland (Biosis, 2023).

Cultural heritage places located within the monitoring EMBA that are significantly mentioned within relevant Country Plans include:

- The Convincing Ground
- Deen Maar
- Discovery Bay Coastal Park
- Wilsons Promontory
- Tyrendarra lava flow.

Potential disruption to Cultural Features

Cultural heritage objects and places within the monitoring EMBA have the potential to be exposed to shoreline hydrocarbons in an unlikely accidental hydrocarbon release event. Hydrocarbon exposure of cultural heritage objects and places has the potential to disturb the intrinsic link between First Nations people values associated with cultural heritage objects and places.

Figure 6-1 shows stochastic modelling predicting shorelines with the potential to be exposed to shoreline hydrocarbon. Shoreline accumulation will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA, 1995). As a result, only coastal/island objects and places along the high tide mark have the potential to be exposure exposed to shoreline hydrocarbons. Cultural heritage objects and places located above the high tide mark are not expected to be exposed, and therefore, not expected to be impacted by shoreline hydrocarbons. Cultural heritage objects and places located below to low tide mark may have some limited exposure to hydrocarbons entrained in the water column.

The exposure of cultural heritage objects and places from shoreline hydrocarbons at the high tide mark may occur. Deen Maar Island, being a place linked to the transition of spirits from the earth, could be exposed to hydrocarbons around its rocky shores. Deen Maar Island is not typically accessed, but is a constant visual and spiritual link for First Nations Peoples on the Mainland; its cultural value in this respect would be unlikely to be disrupted by a spill of hydrocarbons of the nature and scale provided for within this plan. The topography of Deen Maar Island, and exposure to the ocean, provides a natural resilience against hydrocarbon spills; rocky shores lead into steep cliffs to the vegetated plateau high above the water. Due to the exposed location of Deen Maar Island, the highly volatile nature of the hydrocarbons associated with this activity (light non-persistent), in the unlikely event of hydrocarbons being release which then accumulate on shorelines in the region, and potentially around cultural heritage objects and places, are likely to be readily removed in the presence of tidal and/or wave action. Beaches and rocky shores on the mainland, facing Deen Maar Island, and which may hold a place in ceremony and knowledge transfer also have the potential to be exposed to hydrocarbons, though modelling indicates that these areas (~50 km from the operational area) may have the potential to be exposed to only Low concentrations of hydrocarbons; these levels of (light) hydrocarbons do not typically require intervention and are naturally dispersed over days and weeks. The potential exposure risk at Discovery Bay, Wilsons Promontory and Tyrendarra lava flow are the same or less than the coast facing Dean Maar Island.

The heritage value of cultural heritage objects and places temporarily exposed to shoreline hydrocarbons is not expected to change. The temporary exposure of cultural heritage objects and places to shoreline hydrocarbons may temporarily contaminate the objects or sites however, weathering of light non-persistent hydrocarbons will prevent long-term hydrocarbon exposure. This could disrupt cultural linkages to exposed components of the environment; this disruption would be temporary and recoverable. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

Consultation with first nations groups indicates that First Nations People would like to be engaged in the event of a spill, to be part of the recovery efforts (Consultation Day GMTOAC 17 February 2024, Ref: FN-GMTOAC-20240405-Email). The involvement of First Nations People would be expected to accelerate recovery of country and avoid additional disruption to cultural heritage from response efforts.

Relevant First Nations groups will be engaged in the event an accidental hydrocarbon release will expose cultural heritage objects and places to hydrocarbons as specified in Section 10.3.1. Cooper Energy maintains a list of key First Nations persons who have expressed an interest in playing a key role in the protection of cultural heritage during such emergency events.

The intrinsic link between coastal/island objects and associated Cultural Features is expected to be maintained given values of the objects and places is not expected to change and First Nations people will be central to the management of these objects and places in the event of an accidental hydrocarbon release.

10.3.1.2 Submerged Sites

Sea Country is considered to extend beyond formally defined Reconciliation Action Plan areas to include sea and submerged lands to the edge of the continental shelf. Planned activities and aspects with the potential to interact with the seabed are limited to within the operational area. Unplanned events and aspects that could affect submerged sites are accidental release of hydrocarbons.

Potential disruption to Cultural Features

Submerged sites have the potential to be impacted by the East Coast Project aspects that disturb the seabed. Disturbance to seabed within the operational area is expected to be localised and recoverable (Table 10-2). The area of impact is small compared to the extent and distribution of the substrate types within the operational area across the wider region (Sections 8 and 9). No underwater cultural heritage sites, including other cultural artefacts, have been identified within the Operational Area (Section 1.1.1).

Given the operational area, and associated seabed disturbance is located away (>50 km) from described landscape features of particular cultural significance (Tyrendarra Lava Flow), the expected absence of artifacts, and that disturbance to cultural heritage (if it were unexpectedly found) is regulated to avoid damage (CM9: Cooper Energy Cultural Heritage Disturbance Risk Management Measures), the intrinsic link to between submerged sites and First Nations people is expected to be maintained.

An accidental release of hydrocarbons has the potential to impact on submerged sites, via contact with hydrocarbons entrained within the water column. However, given the limited volumes, and low persistence of the hydrocarbons associated with this activity, any hydrocarbon contact would be brief and would not be expected to change the nature or integrity of submerged features.

The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

10.3.2 Intangible Heritage Sites and Values

10.3.2.1 Sea Country

Sea Country is an intrinsic value to First Nations people. It includes parts of open ocean, beaches, land and freshwater on the coast, habitats and encompasses all living things, beliefs, values, creation spirits and cultural obligations connected to an area. The operational area and monitoring

EMBA overlaps Sea Country. Many coastal First Nations groups have a close connection with the sea and its resources which are central to culture, economy and survival of First Nations people. Caring for Sea Country is culturally significant to coastal First Nations groups of the Otway region. It is a place of abundant resources and habitat to culturally significant flora and fauna. First Nations people's wellbeing and confidence is reliant on the authority to access and practice on Country (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023; Eastern Maar Aboriginal Corporation, 2014).

Potential disruption to Cultural Features

Project impacts and risks to the biological and physical components of sea country are described in Sections 8 and 9. First Nations cultural heritage values associated with Sea Country including ecosystems and species are considered based on their ecological values, food sources or culturally significant totemic values. First Nations people's values of marine ecosystems and species has the potential to change if there are impacts to ecosystem functioning and integrity or species population.

As summarised in Table 10-2, potential impacts and risks to fish, marine mammals and seabirds and shorebirds, and water and sediment quality are mostly limited to localised and short-term impacts (Level 1 or 2 consequences), with no impacts at the population level, or which would manifest in disruption to a cultural feature. As an existing activity with limited nature and scale, potential disruption to sea country values is expected to be negligible; energy infrastructure has previously been installed on the seabed as well as onshore, and continues to coexist with first Nations Peoples values, memories and songlines relating to Country (AMCI, 2010; Biosis, 2023).

The introduction, establishment and spread of IMS and accidental hydrocarbon release are a risk of up to Moderate severity, and could affect marine resources, including resources collected by First Nations Peoples in coastal areas. With preventative and response controls in place, impacts and risks from these aspects are not expected eventuate, nor to result in widespread long-term impacts to Sea Country or impacts to ecosystem functioning and integrity or species populations. Links between environment receptors and Cultural Features could be disrupted in the unlikely event of a major hydrocarbon spill, or remote event of IMS introduction and spread, but are expected to be recoverable. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

10.3.2.2 Creation/ Dreaming sites, Songlines, Sacred Sites and Ancestral Beings

Creation/ Dreaming sites, Songlines, ceremonial sites link First Nations people to ancestors, culture, and Country. The Convincing Ground remains a place of ceremony for the Gunditjmara who gather at the site annually to reflect on the ongoing impacts of colonisation on their people (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023). Deen Maar is an important Dreaming site where Ancestors leave the earth. Karntubul (whales) are Ancestors of Gunditj Mirring and feature in dreaming stories, ceremony, song and dance of Gunditjmara.

Potential disruption to Cultural Features

Project impacts to seabed are limited to the operational area, offshore and are not associated with landscapes of particular cultural significance such as the Tyrendarra Lava Flow. Project risks events have the potential to affect cultural features highlighted as of importance during consultation, including the Deen Maar, and whales. These project risks therefore have the potential to disrupt cultural features of Creation/Dreaming, songlines, sacred sites and Ancestral beings. Energy infrastructure has previously been installed on the seabed as well as onshore, and continues to coexist with first Nations Peoples values, memories and songlines relating to Country (AMCI 2010; Biosis, 2023).

Shoreline hydrocarbon exposure to Deen Maar and the Convincing Ground has the potential to change the cultural heritage values (Creation/ Dreaming sites, sacred sites and Ancestral beings) of these sites. As evaluated in Section 10.3.1 the (risk) temporary exposure of Deen Maar and the Convincing Ground to shoreline hydrocarbons is not expected to change the heritage values of the sites. The temporary exposure to shoreline hydrocarbons may temporarily contaminate the sites however, weathering of light non-persistent hydrocarbons will prevent long-term hydrocarbon contamination. Relevant First Nations groups will be notified in the event an accidental hydrocarbon release will expose Deen Maar to hydrocarbons as specified in Section 9.5.6 and 9.6.6. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

Cooper Energy maintains a list of key First Nations persons who have expressed an interest in playing a key role in the protection of cultural heritage during such emergency events. The intrinsic link between First Nations people and cultural heritage values (Creation/ Dreaming sites, sacred sites and Ancestral beings) of Deen Maar and the Convincing Ground is expected to be maintained given First Nations people will be central to the management of these sites in the event of an accidental hydrocarbon release.

As summarised in Table 10-2, potential impacts to whales from Project aspects are mostly limited to localised and short-term impacts (Level 1 or 2 consequences), such as small, temporary changes to migratory or foraging behaviours (see Section 8.2.5), and which be managed to minimise behavioural disturbance to southern right whales and blue whales. The risk of vessels physically interacting with whales is Low and managed through the implementation of cautionary and no-approach zones around whales. These risks, though unlikely, if they were to eventuate, are not anticipated to impact population levels, distribution or local ecosystem function. With controls in place, impacts and risks to whales from Project aspects are not expected to impact the intrinsic link between First Nations people and whales that are valued as Ancestral beings, and will not affect populations or distributions of whales to the extent that Gunditjmara practice of 'calling in' whales would be disrupted. As such, the intrinsic link between First Nations people and Ancestral beings (whales) is expected to be maintained. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

Cooper Energy commits to CM13: Ongoing Engagement to ensure First Nations people will be central to the management of First Nations people's heritage sites and values.

10.3.2.3 Cultural Obligations to Care for Country

First Nations people are culturally obligated and inherently responsible to care, protect and heal Country for present and future generations. The roles held relating to taking care of Country and knowledge holding vary amongst individuals and within clans and family groups. Roles include taking care of culturally significant species or habitats of significant species known to be important food resources (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023). The obligation to care for Country is deep rooted in First Nations cultural laws and customs (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023).

Potential disruption to Cultural Features

By sharing of information through consultation, Country Plans, and on Country teachings, First Nations People have articulated the particular values and sensitivities that are important, and which will require particular consideration within the assessment of impacts and risks and their management. This is consistent with their inherent responsibility to care for Country. As evaluated in Section 10.3.2.1, Project aspects are not expected to result in widespread long-term impacts to Sea Country or impacts to ecosystem functioning and integrity or species populations. Table 10-2 summarises how potential impacts and risks to marine fauna and water and cultural heritage are mostly limited to localised and short-term impacts (Level 1 or 2 consequences). As an existing activity with limited nature and scale, potential disruption to sea country values is expected to be negligible; energy infrastructure has previously been installed on the seabed as well as onshore, and continues to coexist with first Nations Peoples values, memories and Songlines relating to Country (AMCI, 2010; Biosis, 2023).

The unplanned introduction, establishment and spread of IMS and accidental hydrocarbon release has the potential for moderate risk to environment receptors. With controls in place, impacts and risks to Sea Country are not expected to impact ecosystem functioning and integrity or species populations.

The exclusion of First Nations people from accessing Country or decision-making processes for Country may risk disrupting the intrinsic link between First Nations people and obligations to care for Country. Scenarios where First Nations people are restricted in their access to Country could occur in the event of an accidental hydrocarbon release for safety reasons. To maintain and ensure First

Nations people are central to the management of the Country, relevant First Nations groups will be notified in the event an accidental hydrocarbon release as specified in Section 9.5.6 and 9.6.6. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

Cooper Energy maintains a list of key First Nations persons who have expressed an interest in playing a key role in the protection of cultural heritage during such emergency events. First Nations people and obligations to care for Country is expected to be maintained given First Nations people will be central to the management of these sites in the event of an accidental hydrocarbon release which could impact them.

Cooper Energy commits to CM13: Ongoing Engagement, to ensure First Nations people will be central to the management of First Nations people's heritage sites and values.

10.3.2.4 Knowledge Systems

First Nations peoples ecological, spiritual, traditional and cultural knowledge is passed through the generations using cultural practices (Dreaming stories, ceremony, song and dance) where knowledge holders (Elders) are the custodians of knowledge. This knowledge includes culturally significant species, and landscape features that hold Dreaming and creation stories or are events and ceremonial places critical for intergenerational knowledge sharing and cultural practice.

Receptors relevant to First Nations people knowledge systems include:

- Culturally significant species including food resources, cetaceans, pinnipeds, seabirds and the Bonney Upwelling (refer to Sections 10.3.3.1 to 10.3.3.5)
- Cultural heritage places including benthic habitats, The Convincing Ground, Deen Maar, Discovery Bay Coastal Park, Wilson Promontory, and Tyrendarra lava flow (refer to Section 10.3.1.1 and Section 10.3.2.2).

Potential disruption to Cultural Features

Impacts and risks resulting in the exclusion of access to cultural heritage places or displacement/reduction in the population of culturally significant species have the potential to disrupt the intrinsic link between environment receptors and knowledge systems. Project aspects are not expected to result in widespread long-term impacts to environment receptors (including those that are part of knowledge systems). Table 10-2 summarises how potential impacts and risks to environment receptors are mostly limited to localised and short-term impacts (Level 1 or 2 consequences). As an existing activity with limited nature and scale, potential disruption to knowledge systems is expected to be negligible; energy infrastructure has previously been installed on the seabed as well as onshore, and continues to coexist with first Nations Peoples values, memories and Songlines relating to Country (AMCI, 2010; Biosis, 2023).

The unplanned introduction, establishment and spread of IMS and accidental hydrocarbon release have the potential for moderate risk to environment receptors. If access to heritage places is restricted, knowledge systems of that value can potentially be disrupted or lost.

The potential to exclude First Nations people from accessing Country may risk disrupting the intrinsic link between First Nations people and knowledge systems. Scenarios where First Nations people are restricted access to Country may occur in the event of an accidental hydrocarbon release for safety reasons. The temporary exposure of cultural heritage places to shoreline hydrocarbons may temporarily result in restricted access to cultural heritage places. Due to the highly volatile nature of the hydrocarbons (MDO and Condensate) as a light non-persistent hydrocarbon (see Section 9.5.5 and 9.6.5), shoreline hydrocarbons at cultural heritage places, are likely to be easily washed off in the presence of tidal and/or wave action. As a result, access restrictions (if any) would be temporary and not long-term. Relevant First Nations groups will be engaged in the event an accidental hydrocarbon release will expose cultural heritage places to hydrocarbons as specified in Section 9.5.6 and 9.6.6. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

Cooper Energy maintains a list of key First Nations contacts who have expressed an interest in the protection of cultural heritage during such emergency events. The intrinsic link between environment receptors and First Nations Peoples knowledge systems is expected to be maintained given First Nations people will be central to the management of these sites in the event of an accidental hydrocarbon release.

As summarised in Table 10-2, potential impacts and risks to culturally significant species such as fish, marine mammals and seabirds and shorebirds are mostly limited to localised and short-term impacts (Level 1 or 2 consequences). The introduction, establishment and spread of IMS and accidental hydrocarbon release have the potential for moderate risk. With controls in place, impacts and risks from these aspects are not expected to result in impacts to species populations. As such, intrinsic link between environment receptors and First Nations Peoples is expected to be maintained.

Cooper Energy commits to CM13: Ongoing Engagement, to ensure First Nations people will be central to the management of First Nations people's heritage sites and values.

10.3.2.5 Connection to Country

First Nations people hold strong connections to the south-east marine region, as occupation of coastal areas dates back over at least 40,000 years (DoE, 2015a). The Victorian coast is of significance with respect to First Nations cultural heritage. This includes areas where there may be no physical evidence of past cultural activities but includes places of spiritual or ceremonial significance, places where traditional plant or mineral resources occur or trade and travel routes (Aboriginal Victoria, 2008). The operational area and monitoring EMBA overlap Sea Country including coastal and offshore components.

Potential disruption to Cultural Features

Impacts and risks that restrict access to Sea Country have the potential to disrupt First Nations peoples connection to Country.

As evaluated in Section 10.3.2.1, impacts and risks from the East Coast Project aspects are not expected to result in widespread long-term impacts to Sea Country or impacts to ecosystem functioning and integrity or species populations. Table 10-2 summarises how potential impacts and risks to marine fauna, water and sediment quality, and cultural heritage are mostly limited to localised and short-term impacts (Level 1 or 2 consequences). As an existing activity with limited nature and scale, potential disruption of Connections to Country is expected to be negligible; energy infrastructure has previously been installed on the seabed as well as onshore, and continues to coexist with first Nations Peoples values, memories and songlines relating to Country (AMCI, 2010; Biosis, 2023).

The introduction, establishment and spread of IMS and accidental hydrocarbon release have the potential for moderate risk. With controls in place, impacts and risks to Sea Country are not expected to impact ecosystem functioning and integrity or species populations. As such, the intrinsic link between environment receptors and First Nations Peoples connection to Country is expected to be maintained.

As evaluated in Section 10.3.2.4, restriction of access to Country may occur in the event of an accidental hydrocarbon release for safety reasons. The presence of shoreline hydrocarbons may temporarily enforce restricted access to Country. Due to the highly volatile nature of the MDO and condensate as a light non-persistent hydrocarbon, shoreline hydrocarbons are likely to be easily washed off in the presence of tidal and/or wave action. As a result, if restricted access to Country is enacted, it is expected to be temporary and not long-term. Relevant First Nations groups will be notified in the event an accidental hydrocarbon release will expose cultural heritage places to hydrocarbons as specified in Section 9.5.6 and 9.6.6. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

Cooper Energy maintains a list of key First Nations persons who have expressed an interest in playing a key role in the protection of cultural heritage during such emergency events. The intrinsic link between the intrinsic link between environment receptors and First Nations Peoples connection to Country is expected to be maintained given First Nations people will be central to the management of these sites in the event of an accidental hydrocarbon release.

10.3.3 Habitats and Species

10.3.3.1 Culturally Significant Species and Food Resources - Eels

Culturally significant food resources occur in the Otway. Highlighted during consultation and cultural training were short-finned eels (Kooyang). Kooyang migrate through the Otway Region including State waters and the Commonwealth Marine Area to/from freshwater systems in Gunditjmara Country to/from spawning grounds in the Coral Sea. Gunditjmara engineered aquaculture systems from volcanic formations associated with the Tyrendarra Lava flow (circa. 30,000 years old) to create Budj Bim. Eels were captured, fattened up, harvested, smoked and traded.

Potential disruption to Cultural Features

Eels (see Section 6.5.5) are an important resource for First Nations people as identified during consultation and review of relevant First Nations group Country Plans (Table 6-25). First Nations groups and specific individuals within the groups may have responsibility to care for eels and their habitats to ensure associated cultural practices, and ventures such as cultural education tourism, can continue for future generations (Table 6-24). Koster et al. (2024), and Church et al. (2021), identify conservation considerations for the short-finned eel; these include potential changes to river flows from climate change, and physical/anthropogenic habitat modification, both of which have the potential to affect the migratory success of populations, and therefore, affect the cultural practices associated with the eels migration.

As summarised in Table 10-2, potential impacts to eels from East Coast Project aspects are limited to Level 1 consequences of localised and short-term impacts to behaviour of individuals, but no population level impacts. There are no habitat modifications caused by the activity which would be expected to have an impact on migration to or from freshwater systems where they are harvested. This is because of the limited nature and scale of impacts to environment receptors, generally limited to the operational area and planned activity EMBAs, and the offshore location of the activity, away from freshwater habitats where the species migrates from and to, via a highly dispersed migration through the South East Marine Region.

Subsea noise generated by activity vessels and equipment has the potential to cause minor behavioural reactions in fish, including eels (i.e. possible brief changes to swimming speed / direction in the vicinity of project activities), which will not result in changes to eel migratory behaviour or success. The sources of noise, and potential effects on fish and eel is described in more detail in Section 8.1.5 and 8.2.5. There is negligible risk that planned aspects of the activity may either directly or indirectly impact on eel populations or migratory outcomes. As an existing activity with limited nature and scale, potential disruption to sea country values is expected to be negligible; energy infrastructure has previously been installed on the seabed as well as onshore, and continues to coexist with First Nations peoples values, memories and Songlines relating to Country (AMCI, 2010; Biosis, 2023).

The unplanned introduction, establishment and spread of IMS, and accidental hydrocarbon release from the activity carry moderate risk. With controls in place (described in Section 8 and 9), these unplanned events are not expected to occur, or result in long term impacts to species populations. As such, intrinsic link between environment receptors and First Nations peoples is expected to be maintained.

10.3.3.2 Culturally Significant Species – Whales

First Nations people around Australia have long had a strong connection to whales, which has significance as totemic ancestors to some groups. Karntubul (whales) in Sea Country hold deep cultural significance to the Gunditjmara and feature in Dreaming stories, ceremony, song and dance traditions.

Whales are culturally significant species for the First Nations peoples as identified during consultation and review of relevant First Nations group Country Plans (Table 6-25). First Nations people have a cultural responsibility to ensure cetaceans that reside within and migrate through Sea Country are cared for and healthy and their habitat is sustained. Whales feature in Dreaming stories, ceremony, song and dance of some First Nations groups along the coasts of Australia. The protection of Karntubul (whale) species is paramount to Gunditjmara spiritual, physical wellbeing and it is the responsibility of Gunditjmara people to care for Sea Country and protect the species for present and future generations. Whales are also a source of food, and Gunditjmara people still gather resources from beached whales which has been done for thousands of years (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023).

EPBC threatened and migratory cetaceans are present within the operational area and monitoring EMBA during seasonal migrations. Pygmy blue whale distribution and foraging BIAs and a southern right whale migration BIA overlaps the operational area. The monitoring EMBA intersects foraging and distribution BIAs for the pygmy blue whale, migration and reproduction BIAs for the southern right whale and foraging BIAs for the humpback whale.

Potential disruption to Cultural Features

First Nations groups and specific individuals within the groups may have kinship and/or responsibility to care for culturally significant species and their habitats (see Table 6-25). It is considered that impacts to species at a population level may inhibit First Nations people's ability to perform their obligations to care for culturally significant species and their habitats.

There is potential that individual whales could be behaviourally affected or physically impacted by the presence/movement and noise of vessels which may occasionally be required for inspection and maintenance of the subsea facilities. Control measures have been established to minimise the risk of physical impact and behavioural disturbance. Therefore, the potential that overall whale occurrence nearby the coast, or the numbers of beached whales will be influenced by the activity is considered negligible.

As summarised in Table 10-2, potential impacts to cetaceans from the East Coast Project aspects are limited to Level 2 consequences of localised and short-term impacts to behaviour of individuals, but no population level impacts; these consequences are considered to be unlikely to occur, and the risk to whales is considered to be Low. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Low). This is considered appropriate as cultural practices incorporate the movement of populations of whales into the region. Whilst there may be low level impacts to individuals, these impacts are not expected to result in changes to whale migratory outcomes, impact population levels or change population distributions.

An accidental hydrocarbon release carries moderate risks. With controls in place (described in Section 8 and 9), impacts and risks from these aspects are not expected occur, or to result in impacts to species populations. As such, intrinsic link between environment receptors and First Nations Peoples is expected to be maintained.

10.3.3.3 Culturally Significant Species – Pinnipeds

Pinnipeds such as seals and sealions are of significant value to First Nations people. The First Nations people of the Otway region have a profound relationship with Sea Country and seals feature in cultural practices and Dreaming stories and have been hunted as a valuable food resource. Koorn Moorn (seals) feature in song and dance of the Gunditjmara people and are also a food resource. There is evidence of the collection of seals within the Tarragal cave site that date back to 10,000 years (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023).

Seals and sealions are culturally significant species and of value to First Nations peoples of the Otway region. Important colonies and breeding habitats are found within the monitoring EMBA and are in within proximity of the operational area (Figure 6-53 and Figure 6-54).

Potential disruption to Cultural Features

First Nations groups and specific individuals within the groups may have kinship and/or responsibility to care for culturally significant species and their habitats (see Table 6-25). It is considered that impacts to species at a population level may inhibit First Nations people's ability to perform their obligations to care for culturally significant species and their habitats. If responsibilities have not been met it may reinforce a sense of powerlessness to members of First Nation groups responsible for the protection and care of these species (Holcombe, 2022).

As summarised in Table 10-2, potential impacts to pinnipeds from Project aspects are limited to Level 1 consequences of minor and local to behaviour and possible temporary changes to habitat in the offshore environment, within or local to the operational area, and not within coastal environments where fauna are more likely to be encountered by people; no discernible disruption to cultural links would be expected. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Low).

Accidental hydrocarbon releases have the potential for moderate risk wider afield, including in coastal areas. As described in Section 9.5.5 and 9.6.5, hydrocarbon exposure, of the potential nature and scale associated with project risks, would not be expected to result in changes to pinniped foraging and breeding behaviours or impact population levels. With controls in place (described in Section 8 and 9), unplanned events of this nature are not expected to occur, or result in long term impacts to species populations. As such, intrinsic link between environment receptors and First Nations Peoples is expected to be maintained.

10.3.3.4 Culturally Significant Species – Seabirds and Shorebirds

Seabirds and shorebirds play a vital role in First Nations cultural stories and traditions and birds and eggs are a source of food to many First Nations groups. Different avian species hold deep connections to lore and represent spiritual emblems or totems. The arrival of migratory seabirds and shorebirds and breeding seasons of seabirds and shorebirds are important markers for the different seasons observed by First Nations groups (Eastern Maar Aboriginal Corporation, 2014). Magpie gees and Cape Barren geese were harvested for food from wetland habitats Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023). For the Gunaikurnai people of Gippsland, seabirds play a role in their cultural stories and traditions. One notable story involves Borun, the pelican, who is a significant figure in their creation story. Borun is considered the ancestor of the Gunaikurnai people, highlighting the importance of sea birds in their cultural heritage (Gunaikurnai Land and Waters Aboriginal Corporation, 2015).

Seabirds and shorebirds are of significant value to First Nations people. Foraging BIAs for nine seabird species overlap the operational area. Breeding, migration and aggregation areas can be found within the monitoring EMBA (BIAs are displayed in Figure 6-33 to Figure 6-40).

Potential disruption to Cultural Features

First Nations groups and specific individuals within the groups may have kinship and/or responsibility to care for culturally significant species and their habitats (see Table 6-25). It is considered that impacts to species at a population level may inhibit First Nations people’s ability to perform their obligations to care for culturally significant species and their habitats. If responsibilities have not been met it may reinforce a sense of powerlessness to members of First Nation groups responsible for the protection and care of these species (Holcombe, 2022).

As summarised in Table 10-1, potential impacts could result from temporary changes to the physical environment, such as via the introduction of a source of artificial light. As described in Section 8.3.4, impacts from planned aspects such as light, are limited to Level 1 consequences of minor and local to behaviour, not resulting in population level impacts, or which change migratory outcomes, and which could then affect cultural practices and seasonal markers that are linked to the presence of birds. Accidental hydrocarbon release is considered a Low risk for seabirds. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate). With controls in place, these impacts and risks from these aspects are not expected to impact culturally significant species at a population level, as such, the intrinsic link between environment receptors and First Nations Peoples cultural heritage values is expected to be maintained.

The unplanned introduction, establishment and spread of IMS, and accidental hydrocarbon release from the activity carry moderate risk. With controls in place (described in Section 8 and 9), these unplanned events are not expected to occur, or result in long term impacts to species populations. As such, intrinsic link between environment receptors and First Nations Peoples is expected to be maintained.

10.3.3.5 Key Ecological Feature – Bonney Upwelling

First Nations people recognise the significance of plankton and the crucial role it plays in the ecosystems of the Otway region. Plankton supports many culturally significance species and is integral to the diets of species such as whales, seals, fish and seabirds. Gunaikurnai people of Gippsland, plankton is essential for maintaining the health of their coastal waters. Plankton serves as a primary food source for many marine species, which are important for Gunaikurnai traditional fishing practices and Gunaikurnai cultural heritage (Gunaikurnai Land and Waters Aboriginal Corporation, 2015). The Gunditj Mirring people recognise the significance of the Bonney Upwelling as a dominant feature in the Otway marine region which brings cool nutrient rich water to the surface which supports plankton production.

Phytoplankton and zooplankton are widespread throughout oceanic environments and is expected to occur within the operational area and monitoring EMBA with a high level of diversity. Coastal krill swarms throughout the water column of continental shelf waters primarily in summer and autumn (linked to the Bonney Upwelling), feeding on microalgae and providing an important link in the blue whale food chain.

Potential disruption to Cultural Features

First Nations groups and specific individuals within the groups may have kinship and/or responsibility to care for culturally significant species and their habitats (see Table 6-25). Changes in the frequency or intensity of the Bonney Upwelling impacts the abundance of plankton which can have impacts on culturally significant species in the region such as whales, seals, fish and sea birds (Gunditj Mirring Traditional Owners Aboriginal Corporation, 2023).

In relation to the physical occurrence and characteristics of the Bonney Upwelling, Butler et al. (2004) identify climate change as a possible influence on its strength or frequency, though was not of serious concern. As summarised in Table 10-1, potential impacts to physical oceanographic processes are limited; the activity contributes minor quantities of GHG emissions to Australia's carbon budget (Level 1 Consequence); there are no aspects of the activity which may have a discernible effect on the occurrence, extent or productivity of the Bonney Upwelling. With regards the plankton that are associated with upwelling events, project aspects may have localised and temporary impacts to negligible proportions of the plankton population (Table 10-1). These impacts will not result in changes to plankton local or regional diversity or productivity of plankton, or those fauna which rely on them as a food source. Therefore the intrinsic link between these environment receptors and First Nations Peoples cultural heritage values associated with the Bonney Upwelling is expected to be maintained irrespective of the project activities.

10.3.3.6 Water Quality

Water is of particular cultural significance to First Nations Peoples as an integral part Country, songs, ceremonies, hunting and collecting, and other activities that bind people to their Country and each other. Aboriginal communities in Victoria maintain strong connections to waters and culture. Water sources on Country may be culturally significant or archaeologically prospective. Traditional Owners retain knowledge of water sources that may occur within the monitoring EMBA. Water is an intrinsic value to First Nations people. It includes parts of Sea Country, beaches, land and freshwater habitats on the coast.

Potential disruption to Cultural Features

Planned discharges and unplanned releases have the potential to change water quality of offshore and coastal waters. The change in water quality has the potential to impact culturally significant species and harm Country. Community concerns from the Wadawurrung people on changes in water quality from pollution from industry and development has been noted (Wadawurrung Traditional Owners Aboriginal Corporation, 2020).

As summarised in Table 10-1, potential impacts to water quality from planned Project aspects are limited to Level 1 consequences of minor, temporary, and localised changes in the offshore environment. It is inferred that this level of impact in the offshore environment, would not cause disruption to the linkage between the environment receptor and First Nations Peoples cultural practices. However, an accidental hydrocarbon release has the potential for more widespread reduction in water quality in Sea Country, and which could cause concern as to actual or perceived impacts to water quality. Relevant First Nations groups will be engaged in the event of an accidental hydrocarbon release as specified in Section 9.5.6 and 9.6.6. Cooper Energy maintains a list of key First Nations persons who have expressed an interest in playing a key role in the protection of cultural heritage during such emergency events. With controls in place, the risks from an accidental hydrocarbon release are not expected to result in widespread long-term impacts to Sea Country or impacts to ecosystem functioning and integrity, or species populations. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Low). As such, the intrinsic link to between First Nations people and cultural heritage values associated with water quality is expected not expected to be disrupted long term and would be recoverable.

10.3.3.7 Nearshore Benthic Habitats

Benthic habitats are valuable to First Nations people for their ecological values to sustain culturally significant species. Benthic habitats within the monitoring EMBA are comprised of sponge-dominated reef and sandy substrates. Within the operational area, patchy epifauna and presence of hard platform is consistent with the description of a KEF of the South-East bioregion, that is, shelf rocky reefs and hard substrates. On the continental shelf, rocky reefs and hard grounds provide attachment sites for macroalgae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity (DoE, 2015a).

Potential disruption to Cultural Features

Impacts to benthic habitats at a widespread level poses a potential risk to the intrinsic link between First Nations people and the cultural heritage values of benthic habitats. Widespread changes have the potential to impact population levels of culturally significant species.

As evaluated in Section 10.3.1.2, change in benthic habitat in the operational area is expected to be localised, short-term and recoverable (Table 10-1). The area of impact is small compared to the extent and distribution of the benthic habitats identified within the operational area and wider region (Sections 8 and 9, Table 10-1). Landscape scale impacts (widespread) were also not expected given the limited seabed footprints involved (pers comm Heritage Victoria, 2024). It is noted that oil and gas infrastructure on benthic habitats currently exists and operates in First Nations people's Country, and that values, memories and Songlines relating to Country are acknowledged and recognised (Biosis, 2023). Given the change in benthic habitat from the East Coast Project aspects are localised, short-term and recoverable, the intrinsic link between First Nations people and cultural heritage values of benthic habitats is expected to be maintained.

Cooper Energy commits to CM13: Ongoing Engagement, to ensure First Nations people will be central to the management of First Nations people's heritage sites and values.

10.3.3.8 Intertidal Communities and Shorelines

The operational area does not include an intertidal environment. Intertidal environment within the monitoring EMBA comprises a sandy cove and tidally submerged rock platforms with invertebrate colonisation. Sandy shorelines are valued by First Nations people for their ecological values in supporting culturally significant species. Intertidal communities and shorelines provide habitat and shelter to both marine and terrestrial flora and fauna, including infauna and epifaunal invertebrates, fish and birds. Sea Country for Wadawurrung people includes coastal habitats such as seagrass and saltmarsh (Wadawurrung Traditional Owners Aboriginal Corporation, 2020).

Potential disruption to Cultural Features

Changes to ecosystem functioning and integrity of intertidal communities and shorelines poses a potential risk to the intrinsic link between First Nations people and the cultural heritage values of intertidal communities and shorelines.

As summarised in Table 10-2, the introduction, establishment and spread of IMS and accidental hydrocarbon release has the potential for moderate inherent risk of either directly or indirectly impacting intertidal communities and shoreline habitats. With controls in place, impacts and risks from these aspects are not expected to result in widespread long-term impacts to intertidal communities and shorelines including ecosystem functioning and integrity. As such, the intrinsic link to between First Nations people and cultural heritage values of intertidal communities and shorelines is expected to be maintained.

Cooper Energy commits to CM13: Ongoing Engagement, to ensure First Nations people will be central to the management of First Nations people's heritage sites and values.

10.3.3.9 Marine Parks, Coastal Reserves, and wetlands

Marine Parks, coastal reserves, and wetlands are protected areas which are managed the primary purpose of conserving the biodiversity found in them, while also allowing for sustainable use of natural resources. First Nations people have strong cultural associations with Sea Country and have cultural responsibilities of Country within Marine Parks and Reserves. Some First Nations groups including the Gunaikurnai people have joint management over the Marine Parks and reserves within Country. The Marine Parks and reserves around Wilsons Promontory and Ninety Mile Beach National Park were inhabited Gunaikurnai ancestors and are important for the Gunaikurnai peoples connection to Country (Gunaikurnai Land and Waters Aboriginal Corporation, 2015). The Marengo Reef Marine Park holds cultural significance for the Eastern Maar people and is a habitat for culturally significant marine species (Eastern Maar Aboriginal Corporation, 2014).

Potential disruption to Cultural Features

Changes to ecosystem functioning and integrity of Marine Parks, coastal reserves and wetlands poses a potential risk to the intrinsic link between First Nations people and the cultural heritage values of these places.

There is no overlap between the operational area and Marine Parks, Coastal Reserves and wetlands of International and National Importance, therefore, there is no risk to the intrinsic link between First Nations people and cultural heritage values associated with Marine Parks, coastal reserves, and wetlands for planned East Coast Project aspects.

As summarised in Table 10-1, the introduction, establishment and spread of IMS and accidental hydrocarbon release has the potential for moderate inherent risk of either directly or indirectly impacting Marine Park, coastal reserves, and wetlands.

The Marengo Reef Marine Park comprised of rocky substrate overlaps with the monitoring EMBA; at >50 km from the operational area the marine park has the potential to be exposed to only low levels of hydrocarbons, below the threshold for ecological impacts. Relevant First Nations groups will be engaged in the event of an accidental hydrocarbon release as specified in Section 9.6.6. The risk severity is considered to be the same for the Cultural Feature as for the Environment Receptors that are the cultural feature, or form part of the cultural feature (Moderate).

Cooper Energy maintains a list of key First Nations persons who have expressed an interest in playing a role in the protection of cultural heritage during and the recovery of Sea Country in such emergency events. With controls in place to prevent and mitigate impacts if they were to occur, aspects are not expected to result in widespread long-term impacts to Marine Parks, Coastal Reserves, or to wetlands, when considering ecosystem functioning and integrity. As such, the intrinsic link between environment receptors and First Nations Peoples cultural heritage values is not expected to be disrupted long term and would be recoverable.

10.4 Demonstration of Acceptability

To demonstrate that the East Coast Project can be undertaken in such a way that the environmental impacts and risks will be managed to an acceptable level, Cooper Energy has evaluated all impacts and risks against the criteria described in Section 7.3. Predicted levels of environmental impact or risk have been compared to acceptable levels of impact defined in Table 7-6, and EPOs have been assigned to establish a level of environmental performance which enables management response to prevent the acceptable level of impact from being exceeded.

The demonstration of acceptability is presented in Table 10-3.

Table 10-3: Interaction with First Nations Cultural Heritage Acceptability Assessment

Acceptability Criteria	Demonstration of Acceptability	
Cooper Energy Risk Management Protocol	Risk: Coastal/Island places and objects	Risk: Moderate
	Risk: Submerged sites	Risk: Moderate
	Risk: Sea Country	Risk: Moderate
	Risk: Creation/ Dreaming sites, Songlines, sacred sites and Ancestral beings	Risk: Moderate
	Risk: Cultural obligations to care for Country	Risk: Moderate
	Risk: Knowledge Systems	Risk: Moderate
	Risk: Connection to Country	Risk: Moderate
	Risk: Culturally significant species	Risk: Moderate
	Risk: Bonney Coast Upwelling (KEF)	Risk: Low
	Risk: Water quality	Risk: Low
	Risk: Nearshore benthic habitats	Risk: Moderate
	Risk: Intertidal communities and shorelines	Risk: Moderate
	Risk: Marine Parks, coastal reserves and wetlands	Risk: Moderate
Principles of ESD	A) ‘Integration principle’ The Integration principle will be met through a combination of preliminary consultation in the initial preparation of the OPP for public comment, and importantly the opportunity provided through the public comment process. The objective of stage 1 consultation was to gain knowledge through consultation across key categories of stakeholder that may be affected by the proposed activities, and certain government agencies and authorities to which the activities may be relevant. Relevant feedback has been integrated in the OPP where appropriate. The stage 2 public comment period provides the opportunity for broad public and stakeholder input. The revised OPP submitted to NOPSEMA will incorporate relevant feedback and update the evaluation of environmental impacts and risks to physical, ecological, socio-economic, and cultural features of the environment where appropriate. Pre-public comment, risks from First Nations cultural heritage values and sensitivities was identified as: • Moderate risk for coastal/island places and objects, submerged sites and Sea Country • Moderate risk for Creation/Dreaming sites, Songlines, sacred sites and Ancestral beings • Moderate risk for cultural obligations to care for Country, • Moderate risk for knowledge systems, connection to Country and culturally significant species • Low risk for Bonney Coast Upwelling (KEF) and water quality • Moderate risk for nearshore benthic habitats, and intertidal communities and shorelines • Moderate risk for marine parks, coastal reserves and wetlands. The above predicted levels of risk due to First Nations cultural heritage values and sensitivities from the East Coast Project are equal to or better than the defined acceptable levels (Section 7.3).	
	B) ‘Precautionary principle’	

	If there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. The East Coast Project is consistent with the principle of ESD (b) for this aspect as: • Evaluation of impacts and risks were conducted in accordance with Cooper Energy's risk assessment methodology and Cooper Energy's Cultural Heritage Disturbance Risk Management Measures. • The highest inherent risk for interactions with First Nations cultural heritage values and sensitivities was evaluated as Moderate; therefore, interactions with First Nations cultural heritage values and sensitivities from the East Coast Project will not result in serious or irreversible environmental damage, or disruption to the intrinsic links to First Nations people's heritage sites and values. Although serious or irreversible environmental damage is not predicted to occur, Cooper Energy acknowledge there is some uncertainty with the identification of cultural features and heritage values within the Operational Area and EMBA. • The proposed procedures, management measures and ongoing engagement with First Nations Peoples (see Table 10-4) has been developed to enable Cooper Energy to manage potential uncertainty on the impacts and risks to the interactions with First Nations cultural heritage values and sensitivities. • Where ecosystem functions could be affected, and which could impact on resource distribution; these changes would be expected to be ultimately recoverable with involvement of First Nations Peoples in the response to incidents, and repair of components of the environment and associated cultural links. • The potential impacts and risks to First Nations cultural heritage values and sensitivities (such as the introduction, establishment and spread of IMS and LOWC) are well-understood, and management measures are well established and regulated in Australian waters.
	C) 'Intergenerational principle' The principle of inter-generational equity—is that the present generation should ensure that the health, diversity, and productivity of the environment is maintained or enhanced for the benefit of future generations. The East Coast Project is consistent with the principle of ESD (c) for this aspect as: • The highest inherent risk from interactions with First Nations cultural heritage values and sensitivities was evaluated as Moderate and therefore will not forego the health, diversity and productivity of the environment for future generations. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 10.5). The acceptable levels were developed to be consistent with the principles of ESD including the intergenerational principle, ensuring the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.
	D) 'Biodiversity principle' The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. The East Coast Project is consistent with the principle of ESD (d) for this aspect as: • The relevant cultural features to interactions with First Nations cultural heritage values and sensitivities were evaluated in Section 10.3 and the highest inherent risk from interactions with First Nations cultural heritage values and sensitivities was evaluated as Moderate. • The predicted environmental impact can be managed at levels equal to or better than the defined acceptable level of impact or risk by the implementation of controls detailed below (Section 10.5). Acceptable levels were developed to be consistent with the principles of ESD, such that the conservation of biological diversity and ecological integrity is maintained.

Criteria	**Demonstration of Acceptability**
Underwater Cultural Heritage Act 2018 <u>Objective</u>:	Adoption of the following control measures:

Protects the integrity of Australia's underwater cultural heritage sites in-situ and individual artefacts associated with those sites.	CM9: Underwater Cultural Heritage Disturbance Risk Management Measures CM13: Ongoing Engagement
Gunditjmara Sea Country Plan 2023 Objective: Country is protected for present and future generations Management actions: M1 Gunditjmara lead the identification, planning and implementation of natural and cultural resource management programs. Cooper Energy will seek to continue engagement **and** will seek opportunities to support involvement of First Nations Peoples in the management of Country. Sections 8 and 9 of the OPP details how risks to values and sensitivities of Sea Country will be managed, such as avoiding injury to whales, and preventing loss of waste to sea which could cause harm to Country.	
Gunditjmara Sea Country Plan 2023 Objective: Law/Lore/Learning: Nyamat Mirring (Sea Country) heals through practice change in response to knowledge and observations Management actions: L2. Increased understanding and appreciation of the cultural and archaeological values of Nyamat Mirring, including the current ocean floor. Cooper Energy will seek to continue engagement and will seek opportunities to support involvement of First Nations Peoples in the management of Country. Sections 8 and 9 of the OPP details how risks to values and sensitivities of Sea Country will be managed, such as avoiding injury to whales, and preventing loss of waste to sea which could cause harm to Country.	
Eastern Maar Sea County Plan 2014 Objective: Our Country is healthy and our natural resources are managed and used sustainably Management actions: Eastern Maar citizens are employed in the management of Country. Cooper Energy will seek to continue engagement and will seek opportunities to support involvement of First Nations Peoples in the management of Country. Sections 8 and 9 of the OPP details how risks to values and sensitivities of Sea Country will be managed, such as avoiding injury to whales, and preventing loss of waste to sea which could cause harm to Country.	
Eastern Maar Sea County Plan 2014 Objective: Our unique culture is getting stronger and we keep our Dreaming going Management actions: Our cultural heritage is protected, important places are managed and artefacts are returned Section 9.6.6 details the adopted control measures against legislative requirements Cooper Energy are committed to demonstrate acceptability of the unlikely risk to Discovery Bay Coastal Park, Wilsons Promontory, and The Convincing Grounds from an accidental hydrocarbon spill.	

Wadawurrung Country Plan 2020 Objective: Coastal Country - By 2029, native vegetation extent remains or increases and cultural places are protected. event. Section 9.6.6 details the adopted control measures against legislative requirements Cooper Energy are committed to demonstrate acceptability of the unlikely risk to Discovery Bay Coastal Park, Wilsons Promontory, and The Convincing Grounds from an accidental hydrocarbon spill.	
Gunaikurnai Country Plan 2015 Objective: To heal our Country Management action: Develop a 'mob intelligence network' to communicate on-ground information back to Gunaikurnai Land and Waters Aboriginal Corporation to inform future plans and programs for managing Country. Cooper Energy will seek to continue engagement and will seek opportunities to support involvement of First Nations Peoples in the management of Country. Sections 8 and 9 of the OPP detail how risks to values and sensitivities of Sea Country will be managed, such as avoiding injury to whales, and preventing loss of waste to sea which could cause harm to Country.	
Internal Context	Relevant management system processes adopted to implement and manage hazards include: • Risk Management (MS03) • Operations Management (MS07) • Technical Management (MS08) • Health Safety and Environment Management (MS09) • Supply Chain and Procurement Management (MS11). Activities will be undertaken in accordance with the Implementation Strategy (Section 12).
External Context	Feedback from stakeholders and published First Nations' Country Plans has informed the values and sensitivities /existing environment, impacts and risks, performance outcomes or mitigation measures of First Nations people cultural heritage.
Predicted impact compared to Defined Acceptable Level	The defined acceptable level of impacts relevant to First Nations cultural heritage is AL14, AL15 and AL16 identified in Table 10-4. These acceptable levels defined for a change in cultural heritage values are defined in Table 7-6. This chapter assesses how relevant aspects of the project have the potential to affect the link between cultural features of the environment and First Nations people's heritage sites and values. Within Table 10-1, for each interaction the level of impact or risk is identified for the environment component that is intrinsically linked to, is part of, or is also a cultural feature. The evaluation for each relevant environment component is detailed within Sections 8 and 9; the predicted impacts to these components are low-level, localised and / or generally short-term. The most severe risk events are an accidental release of condensate, and the introduction, establishment and spread of IMS. These events are Unlikely, or Remote, and there are established effective measures in place to prevent their occurrence. The intrinsic link between cultural features of the environment and First Nations people's heritage site and values is expected to be maintained. The highest inherent risk for interactions with First Nations cultural heritage values and sensitivities was evaluated as Moderate. Therefore, at its worst-case, the predicted impact to First Nations cultural heritage would not: • Exceed levels which prevent protection and conservation of underwater cultural heritage as defined under the *Underwater Cultural Heritage Act 2018*.

	• Lead to injury or desecration of objects or areas declared for protection under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*. • Interfere with native title rights or users as defined under section 233 of the *Native Title Act 1993*. Therefore, the predicted level of impact to First Nations cultural heritage resulting from the East Coast Project is at or below the defined acceptable levels.
Acceptability Outcome	Cooper Energy has determined that impacts and risks related to First Nations people cultural heritage are acceptable, based on: • Predicted levels of impact (evaluated in Section 10.3) are at or below the defined acceptable levels of impact (Table 10-2) for all receptors; • The planned management of impacts and risks integrates Cooper Energy internal requirements, including relevant management system processes • The activities will be managed in a way that is not inconsistent with the relevant principles of ESD • The proposed controls and impact and risk levels are not inconsistent with relevant First Nations groups Country plans, national and international standards, laws, and policies including applicable plans for management and conservation advices, and significant impact guidelines for MNES • Feedback has been received from stakeholders that has informed the values and sensitivities /existing environment, impacts and risks, performance outcomes and / or mitigation measures. To manage impacts to receptors at or below the defined acceptable levels the following EPO have been applied: **EPO20**: The activity is managed such that: • It does not prevent any cultural practice from taking place • It does not destroy any element of the environment which is a cultural feature, or which forms part of a cultural feature • There is no destruction of underwater cultural heritage.

10.5 Environmental Performance

Table 10-4 lists the acceptable level and EPO defined for the interaction with First Nations Cultural Heritage and the adopted control measures to achieve the outcome.

Table 10-4: Environmental Performance Summary – First Nations cultural heritage

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
AL14: Impacts and risks from activities defined in this OPP will not prevent the protection and conservation of underwater cultural heritage as defined under the *Underwater Cultural Heritage Act 2018.* **AL15:** Impacts and risks from activities defined in this OPP will not lead to injury or desecration of objects or areas declared for protection under the *Aboriginal and Torres Strait Islander Heritage Protection Act 1984.* **AL16:** Impacts and risks from activities defined in this OPP will not interfere	**EPO20**: The activity is managed such that: • It does not prevent any cultural practice from taking place • It does not destroy any element of the environment which is a cultural feature, or which forms part of a cultural feature • There is no destruction of underwater cultural heritage	CM9: Cooper Energy Cultural Heritage Disturbance Risk Management Measures Cooper Energy Cultural Heritage Disturbance Risk Management Measures acknowledge legislative requirements and establishes the methods by which potential disturbance to cultural heritage is identified including via screening, consultation, and expert advice as required. The procedure identifies management measures applicable to the different phases of the offshore project to ensure impacts and risks throughout the project life cycle remain within acceptable levels and are managed to ALARP. CM13: Ongoing Engagement Further opportunities to engage will be provided during the development and implementation of component EPs.

Defined Acceptable Level	Environmental Performance Outcomes	Adopted Control Measures
with native title rights or interests as defined under section 233 of the *Native Title Act 1993 (Cth),* to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the Titleholder.		

11 Cumulative Impact Assessment

In the context of offshore petroleum activities cumulative environmental impacts are defined by the regulator, NOPSEMA, as successive, additive, or synergistic impacts of collectively significant activities or projects with material impacts on the environment that have the potential to accumulate over temporal and spatial scales (NOPSEMA Environment Plan Decision Making Guideline, N-04750-GL1721 A524696, Jan 2024).

The effects of past project activities, and currently operating activities, are captured when describing the existing condition of and any pressure or threats affecting the environment (refer to Section 6 Description of the Environment). This baseline condition and understanding of the capacity of the receiving environment and receptors to accommodate changes, considering existing pressures and threats, informs the environmental impact assessments conducted in Section 8 of this OPP.

The focus of this cumulative impact assessment is to build on these assessments by considering the potential impacts from the planned components of the proposed activity on key matters in conjunction with the potential impacts from other reasonably foreseeable future projects and activities. Impacts and risks from unplanned aspects have not been considered in the cumulative impact assessment. It is not reasonable to consider unplanned aspects for cumulative environmental effects, because of the low likelihood relating to unplanned events for the East Coast Project and other foreseeable future projects and activities.

11.1 Methodology

Operators in the Otway have a history of supporting marine research and the respective operators continue to collaborate and share learnings on best practice from each other's operations. This includes implementing an approach to cumulative impact assessment which considers relevant regional and cumulative guidelines; for this OPP, this includes:

- Guidance from the United Kingdom (UK) Nationally Significant Infrastructure Projects - Advice Note Seventeen: Cumulative effect assessment relevant to nationally significant infrastructure projects (Planning Inspectorate, 2019).
- NSW Cumulative Impact Assessment Guidelines for State Significant Projects (NSW, 2022).

Both the UK and NSW guidelines are intended to apply to large-scale national and state significant projects, respectively, with greater potential for cumulative impacts into the long-term. Consequently, the assessment process applied here has been adapted to the nature and scale of the activities associated with the proposed East Coast Project.

11.2 Scoping the Cumulative Impact Assessment

To determine if impacts from the East Coast Project could result in cumulative impacts to receptors, a scoping assessment was undertaken to define the following factors:

- **Other reasonably foreseeable future projects** to be considered in the cumulative impact assessment based on currently operating projects, approved projects, and projects under assessment (including those under public comment); and if these projects and their associated activities are reasonably foreseeable within the spatial and temporal extent of the assessment.
- This defines the boundaries of the assessment by including projects and activities that have a realistic likelihood of occurring and could contribute to cumulative impacts.
- **Key environmental matters** are features of the environment (ecological, socio-economic, and cultural values and sensitivities) that are valued because of their rarity or importance, including the critical role they play in supporting systems which are essential for the environment, people and / or the economy (NSW, 2022). For example, commercial fisheries and threatened species undertaking biologically important behaviours.

- For the East Coast Project, key environmental matters are the receptors listed as MNES or have social or cultural significance predicted to be impacted by planned aspects (Sections 8 and 10).
- **Spatial extent** is the study area for the cumulative impact assessment, depending on the key environmental matters' range and distribution within the bioregion; and environment that may be affected by the planned aspects. Note where multiple spatial extents (or EMBAs) have been identified for an aspect (e.g. light emissions), the worst-case has been adopted to be conservative.
- **Temporal extent** is the period of the cumulative impact assessment, depending on the duration of the planned aspects or characteristics of the key environmental matters.
- **Material cumulative impacts** resulting from the East Coast Project and other reasonably foreseeable future projects that have the potential to be above the defined acceptable levels, for example, threats of wide-scale, serious or irreversible damage due to cumulative impacts.
- **Cumulative impact assessment approach** based on standard assessment of material cumulative impacts, identify which cumulative impacts require further comprehensive assessment through either issue-specific cumulative impact assessment or combined cumulative impact assessment.

To identify the above factors, the scoping assessment is undertaken in two parts.

- Part 1: Identify reasonably foreseeable future projects and activities (Section 11.2.1).
- Part 2: Identify relevant key environmental matters (Section 11.2.2).

The scoping assessment identifies potential cause-effect pathways which could result in material cumulative impacts. A detailed assessment of these cumulative impacts is then provided in Section 11.3.

11.2.1 Part 1: Identify reasonably foreseeable future projects and activities

To identify reasonably foreseeable future projects and activities, spatial and temporal extents for cumulative impacts have been based on the maximum spatial and temporal influence of the East Coast Project. The spatial extent of impacts and risks from the East Coast Project varies depending on the source of aspect. The spatial extent of impacts and risks from planned activities associated with the East Coast Project is limited to the Otway Marine Bioregion. These are often only temporary activities, the nature and scale of which changes depending on the phase of the project. The maximum temporal extent of the East Coast Project is based on the indicative project life where activities are expected to begin in 2025 and end in 2049 (Section 4.1.3).

The scoping steps of Part 1 are as follows:

- Step 1: Review NOPSEMA and DEECA (Vic) Environment Plan websites to identify projects and activities that overlap the spatial (Otway Marine Bioregion) and temporal (2025 to 2049) extents.
- Step 2: Confirm potential overlap with other Otway Basin petroleum titleholders.

Reasonably foreseeable future projects and activities identified to date, within the lifetime of the East Coast Project (from 2025 to 2049) and located in the Otway Marine Bioregion, are detailed in Table 11-1. Projects and activities that are not reasonably foreseeable have been excluded from the assessment scope to maintain practicality and relevance in decision-making processes.

At the time of writing, DCCEEW have identified 6 priority areas for offshore wind around Australia, 3 of which have been declared. The Southern Ocean area was declared in March 2024 and is the closest to the East Coast Project, located ~5 km from the operational area (DCCEEW, 2024k). Early project feasibility planning is underway for the Barwon OWF in the waters adjacent to Warrnambool in Victoria, which overlap a portion of the Southern Ocean declared area and the western edge of the operational area (Figure 6-102). The Southern Ocean declared area is the only declared area considered within the CIA due its proximity to the East Coast Projects. Other declared areas are outside of the Otway Marine Bioregion and are therefore not considered within the CIA. Prospective windfarms have not been included within the CIA due to insufficient information available to reasonably predict overlap of impacts and will be considered in future activity-specific Environment Plans.

There are no subsea cables which overlap with the East Coast Project activity EMBAs; therefore they have not been considered further.

Information on projects and activities is typically accessible once consultation commences and relevant technical supporting information is submitted for public comment or assessment. Information relevant to this assessment has been shared during engagements with Otway Basin Petroleum Titleholders. Where project/activity-specific data is not yet available, data from similar projects has been used as a proxy prior to technical information being made available. Given the similarity of impacts, there is a high level of certainty in the prediction of cumulative impacts in most cases.

Assumptions around specific timings for projects or activities have been made as there is some level of uncertainty in schedule and timing of approvals to support activities. Consequently, a conservative approach has been adopted whereby credible worst-case scenarios (e.g. concurrent activities with overlapping activity EMBAs) are assessed.

Table 11-1: Part 1 - Reasonably foreseeable future projects or activities in the offshore Otway Basin

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
Petroleum Activities					
Cooper Energy	Operations of the existing CHN facilities to the Athena Gas Plant since 2006 (CHN operations) (Cooper Energy, 2024). Includes regular vessel-based inspections, maintenance and repair; and well workovers using a MODU.	Existing	Ongoing	Yes – potential temporal overlap of CHN operations IMR campaigns schedule with timing of East Coast Project activities, though generally offshore works would be expected to be scheduled sequentially.	Yes – the East Coast Project will tie into the existing CHN facilities, so the operational areas of both projects overlap. **Light EMBA** A 'localised (small radius of light glow around vessels)' assessed for Cooper's CHN activities (Cooper Energy, 2024a), could be entirely overlapped by the East Coast Project's precautionary 49 km flaring EMBA. The CHN EMBA overlaps: • foraging BIAs for multiple bird species, including albatross and gannets. **Sound EMBA** THE CHN EMBA overlaps: • foraging BIAs for pygmy blue whale, including the annual high use area • migration BIA and reproduction BIA for southern right whale • distribution BIA for white shark (Cooper Energy, 2024a)
Beach Energy Limited	Operations of Halladale, Speculant, Geographe, Thylacine gas fields to the Otway Gas Plant (Otway operations) (Beach, 2024). Includes regular vessel-based inspections, maintenance and repair. And well workovers using a MODU.	Existing	Ongoing End of field life ~2037	Yes – potential temporal overlap of IMR campaigns schedule with timing of East Coast Project activities, though there is also potential for activities to occur sequentially.	Yes – potential overlapping of Beach Otway operations underwater sound and light emissions EMBAs with East Coast Project underwater sound and light emissions EMBAs. The East Coast Project operational area is located ~31 km from Geographe-1 and 45 km from Thylacine operational areas. **Light EMBA** A precautionary 20 km light EMBA was applied by Beach (Beach, 2024), which could overlap a relatively large portion of the East Coast Project's precautionary 49 km flaring EMBA. The Beach light EMBA overlaps • foraging BIAs for multiple bird species, such as albatross, petrels, and shearwater species, • breeding BIAs for the wedge-tailed shearwater, and • roosting BIAs for little curlew, pin-tailed snipe, and swinhoe's snipe **Sound EMBA** Modelling predicted the furthest sound contour distance for Beach IMR activities as 2.71 km to reach the noise effect criteria for behavioural effects in marine mammals (Beach, 2024). The Beach noise EMBAs overlaps: • the migration BIA for the southern right whale, • the foraging BIAs for the pygmy blue whale, including the annual high use area (Beach, 2024). Given the East Coast Project modelled ~22 - 31 km as the furthest extent during activities, a slight overlap with Geographe-1 activities may occur, however, only when concurrent activities are occurring for the East Coast Project.

<table>
<tr><th>Titleholder / Operator / Proponent</th><th>Activity Type</th><th>Status</th><th>Timing</th><th>Potential for Temporal Overlap</th><th>Potential for Spatial Overlap</th></tr>
<tr><td>Cooper Energy</td><td>Exploration Drilling</td><td>Proposed</td><td>2025-2029</td><td colspan="2" rowspan="5">It is likely that some or all the currently proposed drilling / P&A activities in the region, including at least one of the planned Cooper Energy exploration wells, will be drilled with the same drilling rig. Therefore, consecutive drilling/P&A activities are expected to occur, rather than activities being concurrent with one another.

Therefore, temporal and spatial overlap in drilling activities is not expected to occur. It is anticipated that activities would occur sequentially. This prevents multiple areas in the region from being directly affected by activity aspects (such as subsea noise and light) at the same time as such there would remain large areas of the region at background levels of disturbance whilst the activities are progressing.

Sequential drilling would however result in aspects from these activities affecting the region, and on the ecosystem components, for longer periods. Whilst some aspects of the activity (such as seabed disturbance) would be apparent at the same time, these disturbances will be localised and are not expected to occur at a level that would affect biodiversity and ecological integrity either at the activity level, or cumulatively. Other aspects such as subsea noise and artificial light would only occur for the duration of the activity, and hence areas would be expected to return to ambient conditions once the activity is complete, and before the next activity commences in a different area. This means that the impact footprint of these aspects remains short-term and relatively local to the activity at the time.</td></tr>
<tr><td>ConocoPhillips</td><td>Drilling</td><td>Proposed</td><td>2024-2028 (typically, 30-40 days per well, max 6 wells)</td></tr>
<tr><td>Woodside Energy</td><td>Decommissioning (P&A) of the Minerva Gas Development.

Pipeline, umbilicals and structures removal.</td><td>Proposed</td><td>2024-2025 Decommissioning activities will take <2 months. Decommissioning of pipeline and structures is expected to follow; however, an EP for this activity has not been submitted to NOPSEMA at time of writing.</td></tr>
<tr><td>Beach Energy Limited</td><td>Well Completion and Intervention Drilling</td><td>Proposed</td><td>2024-2027</td></tr>
<tr><td>Beach Energy Limited</td><td>Decommissioning (P&A)</td><td>Proposed</td><td>2024-2027</td></tr>
<tr><td>Beach Energy Limited</td><td>Geophysical/Geotechnical Survey</td><td>Proposed</td><td>2024-2028</td><td>Yes – potential temporal overlap during geophysical survey and timings of East Coast Project activities.
~ 40 days overlap may occur between the East Coast Project activities and the geophysical surveys within the Otway operational area (Beach, 2024). There is also potential for</td><td>Yes – potential overlapping of Beach Geophysical/Geotechnical surveys underwater sound and light emissions EMBAs with East Coast Project underwater sound and light emissions EMBAs.
The Beach Otway operational area is located ~4 km from the East Coast Project operational area.
Light EMBA
A precautionary 20 km light EMBA applied by Beach (Beach, 2024) could overlap a large portion of the East Coast Project’s precautionary 49 km flaring EMBA. Beach’s light EMBA overlaps:
foraging BIAs for multiple bird species, such as several albatross, petrel, and shearwater species
breeding BIAs for the little penguin, white bellied sea eagle, and short-tailed shearwater, and
roosting BIAs for little curlew, pin-tailed snipe, and swinhoe’s snipe (Beach, 2024).
Sound EMBA</td></tr>
</table>

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
				activities to occur sequentially.	Modelling for Beach activities area predicted the furthest sound contour distance for geophysical surveys within the Otway operational area was 145 m to reach the noise criteria threshold for behavioural effects in marine mammals (Beach, 2023). Beach's noise EMBAs overlaps: • migration BIA for the southern right whale, and • foraging BIAs for the pygmy blue whale, including the annual high use area (Beach, 2024). Given the East Coast Project modelled ~22 - 31 km as the furthest extent during activities, overlap with the Otway activities could occur. However, given the proximity of the geophysical survey Otway operational area only overlap has the potential to occur with the East Coast Project EMBAs.
CGG - Regia	Seismic Survey	Proposed	2024-2028 • 60 days acquisition • 90 days in field • One survey between November – May) or • Two separate surveys April – June, and or September – November.	Yes – potential temporal overlap during seismic acquisition timeframe and timings of East Coast Project activities. ~ 90 days of overlap between the East Coast Project activities and the CGG-Regia survey. There is also potential for activities to occur sequentially.	Yes – potential overlapping of CGG-Regia underwater sound and light emissions EMBAs with East Coast Project underwater sound and light emissions EMBAs. The Regia Seismic Survey operational area overlaps the East Coast Project operational area. **Light EMBA** The East Coast Project's 49 km flaring EMBA will overlap the precautionary 20 km light EMBA applied by CGG. CGG's light EMBA overlaps • foraging BIAs for multiple bird species, such as several albatross, petrel, and shearwater species (CGG, 2024). **Sound EMBA** Modelling for CGG activities predicted the sound contour distance to reach the noise criteria threshold for behavioural effects ranged from 11.9 – 77 km, depending on the location on the continental shelf (TGS, 2023). Results predicted a maximum distance of ~23 km for pygmy blue whale, and ~15 km for southern right whale. CGG's noise EMBA overlaps: • the migration BIA for the southern right whale, • the distribution and foraging BIA (annual high use area) for the pygmy blue whale, and • the foraging BIA for the Australian Fur-seal. Given the East Coast Project modelled ~22 - 31 km as the furthest extent during activities, spatial overlap with the seismic activities may occur. However, given the size of the CGG operational area (~4,000 km^2), only a relatively small portion will be overlapped by the East Coast Project EMBAs.
Beach Energy	Development of Artisan and La Bella gas fields (Beach, 2021).	Proposed	2024-ongoing • Seabed assessments: up to 30 days • Drilling activities for production	Yes – potential temporal overlap during the development of Artisan and La Bella gas fields with timings of East Coast Project	Yes – potential overlapping of Artisan and La Bella development activities' underwater sound and light emissions EMBAs with East Coast Project underwater sound and light emissions EMBAs. The East Coast Project operational area is located approximately 20 km from La Bella and 45 km from Artisan gas fields areas. **Light EMBA** The precautionary 20 km light EMBAs applied by Beach will therefore be overlapped entirely by the East Coast Project's 49 km flaring EMBA during

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
			wells: 70 to 90 days per well • Plugging wells: 30 days per well • Inspections and modifications to existing seabed infrastructure: 30 - 120 days per field.	activities. There is also potential for activities to occur sequentially.	flaring. During non-flaring activities, only the light EMBA from La Bella may be overlapped. Beach's light EMBA overlaps: • foraging BIAs for multiple bird species, such as several albatross, petrel, and shearwater species (Beach, 2023). **Sound EMBA** Preliminary modelling for Beach predicted the furthest sound contour distance to reach the noise criteria threshold as <3-7 km for development activities (Beach, 2023). Given the East Coast Project modelled ~22 - 31 km as the furthest extent during activities, overlap only have the potential to occur with the activities at La Bella. Beach's sound EMBA overlaps: • foraging BIAs for pygmy blue whale, including annual high use area, • migration and reproduction BIAs for southern right whale
Offshore Wind					
Southern Ocean Offshore Wind Declared Area	Construction, operation, decommissioning and associated surveys and monitoring for multiple offshore wind farms. The declared area is 1,030 km^2 in size and expected to support developments up to 2.9 GW in size. It is located ~5 km from the East Coast Project operational area.	Declared Area	The area was declared in March 2024, with feasibility license applications closing in July 2024. At the time of writing, no feasibility licenses within this declared area have been awarded. It typically takes around 10 years to develop an offshore wind project. If an offshore wind farm is feasible and receives approvals, construction could start in 2027 to deliver power by 2032.	Yes – potential temporal overlap of offshore wind farm activities in the Southern Ocean Wind Area with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	Yes – The Southern Ocean declared area is located ~5 km from the East Coast Project operational area. There is potential spatial overlap of underwater sound EMBAs associated with offshore wind projects in the Southern Ocean Offshore Wind Area and the East Coast Project underwater sound EMBA. **Light EMBA** Due to the early phase of development, no modelling has been completed to identify the light EMBA for the Southern Ocean Project, however, the East Coast Project predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3), therefore an overlap of at least 15-44 km could occur. The declared area will overlap: • foraging BIAs for multiple bird species, such as several albatross, petrel, and shearwater species **Sound EMBA** Due to the early phase of development, there is no publicly available modelling to identify the sound EMBA for the Southern Ocean Project. However the East Coast Project predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2), therefore, an overlap of ~17- 26 km could occur. The declared area overlaps: • foraging BIAs for pygmy blue whale, including annual high use area, • migration BIAs for southern right whale However, given the nature and scale of the East Coast Project, and the control measures in place (designed with consideration to relevant species recovery plans), the additive effect of the East Coast project activities are expected to be negligible.

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
Commercial Fisheries					
Bass Strait Central Zone Scallop Fishery	Towed dredge fishing method with managed seasonal / area closures and total allowable catch controls.	Active	July to 31 December each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	No – The East Coast Project operational area overlaps with the fishery management area, however based on current fishing activity presence of fishing vessels in the operational area is unlikely. Potential overlap of underwater sound and light emissions EMBAs between fishing vessels and the East Coast Project is not expected. Refer to Table 6-19 for further information on commercial fisheries.
Eastern Tuna and Billfish Fishery	Fishing conducted using pelagic longline, minor line (such as handline, troll, rod and reel) method.	Active	Season goes all year, commencing on 1 January each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	No – The East Coast Project operational area overlaps with the fishery management area, however based on current fishing activity presence of fishing vessels in the operational area is unlikely. Potential overlap of underwater sound and light emissions EMBAs between fishing vessels and the East Coast Project is not expected. Refer to Table 6-19 for further information on commercial fisheries.
Small Pelagic Fishery	Midwater trawl, purse seine and jigging and mine line methods are permitted for fishing.	Active	12-month fishing season commences 1st May each year	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	No – The East Coast Project operational area overlaps with the fishery management area, however based on current fishing activity presence of fishing vessels in the operational area is unlikely. Potential overlap of underwater sound and light emissions EMBAs between fishing vessels and the East Coast Project is not expected. Refer to Table 6-19 for further information on commercial fisheries.
Southern and Eastern Scalefish and Shark Fishery – Commonwealth Gillnet and Shark Hook Sector	Fishing conducted using demersal gillnet, demersal longline and auto-longline methods.	Active	12-month fishing season commences 1st May each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap:

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
				activities to occur sequentially.	- foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: - foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. However, given the spatial area of the fishery (Figure 6-70), the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds. Refer to Table 6-19 for further information on commercial fisheries.
Southern and Eastern Scalefish and Shark Fishery – Commonwealth Scalefish Hook Sector	Multi-gear fishery.	Active	12-month fishing season commences 1st May each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap: - foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: - foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. Given the spatial area of the fishery (Figure 6-72), the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds. Refer to Table 6-19 for further information on commercial fisheries.
Southern and Eastern Scalefish and Shark Fishery –	Multi-gear fishery.	Active	12-month fishing season commences 1st May each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA.

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
Commonwealth Trawl Sector				also potential for activities to occur sequentially.	Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap: • foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: • foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. Given the spatial area of the fishery (Figure 6-73), the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds. Refer to Table 6-19 for further information on commercial fisheries.
Southern Blue Fin Tuna Fishery	Pelagic longline and purse seine fishing gear is used in this fishery.	Active	12-month fishing seasons commences 1st December each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities	No – The East Coast Project operational area overlaps with the fishery management area, however based on current fishing activity presence of fishing vessels in the operational area is unlikely. Potential overlap of underwater sound and light emissions EMBAs between fishing vessels and the East Coast Project is not expected Refer to Table 6-19 for further information on commercial fisheries.
Southern Squid Jig Fishery	Single method of jigging.	Active	12-month fishing seasons commences 1st December each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap: • foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: • foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. Given the spatial area of the fishery (Figure 6-67), the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds.

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
					Refer to Table 6-19 for further information on commercial fisheries.
Victorian Abalone Fishery	Hand collected by divers.	Active	12-month fishing season commences 1st April each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	No – The East Coast Project operational area overlaps with the fishery management area, however based on current fishing activity presence of fishing vessels in the operational area is unlikely. Potential overlap of underwater sound and light emissions EMBAs between fishing vessel and the East Coast Project is not expected. Refer to Table 6-20 for further information on commercial fisheries in Victorian state waters.
Victorian Rock Lobster Fishery	Baited pot collection method. Season is split into male and female open seasons.	Active	Female open season: Nov 16-May 31. Male open season: Nov 16 – 16 Sept	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap: • foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: • foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. Given the spatial area of the fishery (Figure 6-77), the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds. Refer to Table 6-20 for further information on commercial fisheries in Victorian state waters.
Victorian Giant Crab Fishery	Baited pot collection method with only one entrance and one chamber. Season is split into male and female open seasons.	Active	Female open season: Nov 16-May 29 Male open season: Nov 16 – 16 Sept	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap:

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
				activities to occur sequentially.	• foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: • foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. Given the spatial area of the fishery (Figure 6-78 the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds. Refer to Table 6-20 for further information on commercial fisheries in Victorian state waters.
Victorian Scallop Fishery	Using scallop dredge.	Active	12-month fishing season commencing 1st April.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	No – The East Coast Project operational area overlaps with the fishery management area, however based on current fishing activity presence of fishing vessels in the operational area is unlikely. Potential overlap of underwater sound and light emissions EMBAs between fishing vessels and the East Coast Project is not expected. Refer to Table 6-20 for further information on commercial fisheries in Victorian state waters.
Victorian Octopus Fishery	Baited pots collection method.	Active	Year-round season	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap: • foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: • foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks.

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
					Given the spatial area of the fishery (Figure 6-80) the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds. Refer to Table 6-20 for further information on commercial fisheries in Victorian state waters.
Victorian Sea Urchin Fishery	Hand collection.	Active	12-month fishing season commencing 1st July each year.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	No – The East Coast Project operational area overlaps with the fishery management area, however based on current fishing activity presence of fishing vessels in the operational area is unlikely. Potential overlap of underwater sound and light emissions EMBAs between fishing vessels and the East Coast Project is not expected. Refer to Table 6-20 for further information on commercial fisheries in Victorian state waters.
Victorian Wrasse Fishery	Hook and line collection.	Active	Year-round season.	Yes – potential temporal overlap of fishing vessel activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	Yes – There is a potential that fishing vessels associated with this fishery may be actively fishing within or in proximity to the East Coast Project operational area and therefore there is potential overlap of underwater sound and light emissions EMBAs. **Light EMBA** The localised (small radius of light glow) expected around fishing vessels may be overlapped by the East Coast Project if fishing occurs within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The fishery may overlap: • foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the fishing vessel may be overlapped by the East Coast Project if fishing occurs within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The fishery may overlap: • foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. Given the spatial area of the fishery (Figure 6-83) the overlap from the light and sound EMBAs will be relatively small compared to the area of available fishing grounds. Refer to Table 6-20 for further information on commercial fisheries in Victorian state waters.
Commercial Shipping					
Numerous shipping channels	The South-east Marine Region is one of the busiest shipping	Active	All year round, about 3-4 vessels per day.	Yes – potential temporal overlap of shipping activities	Yes – potential overlapping with underwater sound and light emissions. **Light EMBA**

Titleholder / Operator / Proponent	Activity Type	Status	Timing	Potential for Temporal Overlap	Potential for Spatial Overlap
throughout the Otway Basin	regions in Australia and Bass Strait is one of Australia's busiest shipping routes. The main shipping channel for vessels (e.g., cargo tankers) travelling between major Australian and foreign ports is located south of the Otway Development, about 75 km (40 nm) south of Warrnambool.			with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	The localised (small radius of light glow) expected around shipping vessels may be overlapped by the East Coast Project if shipping comes within the light EMBA. Modelling predicted the light EMBAs to range from 20 - 49 km, depending on flaring (see Section 8.3). The Shipping activity throughout the Otway Basin may overlap: • foraging and breeding BIAs for multiple bird species, such as several albatross, petrel, and shearwater species. **Sound EMBA** The localised sound EMBA around the shipping vessel may be overlapped by the East Coast Project if shipping comes within the sound EMBA. Modelling predicted ~22 - 31 km as the furthest extent to the noise criteria threshold (see Section 8.2). The Shipping activity throughout the Otway Basin may overlap: • foraging, distribution and migrations BIAs for marine fauna, including cetaceans, pinnipeds, and sharks. Given the spatial area of the shipping areas (Figure 6-99) the overlap from the light and sound EMBAs will be relatively small compared to the available shipping channels throughout the Otway Basin.
Defence					
King Island UXO	The King Island UXO was used during 1954 as an Air to Air Firing Range. This area is classed as slight potential.	Existing	Ongoing	N/A	No – the East Coast Project does not intersect any UXO sites. The King Island UXO is located ~32 km from the operational area.
Bass Strait Sea Dumping UXO	The Bass Strait Sea Dumping UXO area was used for the dumping of ordnance and other items in 1998-1999.	Existing	Ongoing	N/A	No – the East Coast Project does not intersect any UXO sites. The Bass Strait Sea Dumping UXO is located ~28 km from the operational area.
Swan Island Defence Precinct	The Swan Island training area is located in the eastern side of Swan Island, near to Queenscliff in Victoria. It is a join training facility operated by the Australian Secret Intelligence Services.	Existing	Ongoing	Yes – potential temporal overlap of Swan Island Defence Precinct activities with timings of East Coast Project activities. There is also potential for activities to occur sequentially.	No – The Swan Island Defence Precinct is located ~170 km away from the operational area. The large distance between the two areas prevents potential spatial overlap of underwater sound EMBAs.

11.2.2 Part 2: Scoping assessment to identify relevant key environmental matters

The scoping steps of Part 2 are detailed as follows:

- **Step 1:** Review Sections 8 and 10 to identify the planned project aspects of the East Coast Project, relevant key environmental matters, and the acceptable levels of impact for each key environmental matter.
- **Step 2:** Based on the Otway Marine Bioregion spatial extent, identify potential pathways for cumulative impacts from the East Coast Project and other reasonably foreseeable future projects and activities for each key environmental matter (i.e. multiple planned aspects that have spatial overlap with areas of significance for key environmental matters such as BIAs, critical habitat, active fishing cells, petroleum titles).
- **Step 3:** Based on the indicative East Coast Project life (2025 to 2049), identify potential pathways for cumulative impacts from the East Coast Project and other reasonably foreseeable future projects and activities for each key environmental matter (i.e. multiple planned aspects that have temporal overlap with the presence of key environmental matters present in the Otway Marine Bioregion).
- **Step 4:** From the identified spatial and temporal pathways for cumulative impacts, confirm if there is potential for material cumulative cause-effect pathways and the resulting cumulative impacts.
- **Step 5:** Identify the level of certainty of the scoping assessment data used to define the above factors.
- **Step 6:** Review the potential of material cumulative impacts and level of certainty for each key environmental matter:
  - If there is potential for material cumulative impacts, the key environmental matter is required to have a detailed cumulative impact assessment (Section 11.3).
  - If the certainty of the scoping assessment data does not meet the following points below, the key environmental matter is required to have a detailed cumulative impact assessment (Section 11.3):
    - Impacts are well understood,
    - Impacts are relatively easy to predict using standard methods,
    - Impacts are capable of being mitigated to comply with relevant standards and to meet the acceptable level.

Table 11-2 details the results of Part 2 scoping assessment. As described in Section 6.6, there is no overlap between the East Coast Project operational area and AMPs in the south-east marine region. The shelf rocky reef / hard substrate KEF is known to be a common feature throughout the Otway Bioregion, including within the operational area of the East Coast Project. On the continental shelf, rocky reefs and hard grounds provide attachment sites for macroalgae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity. Potential cumulative impacts to these values and sensitivities have been considered in the table below.

The cumulative impact assessment to First Nations values and sensitivities has been described in Section 10, considering the interconnectedness of key environmental matters and values. For this, Section 10 draws on elements of both Sections 8 and 10.

Table 11-2: Part 2 - Identification of relevant key environmental matters and detailed cumulative impact assessment scoping

Environmental Component	Key Environmental Matter	East Coast Project Aspects									Acceptable Level for key environmental matters	Cumulative Impact Scoping: Based on Planned Aspects from the East Coast Project and Reasonably Foreseeable Future Projects				
		Underwater sound emissions - Impulsive	Underwater sound emissions - continuous	Light emissions	Atmospheric emissions	GHG emissions	Planned discharges – Drilling	Planned discharges – Operational	Seabed disturbance	Displacement of marine users		Potential for cumulative impact - Spatial	Potential for cumulative impact - Temporal	Material cumulative cause-effect pathway	Level of Certainty of Scoping Assessment	Does the material cumulative impact require detailed assessment?
Physical Environment	Water quality						✓	✓			Temporary, small-scale and low intensity impacts.	No Spatial interference is incidental	No Temporal interference is incidental	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary and localised change to water quality. Changes to water quality from individual activities are likely to be localised and temporary. Based on the spatial and temporal overlap of the East Coast Project with other reasonably foreseeable projects and activities and the localised scale of potential impacts, no material cumulative cause-effect pathways are identified.	Impacts are well understood.	No. No material cumulative impacts anticipated.
	Sediment quality						✓	✓			Temporary, small-scale and low intensity impacts.	No Spatial interference is incidental	No Temporal interference is incidental	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary and localised change to sediment quality. Non-routine seabed discharges during the East Coast Project are related to activities that are intermittent, brief and likely result in localised changes to sediment quality. Based on the spatial and temporal overlap of the East Coast Project with other reasonably foreseeable projects and activities and the localised scale of potential impacts, no material cumulative cause-effect pathways are identified.	Impacts are well understood.	No. No material cumulative impacts anticipated.
	Ambient light			✓							Temporary, small-scale and low intensity impacts.	No Spatial interference is incidental	No Temporal interference is incidental	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary and localised change to ambient light. Light emission sources of the East Coast Project are related to activities that are intermittent, of a short-term duration and relatively localised. Following the completion of phase activities, light emissions will return to ambient levels with no remedial or recovery work required. Based on the spatial and temporal overlap of the East Coast Project with other reasonably foreseeable projects and activities and the localised scale of potential impacts, no material cumulative cause-effect pathways are identified.	Impacts are well understood.	No. No material cumulative impacts anticipated.
	Underwater noise	✓	✓								Temporary, small-scale and low intensity impacts.	No Spatial interference is incidental	No Temporal interference is incidental	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary and localised change to ambient sound. The extent and duration of underwater sound generated by the East Coast Project is related to activities that are intermittent, of a short-term duration and relatively localised. Following the completion of phase activities, underwater sound will return to ambient levels with no remedial or recovery work required. Based on the spatial and temporal overlap of the East Coast Project with other reasonably foreseeable projects and activities and the localised scale of potential impacts, no material cumulative cause-effect pathways are identified.	Impacts are well understood.	No. No material cumulative impacts anticipated.
	Climate					✓					Will not result in direct and / or indirect GHG emissions which are inconsistent with Australia's international GHG emissions commitments.	No Low levels of contribution to Australian and Victorian carbon budgets	No (not outside the framework of the national and domestic emissions reduction targets)	The East Coast Project and other reasonably foreseeable projects and activities will require fuels and energy that will result in greenhouse gases being released into the atmosphere. The cumulative emissions are anticipated to be relatively small in the context of Australian and Victorian carbon budgets. Collectively direct and / or indirect low levels of GHG emissions from the East Coast Project and other reasonably foreseeable projects and	Impacts are capable of being mitigated to comply with relevant standards and to meet the	No. No material cumulative impacts anticipated.

														activities will not result in material cumulative impacts to climate systems. The detailed impact assessment on GHG emissions includes an assessment of cumulative impacts (Section 8.5).	acceptable level.	
Ecological Environment	Benthic assemblages						✓		✓		No serious or irreversible harm to threatened or critical habitat	No No critical habitat overlaps	No No seasonal presence overlap	There are no threatened or critical habitats in the East Coast Project operational area. Hard substrates along the continental shelf are considered values associated with the shelf rocky reefs KEF, supporting increased productivity and diversity of benthic assemblages. The East Coast Project and other reasonably foreseeable projects and activities have the potential to result in incidental and localized seabed disturbance. This incidental seabed disturbance does not have potential to result in serious or irreversible damage to benthic assemblage's characteristic of the region, as seen by the recovery of seabed communities around existing infrastructure in the Otway region. The sand or gravelly / rubble and hard platform substrates are highly represented in the wider Otway Basin Bioregion. Seabed disturbance is minimised through utilisation of existing infrastructure where practicable and the planning and design of the new infrastructure to minimise its footprint. Additional impacts from the East Coast Project and other reasonably foreseeable projects and activities are not expected to result in material cumulative impacts.	Impacts are well understood.	No. Seabed disturbance is a localised and incidental consequence of the East Coast Project Localised and recoverable loss of benthic assemblages that are not threatened listed ecological communities is considered an acceptable impact (Section 8.8.4.1).
	Plankton	✓	✓	✓			✓	✓			No serious or irreversible harm to a threatened or migratory listed species. No disruption to the breeding cycle of an important population Will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No No BIA or critical habitat overlap	No No seasonal presence overlap	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause incidental and indiscernible levels of disturbance to fish eggs and larvae (plankton). Fish eggs and larvae are subject to a diverse array of predators, resulting in frequent predator avoidance behaviours and loss of eggs and larvae from consumption (Reebs, 2008). Based on the spatial and temporal overlap of the East Coast Project and other reasonably foreseeable projects and activities, additional temporary impacts to fish eggs and larvae will not result in material cumulative impacts.	Impacts are well understood.	No. Incidental localised and temporary disturbance to fish eggs and larvae is considered an acceptable impact (Section 8.6.4.4).
	Invertebrates			✓					✓			No No critical habitat overlaps	No No seasonal presence overlap	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary behavioural change and incidental injury/mortality to sessile benthic invertebrates from disturbance to the seabed. This incidental seabed disturbance does not have potential to result in serious or irreversible damage to benthic assemblage's characteristic of the region, as seen by the recovery of seabed communities around existing infrastructure in the Otway region. The sand or gravelly / rubble and hard platform substrates are highly represented in the wider Otway Basin Bioregion. Seabed disturbance is minimised through utilisation of existing infrastructure where practicable and the planning and design of the new infrastructure to minimise its footprint. Additional impacts from the East Coast Project and other reasonably foreseeable projects and activities are not expected to result in material cumulative impacts.	Impacts are well understood.	No. Temporary incidental loss of sessile marine invertebrates that are well represented in the region and is not defined as a critical habitat, is considered an acceptable impact (Section 8.8.4.2).
	Fish	✓	✓	✓			✓	✓	✓			No No BIA or critical habitat overlap	No No seasonal presence overlap	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary behavioural change to fish. Based on the spatial and temporal overlap of the East Coast Project and other reasonably foreseeable projects and activities, additional temporary impacts to fish will not result in material cumulative impacts.	Impacts are well understood.	No. Incidental, localised and temporary disturbance fish is considered an acceptable impact (Section 8.2.5.6).
	Marine reptiles	✓	✓	✓			✓	✓				No No BIA or critical habitat overlap	No No seasonal presence overlap	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause behavioural change to occasional individual marine reptiles. Behavioural change to occasional individual marine reptiles will not result in material cumulative impacts to marine reptiles.	Impacts are well understood.	No. Temporary and localised behavior change to occasional individual marine reptiles not in habitat critical to survival is considered an acceptable impact (Section 8.2.5.4).
	Seabirds and shorebirds			✓								Yes Impact is BIAs	Yes Impact during seasonal presence	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary behavioural change to seabirds and shorebirds undertaking biologically important behaviours. Light emissions are the cause-effect pathway. Collectively, light emissions from the East Coast Project and other reasonably foreseeable project and activities have the potential to cause cumulative impacts to seabirds and shorebirds	Impacts are capable of being mitigated to comply with relevant standards and to meet the	Yes. Detailed assessment required to determine if l cumulative impacts are acceptable.

														by disturbing them whilst they are undertaking biologically important behaviours.	acceptable level.	
	Marine mammals	✓	✓				✓	✓				Yes Multiple impacts overlap BIAs	Yes Multiple impacts during seasonal presence	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause behavioural change to marine mammals undertaking biologically important behaviours. Cause-effect pathways include underwater sound emissions. Collectively these projects have the potential to cause cumulative impacts to marine mammals by disturbing them whilst they are undertaking important behaviours.	Impacts are capable of being mitigated to comply with relevant standards and to meet the acceptable level.	Yes. Detailed assessment required to determine if cumulative impacts are acceptable for Endangered species of marine mammals (i.e., blue whale and southern right whale) with BIAs overlapped by multiple offshore activities.
Socio-economic Environment	Commercial fisheries									✓	Will not have a substantial adverse effect on the sustainability of a commercial fishery.	Yes Fishing area overlap	Yes Impact during seasonal presence	The East Coast Project and other reasonably foreseeable oil and gas projects and activities have the potential to cause temporary and localised change in commercial fishing activities. Temporary and localised change in fishing activities to avoid the East Coast Project will not cause material change or result in material cumulative impacts to commercial fisheries. Large renewable infrastructure projects have the potential to obstruct some fisheries long term; however, the East Coast project facilities are all located at seabed and outside of trawl grounds, and would not be expected to have a discernable additive impact to fishing when considered alongside reasonably foreseeable future renewable projects.	Impacts are well understood.	No. No material cumulative impacts anticipated.
	Other offshore industry - Shipping									✓	No interference with other marine users to a greater extent than necessary to exercise the right conferred by the titles granted.	No Spatial interference is incidental	No Temporal interference is incidental	The East Coast Project and other reasonably foreseeable projects and activities have the potential to cause temporary and localised change in shipping movements. Temporary and localised change in shipping routes to avoid the East Coast Project and other reasonably foreseeable project and activities will not result in material cumulative impacts to the shipping industry.	Impacts are well understood.	No. Temporary and localised change to shipping movements outside of major shipping routes is considered an acceptable impact (Section 8.9.4.1).
	Other offshore industry - Petroleum exploration and production									✓	No interference with other marine users to a greater extent than necessary to exercise the right conferred by the titles granted.	No No overlap with other petroleum titles	No Temporal overlap results in no interference	Operations of the East Coast Project and other reasonably foreseeable projects and activities will not overlap as activities will be limited to within each operator's title, or otherwise arranged through defined processes and Title agreements. No material cumulative cause-effect pathways identified.	Impacts are well understood.	No. No material cumulative impacts anticipated.
	Other offshore infrastructure – Offshore renewable energies									✓	No interference with other marine users to a greater extent than necessary to exercise the right conferred by the titles granted.	No No overlap with other offshore infrastructure	No Temporal overlap results in no interference	Operations of the East Coast Project and other reasonably foreseeable projects and activities will not overlap declared offshore wind areas as activities will be limited to within each operators' title. No material cumulative cause-effect pathways identified.	Impacts are well understood.	No. No material cumulative impacts anticipated.
	Recreation and tourism									✓	No interference with other marine users to a greater extent than necessary to exercise the right conferred by the titles granted.	No No spatial overlap	No Temporal interference is inconsequential	Operations of the East Coast Project and other reasonably foreseeable projects and activities will not overlap recreation and tourism activities that are generally land-based or near-shore. Large renewable infrastructure projects have the potential to obstruct some recreational and charter fishing long term; however, the East Coast Project facilities are all located at seabed have very limited exclusion zones and would not be expected to have a discernable additive impact to recreational or charter fishing when considered alongside reasonably foreseeable future renewable projects. No material cumulative cause-effect pathways identified.	Impacts are well understood.	No. No material cumulative impacts anticipated.

11.3 Detailed cumulative impact assessment

For those receptors and aspects where a potential cumulative cause-effect pathway and material impact was identified in the Part 2: scoping assessment (Table 11-2), a detailed Cumulative Impact Assessment (CIA) was applied in general alignment with the project-specific methodology described in Section 5.

The CIA process applied to each aspect and component of the environment was:

- Identification of:
  - receptor conservation values or values relevant to CIA e.g. EPBC Listed Threatened Species, MNES, commercial or cultural significance
  - legislative or other requirements relevant to the assessment
  - relevant threatening processes.
  - relevant spatial extent such as BIAs, and temporal extent when receptor present including any biologically important features such as behaviours or critical life-cycle stages or, timings.
  - relevant actions from legislative or other requirements.
- Detail the baseline existing environment including pressures and condition.
- Define the cumulative impact acceptable level.
- Identification of other reasonably foreseeable future projects where the aspect overlaps the identified relevant spatial and temporal extents.
- Assessment of potential for cumulative impacts:
  - Description of potential cumulative impact
  - Detail the level of certainty of the assessment
  - Detail Cooper Energy's existing control measures
  - Detailing any additional control measures
  - Assess aspect specific cumulative impact consequence level
  - If applicable, assess combined cumulative impact consequence level.

The following tables in the subsections below provide detailed cumulative impact assessments for the identified key environmental matters identified in the Part 2: scoping assessment:

- Table 11-3 – Blue whales
- Table 11-4 – Southern right whales
- Table 11-5 – Seabirds and shorebirds.

11.3.1 Marine Mammals

Table 11-3: Detailed cumulative impact assessment: blue whale

Key Environmental Matter	Marine Mammals – Blue Whale
Conservation (or other) Value and Status	EPBC Act listed: Endangered, Cetacean, Migratory.
Legislative or Other Requirements	Guidance on key terms within the Blue Whale Conservation Management Plan (DAWE 2021a) Conservation Management Plan for the Blue Whale (DoE 2015a), identified anthropogenic threats relevant to the East Coast Project: • Noise interference
Spatial and Temporal Extent of Key Environmental Matter	Typically, blue whales migrate between breeding grounds (low latitudes) where mating and calving take place in the winter, to feeding grounds (high latitudes) where foraging occurs in the summer. Australia has 2 known seasonal feeding aggregations of blue whales; one occurs adjacent to the Bonney Upwelling system off South Australia and Victoria. The blue whale is known to aggregate each year during the summer (January to April) off southern Australia due to seasonal upwellings that result in high concentrations of prey (DoE, 2023). The abundance of whales in the area varies within and between seasons and is closely in-sync with the strength of the Bonney Upwelling (DoE, 2015a., Gill et al., 2011, McCauley et al., 2018). Blue whales migrate through the southern waters of the Indian Ocean and south of Australia, including Otway Basin, between January and June.
Acceptable Level	Project will not result in serious or irreversible harm to the species population, its life cycle or special distribution. Also ensure Project activity EPs are not inconsistent with Action A.2: *Blue whales can continue to utilise the area without injury and [are] not displaced from a foraging area* (or as revised under relevant statutory conservation listing advice and plans).

Planned Project Aspects Relevant to Identified Threats	Underwater Sound Emissions - Impulsive	Underwater Sound Emissions - Continuous
Relevant Spatial and Temporal Extent of Identified Threats	Multiple localised and short-term impulsive underwater sound EMBAs overlapping foraging and distribution BIAs in the Otway Basin from the East Coast Project and other reasonably foreseeable future projects and activities. This includes the potential localised and short-term impulsive underwater sound EMBAs from sequential drilling activities.	Multiple localised and short-term continuous underwater sound EMBAs overlapping foraging and distribution BIAs in the Otway Basin from the East Coast Project and other reasonably foreseeable future projects and activities. There is also potential for localised continuous underwater sound EMBAs from sequential drilling activities.
Baseline Environmental Condition	The foraging and distribution BIAs are overlapped by area of high commercial fishing effort, and existing oil and gas activity. These activities may temporarily use impulsive sources.	The foraging and distribution BIAs are overlapped by existing shipping channel, area of high commercial fishing effort, and existing oil and gas activity. These activities use continuous sound sources.
Other Reasonably Foreseeable Projects/ Activities Relevant to Aspect	Together the following projects that occur between Cape Otway and Robe during the biologically important period (January to June) will generate multiple sources of impulsive sound: • Commercial fishing • CHN operations – Cooper Energy	Together the following projects that occur between Cape Otway and Robe during the biologically important period (January to June) will generate multiple sources of continuous sound: • Commercial shipping • Commercial fishing

	• Otway Operations – Beach Energy • Minerva decommissioning – Woodside Energy • Drilling – Beach Energy • Decommissioning – Beach Energy • Geophysical/geotechnical survey – Beach Energy • Drilling – ConocoPhillips • Seismic survey – CGG-Regia.	• CHN operations – Cooper Energy • Otway Operations – Beach Energy • Minerva decommissioning – Woodside Energy • Drilling – Beach Energy • Decommissioning – Beach Energy • Drilling – ConocoPhillips. Drilling activities are expected to occur consecutively, therefore instead of multiple sound sources occurring at one time, one drilling sound source in the Otway Basin is expected to occur over a long period of time.
Description of Cumulative Impact	Foraging or migrating blue whales may exert more energy to avoid temporary and localised impulsive sound sources from the East Coast Project and other reasonably foreseeable projects. As described in Section 8.1, behavioural EMBA for low-frequency cetaceans from the East Coast Project impulsive sound sources is 130 m around the operational area. This is assumed representative of impulsive sound sources from other reasonably foreseeable projects, aside from seismic surveys which have a larger footprint (e.g. 8.09 km to behavioural thresholds from CGG-Regia Seismic survey). Based on this, it is not credible to consider that cumulative behavioural impacts to blue whale will occur as a result of the East Coast Project in combination with other oil and gas projects of a similar nature and scale. Vessels / activities would never be within 130 m of each other due to safety and navigation risk, therefore overlap in behaviour EMBAs is not predicted. Even if several similar activities were being undertaken at once or sequentially within the foraging BIA, the overall footprint of impulsive sound impacts would still be very small, and displacement of blue whale is not predicted. Potential behavioural disturbance to blue whale is predicted within 8.09 km of the Regia MSS, however CGG plans to implement an activity limitation where the sound source will only be operated in the pygmy blue whale foraging BIA during April, May & June or September, October & November when low numbers of pygmy blue whales and other foraging whales are in the BIA. This activity limitation is designed to meet the action from the Conservation Management Plan for Blue Whale (DoE 2015) and reduce impacts to ALARP and acceptable levels. Minor avoidance behaviours of blue whales within the foraging BIA from multiple highly temporary impulsive sources is not expected to result in the displacement of blue whales from a foraging area, including stopping or preventing a blue whale from foraging, causing a blue whale to move on when foraging or stopping or preventing a blue whale from entering a foraging area (DAWE 2021a).	Foraging or migrating blue whales may exert more energy to avoid localised continuous sound sources from the East Coast Project and other reasonably foreseeable projects. As described in Section 8.2, behavioural EMBA for low-frequency cetaceans from the East Coast Project continuous sound sources is 0.44 km from a single source and 30 km from concurrent sources (up to 4). This is assumed representative of continuous sound sources from other reasonably foreseeable projects and activities. Based on what is known about other reasonably foreseeable projects and activities in the region, it is likely that most activities will involve a single vessel operating, therefore the 0.44 km EMBA for continuous sound sources is most relevant for this assessment. Based on this EMBA, the likelihood of cumulative impacts occurring is low. Vessels / activities would rarely be within 0.44 km of each other due to safety and navigation risk, therefore overlap in behaviour EMBAs is not expected. Even if several similar activities were being undertaken at once or sequentially within the foraging BIA, the overall footprint of continuous sound impacts would still be very small. Minor avoidance behaviours of blue whales within the foraging BIA from multiple continuous sources is not expected to result in the displacement of blue whales from a foraging area, including stopping or preventing a blue whale from foraging, causing a blue whale to move on when foraging or stopping or preventing a blue whale from entering a foraging area (DAWE 2021a).

Certainty of Assessment	High certainty in the limited potential for cumulative impacts, based on underwater sound requirements to prevent impacts.	High certainty in the limited potential for cumulative impacts, based on underwater sound requirements to prevent impacts.
Existing Control Measures	CM1: Marine Assurance Process CM2: Offshore Operational Procedures CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process	
Additional Control Measures / Environmental Performance Standards	Cooper Energy will communicate work programs with other the Otway Basin Petroleum Titleholders with the aim of minimising the potential for cumulative impacts associated with underwater sound, should activity timings overlap biologically important period (January to June) for blue whales. Additional commitments will be included within CM3 (Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process).	
Aspect Specific Cumulative Consequence	Level 2	Level 2
Combined Cumulative Consequence	Level 2 The combination of multiple highly temporary and localised sources of potential behavioural disturbance to blue whales, including long-term and localised sources from sequential drilling activities, in the Otway could result in minor impacts to species of recognised conservation value across multiple seasonal biologically important periods. With sufficient management measures in place appropriate to the nature and scale of each project, potential impacts are not expected to result in the displacement of blue whales from a foraging area, including stopping or preventing a blue whale from foraging, causing a blue whale to move on when foraging or stopping or preventing a blue whale from entering a foraging area. If appropriate management is not implemented then the risk of displacement increases; the Blue Whale CMP assess the potential impacts of anthropogenic noise from shipping and industry, which is present across multiple seasonal biologically important periods, as Minor; having the potential to affect individuals but with no effect at the population level (DoE, 2015).	
Acceptable Level Achieved	Yes – the consequence of combined cumulative impacts of Level 2 is considered acceptable because potential cumulative impacts can be managed such that they are not inconsistent with the Conservation Management Plan for the Blue Whale such that blue whales can continue to utilise the area without injury and [are] not displaced from a foraging area.	

Table 11-4: Detailed cumulative impact assessment: southern right whale

Key Environmental Matter	Marine Mammals – Southern Right Whale
Conservation (or other) Value and Status	EPBC Act listed: Endangered, Cetacean, Migratory.
Legislative or Other Requirements	National Recovery Plan for the Southern Right Whale (DCCEEW, 2024l), identified anthropogenic threats relevant to the East Coast Project: • Anthropogenic underwater noise

Spatial and Temporal Extent of Key Environmental Matter	There is the potential for southern right whales to be transiting through the area offshore Victoria during May-June and September-October as they move to and from coastal reproduction areas. Occasionally entry to coastal waters happens as early as April and exit as late as November (DCCEEW, 2024l). The Victorian coastline has been identified as a reproduction BIA and is located within the monitoring EMBA (Figure 6-47).	

Acceptable Level	Anthropogenic threats are demonstrably minimised, ensuring the Project will not result in serious or irreversible harm to the species population, its life cycle or special distribution.
	Also ensure Project activity EPs are not inconsistent with Action A.5;
	• Improve baseline understanding of southern right whale acoustic communication to better inform potential impacts from anthropogenic underwater noise.
	• Actions within and adjacent to southern right whale BIAs and habitat critical to survival should demonstrate that:
	  • it does not prevent any southern right whale from utilising the area or cause auditory impairment, and
	  • the risk of behavioural disturbance is minimised.
	• Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to southern right whales to the lowest possible level.
	• Quantify risks of anthropogenic underwater noise to southern right whales, including studies aimed to measure physiological effects, behavioural disturbance, and changes to acoustic communication (e.g., masking of vocalisations) to whales.
	• Prioritise government/industry funding opportunities to support research to identify short and long-term responses of southern right whales to underwater noise.
	Improve understanding and characterisation of marine soundscapes, including the application of new technologies for data processing, within southern right whale BIAs to facilitate quantification of anthropogenic noise in the marine soundscape.	

Planned Project Aspects Relevant to Identified Threats	**Underwater Sound Emissions - Impulsive**	**Underwater Sound Emissions - Continuous**
Relevant Spatial and Temporal Extent of Identified Threats	Multiple localised and short-term impulsive underwater sound EMBAs overlapping the migration BIA in the Otway Basin from the East Coast Project and other reasonably foreseeable future projects and activities. This includes the potential localised and short-term impulsive underwater sound EMBAs from sequential drilling activities.	Multiple localised and short-term continuous underwater sound EMBAs overlapping the migration BIA in the Otway Basin from the East Coast Project and other reasonably foreseeable future projects and activities. There is also potential for localised continuous underwater sound EMBAs from sequential drilling activities.
Baseline Environmental Condition	The migration BIA is overlapped by area of high commercial fishing effort, and existing oil and gas activity. These activities may temporarily use impulsive sources.	The migration BIA is overlapped by existing shipping channel, area of high commercial fishing effort, and existing oil and gas activity. These activities use continuous sound sources.
Other Reasonably Foreseeable Projects/ Activities Relevant to Aspect	Together the following projects that occur between Cape Otway and Robe during the biologically important period (April to November) will generate multiple sources of impulsive sound: • Commercial fishing • CHN operations – Cooper Energy • Otway Operations – Beach Energy	Together the following projects that occur between Cape Otway and Robe during the biologically important period (April to November) will generate multiple sources of continuous sound: • Commercial shipping • Commercial fishing • CHN operations – Cooper Energy

	• Minerva decommissioning – Woodside Energy • Drilling – Beach Energy • Decommissioning – Beach Energy • Geophysical/geotechnical survey – Beach Energy • Drilling – ConocoPhillips • Seismic survey – CGG-Regia.	• Otway Operations – Beach Energy • Minerva decommissioning – Woodside Energy • Drilling – Beach Energy • Decommissioning – Beach Energy • Drilling – ConocoPhillips. Drilling activities are expected to occur consecutively, therefore instead of multiple sound sources occurring at one time, one drilling sound source in the Otway Basin is expected to occur over a long period of time.
Description of Cumulative Impact	Migrating southern right whales may exert more energy to avoid temporary and localised impulsive sound sources from the East Coast Project and other reasonably foreseeable projects. As described in Section 8.1, behavioural EMBA for low-frequency cetaceans from the East Coast Project impulsive sound sources is 130 m around the operational area. This is assumed representative of impulsive sound sources from other reasonably foreseeable projects, aside from seismic surveys which have a larger footprint (e.g. 8.17 km to behavioural thresholds from CGG-Regia Seismic survey). Based on this, it is not credible to consider that cumulative behavioural impacts to southern right whale will occur as a result of the East Coast Project in combination with other oil and gas projects of a similar nature and scale. Vessels / activities would never be within 130 m of each other due to safety and navigation risk, therefore overlap in behaviour EMBAs is not predicted. Even if several similar activities were being undertaken at once or sequentially within the migration BIA, the overall footprint of impulsive sound impacts would still be very small, and displacement of southern right whale is not predicted. Potential behavioural disturbance to southern right whale is predicted within 8.17 km of the Regia MSS, however a suite of control measures is proposed to reduce potential impacts to marine mammals (including southern right whale) to ALARP and acceptable levels, ensuring that the activity meets the actions of the National Recovery Plan for the Southern Right Whale (DCCEEW 2024l). Minor avoidance behaviours of migrating southern right whales from multiple highly temporary impulsive sources is not expected to result in the disruption of migratory behaviours of southern right whales.	Migrating southern right whales may exert more energy to avoid localised continuous sound sources from the East Coast Project and other reasonably foreseeable projects. As described in Section 8.2, behavioural EMBA for low-frequency cetaceans from the East Coast Project continuous sound sources is 0.44 km from a single source and 30 km from concurrent sources (up to 4). This is assumed representative of continuous sound sources from other reasonably foreseeable projects and activities. Based on what is known about other reasonably foreseeable projects and activities in the region, it is likely that most activities will involve a single vessel operating, therefore the 0.44 km EMBA for continuous sound sources is most relevant for this assessment. Based on this EMBA, the likelihood of cumulative impacts occurring is low. Vessels / activities would rarely be within 0.44 km of each other due to safety and navigation risk, therefore overlap in behaviour EMBAs is not expected. Even if several similar activities were being undertaken at once or sequentially within the migration BIA, the overall footprint of continuous sound impacts would still be very small. In the event of multiple sound sources (i.e. concurrent activities, as described in Section 8.2), the behavioural EMBA for low frequency cetaceans will not overlap the reproduction. Evaluation of the closest maximum behavioural threshold distance to the reproduction BIA was from Scenario 2 (MODU positioning at Annie-1). This scenario does not overlap the reproduction BIA (see Section 8.2). Much of the Australian coastline, particularly within the south-east marine region, has been identified as a reproduction BIA for southern right whale which is also identified as a habitat critical to the survival of the southern right whale (DCCEEW 2024l). Assuming activities were centred around the closest point in the operational area to this important reproductive area, the behavioural EMBA would not be sufficiently large enough to restrict movement into or out of the reproductive area, and continuous underwater sound emissions from the East Coast Project are not expected to present a barrier to movement for southern right whale into the reproduction BIA. Minor avoidance behaviours of southern right whale within the migration BIA from multiple highly temporary continuous sources is not expected to result in the disruption of migratory behaviours of southern right whales. Barriers to movement of southern right whale into / out of the reproductive BIA is not predicted.
Certainty of Assessment	High certainty in the limited potential for cumulative impacts, based on underwater sound requirements to prevent impacts.	High certainty in the limited potential for cumulative impacts, based on underwater sound requirements to prevent impacts.

Existing Control Measures	CM1: Marine Assurance Process CM2: Offshore Operational Procedures CM3: Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process	
Additional Control Measures / Environmental Performance Standards	Cooper Energy will communicate work programs with other the Otway Basin Petroleum Titleholders with the aim of minimising the potential for cumulative impacts associated with underwater sound, should activity timings overlap biologically important period (April to November) for southern right whales. Additional commitments will be included within CM3 (Cooper Energy Offshore Victoria Whale Disturbance Risk Management Process).	
Aspect Specific Cumulative Consequence	Level 2	Level 2
Combined Cumulative Consequence	Level 2 The combination of multiple highly temporary and localised sources of potential behavioural disturbance to southern right whales, including long-term and localised sources from sequential drilling activities, in the Otway could result in minor impacts to species of recognised conservation value across multiple seasonal biologically important periods. With sufficient management measures in place appropriate to the nature and scale of each project, potential impacts are not expected to result in the disturbance and subsequent displacement of southern right whales from habitat critical to the survival of the species. If appropriate management is not implemented, then the risk of disturbance and displacement increases; the National Recovery Plan for the southern right whale assesses the potential impacts to the eastern population from anthropogenic noise from shipping and industry, which is present across multiple seasonal biologically important periods, as Minor (individuals are affected but no affect at the population level).	
Acceptable Level Achieved	Yes – the consequence of combined cumulative impacts of Level 2 is considered acceptable because potential cumulative impacts can be managed to ensure outcomes are not inconsistent with the National Recovery Plan for the southern right whale (DCCEEW 2024l). The activities are not expected to prevent Southern Right Whales utilising the migration BIA, nor to cause injury (TTS and PTS), or significant behavioural changes within habitat critical to the survival of the species.	

11.3.2 Birds

Table 11-5: Detailed cumulative impact assessment: Seabirds and Shorebirds

Key Environmental Matter	Seabirds and shorebirds
Conservation (or other) Value and Status	The flaring light EMBA for the East Coast Project overlaps 10 known or likely foraging BIAs for the following albatross and petrel species: • Wedge-tailed shearwater • Short-tailed shearwater • Wandering albatross • Antipodean albatross • Common diving-petrel

	• Bullers albatross • Shy albatross • Indian yellow-nosed albatross • Black-browed albatross • Campbell albatross. The flaring light EMBA for the East Coast Project also overlaps the migration route known to occur within area for: • Orange-bellied parrot. The National recovery plan for the Orange Bellied Parrot does not identify light as a major threat to migration, but as a potential barrier that could modify the behaviour of individuals (DELWP, 2016). EPBC Act listed: • Threatened species (Critically Endangered) • Marine.
Legislative or Other Requirements	Wildlife Conservation Plan for Seabirds (CoA, 2020) has objectives to protect and manage habitats from anthropogenic disturbances. National Light Pollution Guidelines for Wildlife (DCCEEW, 2023k) includes information relevant to assessment and management of artificial light.
Spatial and Temporal Extent of Key Environmental Matter	Shearwaters forage in areas offshore Victoria during late-August/early-September to May as they move to and from breeding islands (DoE, 2023). Albatrosses forage in areas offshore Victoria between September and April as they move to and from breeding islands (ACAP, 2023). The common diving-petrel is present year-round to forage in areas offshore Victoria, however, are not listed as threatened species under the EPBC Act (DCCEEW, 2023).
Acceptable Level	Artificial light will be managed so that is does not: • Result in serious or irreversible harm to a threatened or migratory listed species. • Result in a substantial adverse effect on a population of a marine species including its life cycle and spatial distribution
Planned Project Aspects Relevant to Identified Threats	**Light Emissions**
Relevant Spatial and Temporal Extent of Identified Threats	Multiple localised and short-term artificial light emissions (from vessels hired for offshore activities) overlapping the foraging BIAs in the Otway Basin from the East Coast Project and other reasonably foreseeable future projects and activities. This includes the potential localised and short-term artificial light emissions from sequential drilling activities.
Baseline Environmental Condition	The foraging BIAs of seabirds and shorebird migration routes are overlapped by an existing shipping channel, area of high commercial fishing effort, and existing and proposed oil and gas activities. These activities temporarily use and result in artificial light during operations, including flaring.
Other Reasonably Foreseeable Projects/ Activities Relevant to Aspect	Together the following projects operate within seabird foraging BIAs during known foraging periods (August to May), and shorebird migration routes, and will generate multiple sources of artificial light: • Commercial shipping • Commercial fishing • CHN operations – Cooper Energy • Otway Operations – Beach Energy • Minerva decommissioning – Woodside Energy

	• Drilling – Beach Energy • Decommissioning – Beach Energy • Geophysical/geotechnical survey – Beach Energy • Drilling – ConocoPhillips • Seismic survey – CGG-Regia.
Description of Cumulative Impact	Additional temporary artificial light emissions from the East Coast Project are not expected to not result in significant behavioural changes to foraging or migrating seabirds that are adapted to pre-existing artificial light sources from commercial vessels and oil and gas activities. Offshore artificial light emissions are expected to attract seabird prey including fish and squid, which results in an increase of foraging opportunities for nocturnal foraging seabirds in lit areas (Marangoni et al., 2022). Potential minor attraction behaviours are not expected to result in significant disruption of foraging or migrating behaviours of seabirds with BIAs overlapped by the light EMBA. There are no planned permanent light fixtures associated with the project offshore to which birds could habituate and modify behaviours in the longer-term. As outlined in the National Recovery Plan for the orange-bellied parrot (DELWP 2016), anecdotal evidence suggests illuminated structures and boats may act as behavioural barriers for individuals of this species, particularly along migration routes (Holdsworth 2006). Localised and short-term artificial light emissions from the East Coast Project and other reasonably foreseeable future projects and activities will not impact a large extent of the migration route to effectively form a barrier that will result in population impacts to the orange-bellied parrot. Migrating orange-bellied parrots are anticipated to be adapted to pre-existing artificial light sources from commercial vessels and oil and gas activities, based on the record number of 81 orange-bellied parrots returning to breeding grounds in Tasmania in 2023, the highest number in over 15 years (DNRET 2024).
Certainty of Assessment	High certainty in the limited potential for cumulative impacts, based on artificial light management requirements to prevent impacts.
Existing Control Measures	CM1: Marine Assurance Process CM2: Offshore Operational Procedures CM4: Light Management Measures
Additional Control Measures / Environmental Performance Standards	Cooper Energy will communicate work programs with other the Otway Basin Petroleum Titleholders with the aim of minimising the potential for cumulative impacts associated with light emissions, should activity timings overlap biologically important period (August to May) for shearwaters and albatrosses.
Aspect Specific Cumulative Consequence	Level 1 The combination of multiple and sequential minor local behavioural impacts to seabirds in the Otway will result in minor local impacts to species of recognized conservation value. Minor local attraction or avoidance behaviours to foraging seabirds is not expected to affect population levels.
Acceptable Level Achieved	Yes – the Level 1 consequence for a cumulative impact is considered acceptable because potential cumulative impacts are not inconsistent with the defined acceptable levels, consistent with the EPBC Act Significant impact guidelines.

12 Implementation Strategy

Cooper Energy retains full and ultimate responsibility as the proponent of the East Coast Project and is responsible for ensuring that the Development and associated activities are implemented in accordance with the performance outcomes outlined in this OPP.

The Implementation Strategy described in this section provides a summary of the Cooper Energy Management System (CEMS), which will help achieve the EPOs (detailed in Section 8 and 9), as per the requirements of Section 7 of the OPGGS(E)R. This will be described in more detail in future activity-specific EPs.

12.1 Cooper Energy Management System

The Cooper Energy Management System (CEMS) is Cooper Energy's integrated system which consolidates all of Cooper Energy's business processes into one system of management. It incorporates HSEC, Operations, Well Construction, Engineering and Finance in accordance with a set of core concepts (Table 12-1).

The CEMS document hierarchy is shown in Table 12-1: with Cooper Energy's Health, Safety, Environment and Community (HSEC) Policy shown in Figure 12-2 and the CEMS standards list in Table 12-2.

Table 12-1: Cooper Energy's Management System Core Concepts

Core Concepts	
People	How we organise (line and function) Which roles we need Which skills we need How we build and sustain capability
Culture	Why we exist What we value How we work together How we communicate
Process	What we do How we do it How we learn How we continuously improve
Technology	Which tools we use How we use them How we support people to perform their role
Governance	How we manage risk How we make decisions How we ensure safety, quality and technical integrity

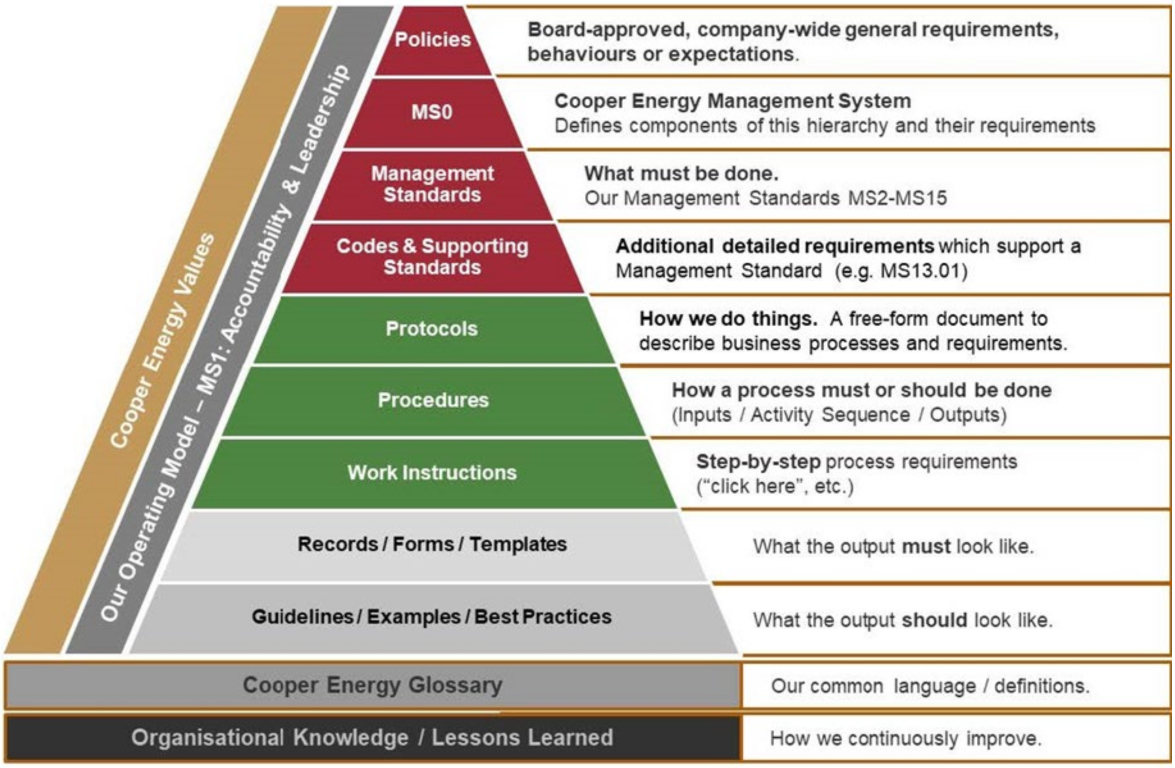


Figure 12-1: CEMS Document Hierarchy

Table 12-2: CEMS Standards

CEMS Standard	Focus Area
MS00	Statement of Intent and Expectations
MS01	Accountability and Leadership
MS02	People Management
MS03	Risk Management
MS04	Strategy and Planning Management
MS05	External Affairs, Investor Relations, Community and Stakeholder Management
MS06	Information Systems
MS07	Operations Management
MS08	Technical Management
MS09	Health, Safety and Environment Management
MS10	Incident and Crisis Management
MS11	Supply Chain and Procurement Management
MS12	Technical Assurance and Compliance Management
MS13	Financial Management
MS14	Commercial Marketing and Economics Management
MS15	Asset Lifecycle Management

Health, Safety and Environment Policy

Cooper Energy | HSEC | Policy

This policy describes our approach to managing Health, Safety and Environmental risks at Cooper Energy

Our Commitment

Cooper Energy is committed to taking all reasonably practicable steps to protect the health and safety of our workers, contractors, partners, and the communities in the areas where we operate.

In addition, we will ensure our business is conducted in an environmentally responsible manner.

Our Actions

We will:

- **Integrate** health, safety and environmental requirements into our daily work, our business planning and our decision making
- **Comply** with all relevant health, safety and environmental laws and regulations
- **Provide** resources and systems to enable delivery of our health, safety and environmental objectives
- **Identify, control and monitor** risks that have the potential to harm people and the environment to as low as reasonably practical
- **Empower** our people, regardless of position, to "Stop the Job" if they consider it necessary to prevent harm to themselves, others or the environment
- **Consult, communicate and promote participation** of our workforce to build and maintain a strong health, safety and environment culture
- **Ensure** all employees and contractors are trained, competent and suitably supervised so that works are undertaken in a safe and environmentally responsible manner
- **Collaborate** proactively with our stakeholders and the communities where we operate
- **Investigate and learn** from our incidents and from those in our industry
- **Set, measure and monitor** health, safety and environmental targets to drive continuous improvement in our performance
- **Report** publicly and transparently on our health, safety and environmental performance

Governance

The HSE Improvement Forum has oversight of this policy. The Managing Director is accountable for communicating this Policy and for ensuring compliance with its undertakings. All Executive Leadership Team members and Managers shall ensure the effective implementation, management and monitoring of our HSE Management System and its subsequent outcomes.

All Staff are responsible for compliance with our policy, standards, and procedures.

This policy will be reviewed at appropriate intervals and revised as necessary to keep it current.

Policy authorised by

Jane Norman
Managing Director & CEO
Date: 13 July 2023   Review Date: 13 July 2026

Figure 12-2: Cooper Energy Health, Safety and Environment Policy

12.2 Asset Integrity Management

The integrity of all Cooper Energy Assets is managed in line with MS08: Technical Management.

An accepted Well Operations Management Plan (WOMP) is required before drilling can commence, which describes the well integrity management, controls, verification, and maintenance for well activities in the offshore Otway. Well integrity is demonstrated through the maintenance of a primary and a secondary well barrier envelope. The WOMP details the well barrier elements and performance standards and their implementation through the well life cycle.

Cooper Energy manage the integrity of the existing CHN facilities through an Offshore Integrity Management Plan. This plan would be expanded to include provision for the future tie-ins. The overall strategy of the integrity management plan is to maintain the assets as close to their design condition as possible. Accordingly, the integrity of the Otway offshore assets is maintained and monitored in several ways, including:

- Design, pressure containment and primary protection functions:
  - Design basis and documentation.
  - Protection and support structures.
  - External corrosion protection system.
  - Internal corrosion control system.
  - Restriction and safety zone systems.
  - Intervention procedures.
  - Pipeline integrity reviews.
- Monitoring and inspection:
  - Marine activity monitoring.
  - Weather (exceedance) monitoring.
  - ROV visual and CP inspection.
  - Stakeholder engagement (facility awareness).

This approach is preferred to 'controlled deterioration' as it attempts to maintain enough control effectiveness to prevent 'surprise' deterioration threatening integrity, acknowledges that individual control effectiveness will not always be perfect and provides operational flexibility for decommissioning options.

12.3 Project Planning

Activities such as IMR, new stages and decommissioning are planned and executed in accordance with MS15: Asset Lifecycle Management. Cooper Energy uses a gated process; the process workflow is divided into phases (Figure 12-3). Each phase is subject to assurance processes and a gate review, the outcomes of which include continue, stop, hold, or recycle.

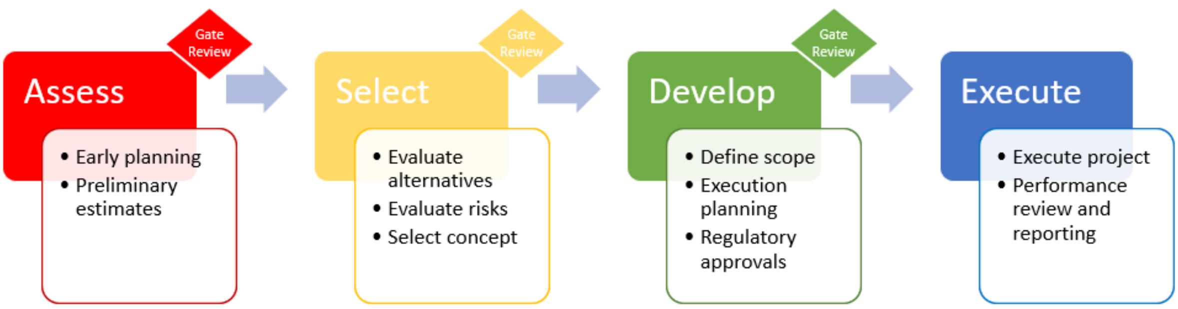


Figure 12-3: Project Workflow

12.3.1 Decommissioning Planning

Decommissioning an asset involves permanently sealing wells, deconstruction and removal (base case) of infrastructure, processing of waste and infrastructure associated with the operations, and rehabilitation of the area.

Section 572(3) of the OPGGS Act requires titleholders to remove all equipment and other property in their title area that is neither used, nor to be used, in connection with operations. This obligation is ongoing and covers both the removal of equipment and property at the end of production and the removal of disused infrastructure at appropriate points throughout the life of an asset.

Cooper Energy's Decommissioning Protocol acknowledges legislative requirements and illustrates the company's management system for integrating decommissioning planning across operations. The Protocol outlines roles, responsibilities, and requirements for decommissioning planning for onshore and offshore assets and associated financial provisions.

The objectives of this protocol are to:

- define the requirement for decommissioning as part of the lifecycle of assets
- define the requirement for a decommissioning plan to be developed and maintained for each asset, or group of assets within an operational area. The decommissioning plan must consider, where practical, progressive decommissioning of assets when equipment is not intended to be returned to operation.
- define the requirements for financial provisions to ensure decommissioning is completed in accordance with the decommissioning plan and that appropriate provisions are allocated for non-operated assets.

Options for other than the complete removal of all property may be considered, in which case the decommissioning plan must demonstrate that the alternative delivers equal or better environmental outcomes compared to complete removal, and that the approach complies with all other legislative and regulatory requirements. Therefore, for the purposes of planning, full removal must be the base case until the regulator accepts an alternative end-state.

Where onshore treatment and disposal of wastes is to be undertaken as a component of decommissioning, management of this waste must be in accordance with the respective legislation of the States or Territory. Depending on the remaining operational life, this may require specific plans for:

- waste management; and
- licensing and regulation of waste transport, storage, treatment, resource recovery and disposal.

12.4 Contractor Management

The Supply Chain and Procurement Management Standard details Cooper Energy's contractor management system, which provides a systematic approach for the selection and management of contractors to ensure any third party has the appropriate safety and environment management system and structures in place to achieve HSEC performance in accordance with Cooper Energy's expectations.

This standard applies to sub-contractors, Third Party Contractors (TPCs) and suppliers conducting work at Cooper Energy sites or providing services to Cooper Energy. The Standard addresses the operational HSEC performance of all contractors while working under a Cooper Energy contract or in an area of Cooper Energy responsibility or which may be covered under the HSEC Management System. The key HSEC steps include:

- planning – HSEC assessment of potential contractors, suppliers and/or TPCs
- selection – submission and review of contractors and/or TPCs HSEC management data
- implementation – onsite contractors and/or TPCs HSEC requirements, including induction and training requirements
- monitoring, review and closeout – ongoing review of contractors and/or TPCs HSEC performance, including evaluation at work handover.

Before activities commence in the Operational Area, Cooper Energy will ensure contractors have a HSE Management System in place that meets the requirements of future EPs, and ensure that contractors are aware of, and comply with, EP requirements.

12.5 Emergency Response

Cooper Energy manages emergencies from offshore Victoria activities in accordance with its Incident Management Plan (IMP). The purpose of the IMP is to provide the Cooper Energy Incident Management Team (IMT) with the necessary information to respond to an emergency affecting operations or business interruptions. The IMP:

- Describes the Emergency Management Process;
- Details the response process; and
- Lists the roles and responsibilities of the IMT members.

Any future EPs for the East Coast Project are required to have an accepted OPEP/Emergency Response Plan (ERP) as per Section 22(8) of the OPGGS(E)R. Section 22(9) provides a framework for the control measures and arrangements for responding to and monitoring oil pollution.

Roles and responsibilities for maintaining oil spill response capability and preparedness, testing and review arrangements and oil spill response competency and training requirements would be detailed in the activity specific OPEP/ERP.

12.6 Chemical Assessment and Selection

Cooper Energy's Offshore Chemical Assessment Procedure requires that chemicals used offshore for a project and operations, that will be or have the potential to be discharged to the environment, are assessed and approved before use. This process guides selection of the lowest toxicity, most biodegradable and least bioaccumulative chemicals that meet the technical requirements are selected.

12.7 Marine Assurance Process

Cooper Energy's Marine Assurance Process requires that vessels, MODUs and equipment to be used offshore for a project or operations, have been assessed as compliant with applicable International MARPOL, SOLAS requirements, Australian legislation, and Cooper Energy MS requirements. This process ensures vessels and equipment are fit for purpose, maintained in good order, and that the crew and offshore project team are suitable for the scope of work, prior to the commencement of work in the Operational Area.

12.8 Invasive Marine Species Risk Assessment

Cooper Energy's Invasive Marine Species Risk Management Process was developed to integrate Australian IMS prevention efforts into Cooper Energy's offshore operations. The procedure details the actions to be undertaken during the contracting phase for a vessel, MOU and submersible equipment (e.g., ROVs) for a project within a Cooper Energy operational area (as defined under the OPP for the activity). The procedure incorporates key considerations from IMO (2011) and Australian Government (2009) biofouling guidelines and supports compliance with the Biosecurity Amendment (Biofouling Management) Regulations 2021. The current the inputs, decision points and general flow of the IMS risk management actions are shown in Figure 12-4.

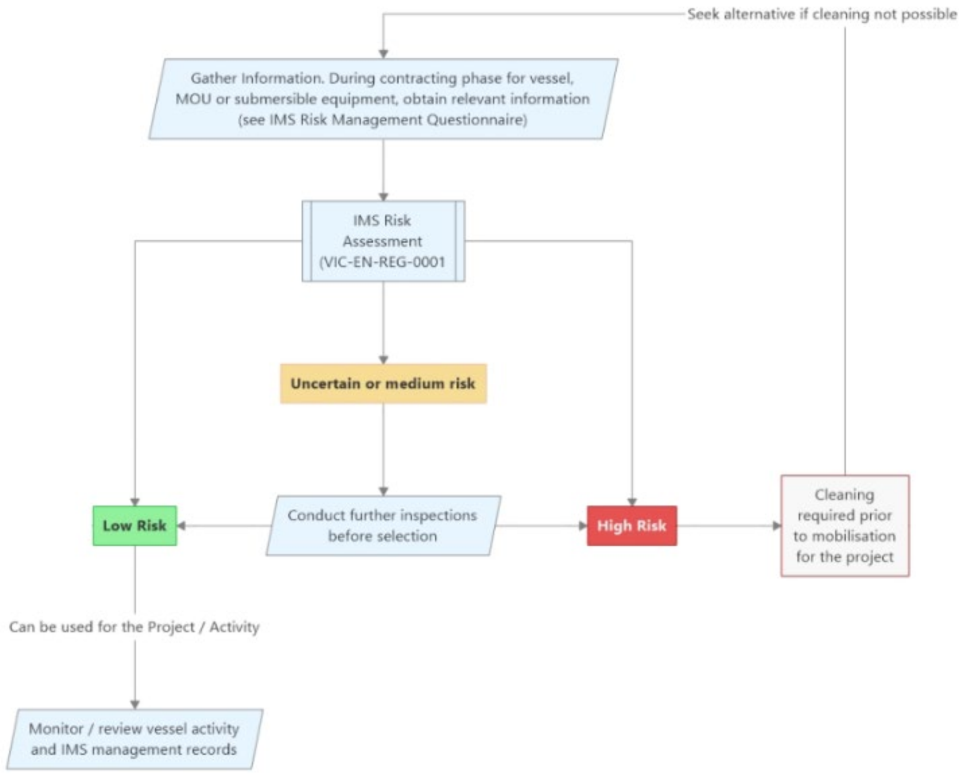


Figure 12-4: Cooper Energy IMS Risk Management Flow

12.9 Marine Mammal Risk Review and Management

Cooper Energy implements risk reviews before undertaking offshore campaigns.

The Cooper Energy Whale Disturbance Risk Management Process is designed to guide alignment with current government guidelines and is adjusted according to operational needs and new information such as additional baseline. The process outlines the level of whale observation effort required under different operational circumstances, triggers for actions, and the actions to be taken (Figure 12-5).

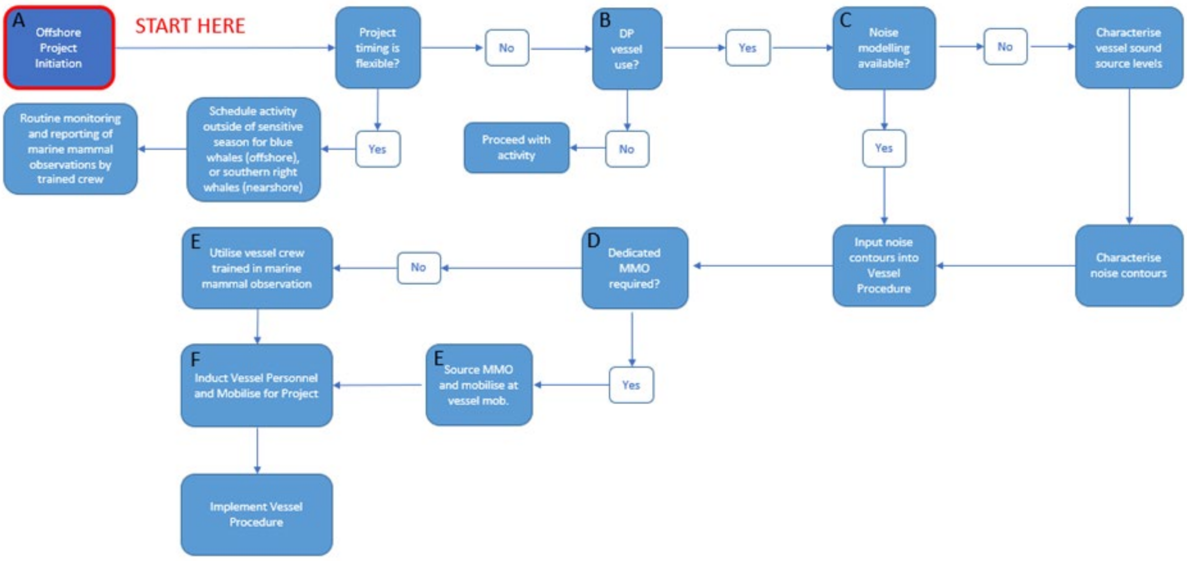


Figure 12-5: Whale Disturbance Risk Management – key steps when planning an offshore campaign

12.10 Management of Change

MS08 Technical Management and Management of Change (MoC) General Protocol describes the requirements for dealing with change management. The objective of the MoC process is to eliminate, or reduce so far as is reasonably practicable, the potential hazards and risks associated with changes. This includes:

- deviation from established corporate processes
- changes to offshore operations and/or status of infrastructure
- deviation from specified safe working practice or work instructions/procedures
- implementation of new systems
- significant change of HSEC-critical personnel
- environmentally relevant changes.

These changes will be addressed to determine if there is potential for any new or increased environmental impact or risk not already provided for in this OPP. In the EP phase, the trigger for resubmission of an EP will be evaluated against the requirements of Section 38 and 39 of the OPGGS(E)R.

12.11 Assurance

The CEMS manages compliance assurance to ensure that identified controls are effective and any non-compliances are resolved.

The environmental performance of offshore operations and activities will be audited and reviewed in several ways to ensure that:

- applicable legal and CEMS requirements are being met
- EPOs are being met
- potential non-compliances and opportunities for continuous improvement are identified, and
- Environmental monitoring requirements are being met.

A record of all assurance activities undertaken, and the outcomes, are maintained and actions are tracked until completed.

12.12 Incident Reporting and Recording

Cooper Energy's Incident and Crisis Management Protocol and Incident Investigation and Reporting Protocol provide for a systematic method of incident reporting and investigation and a process for monitoring close out of preventative actions.

The incident reporting and investigation documentation defines the:

- method to record, report, investigate and analyse accidents and incidents
- legal reporting requirements to the regulators within mandatory reporting timeframes
- process for escalating reports to Cooper Energy senior management and the Cooper Energy Board
- methodology for determining root cause
- responsible persons to undertake investigation, and
- classification and analysis of incidents.

Notification and reporting requirements for environmental incidents to external agencies will be provided in future EPs.

As defined under Section 48 of the OPGGS(E)R incidents are required to be reported for future EPs related to this OPP.

As defined in the legislation, a recordable incident which arises from the activity is one that is:

'a breach of an environmental performance outcome or environmental performance standard, in the environment plan that applies to the activity, that is not a reportable incident'

Recordable incidents must be reported to NOPSEMA no later than 15 days after the end of the calendar month and include breaches to the environmental performance outcomes set within future activity specific EPs related to EPOs listed in this OPP (Section 8 and 9).

As defined in the legislation, a reportable incident which arises from the activity is one that:

'has caused, or has the potential to cause, moderate to significant environmental damage'

All reportable incidents will be notified to NOPSEMA, as per the requirements of Sections 47, 48 and 49 of the OPGGS(E)R.

12.13 Implementing Requirements of the OPP in Future EPs

NOPSEMA's Offshore Project Proposal Content Requirements (NOPSEMA, 2019) state that an OPP must include:

'appropriate environmental performance outcomes that are consistent with the principles of ecologically sustainable development; and demonstrate that the environmental impacts and risks of the project will be managed to an acceptable level.'

EPOs are supported by adopted control measures which provide additional context on how the EPO will be achieved. Control measures are developed as the result of the impact assessment process and are a content requirement of future activity specific EPs related to the activity assessed within this OPP.

Setting environmental performance standards (EPSs) is not a component of the OPP phase but is a requirement of future activity specific EPs. These EPs must also include appropriate measurement criteria to monitor the performance of control measures and determine whether the EPOs and EPSs have been met.

The implementation strategy described within this OPP will be presented in greater detail in future EPs. The strategy will ensure control measures are effective in reducing the environmental impacts and risks of the specific activity to ALARP and acceptable levels, and that EPOs and EPSs are continually met.

12.14 Environmental Performance Monitoring and Reporting

Cooper Energy will undertake monitoring to ensure that the EPOs provided in this OPP are demonstrated within future EPs. This includes:

- environmental impacts and risks of the activity continue to be identified and will be reduced to a level that is ALARP
- control measures detailed in future activity specific EPs are effective in reducing the environmental impacts and risks of the activity to ALARP and an acceptable level; and
- environmental performance outcomes and standards set out in activity specific EPs are being met
- emissions and discharges are monitored.

Routine reporting will be undertaken as per Section 51 of the OPGGS(E)R, which requires environmental performance reporting for activities described in future EPs, including recordable incidents.

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13.2 Guidance

Document Number	Document Name
NOPSEMA Guidance	
N-04790-GN1663 A473026	Offshore Project Proposal Content Requirements Guidance Note (NOPSEMA, 2020a)
N-04790-GL1816 A630598	Offshore project proposal decision making guideline (NOPSEMA, 2024a)
N-04790-GN1663 A473026	Offshore Project proposal Content Requirements Guidance Note (NOPSEMA, 2024b)
N-00500-PL1903 A720369	Maintenance and removal of property Policy (Section 572) (NOPSEMA, 2020b)
N-04750-IP1765 A625748	Acoustic impact evaluation and management (NOPSEMA, 2020c)
N-00500-PL1959 A800981	Consent to surrender Title (Section 270) (NOPSEMA, 2022)
N-04750-GL1721 A524696	Environment Plan Decision Making Guideline (NOPSEMA, 2024)
N-04750-IP1899	Reducing marine pest biosecurity risks through good practice biofouling management (NOPSMEA, 2020d)
N-00500-IP2002	Planning for proactive decommissioning Information Paper (NOPSEMA, 2021)
No ID	NOPSEMA Decommissioning Compliance Strategy 2024 – 2029 Referenced in OPP RFFWI #2. NOPSEMA ID: 7895 A1139619
Other Guidance	
ANZG	Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018

Document Number	Document Name
CoA	National Biofouling Management Guidance for the Petroleum Production and Exploration Industry
DAFF	Antifouling and In-water Cleaning Guidelines
CoA	National biofouling management guidelines for commercial vessels
DCCEEW	National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds (2023)
CoA	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna
DAFF	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (2017)
EPA Victoria	Guideline for minimizing greenhouse gas emissions (2022)
DISER	Offshore Petroleum Decommissioning Guideline (2022)
UK Government	Nationally Significant Infrastructure Projects - Advice Note 17: Cumulative effects assessment relative to nationally significant infrastructure projects (2019)
State of NSW	Cumulative Impact Assessment Guideline for State Significant Projects (2022)
DEWHA	EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales

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Appendix 1. EPBC Database Protected Matters Search Tool Results

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Figure: East Coast Project Monitoring EMBA

Report created: 03-Apr-2024

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	5
Wetlands of International Importance (Ramsar	7
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	22
Listed Threatened Species:	207
Listed Migratory Species:	91

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	88
Commonwealth Heritage Places:	13
Listed Marine Species:	148
Whales and Other Cetaceans:	33
Critical Habitats:	1
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	11
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	263
Regional Forest Agreements:	6
Nationally Important Wetlands:	45
EPBC Act Referrals:	335
Key Ecological Features (Marine):	6
Biologically Important Areas:	57
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Legal Status
Tasmanian Wilderness	TAS	Declared property

National Heritage Places [Resource Information]

Name	State	Legal Status
Historic		
Great Ocean Road and Scenic Environs	VIC	Listed place
Point Nepean Defence Sites and Quarantine Station Area	VIC	Listed place
Quarantine Station and Surrounds	VIC	Within listed place
Indigenous		
Western Tasmania Aboriginal Cultural Landscape	TAS	Listed place
Natural		
Tasmanian Wilderness	TAS	Listed place

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Corner inlet	Within Ramsar site
Gippsland lakes	Within Ramsar site
Glenelg estuary and discovery bay wetlands	Within Ramsar site
Lavinia	Within Ramsar site
Piccaninnie ponds karst wetlands	Within Ramsar site
Port phillip bay (western shoreline) and bellarine peninsula	Within Ramsar site
Western port	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)

Feature Name
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Alpine Sphagnum Bogs and Associated Fens	Endangered	Community may occur within area
Araluen Scarp Grassy Forest	Endangered	Community may occur within area
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area
Brogo Vine Forest of the South East Corner Bioregion	Endangered	Community likely to occur within area
Coastal Swamp Oak (Casuarina glauca) Forest of New South Wales and South East Queensland ecological community	Endangered	Community likely to occur within area
Coastal Swamp Sclerophyll Forest of New South Wales and South East Queensland	Endangered	Community may occur within area
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area
Gippsland Red Gum (Eucalyptus tereticornis subsp. mediana) Grassy Woodland and Associated Native Grassland	Critically Endangered	Community likely to occur within area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Illawarra and south coast lowland forest and woodland ecological community	Critically Endangered	Community may occur within area
Karst springs and associated alkaline fens of the Naracoorte Coastal Plain Bioregion	Endangered	Community likely to occur within area
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia	Critically Endangered	Community likely to occur within area
Lowland Grassy Woodland in the South East Corner Bioregion	Critically Endangered	Community likely to occur within area

Community Name	Threatened Category	Presence Text
Lowland Native Grasslands of Tasmania	Critically Endangered	Community likely to occur within area
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community likely to occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Tasmanian Forests and Woodlands dominated by black gum or Brookers gum (Eucalyptus ovata / E. brookeriana)	Critically Endangered	Community likely to occur within area
Tasmanian white gum (Eucalyptus viminalis) wet forest	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Acanthiza pusilla magnirostris		
King Island Brown Thornbill, Brown Thornbill (King Island) [91709]	Endangered	Species or species habitat known to occur within area
Acanthornis magna greeniana		
King Island Scrubtit, Scrubtit (King Island) [82329]	Critically Endangered	Species or species habitat known to occur within area
Anthochaera phrygia		
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat known to occur within area
Aphelocephala leucopsis		
Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Aquila audax fleayi Tasmanian Wedge-tailed Eagle, Wedge-tailed Eagle (Tasmanian) [64435]	Endangered	Breeding likely to occur within area
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Breeding known to occur within area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii graptogyne South-eastern Red-tailed Black-Cockatoo [25982]	Endangered	Foraging, feeding or related behaviour known to occur within area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat known to occur within area
Ceyx azureus diemenensis Tasmanian Azure Kingfisher [25977]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat known to occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Roosting known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Breeding known to occur within area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Platycercus caledonicus brownii Green Rosella (King Island) [67041]	Vulnerable	Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area
Pterodroma heraldica Herald Petrel [66973]	Critically Endangered	Species or species habitat may occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Breeding known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Pterodroma neglecta neglecta Kermadec Petrel (western) [64450]	Vulnerable	Foraging, feeding or related behaviour may occur within area
Pycnoptilus floccosus Pilotbird [525]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Strepera fuliginosa colei Black Currawong (King Island) [67113]	Vulnerable	Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area
Tyto novaehollandiae castanops (Tasmanian population) Masked Owl (Tasmanian) [67051]	Vulnerable	Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area
CRUSTACEAN		
Euastacus bidawalus Bidhawal Crayfish, Bidawal Crayfish, East Gippsland Spiny Crayfish [83136]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Euastacus bispinosus		
Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat known to occur within area
Euastacus diversus		
Orbost Spiny Crayfish [66782]	Endangered	Species or species habitat may occur within area
FISH		
Brachiopsilus ziebelli		
Ziebell's Handfish, Waterfall Bay Handfish [83757]	Vulnerable	Species or species habitat likely to occur within area
Epinephelus daemelii		
Black Rockcod, Black Cod, Saddled Rockcod [68449]	Vulnerable	Species or species habitat likely to occur within area
Galaxiella pusilla		
Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Endangered	Species or species habitat known to occur within area
Hoplostethus atlanticus		
Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area
Mordacia praecox		
Non-parasitic Lamprey, Precocious Lamprey [81530]	Endangered	Species or species habitat likely to occur within area
Nannoperca obscura		
Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area
Nannoperca variegata		
Variegated Pygmy Perch, Ewens Pygmy Perch, Golden Pygmy Perch [26178]	Vulnerable	Species or species habitat known to occur within area
Prototroctes maraena		
Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Rexea solandri (eastern Australian population)		
Eastern Gemfish [76339]	Conservation Dependent	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Seriolella brama		
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
Thunnus maccoyii		
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area
Thymichthys politus		
Red Handfish [83756]	Critically Endangered	Species or species habitat may occur within area
FROG		
Heleioporus australiacus		
Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat known to occur within area
Litoria aurea		
Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat known to occur within area
Litoria raniformis		
Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Litoria watsoni		
Southern Heath Frog, Watson's Tree Frog [91509]	Endangered	Species or species habitat known to occur within area
Mixophyes balbus		
Stuttering Frog, Southern Barred Frog (in Victoria) [1942]	Vulnerable	Species or species habitat may occur within area
Uperoleia martini		
Martin's Toadlet [1873]	Endangered	Species or species habitat known to occur within area
INSECT		
Synemon plana		
Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area
MAMMAL		
Antechinus minimus maritimus		
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Chalinolobus dwyeri Large-eared Pied Bat, Large Pied Bat [183]	Endangered	Species or species habitat may occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (Tasmanian population) Spotted-tail Quoll, Spot-tailed Quoll, Tiger Quoll (Tasmanian population) [75183]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area
Mirounga leonina Southern Elephant Seal [26]	Vulnerable	Breeding may occur within area

Scientific Name	Threatened Category	Presence Text
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat known to occur within area
Perameles gunnii Victorian subspecies Eastern Barred Bandicoot (Mainland) [88020]	Endangered	Translocated population known to occur within area
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat known to occur within area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat known to occur within area
Potorous longipes Long-footed Potoroo [217]	Endangered	Species or species habitat known to occur within area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat known to occur within area
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Sarcophilus harrisii Tasmanian Devil [299]	Endangered	Species or species habitat likely to occur within area
OTHER		
Hyridella glenelgensis Glenelg Freshwater Mussel [82953]	Critically Endangered	Species or species habitat may occur within area
PLANT		
Acacia caerulescens Limestone Blue Wattle, Buchan Blue, Buchan Blue Wattle [21883]	Vulnerable	Species or species habitat known to occur within area
Acacia constablei Narrabarba Wattle [10798]	Critically Endangered	Species or species habitat known to occur within area
Acacia georgensis Bega Wattle [9848]	Vulnerable	Species or species habitat known to occur within area
Acacia lanigera var. gracilipes [31652]	Endangered	Species or species habitat may occur within area
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat known to occur within area
Astelia australiana Tall Astelia [10851]	Vulnerable	Species or species habitat may occur within area
Astrotricha crassifolia Thick-leaf Star-hair [10352]	Vulnerable	Species or species habitat may occur within area
Astrotricha sp. Wingan Inlet (J.A.Jeanes 2268) Wingan Star-hair [85675]	Endangered	Species or species habitat known to occur within area
Caladenia calcicola Limestone Spider-orchid [10065]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Caladenia colorata Coloured Spider-orchid, Small Western Spider-orchid, Painted Spider-orchid [54999]	Endangered	Species or species habitat known to occur within area
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat may occur within area
Caladenia dienema Windswept Spider-orchid [64858]	Endangered	Species or species habitat known to occur within area
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area
Caladenia insularis French Island Spider-orchid [24372]	Vulnerable	Species or species habitat known to occur within area
Caladenia orientalis Eastern Spider Orchid [83410]	Endangered	Species or species habitat known to occur within area
Caladenia ornata Ornate Pink Fingers [76213]	Vulnerable	Species or species habitat known to occur within area
Caladenia richardsiorum Little Dip Spider-orchid [55018]	Endangered	Species or species habitat likely to occur within area
Caladenia robinsonii Frankston Spider-orchid [24375]	Endangered	Species or species habitat likely to occur within area
Caladenia tensa Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat may occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Calochilus pulchellus Pretty Beard Orchid, Pretty Beard-orchid [84677]	Endangered	Species or species habitat may occur within area
Centrolepis pedderensis Pedder Centrolepis, Pedder Bristlewort [12647]	Endangered	Species or species habitat likely to occur within area
Commersonia prostrata Dwarf Kerrawang [87152]	Endangered	Species or species habitat likely to occur within area
Correa baeuerlenii Chef's Cap [17007]	Vulnerable	Species or species habitat known to occur within area
Correa lawrenceana var. genoensis Genoa River Correa [66626]	Endangered	Species or species habitat may occur within area
Corunastylis vernalis listed as Genoplesium vernale East Lynne Midge-orchid [78699]	Vulnerable	Species or species habitat may occur within area
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat known to occur within area
Deyeuxia ramosa Climbing Bent-grass [87970]	Critically Endangered	Species or species habitat known to occur within area
Dianella amoena Matted Flax-lily [64886]	Endangered	Species or species habitat likely to occur within area
Diuris basaltica Small Golden Moths Orchid, Early Golden Moths [64654]	Endangered	Species or species habitat may occur within area
Dodonaea procumbens Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Eucalyptus stenostoma Jillaga Ash [3976]	Endangered	Species or species habitat may occur within area
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area
Euphrasia collina subsp. muelleri Purple Eyebright, Mueller's Eyebright [16151]	Endangered	Species or species habitat known to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area
Grevillea infecunda Anglesea Grevillea [22026]	Vulnerable	Species or species habitat known to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Hiya distans listed as Hypolepis distans Scrambling Ground-fern [92548]	Endangered	Species or species habitat known to occur within area
Ixodia achillaeoides subsp. arenicola Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat known to occur within area
Lachnagrostis adamsonii Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat known to occur within area
Leiocarpa gatesii Wrinkled Buttons [76212]	Vulnerable	Species or species habitat known to occur within area
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area
Leucochrysum albicans subsp. tricolor Hoary Sunray, Grassland Paper-daisy [89104]	Endangered	Species or species habitat may occur within area
Lomatia tasmanica King's Lomatia [3745]	Critically Endangered	Species or species habitat likely to occur within area
Persicaria elatior Knotweed, Tall Knotweed [5831]	Vulnerable	Species or species habitat known to occur within area
Phaius australis Lesser Swamp-orchid [5872]	Endangered	Species or species habitat may occur within area
Pimelea spinescens subsp. spinescens Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat likely to occur within area
Pomaderris cotoneaster Cotoneaster Pomaderris [2043]	Endangered	Species or species habitat may occur within area
Pomaderris halmaturina subsp. halmaturina Kangaroo Island Pomaderris [21964]	Vulnerable	Species or species habitat known to occur within area
Pomaderris parrisiae Parris' Pomaderris [22119]	Vulnerable	Species or species habitat known to occur within area
Prasophyllum diversiflorum Gorae Leek-orchid [13210]	Endangered	Species or species habitat likely to occur within area
Prasophyllum favonium Western Leek-orchid [64949]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Prasophyllum frenchii Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat known to occur within area
Prasophyllum litorale listed as Prasophyllum littorale Coastal Leek Orchid [55234]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum pulchellum Pretty Leek-orchid [64953]	Critically Endangered	Species or species habitat may occur within area
Prasophyllum secutum Northern Leek-orchid [64954]	Endangered	Species or species habitat likely to occur within area
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area
Prasophyllum suaveolens Fragrant Leek-orchid [64956]	Endangered	Species or species habitat may occur within area
Pseudocephalozia paludicola Alpine Leafy Liverwort [66441]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat known to occur within area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat known to occur within area
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area
Pterostylis ziegeleri Grassland Greenhood, Cape Portland Greenhood [64971]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Rhodamnia rubescens Scrub Turpentine, Brown Malletwood [15763]	Critically Endangered	Species or species habitat likely to occur within area
Rutidosis leptorhynchoides Button Wrinklewort [67251]	Endangered	Species or species habitat may occur within area
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat likely to occur within area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area
Taraxacum cygnorum Coast Dandelion, Native Dandelion [2508]	Vulnerable	Species or species habitat known to occur within area
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat known to occur within area
Thelymitra orientalis Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat known to occur within area
Thesium australe Austral Toadflax, Toadflax [15202]	Vulnerable	Species or species habitat known to occur within area
Westringia davidii [19079]	Vulnerable	Species or species habitat may occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Zieria tuberculata Warty Zieria [56736]	Vulnerable	Species or species habitat known to occur within area
REPTILE		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Carinascincus orocryptus Heath Cool-skink, Mountain Skink [90209]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Lissolepis coventryi Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Tympanocryptis pinguicolla Victorian Grassland Earless Dragon [66727]	Critically Endangered	Species or species habitat likely to occur within area
SHARK		

Scientific Name	Threatened Category	Presence Text
Carcharias taurus (east coast population)		
Grey Nurse Shark (east coast population) [68751]	Critically Endangered	Congregation or aggregation known to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Centrophorus harrissoni		
Harrisson's Dogfish, Endeavour Dogfish, Dumb Gulper Shark, Harrison's Deepsea Dogfish [68444]	Conservation Dependent	Species or species habitat likely to occur within area
Centrophorus uyato		
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area
Galeorhinus galeus		
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat likely to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area
Ardenna grisea		
Sooty Shearwater [82651]	Vulnerable	Breeding known to occur within area
Ardenna pacifica		
Wedge-tailed Shearwater [84292]		Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]		Foraging, feeding or related behaviour known to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Roosting known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Symposiachrus trivirgatus as Monarcha trivirgatus		
Spectacled Monarch [83946]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area
Calidris alba		
Sanderling [875]		Roosting known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis		
Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta		
Long-toed Stint [861]		Species or species habitat known to occur within area
Calidris tenuirostris		
Great Knot [862]	Vulnerable	Roosting known to occur within area
Charadrius bicinctus		
Double-banded Plover [895]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa incana Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Communications, Information Technology and the Arts - Australian Postal Corporation	
Commonwealth Land - Australian Postal Commission [12052]	NSW
Communications, Information Technology and the Arts - Telstra Corporation Limited	

Commonwealth Land Name	State
Commonwealth Land - Australian Telecommunications Commission [15611]	NSW
Commonwealth Land - Australian Telecommunications Commission [12053]	NSW
Commonwealth Land - Telstra Corporation Limited [15888]	NSW
Commonwealth Land - Telstra Corporation Limited [12051]	NSW
Defence	
Defence - CROWS NEST CAMP - QUEENSCLIFF [21028]	VIC
Defence - CROWS NEST CAMP - QUEENSCLIFF [21029]	VIC
Defence - CROWS NEST CAMP - QUEENSCLIFF [21026]	VIC
Defence - CROWS NEST CAMP - QUEENSCLIFF [21027]	VIC
Defence - HMAS CERBERUS [20082]	VIC
Defence - HMAS CERBERUS [20083]	VIC
Defence - HMAS CERBERUS [20080]	VIC
Defence - HMAS CERBERUS [20081]	VIC
Defence - HMAS CERBERUS [20086]	VIC
Defence - HMAS CERBERUS [20087]	VIC
Defence - HMAS CERBERUS [20084]	VIC
Defence - HMAS CERBERUS [20092]	VIC
Defence - HMAS CERBERUS [20090]	VIC
Defence - HMAS CERBERUS [20098]	VIC
Defence - HMAS CERBERUS [20093]	VIC
Defence - HMAS CERBERUS [20099]	VIC
Defence - HMAS CERBERUS [20096]	VIC
Defence - HMAS CERBERUS [20091]	VIC
Defence - HMAS CERBERUS [20094]	VIC
Defence - HMAS CERBERUS [20095]	VIC
Defence - HMAS CERBERUS [20097]	VIC

Commonwealth Land Name	State
Defence - HMAS CERBERUS [20085]	VIC
Defence - HMAS CERBERUS [20088]	VIC
Defence - HMAS CERBERUS [20089]	VIC
Defence - HMAS CERBERUS [20102]	VIC
Defence - HMAS CERBERUS [20101]	VIC
Defence - HMAS CERBERUS [20100]	VIC
Defence - HMAS CERBERUS [20104]	VIC
Defence - HMAS CERBERUS [20103]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21442]	VIC
Defence - POINT WILSON EXPLOSIVES AREA [21441]	VIC
Defence - STAFF COLLEGE-FORT QUEENSCLIFF [21033]	VIC
Defence - STAFF COLLEGE-FORT QUEENSCLIFF [21031]	VIC
Defence - STAFF COLLEGE-FORT QUEENSCLIFF [21032]	VIC
Defence - STAFF COLLEGE-FORT QUEENSCLIFF [21034]	VIC
Defence - STAFF COLLEGE-FORT QUEENSCLIFF [21030]	VIC
Defence - SWAN ISLAND TRAINING AREA [21448]	VIC
Defence - SWAN ISLAND TRAINING AREA [21446]	VIC
Defence - SWAN ISLAND TRAINING AREA [21447]	VIC
Defence - TRAINING CENTRE (Norris Barracks) - Portsea [21025]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21012]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21016]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21011]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21010]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21013]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21018]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21015]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21014]	VIC

Commonwealth Land Name	State
Defence - Training Depot, Darts RD 3305 Portland [21017]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21024]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21022]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21023]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21020]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21021]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21019]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21007]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21009]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21008]	VIC
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC
Defence - WEST HEAD GUNNERY RANGE [21112]	VIC
Transport and Regional Services - Australian Maritime Safety Authority	
Commonwealth Land - Australian Maritime Safety Authority [41289]	SA
Commonwealth Land - Australian Maritime Safety Authority [41288]	SA
Commonwealth Land - Australian Maritime Safety Authority [41263]	SA
Commonwealth Land - Australian Maritime Safety Authority [41215]	SA
Unknown	
Commonwealth Land - [21570]	VIC
Commonwealth Land - [21582]	VIC
Commonwealth Land - [21583]	VIC
Commonwealth Land - [21497]	VIC
Commonwealth Land - [21496]	VIC
Commonwealth Land - [60113]	TAS
Commonwealth Land - [21498]	VIC
Commonwealth Land - [21491]	VIC
Commonwealth Land - [21490]	VIC
Commonwealth Land - [21492]	VIC

Commonwealth Land Name	State
Commonwealth Land - [21487]	VIC
Commonwealth Land - [21488]	VIC
Commonwealth Land - [21489]	VIC
Commonwealth Land - [60112]	TAS
Commonwealth Land - [60114]	TAS
Commonwealth Land - [60115]	TAS
Commonwealth Land - [60111]	TAS
Commonwealth Land - [22391]	VIC
Commonwealth Land - [21509]	VIC

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Cape Northumberland Lighthouse	SA	Listed place
Cape Sorell Lighthouse	TAS	Listed place
Cape Wickham Lighthouse	TAS	Listed place
Fort Queenscliff	VIC	Listed place
Gabo Island Lighthouse	VIC	Listed place
HMAS Cerberus Central Area Group	VIC	Listed place
Montague Island Lighthouse	NSW	Listed place
Sorrento Post Office	VIC	Listed place
Swan Island Defence Precinct	VIC	Listed place
Wilsons Promontory Lighthouse	VIC	Listed place
Natural		
HMAS Cerberus Marine and Coastal Area	VIC	Listed place
Point Wilson Defence Natural Area	VIC	Listed place
Swan Island and Naval Waters	VIC	Listed place

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		

Scientific Name	Threatened Category	Presence Text
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Breeding known to occur within area
Ardenna pacifica as Puffinus pacificus Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Ardenna tenuirostris as Puffinus tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area overfly marine area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni as Diomedea gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat may occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area
Gallinago stenura Pin-tailed Snipe [841]		Roosting known to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Roosting known to occur within area overfly marine area
Hydroprogne caspia as Sterna caspia Caspian Tern [808]		Breeding known to occur within area
Larus dominicanus Kelp Gull [809]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area overfly marine area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area
Morus capensis Cape Gannet [59569]		Breeding known to occur within area
Morus serrator Australasian Gannet [1020]		Breeding known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Breeding known to occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Onychoprion fuscatus as Sterna fuscata Sooty Tern [90682]		Breeding known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area
Pelecanoides urinatrix Common Diving-Petrel [1018]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area overfly marine area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area overfly marine area
Pterodroma cervicalis White-necked Petrel [59642]		Breeding likely to occur within area
Pterodroma macroptera Great-winged Petrel [1035]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Breeding known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area overfly marine area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Stercorarius antarcticus as Catharacta skua		
Brown Skua [85039]		Species or species habitat may occur within area
Sterna striata		
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons as Sterna albifrons		
Little Tern [82849]		Breeding known to occur within area
Sternula nereis as Sterna nereis		
Fairy Tern [82949]		Breeding known to occur within area
Stiltia isabella		
Australian Pratincole [818]		Species or species habitat known to occur within area overfly marine area
Symposiachrus trivirgatus as Monarcha trivirgatus		
Spectacled Monarch [83946]		Species or species habitat known to occur within area overfly marine area
Thalassarche bulleri		
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov.		
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri		
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta		
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area overfly marine area
Tringa incana as Heteroscelus incanus Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area
Xenus cinereus Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area overfly marine area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Acentronura tentaculata Shortpouch Pygmy Pipehorse [66187]		Species or species habitat may occur within area
Campichthys tryoni Tryon's Pipefish [66193]		Species or species habitat may occur within area
Cosmocampus howensis Lord Howe Pipefish [66208]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus minotaur Bullneck Seahorse [66705]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Mitotichthys mollisoni Mollison's Pipefish [66260]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Vanacampus vercoi Verco's Pipefish [66286]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Breeding known to occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area
Mirounga leonina Southern Elephant Seal [26]	Vulnerable	Breeding may occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Reptile		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis		
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera edeni		
Bryde's Whale [35]		Species or species habitat likely to occur within area

Current Scientific Name	Status	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Hyperoodon planifrons Southern Bottlenose Whale [71]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Foraging, feeding or related behaviour known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Foraging, feeding or related behaviour known to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Critical Habitats [Resource Information]

Name	Type of Presence
Thalassarche cauta (Shy Albatross) - Albatross Island, The Mewstone, Pedra Branca	Listed Critical Habitat

Australian Marine Parks [Resource Information]

Park Name	Zone & IUCN Categories
Murray	Marine National Park Zone (IUCN II)
Apollo	Multiple Use Zone (IUCN VI)
Beagle	Multiple Use Zone (IUCN VI)
Boags	Multiple Use Zone (IUCN VI)
East Gippsland	Multiple Use Zone (IUCN VI)

Park Name	Zone & IUCN Categories
Franklin	Multiple Use Zone (IUCN VI)
Murray	Multiple Use Zone (IUCN VI)
Zeehan	Multiple Use Zone (IUCN VI)
Murray	Special Purpose Zone (IUCN VI)
Nelson	Special Purpose Zone (IUCN VI)
Zeehan	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves

[Resource Information]

Protected Area Name	Reserve Type	State
Aire River	Heritage River	VIC
Aire River W.R.	Natural Features Reserve	VIC
Aireys Inlet B.R.	Natural Features Reserve	VIC
Anglesea B.R.	Natural Features Reserve	VIC
Anser Island	Reference Area	VIC
Arthur-Pieman	Conservation Area	TAS
Arthurs Seat	State Park	VIC
Baawang	Reference Area	VIC
Badger Box Creek	Nature Reserve	TAS
Badger River	Regional Reserve	TAS
Bald Hills B.R.	Natural Features Reserve	VIC
Balnarring G95 B.R.	Natural Features Reserve	VIC
Barham Paradise S.R.	Natural Features Reserve	VIC
Barwon Bluff	Marine Sanctuary	VIC

Protected Area Name	Reserve Type	State
Bass River SS.R.	Natural Features Reserve	VIC
Batemans	Marine Park	NSW
Bats Ridge W.R	Nature Conservation Reserve	VIC
Bay of Islands Coastal Park	Conservation Park	VIC
Beachport	Conservation Park	SA
Bellarine I109 B.R.	Natural Features Reserve	VIC
Bellarine I110 B.R.	Natural Features Reserve	VIC
Bemm, Goolengook, Arte and Errinundra Rivers	Heritage River	VIC
Ben Boyd	National Park	NSW
Benedore River	Reference Area	VIC
Beware Reef	Marine Sanctuary	VIC
Black Pyramid Rock	Nature Reserve	TAS
Bolwarra H43 B.R.	Natural Features Reserve	VIC
Bolwarra H44 B.R.	Natural Features Reserve	VIC
Bolwarra H45 B.R.	Natural Features Reserve	VIC
Bournda	National Park	NSW
Breamlea F.F.R.	Nature Conservation Reserve	VIC
Brodribb River F.F.R	Nature Conservation Reserve	VIC
Buckley N.C.R.	Natural Features Reserve	VIC
Bucks Lake	Game Reserve	SA
Bunurong	Marine National Park	VIC
Bunurong Marine Park	National Parks Act Schedule 4 park or reserve	VIC

Protected Area Name	Reserve Type	State
Cabbage Tree Creek F.R	Nature Conservation Reserve	VIC
Canunda	National Park	SA
Cape Conran Coastal Park	Conservation Park	VIC
Cape Howe	Wilderness Zone	VIC
Cape Howe	Marine National Park	VIC
Cape Liptrap Coastal Park	Conservation Park	VIC
Cape Nelson	State Park	VIC
Cape Patterson N.C.R	Natural Features Reserve	VIC
Cape Sorell	Historic Site	TAS
Cape Wickham	State Reserve	TAS
Cape Wickham	Conservation Area	TAS
Carpenter Rocks	Conservation Park	SA
Cataraqui Point	Conservation Area	TAS
Christmas Island	Nature Reserve	TAS
Churchill Island	Marine National Park	VIC
City of Melbourne Bay	Conservation Area	TAS
Colliers Forest Reserve	Conservation Covenant	TAS
Colliers Swamp	Conservation Area	TAS
Cone Islet	Conservation Area	TAS
Conewarre K47 SS.R.	Natural Features Reserve	VIC
Conewarre K48 SS.R.	Natural Features Reserve	VIC
Corner Inlet	Marine National Park	VIC
Corner Inlet Marine and Coastal Park	National Parks Act Schedule 4 park or reserve	VIC
Councillor Island	Nature Reserve	TAS

Protected Area Name	Reserve Type	State
Counsel Hill	Conservation Area	TAS
Crib Point G228 B.R.	Natural Features Reserve	VIC
Crib Point G229 B.R.	Natural Features Reserve	VIC
Croajingolong	National Park	VIC
Currie Lightkeepers Residence	Historic Site	TAS
Curtis Island	Nature Reserve	TAS
Deen Maar	Indigenous Protected Area	VIC
Devils Tower	Nature Reserve	TAS
Dingley Dell	Conservation Park	SA
Disappointment Bay	State Reserve	TAS
Discovery Bay	Marine National Park	VIC
Discovery Bay Coastal Park	Conservation Park	VIC
Double Creek	Natural Catchment Area	VIC
Douglas Point	Conservation Park	SA
Drakes B.R.	Natural Features Reserve	VIC
Dromana B.R.	Natural Features Reserve	VIC
Drumdlemara H1 B.R	Natural Features Reserve	VIC
Drumdlemara H2 B.R	Natural Features Reserve	VIC
Drumdlemara H4 B.R	Natural Features Reserve	VIC
Dry Creek	Forest Reserve	SA
Eagle Rock	Marine Sanctuary	VIC
East Gippsland Coastal streams	Natural Catchment Area	VIC
East Moncoeur Island	Conservation Area	TAS

Protected Area Name	Reserve Type	State
Edna Bowman N.C.R.	Natural Features Reserve	VIC
Eldorado	Conservation Area	TAS
Entrance Point	Reference Area	VIC
Eurobodalla	National Park	NSW
Ewens Ponds	Conservation Park	SA
Ewing Morass W.R	Natural Features Reserve	VIC
Fingal B.R	Natural Features Reserve	VIC
First and Second Islands F.R.	Nature Conservation Reserve	VIC
Flinders G234 B.R.	Natural Features Reserve	VIC
Flinders N.F.R.	Natural Features Reserve	VIC
Four Mile Beach	Regional Reserve	TAS
French Island	National Park	VIC
French Island	Marine National Park	VIC
French Island (north)	Reference Area	VIC
French Island G230 B.R	Natural Features Reserve	VIC
Gentle Annie	Conservation Area	TAS
Gippsland Lakes Coastal Park	Conservation Park	VIC
Glenelg River	Heritage River	VIC
Goose Lagoon W.R	Natural Features Reserve	VIC
Gorae B.R.	Natural Features Reserve	VIC
Great Otway	National Park	VIC
Hedditch Hill S.R.	Natural Features Reserve	VIC
Hogan Group	Conservation Area	TAS

Protected Area Name	Reserve Type	State
Johanna Falls S.R.	Natural Features Reserve	VIC
Johnstones Creek F.R	Nature Conservation Reserve	VIC
Kangerong N.C.R	Natural Features Reserve	VIC
Kentbruck H14 B.R	Natural Features Reserve	VIC
Kentbruck H50 B.R.	Natural Features Reserve	VIC
Kent Group	National Park	TAS
Kilcunda N.C.R.	Natural Features Reserve	VIC
Lady Julia Percy Island W.R.	Nature Conservation Reserve	VIC
Lake Aringa W.R	Nature Conservation Reserve	VIC
Lake Connewarre W.R	Natural Features Reserve	VIC
Lake Corringle W.R	Natural Features Reserve	VIC
Lake Curlip W.R.	Natural Features Reserve	VIC
Lake Frome	Conservation Park	SA
Lake Gillear W.R	Natural Features Reserve	VIC
Lake Robe	Game Reserve	SA
Lake St Clair	Conservation Park	SA
Lake Tyers S.P.	State Park	VIC
Latrobe B.R.	Natural Features Reserve	VIC
Lavinia	State Reserve	TAS
Lawrence Rocks W.R.	Nature Conservation Reserve	VIC
Leongatha H3 B.R.	Natural Features Reserve	VIC

Protected Area Name	Reserve Type	State
Lily Pond B.R.	Natural Features Reserve	VIC
Little Dip	Conservation Park	SA
Lonsdale Lakes W.R	Nature Conservation Reserve	VIC
Lower Glenelg	National Park	VIC
Lower Glenelg River	Conservation Park	SA
Lower South East	Marine Park	SA
Main Ridge N.C.R.	Natural Features Reserve	VIC
Mallacoota B.R.	Natural Features Reserve	VIC
Marengo N.C.R.	Nature Conservation Reserve	VIC
Marengo Reefs	Marine Sanctuary	VIC
Merri	Marine Sanctuary	VIC
Merricks Creek B.R.	Natural Features Reserve	VIC
Millwood Road	Conservation Covenant	TAS
Mimosa Rocks	National Park	NSW
Montague Island	Nature Reserve	NSW
Mornington Peninsula	National Park	VIC
Mortimers Paddock B.R.	Natural Features Reserve	VIC
Mount Heemskirk	Regional Reserve	TAS
Mount Richmond	National Park	VIC
Mount Vereker Creek	Natural Catchment Area	VIC
Mouzie B.R	Natural Features Reserve	VIC
Mouzie N.F.R	Natural Features Reserve	VIC
Muddy Lagoon	Nature Reserve	TAS

Protected Area Name	Reserve Type	State
Mumbulla	Flora Reserve	NSW
Mushroom Reef	Marine Sanctuary	VIC
Nadgee	Nature Reserve	NSW
Narrawong F.R.	Nature Conservation Reserve	VIC
Nelson SS.R.	Natural Features Reserve	VIC
Nene Valley	Conservation Park	SA
New Year Island	Game Reserve	TAS
Nooramunga Marine & Coastal Park	National Parks Act Schedule 4 park or reserve	VIC
North East Islet	Nature Reserve	TAS
North Western Port N.C.R.	Natural Features Reserve	VIC
Ocean Beach	Conservation Area	TAS
Painkalac Creek	Reference Area	VIC
Parker River	Reference Area	VIC
Pegarah	Private Nature Reserve	TAS
Pegarah Forest	Conservation Covenant	TAS
Pegarah Rd King Island	Conservation Covenant	TAS
Penguin Island	Conservation Park	SA
Phillip Island Nature Park	Other	VIC
Piccaninnie Ponds	Conservation Park	SA
Pieman River	State Reserve	TAS
Point Addis	Marine National Park	VIC
Point Danger	Marine Sanctuary	VIC
Point Hicks	Marine National Park	VIC
Point Nepean	National Park	VIC
Porky Beach	Conservation Area	TAS

Protected Area Name	Reserve Type	State
Portarlington (Point Richard) F.F.R.	Nature Conservation Reserve	VIC
Port Campbell	National Park	VIC
Portland H46 B.R.	Natural Features Reserve	VIC
Portland H47 B.R.	Natural Features Reserve	VIC
Port Phillip Heads	Marine National Park	VIC
Princetown W.R	Natural Features Reserve	VIC
Queenscliff N.F.R	Natural Features Reserve	VIC
Rame Head	Remote and Natural Area - Schedule 6, National Parks Act	VIC
Red Hut Point	Conservation Area	TAS
Red Hut Road #1	Conservation Covenant	TAS
Red Hut Road #2	Conservation Covenant	TAS
Reef Island and Bass River Mouth N.C.R	Natural Features Reserve	VIC
Reid Rocks	Nature Reserve	TAS
Rivoli Bay	Rock Lobster Sanctuary	SA
Rodondo Island	Nature Reserve	TAS
Rosebud B.R.	Natural Features Reserve	VIC
Salt Lagoon, St Leonards W.R	Nature Conservation Reserve	VIC
Sandpatch	Wilderness Zone	VIC
Screw Creek N.C.R.	Natural Features Reserve	VIC
Sea Elephant	Conservation Area	TAS
Sea Elephant River	Conservation Covenant	TAS
Seal Creek	Reference Area	VIC

Protected Area Name	Reserve Type	State
Seal Islands W.R.	Nature Conservation Reserve	VIC
Seal Rocks	State Reserve	TAS
Seal Rocks	Conservation Area	TAS
Shallow Inlet Marine and Coastal Park	National Parks Act Schedule 4 park or reserve	VIC
Snowy River	Heritage River	VIC
Southern Wilsons Promontory	Remote and Natural Area - Schedule 6, National Parks Act	VIC
South Rd Nugara	Conservation Covenant	TAS
Southwest	National Park	TAS
Southwest	Conservation Area	TAS
Stokes Point	Conservation Area	TAS
Stony Creek (Otways)	Reference Area	VIC
Sugarloaf Rock	Conservation Area	TAS
Swan Bay - Edwards Point W.R	Nature Conservation Reserve	VIC
Tathams Lagoon	Conservation Area	TAS
The Arches	Marine Sanctuary	VIC
Tikkawoppa Plateau	Regional Reserve	TAS
Tower Hill W.R	Natural Features Reserve	VIC
Trewalla H48 B.R.	Natural Features Reserve	VIC
Trewalla H49 B.R.	Natural Features Reserve	VIC
Trial Harbour	State Reserve	TAS
Tully River	Conservation Area	TAS
Twelve Apostles	Marine National Park	VIC
Tyrendarra F.R	Nature Conservation Reserve	VIC

Protected Area Name	Reserve Type	State
Unnamed (No.HA1038)	Heritage Agreement	SA
Unnamed (No.HA1166)	Heritage Agreement	SA
Unnamed (No.HA1361)	Heritage Agreement	SA
Unnamed (No.HA1404)	Heritage Agreement	SA
Unnamed (No.HA1457)	Heritage Agreement	SA
Unnamed (No.HA1560)	Heritage Agreement	SA
Unnamed (No.HA1626)	Heritage Agreement	SA
Unnamed (No.HA177)	Heritage Agreement	SA
Unnamed (No.HA197)	Heritage Agreement	SA
Unnamed (No.HA245)	Heritage Agreement	SA
Unnamed (No.HA26)	Heritage Agreement	SA
Unnamed (No.HA42)	Heritage Agreement	SA
Unnamed (No.HA497)	Heritage Agreement	SA
Unnamed C0293	Private Nature Reserve	VIC
Unnamed P0176	Private Nature Reserve	VIC
Upper South East	Marine Park	SA
Ventnor B.R.	Natural Features Reserve	VIC
Vereker Creek	Reference Area	VIC
Waratah B.R	Natural Features Reserve	VIC
Welshpool H17 B.R	Natural Features Reserve	VIC
West Moncoeur Island	Nature Reserve	TAS
Wicks Road Nugara	Conservation Covenant	TAS
Wild Dog B.R.	Natural Features Reserve	VIC
Wild Dog Creek SS.R.	Natural Features Reserve	VIC
William Hunter F.R	Nature Conservation Reserve	VIC

Protected Area Name	Reserve Type	State
Wilsons Promontory	Wilderness Zone	VIC
Wilsons Promontory	National Park	VIC
Wilsons Promontory	Marine National Park	VIC
Wilsons Promontory Islands	Remote and Natural Area - Schedule 6, National Parks Act	VIC
Wilsons Promontory Marine Park	National Parks Act Schedule 4 park or reserve	VIC
Wilsons Promontory Marine Reserve	National Parks Act Schedule 4 park or reserve	VIC
Wongarra B.R.	Natural Features Reserve	VIC
Wonthaggi G237 B.R.	Natural Features Reserve	VIC
Wonthaggi G238 B.R.	Natural Features Reserve	VIC
Wonthaggi G239 B.R.	Natural Features Reserve	VIC
Wonthaggi G240 B.R.	Natural Features Reserve	VIC
Wonthaggi G241 B.R.	Natural Features Reserve	VIC
Wonthaggi Heathlands N.C.R	Natural Features Reserve	VIC
Yambacoona	Conservation Covenant	TAS
Yambuk F.F.R.	Nature Conservation Reserve	VIC
Yambuk Wetlands N.C.R.	Natural Features Reserve	VIC
Yanakie F.R	Nature Conservation Reserve	VIC
Yaringa	Marine National Park	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State
East Gippsland RFA	Victoria
Eden RFA	New South Wales
Gippsland RFA	Victoria
Southern RFA	New South Wales
Tasmania RFA	Tasmania
West Victoria RFA	Victoria

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Aire River	VIC
Anderson Inlet	VIC
Benedore River	VIC
Bondi Lake	NSW
Bungaree Lagoon	TAS
Corner Inlet	VIC
Ewens Ponds	SA
Ewing's Marsh (Morass)	VIC
Glenelg Estuary	VIC
Glenelg River	VIC
Lake Bunga	VIC
Lake Connewarre State Wildlife Reserve	VIC
Lake Flannigan	TAS
Lake Frome & Mullins Swamp	SA
Lake King Wetlands	VIC
Lake Tyers	VIC

Wetland Name	State
Lavinia Nature Reserve	TAS
Long Swamp	VIC
Lower Aire River Wetlands	VIC
Lower Merri River Wetlands	VIC
Lower Snowy River Wetlands System	VIC
Mallacoota Inlet Wetlands	VIC
Mud Islands	VIC
Nadgee Lake and tributary wetlands	NSW
Nargal Lake	NSW
Pearshape Lagoon 1	TAS
Pearshape Lagoon 2	TAS
Pearshape Lagoon 3	TAS
Pearshape Lagoon 4	TAS
Piccaninnie Ponds	SA
Powlett River Mouth	VIC
Princetown Wetlands	VIC
Shallow Inlet Marine & Coastal Park	VIC
Snowy River	VIC
South East Coastal Salt Lakes	SA
Swan Bay & Swan Island	VIC
Sydenham Inlet Wetlands	VIC
Tamboon Inlet Wetlands	VIC
Thurra River	VIC
Tower Hill	VIC
Wallaga Lake	NSW
Wallagoot Lagoon (Wallagoot Lake)	NSW
Werribee-Avalon Area	VIC

Wetland Name	State
Western Port	VIC
Yambuk Wetlands	VIC

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Apollo Bay to Skenes Creek Coastal Trail	2022/09274		Assessment
Barwon Heads Road Reserve Road to Lower Duneed Road Upgrade Project	2023/09724		Completed
Blue Marlin Offshore Wind Energy Project	2023/09532		Referral Decision
Cape Winds Offshore Windfarm Geophysical, Geotechnical and Marine Studies	2023/09629		Referral Decision
Dolphin Tungsten Mine Grassy King Island	2023/09653		Referral Decision
Gelliondale Wind Farm Project	2023/09577		Assessment
Gippsland Offshore Wind Farm Marine Survey Investigations	2023/09682		Referral Decision
Greater Gippsland Offshore Wind Project	2022/09379		Assessment
Greater Gippsland Offshore Wind Project Initial Marine Field Investigations	2022/09374		Completed
Marine Farming Expansion, Macquarie Harbour, TAS	2012/6406		Assessment
Nora Creina integrated golf course and tourism development, SA	2014/7249		Assessment
Offshore Tidal Energy Facility and Submarine Cable	2008/4480		Completed
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed
South East Australia Carbon Capture and Storage Project, Commonwealth waters	2023/09732		Referral Decision
Southern Winds Offshore Wind Project	2022/09435		Assessment

Title of referral	Reference	Referral Outcome	Assessment Status
Southern Winds Offshore Wind Project Initial Marine Field Investigations	2022/09436		Completed
Spinifex Offshore Surveys	2022/09359		Completed
Victorian Renewable Energy Terminal	2023/09609		Referral Decision
Controlled action			
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval
Bald Hills Wind Farm 80 Turbines	2002/730	Controlled Action	Post-Approval
Basalt Quarry Extension (Mountainview Quarry)	2004/1329	Controlled Action	Completed
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval
City Of Greater Geelong Mosquito Control Program 2021-2030, Vic	2020/8782	Controlled Action	Further Information Request
Construction of a factory for the production of ACV's	2007/3842	Controlled Action	Completed
Crib Point to Pakenham Gas Pipeline, Vic	2018/8297	Controlled Action	Completed
DPIPWE - Arthur-Pieman Conservation Area - off-road vehicle mitigation actions	2017/8038	Controlled Action	Completed
Establishment of plantation for use of effluent water	2003/1063	Controlled Action	Completed
Extension of Mountain View basalt quarry by 490 hectares (Stage 2)	2004/1590	Controlled Action	Post-Approval
Gas Import Facility, Crib Point, Vic	2018/8298	Controlled Action	Completed
Gippsland Regional Port Project	2020/8667	Controlled Action	Assessment Approach
Glenelg Dolomite Quarry	2017/8021	Controlled Action	Post-Approval
Green Point Wind Farm	2001/529	Controlled Action	Post-Approval
Heemskirk Windfarm Development	2002/678	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Installation of replacement crude-condensate pipeline, Vic	2014/7202	Controlled Action	Post-Approval
Kentbruck Green Power Hub, Vic	2019/8510	Controlled Action	Assessment Approach
Lonsdale Golf Club Redevelopment	2003/969	Controlled Action	Post-Approval
Lorne Golf Course redevelopment	2004/1513	Controlled Action	Post-Approval
Mosquito Control	2005/2132	Controlled Action	Post-Approval
Otway Development	2002/621	Controlled Action	Post-Approval
Pacific Hydro (Portland) Wind Farm SW Victoria	2000/18	Controlled Action	Post-Approval
Pelican Point residential subdivision	2006/2529	Controlled Action	Completed
Port Phillip Bay Channel Deepening	2002/576	Controlled Action	Post-Approval
Redevelopment of post office and construction of dwellings	2007/3639	Controlled Action	Completed
Residential and Golf Course Development Project	2003/1144	Controlled Action	Post-Approval
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
Star of the South Offshore Wind Farm Project	2020/8650	Controlled Action	Guidelines Issued
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval
Upgrade and expansion of existing Yaringa Boat Harbour	2011/6014	Controlled Action	Post-Approval
VIC Offshore Windfarm	2021/8966	Controlled Action	Assessment Approach
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Victorian Desalination Project, Bass Coast	2008/3948	Controlled Action	Post-Approval
Viva Energy Gas Terminal Project	2020/8838	Controlled Action	Assessment Approach
Windfarm	2003/1109	Controlled Action	Completed
Wind Turbines	2001/439	Controlled Action	Completed
Yolla Gas Field (TRL1) Development	2001/321	Controlled Action	Post-Approval
Not controlled action			
2004/2005 drilling program for exploration and production (VIC 01-06, 09-11, 16, 18 & 19 and VIC/RL	2003/1282	Not Controlled Action	Completed
2D seismic survey, Petroleum Exploration Permit Area T/36P	2004/1787	Not Controlled Action	Completed
2D seismic Survey in VIC/P55, VIC/RL2 and VIC/P41	2004/1876	Not Controlled Action	Completed
accomodation units and associatedadministration and recreational facilities	2001/430	Not Controlled Action	Completed
Acquistion of 2D seismic data in State Waters adjacent to Ninety Mile Beach-VIC/P39(V)	2004/1889	Not Controlled Action	Completed
Airey Inlet water reclamation plant to Anglesea sewerage system	2006/2539	Not Controlled Action	Completed
Allendale wind farm	2007/3549	Not Controlled Action	Completed
Alteration of Grass Maintenance Regime within Powling St Wetlands	2012/6527	Not Controlled Action	Completed
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed
Angas and Galloway Exploration Wells VIC/P39(v)	2005/2330	Not Controlled Action	Completed
Anglesea Mine South Wall Vegetation removal, Anglesea, Vic	2017/8060	Not Controlled Action	Completed
Apollo Bay Water Storage Basin, VIC	2012/6484	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Aquacullture facility for rainbow trout and yabbies and recreational facilities	2002/822	Not Controlled Action	Completed
Barwon Heads Rd gas pipeline installation	2006/2769	Not Controlled Action	Completed
Barwon Heads Stormwater Outfall upgrade, Victoria	2016/7650	Not Controlled Action	Completed
Basker-Manta-Gummy Oil Development	2011/6052	Not Controlled Action	Completed
Basker-Manta-Gummy Oil Field Development	2007/3402	Not Controlled Action	Completed
Basker-Manta Oil Field Development	2005/2026	Not Controlled Action	Completed
Beardie-1 Field wildcat oil well	2001/505	Not Controlled Action	Completed
Biodiversity Impacts Audit	2011/6191	Not Controlled Action	Completed
Bluff Heights Estate Stages 2 to 4	2003/1047	Not Controlled Action	Completed
Boneo Park Equestrian Centre	2008/4639	Not Controlled Action	Completed
Capture of Juvenile Tasmanian Devils for Conservation Purposes	2007/3261	Not Controlled Action	Completed
Capture of Tasmanian Devils from Disease-Free Areas	2007/3883	Not Controlled Action	Completed
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed
Communications tower extension	2003/1099	Not Controlled Action	Completed
Construct a Recycled Water Pipeline from Somers Treatment Plant to Blue Scope S	2009/4982	Not Controlled Action	Completed
Construction and operation of Barwon Water biosolids treatment facility	2008/4345	Not Controlled Action	Completed
Construction of a flexi mat boat ramp	2011/5838	Not Controlled Action	Completed
Construction of an ocean access boat ramp at Bastion Point	2004/1407	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Construction of Barwon Heads Bridge	2005/2375	Not Controlled Action	Completed
Construction of Infrastructure to Extract, Treat & Transfer Groundwater to Wurde	2008/4104	Not Controlled Action	Completed
Construction of Overtaking Lanes on Great Ocean Rd	2008/4044	Not Controlled Action	Completed
construction of pump station for pump diversion from the Barham River	2003/1242	Not Controlled Action	Completed
Construction of the Edgars Road Extension, from Childs Road, Lalor to Cooper Street, Epping	2003/1135	Not Controlled Action	Completed
Cowes Primary School Gymnasium	2020/8683	Not Controlled Action	Completed
Cunninghame Arm Redevelopment (Stage 3)	2002/618	Not Controlled Action	Completed
Development of Kipper gas field within Vic/L3, Vic/L4 Vic/RL2	2005/2484	Not Controlled Action	Completed
Development of Pt Nepean Quarantine Station (former) National Centre for Coasts and Climate	2008/4653	Not Controlled Action	Completed
development of retirement resort	2004/1828	Not Controlled Action	Completed
Development of Turrum Oil Field and associated infrastructure	2003/1204	Not Controlled Action	Completed
Divestment of Norris Barracks	2003/963	Not Controlled Action	Completed
Dredging of Tuross Lake channel and depositon of spoil in lake	2004/1554	Not Controlled Action	Completed
Drilling and side track completion at Baleen gas production well in Production Licence area VIC/L21	2004/1535	Not Controlled Action	Completed
Drilling of 'Culverin' oil exploration well, permit VIC/P56	2005/2279	Not Controlled Action	Completed
Drilling of Callister-1 exploration well in VIC/P51	2004/1633	Not Controlled Action	Completed
Drilling of Scallop-1 Exploration Well	2003/917	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
East Pilchard exploration well	2001/137	Not Controlled Action	Completed
Eight Mile Creek Drainage Works, Peacocks Road, Eight Mile Creek, SA	2014/7170	Not Controlled Action	Completed
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed
Establishment of a 6 turbine windfarm near Wonthaggi	2002/820	Not Controlled Action	Completed
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed
Exploration Drilling Well Trefoil-1	2003/1058	Not Controlled Action	Completed
Extension of Mountain View basalt quarry by 113 hectares (stage one)	2004/1591	Not Controlled Action	Completed
Fabrication and Spooling of Pipe Strings at Crib Point	2008/4127	Not Controlled Action	Completed
Ferry Service Infrastructure Development	2001/269	Not Controlled Action	Completed
Flinders Backlog Sewer Project	2005/2275	Not Controlled Action	Completed
Gas Field Development	2006/2635	Not Controlled Action	Completed
Gas Fields Development	2011/5879	Not Controlled Action	Completed
Gas Pipeline Installation	2005/2495	Not Controlled Action	Completed
Gippsland Basin Seismic Programme	2004/1866	Not Controlled Action	Completed
Gleneig Spiny Crayfish Habitat Rehabilitation	2011/6164	Not Controlled Action	Completed
Golflinks Road Residential Development & Water Storage Facility at Barwon Heads	2004/1793	Not Controlled Action	Completed
Grevillea infecunda tip cuttings and soil samples	2005/1979	Not Controlled Action	Completed
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Hemingway1/Oil Exploration	2001/177	Not Controlled Action	Completed
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed
Huxley Hill Wind Farm expansion	2005/2499	Not Controlled Action	Completed
Huxley Hill Wind Farm Expansion	2002/570	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Installation of a 35 metre telecommunications facility at Jirrahlinga Animal San	2003/1151	Not Controlled Action	Completed
Installation of optic fibre cable from Inverloch, Victoria to Stanley, Tasmania	2002/906	Not Controlled Action	Completed
Kelly Swamp Boardwalk Construction	2010/5371	Not Controlled Action	Completed
Kipper Tuna Turrum Project Maintenance Dredging	2010/5430	Not Controlled Action	Completed
Kongorong Wind Farm	2002/568	Not Controlled Action	Completed
Longtom-3 Gas Appraisal Well, VIC/P54	2005/2494	Not Controlled Action	Completed
Longtom Gas Pipeline Development, VIC/P54	2006/3072	Not Controlled Action	Completed
Lot 5 Pelican Point Road, Pelican Point SA - Proposed New Dwelling	2021/9011	Not Controlled Action	Completed
Maintenance and priority works to heritage buildings at Point Nepean Quarantine	2006/3151	Not Controlled Action	Completed
Maintenance dredging of Yaringa Channel	2004/1360	Not Controlled Action	Completed
Maintenance Dredging South Channel 2012	2011/6198	Not Controlled Action	Completed
Maintenance of Access Track and Weed Removal	2009/4973	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Maintenance works at Barwon Heads Bridge	2003/1199	Not Controlled Action	Completed
Marine and Freshwater Resources Institute (MAFRI) Facility	2000/121	Not Controlled Action	Completed
Marlin-Snapper Gas Pipeline Project	2006/3197	Not Controlled Action	Completed
Melville 1 Oil Exploration Well	2001/167	Not Controlled Action	Completed
Merricks Beach Backlog Sewer Project	2010/5300	Not Controlled Action	Completed
Millwood Road Gravel Quarry	2002/602	Not Controlled Action	Completed
Milton/Ulladulla Sewerage Scheme	2001/251	Not Controlled Action	Completed
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed
Newfield wind farm	2007/3226	Not Controlled Action	Completed
Newhaven Yacht Squadron marina extension	2004/1450	Not Controlled Action	Completed
New Water Infrastructure Upgrade, Grassy Dam, King Island	2013/6882	Not Controlled Action	Completed
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed
Northright-1 Exploration Well	2001/209	Not Controlled Action	Completed
Ocean Grove rising main 2 upgrade	2009/4978	Not Controlled Action	Completed
Ocean Grove Rising Main 2 Upgrade (OGRM2) - East Section & River Crossing	2010/5508	Not Controlled Action	Completed
Oceanlinx South Australia 1mW Greenwave Project	2012/6528	Not Controlled Action	Completed
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed
Offshore Petroleum Exploration	2001/289	Not Controlled Action	Completed
Offshore Seismic Survey	2001/498	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Optic fibre cable installation - San Remo to Cowes	2005/2386	Not Controlled Action	Completed
Piccaninnie Ponds flow path restoration project, SA	2013/6711	Not Controlled Action	Completed
Pipeline easement regrowth removal	2011/5817	Not Controlled Action	Completed
Point Nepean Quarantine Station (former)/Restoration of Medical Superintendent's	2006/3149	Not Controlled Action	Completed
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed
Portland Landfill Borehole Installation, Vic	2017/7886	Not Controlled Action	Completed
Port Phillip Channel Deepening Project - Trial Dredge Program	2005/2164	Not Controlled Action	Completed
Port Welshpool Harbour Dredging	2007/3521	Not Controlled Action	Completed
Proposed replacement of existing road culvert	2013/7077	Not Controlled Action	Completed
Queenscliff Harbour Redevelopment	2004/1352	Not Controlled Action	Completed
Railway Bridge (H0151) Partial Demolition, Merri River	2010/5534	Not Controlled Action	Completed
Redevelopment Project to Upgrade and Extend the Portland Trawler Wharf	2008/4317	Not Controlled Action	Completed
Rehabilitation of Lake Connewarre State Game Reserve	2002/708	Not Controlled Action	Completed
Remedial Works to the Swan Island Bridge	2003/1129	Not Controlled Action	Completed
Remote power generation project	2005/2287	Not Controlled Action	Completed
Replacement of sewer pipelines	2002/623	Not Controlled Action	Completed
Residential/Resort/Golf Course development	2002/907	Not Controlled Action	Completed
Residential Development, 409 The Esplanade, St Leonards	2006/2950	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Residential Dwelling	2004/1896	Not Controlled Action	Completed
Robe Golf Club - Golf Course Extension, SA	2017/7928	Not Controlled Action	Completed
Robe Golf Course, Allotment 2, Davenport Street, Robe, SA	2014/7178	Not Controlled Action	Completed
Ryan Corner Wind Farm	2005/2142	Not Controlled Action	Completed
Ship to ship crude oil lightering	2008/4279	Not Controlled Action	Completed
Ship to Ship Crude Oil Lightering	2001/271	Not Controlled Action	Completed
Sole-2 appraisal gas well, VIC/RL3	2002/636	Not Controlled Action	Completed
Sole gas field development	2003/937	Not Controlled Action	Completed
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed
St Quentin Consulting Pty Ltd /Residential development/305 Great Ocean Road, Jan Juc/VIC/Development	2014/7184	Not Controlled Action	Completed
Telstra optic fibre cable across Bass Strait - Sub bottom profiler Surve	2002/779	Not Controlled Action	Completed
To construct a shared trail within the Arthurs Seat Road, road reserve south side from Mornington Fl	2004/1565	Not Controlled Action	Completed
Torquay Sewerage Strategy - pipe replacement between Torquay and the Black Rock	2004/1704	Not Controlled Action	Completed
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed
Transfer of 90ha Point Nepean Quarantine Station from Commonwealth to Victorian	2008/4521	Not Controlled Action	Completed
Turrum Phase 2 Development Project	2008/4191	Not Controlled Action	Completed
Upgrade and Repairs to Flinders Pier	2008/4331	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Upgrade of existing access track	2011/5933	Not Controlled Action	Completed
Venus Bay Outfall Extension	2004/1555	Not Controlled Action	Completed
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed
Victorian Generator Project	2005/1984	Not Controlled Action	Completed
Wastewater Treatment System Upgrade	2004/1420	Not Controlled Action	Completed
West Triton Drilling Program - Gippsland Basin	2007/3915	Not Controlled Action	Completed
West Triton Drilling Program - Otway Basin	2007/3909	Not Controlled Action	Completed
Wind Farm	2002/691	Not Controlled Action	Completed
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed
Not controlled action (particular manner)			
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey, EPP33	2004/1794	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey in Permit Areas T/32P and T/33P	2002/845	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2008/4131	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2008/3962	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2008/4066	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey, Petroleum Exploration Permit Area EPP27	2006/2776	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey in the Sole gas field and adjacent acreage in the Gippsland Basin (VIC RL/3 & VIC/	2002/871	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey in VIC/P50 and VIC/P46	2004/1810	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey Permit Area VIC/P49	2006/2943	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey Program in Bass Strait	2008/4040	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey VIC/P50	2005/2313	Not Controlled Action (Particular Manner)	Post-Approval
2D Siesmic Marine Survey	2008/4074	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey within Torquay Sub-basin off sthn Victoria	2012/6256	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
3D Seismic Survey	2008/4528	Not Controlled Action (Particular Manner)	Post-Approval
Apache 3D seismic exploration survey	2006/3146	Not Controlled Action (Particular Manner)	Post-Approval
Aroo Chappell 3D seismic survey	2010/5701	Not Controlled Action (Particular Manner)	Post-Approval
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval
Barwon Heads Rising Main No.11 Sewerage Pipe Upgrade	2008/4091	Not Controlled Action (Particular Manner)	Post-Approval
Bass Basin 2D and 3D seismic surveys (T/38P & T/37P)	2007/3650	Not Controlled Action (Particular Manner)	Post-Approval
Benbows Paddock residential development, Cape Bridgewater	2007/3247	Not Controlled Action (Particular Manner)	Post-Approval
Bernoulli 3D Seismic Survey	2006/3053	Not Controlled Action (Particular Manner)	Post-Approval
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval
Bitumen Storage Facility	2007/3676	Not Controlled Action (Particular Manner)	Post-Approval
Bream 3D seismic survey	2006/2556	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
construction of a 14km , 33kV distribution line, including connection to the Lake Bonney Central win	2003/1108	Not Controlled Action (Particular Manner)	Post-Approval
Construction of bridge across Barwon River	2006/2947	Not Controlled Action (Particular Manner)	Post-Approval
Construction of wharf	2003/1050	Not Controlled Action (Particular Manner)	Post-Approval
Construct private dwelling	2008/4234	Not Controlled Action (Particular Manner)	Post-Approval
Construct single dwelling	2008/4504	Not Controlled Action (Particular Manner)	Post-Approval
Controlled Burn, Understorey Clearance and Removal of UXO	2003/1030	Not Controlled Action (Particular Manner)	Post-Approval
Corio Bay Channel Safety Adjustment Program	2011/6208	Not Controlled Action (Particular Manner)	Post-Approval
Dalrymple 3D Seismic Survey	2010/5680	Not Controlled Action (Particular Manner)	Post-Approval
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval
Drainage, Trenching & Cable Laying as Part of the Regional Fast Rail Project	2003/1133	Not Controlled Action (Particular Manner)	Post-Approval
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval
Eden Breakwater Wharf extension, NSW	2015/7582	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Eden Breakwater Wharf Extension, NSW	2016/7828	Not Controlled Action (Particular Manner)	Completed
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval
Exploration drilling of the Craigow-1 and Tolpuddle-1 wells	2010/5725	Not Controlled Action (Particular Manner)	Post-Approval
Fuelbreak construction	2009/4915	Not Controlled Action (Particular Manner)	Post-Approval
Gas Pipeline	2000/20	Not Controlled Action (Particular Manner)	Post-Approval
Geelong Bypass Section 3	2005/2099	Not Controlled Action (Particular Manner)	Post-Approval
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval
Gippsland 2D Marine Seismic Survey - VIC/P-63, VIC/P-64 and T/46P	2009/5241	Not Controlled Action (Particular Manner)	Post-Approval
Golden Beach gas field development	2003/1031	Not Controlled Action (Particular Manner)	Post-Approval
Granville Wind Farm, TAS	2012/6585	Not Controlled Action (Particular Manner)	Post-Approval
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
Inspection of project vessels for presence of invasive marine pests in Commonwealth waters off Victo	2012/6362	Not Controlled Action (Particular Manner)	Post-Approval
Labatt 3D Seismic Survey T/47P Bass Strait	2007/3759	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval
Lakes Entrance Sand Management Program Trial Dredging	2007/3852	Not Controlled Action (Particular Manner)	Post-Approval
Lakes Oil 3D Seismic Survey	2002/768	Not Controlled Action (Particular Manner)	Post-Approval
Longtom-5 Offshore Production Drilling (Vic/L29), VIC	2012/6498	Not Controlled Action (Particular Manner)	Post-Approval
Longtom South -1 Exploration Drilling	2011/6217	Not Controlled Action (Particular Manner)	Post-Approval
Luxury Cruise on the Gordon River, Tasmanian Wilderness PT 2	2006/3044	Not Controlled Action (Particular Manner)	Post-Approval
Luxury Cruise on the Gordon River, Tasmanian Wilderness WHA	2004/1846	Not Controlled Action (Particular Manner)	Post-Approval
Maintenance Dredging of Oceanic Sand	2011/5932	Not Controlled Action (Particular Manner)	Post-Approval
Maintenance Dredging Program	2009/4953	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Maintenance Dredging Program 2012-21 in Port of Melbourne	2012/6332	Not Controlled Action (Particular Manner)	Post-Approval
Non-exclusive 3-D Marine Seismic Survey, Bass Strait	2002/775	Not Controlled Action (Particular Manner)	Post-Approval
Northern Fields 3D Seismic Survey	2001/140	Not Controlled Action (Particular Manner)	Post-Approval
Origin Energy Silvereye-1 Exploration Drilling Programme	2010/5702	Not Controlled Action (Particular Manner)	Post-Approval
OTE10 2D Marine Seismic Survey	2009/5223	Not Controlled Action (Particular Manner)	Post-Approval
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval
Pelican 3D Marine Seismic Survey, Gippsland Basin, Vic	2017/8097	Not Controlled Action (Particular Manner)	Post-Approval
Point Wilson Explosives Area Waterside Infrastructure Remediation	2012/6376	Not Controlled Action (Particular Manner)	Post-Approval
Residential Development and Associated Infrastructure at Port Fairy	2012/6687	Not Controlled Action (Particular Manner)	Post-Approval
Rockhopper-1 and Trefoil-2 Exploration Drilling in Permit Area T/18P	2009/4776	Not Controlled Action (Particular Manner)	Post-Approval
Santos 2D Seismic Survey VIC/P44 & VIC/P51	2003/1213	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval
Seismic Exploration in Permit VIC/P41	2001/267	Not Controlled Action (Particular Manner)	Post-Approval
Seismic Survey	2001/206	Not Controlled Action (Particular Manner)	Post-Approval
Seismic survey, Gippsland Basin	2001/525	Not Controlled Action (Particular Manner)	Post-Approval
Seismic Survey in Petroleum Permit Area EPP27	2002/648	Not Controlled Action (Particular Manner)	Post-Approval
Seismic Survey VIC-P46	2002/826	Not Controlled Action (Particular Manner)	Post-Approval
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular Manner)	Post-Approval
Shaw River Power Station Project - Water Supply Pipeline	2009/5091	Not Controlled Action (Particular Manner)	Post-Approval
Shearwater 2D and 3D marine seismic survey	2005/2180	Not Controlled Action (Particular Manner)	Post-Approval
Silvereye 3D Seismic Survey	2007/3551	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Southern Flanks 2D Marine Seismic Survey	2010/5288	Not Controlled Action (Particular Manner)	Post-Approval
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval
Southern Margins 3D Seismic Survey VIC/P55	2007/3780	Not Controlled Action (Particular Manner)	Post-Approval
Southern Margins T/35P and T/36P 3D Seismic Surveys	2007/3817	Not Controlled Action (Particular Manner)	Post-Approval
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval
supersonic missile launch facility	2000/120	Not Controlled Action (Particular Manner)	Post-Approval
Surface Geochemical Exploration Program, TAS	2010/5780	Not Controlled Action (Particular Manner)	Post-Approval
Tap Oil Ltd Molson 2D Seismic Survey T47P	2008/3967	Not Controlled Action (Particular Manner)	Post-Approval
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Torquay Sub-basin (VIC/P62) OTE12-3D Seismic Survey	2012/6655	Not Controlled Action (Particular Manner)	Post-Approval
Tuskfish 3D Seismic Survey, Bass Strait	2002/864	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval
Vegetation clearance and residential subdivision near Mt Gambier	2004/1370	Not Controlled Action (Particular Manner)	Post-Approval
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval
West Seahorse Oil Development Project, Commonwealth waters offshore Victoria	2013/6973	Not Controlled Action (Particular Manner)	Post-Approval
Wolseley 3D seismic acquisition survey	2010/5703	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D & 3D Seismic Surveys - Permit Area - VIC/P50	2008/4517	Referral Decision	Completed
2D Seismic Survey	2008/3978	Referral Decision	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Referral decision			
3D Marine Seismic Survey	2011/6156	Referral Decision	Completed
3D Seismic Survey	2008/4014	Referral Decision	Completed
8 Lot Industrial Subdivision	2008/4527	Referral Decision	Completed
All actions taken in response to the current severe bushfires in Victoria.	2009/4787	Referral Decision	Completed
Alteration Reconstruction Restoration and Repairs to Buildings	2008/4179	Referral Decision	Completed
Beardie-1 Field wildcat oil well	2001/469	Referral Decision	Completed
Breeding program for Grey Nurse Sharks	2007/3245	Referral Decision	Completed
Darymple 3D Seismic Survey, Petroleum Exploration Permit T/41P	2010/5322	Referral Decision	Completed
Holloman 2010 Vic/P60 3D Seismic Acquisition Survey Program	2009/5251	Referral Decision	Completed
Longtom 5 Offshore Production Drilling (VIC/L29)	2012/6404	Referral Decision	Completed
Longtom-5 Offshore Production Drilling (Vic/L29)	2012/6413	Referral Decision	Completed
Portland Wave Energy Project	2008/3946	Referral Decision	Completed
Residential Development Elizabeth Avenue, Rosebud West, VIC	2015/7603	Referral Decision	Completed
Shark 3D Seismic Survey	2007/3294	Referral Decision	Completed
Stanton 3D Marine Seismic Survey	2013/6764	Referral Decision	Completed
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed
Upgrade of Corringle Road	2009/4825	Referral Decision	Completed
Upgrade of Services Infrastructure Point Nepean Quarantine Station	2008/4591	Referral Decision	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Referral decision			
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed
Wind Farm	2001/139	Referral Decision	Completed
Wolseley 3D Seismic Acquisition Survey in Permit T/32P	2010/5291	Referral Decision	Completed
Works to the buildings and surrounds at the former Point Nepean Quarantine Stati	2008/4156	Referral Decision	Completed

Key Ecological Features

[Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Big Horseshoe Canyon	South-east
Bonney Coast Upwelling	South-east
Canyons on the eastern continental slope	Temperate east
Shelf rocky reefs	Temperate east
Upwelling East of Eden	South-east
West Tasmania Canyons	South-east

Biologically Important Areas

[Resource Information]

Scientific Name	Behaviour	Presence
Dolphins		
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Breeding	Likely to occur
Seabirds		
Ardenna carneipes Flesh-footed Shearwater [82404]	Foraging	Known to occur
Ardenna grisea Sooty Shearwater [82651]	Breeding	Known to occur
Ardenna grisea Sooty Shearwater [82651]	Foraging	Likely to occur
Ardenna grisea Sooty Shearwater [82651]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Breeding	Known to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Likely to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Eudyptula minor Little Penguin [1085]	Breeding	Known to occur
Eudyptula minor Little Penguin [1085]	Breeding	Likely to occur
Eudyptula minor Little Penguin [1085]	Foraging	Known to occur
Macronectes giganteus Southern Giant Petrel [1060]	Foraging	Known to occur
Macronectes halli Northern Giant Petrel [1061]	Foraging	Known to occur
Morus serrator Australasian Gannet [1020]	Aggregation	Known to occur
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Oceanites oceanites Wilsons Storm Petrel [1034]	Migration	Known to occur
Pelagodroma marina White-faced Storm-petrel [1016]	Breeding	Known to occur
Pelagodroma marina White-faced Storm-petrel [1016]	Foraging	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Breeding	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur
Phalacrocorax fuscescens Black-faced Cormorant [59660]	Breeding	Known to occur
Phalacrocorax fuscescens Black-faced Cormorant [59660]	Foraging	Known to occur
Procellaria parkinsoni Black Petrel [1048]	Foraging	Likely to occur
Pterodroma macroptera Great-winged Petrel [1035]	Foraging	Likely to occur
Pterodroma mollis Soft-plumaged Petrel [1036]	Breeding	Known to occur
Pterodroma mollis Soft-plumaged Petrel [1036]	Foraging	Known to occur
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche cauta steadi White-capped Albatross [82344]	Foraging	Known to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Likely to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Foraging	Likely to occur
Seals		
Neophoca cinerea Australian Sea Lion [22]	Foraging (male)	Known to occur
Neophoca cinerea Australian Sea Lion [22]	Foraging (male and female)	Known to occur
Sharks		
Carcharias taurus Grey Nurse Shark [64469]	Foraging	Known to occur
Carcharias taurus Grey Nurse Shark [64469]	Migration	Known to occur
Carcharodon carcharias White Shark [64470]	Breeding (nursery area)	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (abundant food source)	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Known Foraging Area	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Foraging	Known to occur
Physeter macrocephalus Sperm Whale [59]	Foraging likely (abundant food source)	Known to occur

Bioregional Assessments [Resource Information]

SubRegion	BioRegion	Website
Gippsland	Gippsland Basin	BA website

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

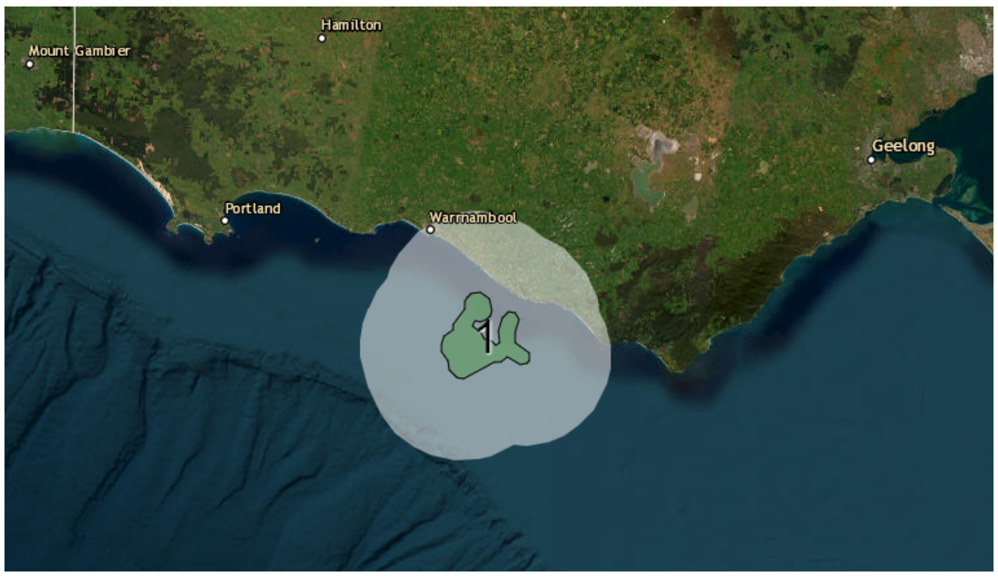
Please feel free to provide feedback via the Contact us page.

Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.



Noise EMBA (Operational Area + 30km Buffer)

Report created: 26-Jun-2024

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	94
Listed Migratory Species:	63

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	101
Whales and Other Cetaceans:	28
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	18
Regional Forest Agreements:	1
Nationally Important Wetlands:	2
EPBC Act Referrals:	56
Key Ecological Features (Marine):	1
Biologically Important Areas:	14
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In buffer area only

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In buffer area only
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area	In buffer area only
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area	In buffer area only
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only

Listed Threatened Species			[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia			
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Ardenna grisea			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Arenaria interpres			
Ruddy Turnstone [872]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In buffer area only
Botaurus poiciloptilus			
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In buffer area only
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Callocephalon fimbriatum			
Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In buffer area only
Charadrius leschenaultii			
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus			
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In buffer area only
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
FISH			
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In buffer area only
Nannoperca obscura Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thunnus maccoyii			
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
FROG			
Litoria raniformis			
Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
INSECT			
Synemon plana			
Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area	In buffer area only
MAMMAL			
Antechinus minimus maritimus			
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isoodon obesulus obesulus			
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area	In buffer area only
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area	In buffer area only
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area	In buffer area only
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In buffer area only
PLANT			
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dianella amoena Matted Flax-lily [64886]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Prasophyllum suaveolens Fragrant Leek-orchid [64956]	Endangered	Species or species habitat may occur within area	In buffer area only
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thelymitra orientalis Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Lissolepis coventryi Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area	In buffer area only
SHARK			
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Centrophorus uyato Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In buffer area only
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Migratory Marine Species

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In buffer area only
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lagenorhynchus obscurus			
Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus			
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae			
Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca			
Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus			
Sperm Whale [59]		Species or species habitat may occur within area	In buffer area only
Migratory Terrestrial Species			
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Monarcha melanopsis			
Black-faced Monarch [609]		Species or species habitat may occur within area	In buffer area only
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In buffer area only
Myiagra cyanoleuca			
Satin Flycatcher [612]		Breeding known to occur within area	In buffer area only
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area	In buffer area only
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In buffer area only
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Tringa brevipes Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anseranas semipalmata			
Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In buffer area only
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris as Puffinus tenuirostris			
Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Arenaria interpres			
Ruddy Turnstone [872]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Breeding likely to occur within area overfly marine area	In buffer area only
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Calidris alba			
Sanderling [875]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Calidris canutus			
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis			
Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In buffer area only
Chalcites osculans as Chrysococcyx osculans			
Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In buffer area only
Charadrius bicinctus			
Double-banded Plover [895]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area	In buffer area only
Charadrius ruficapillus Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In buffer area only
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In buffer area only
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In buffer area only
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In buffer area only
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche bulleri platei as Thalassarche sp. nov.			
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma			
Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini			
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus as Thinornis rubricollis			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa brevipes as Heteroscelus brevipes			
Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa stagnatilis			
Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area overfly marine area	In buffer area only
Fish			
Heraldia nocturna			
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis			
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps			
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii			
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus			
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus			
Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus			
Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat likely to occur within area	In feature area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area

Whales and Other Cetaceans

[Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata			
Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis			
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In buffer area only
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Berardius arnuxii			
Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In buffer area only
Caperea marginata			
Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In buffer area only
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In buffer area only
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In buffer area only
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In buffer area only
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In buffer area only
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In buffer area only

Current Scientific Name	Status	Type of Presence	Buffer Status
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In buffer area only
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In buffer area only
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In buffer area only
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In buffer area only
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In buffer area only
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Bay of Islands Coastal Park	Conservation Park	VIC	In buffer area only
Brucknell Creek F.F.R	Nature Conservation Reserve	VIC	In buffer area only
Cooriemungle	Reference Area	VIC	In buffer area only
Cooriemungle Creek F.R	Nature Conservation Reserve	VIC	In buffer area only
Curdie Vale N.C.R.	Natural Features Reserve	VIC	In buffer area only
Ecklin South Swamp N.C.R.	Natural Features Reserve	VIC	In buffer area only
Framlingham Forest	Indigenous Protected Area	VIC	In buffer area only
Great Otway	National Park	VIC	In buffer area only
Hopkins Falls S.R.	Natural Features Reserve	VIC	In buffer area only
Lake Gillear W.R	Natural Features Reserve	VIC	In buffer area only
Merri	Marine Sanctuary	VIC	In buffer area only
Nullawarre F.R.	Nature Conservation Reserve	VIC	In buffer area only
Port Campbell	National Park	VIC	In buffer area only
Princetown W.R	Natural Features Reserve	VIC	In buffer area only
The Arches	Marine Sanctuary	VIC	In buffer area only
Timboon I1 B.R	Natural Features Reserve	VIC	In buffer area only
Twelve Apostles	Marine National Park	VIC	In buffer area only
Unnamed P0126	Private Nature Reserve	VIC	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In buffer area only

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Cobden-Terang Volcanic Craters	VIC	In buffer area only
Princetown Wetlands	VIC	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Marine Route Survey for Subsea Fibre Optic Data Cable System - Australia East	2024/09795		Completed	In buffer area only
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In buffer area only
Controlled action				
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval	In buffer area only
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed	In feature area
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval	In buffer area only
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed	In buffer area only
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In buffer area only
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In feature area
Gas Field Development	2006/2635	Not Controlled Action	Completed	In feature area
Gas Fields Development	2011/5879	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed	In buffer area only
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In buffer area only
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Newfield wind farm	2007/3226	Not Controlled Action	Completed	In buffer area only
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed	In buffer area only
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed	In feature area
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In feature area
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In buffer area only
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Gas Pipeline Crossing at Mount Emu Creek	2009/4913	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features

[Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
West Tasmania Canyons	South-east	In buffer area only

Biologically Important Areas

[Resource Information]

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In buffer area only
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Likely to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur	In buffer area only
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In buffer area only
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

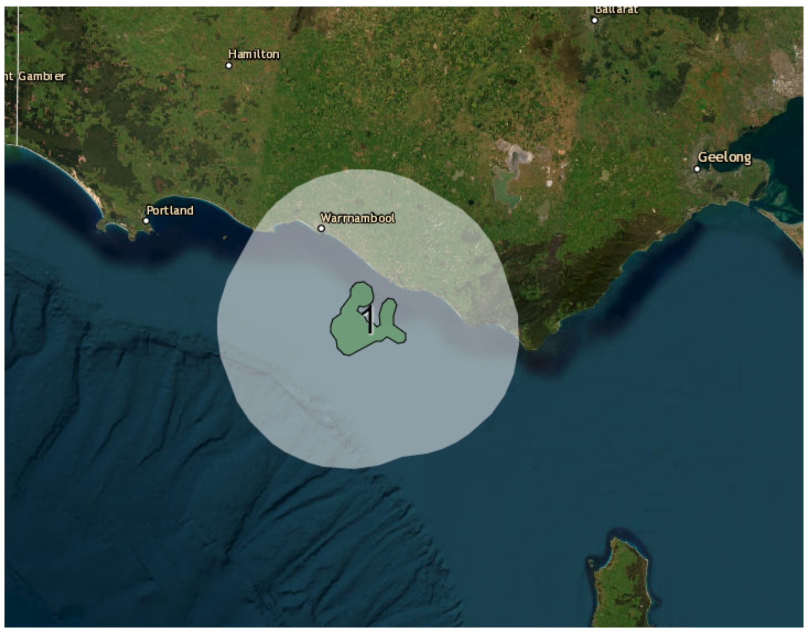
Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.



Light EMBA (Operational Area + 49km Buffer)

Report created: 27-Jun-2024

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	8
Listed Threatened Species:	105
Listed Migratory Species:	66

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	105
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	31
Regional Forest Agreements:	1
Nationally Important Wetlands:	4
EPBC Act Referrals:	81
Key Ecological Features (Marine):	2
Biologically Important Areas:	15
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In buffer area only

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Western district lakes	Within 10km of Ramsar site	In buffer area only

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In buffer area only
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area	In buffer area only
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community may occur within area	In buffer area only
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area	In buffer area only
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area	In buffer area only

Community Name	Threatened Category	Presence Text	Buffer Status
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour may occur within area	In buffer area only
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In buffer area only
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini			
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
CRUSTACEAN			
Euastacus bispinosus			
Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat likely to occur within area	In buffer area only
FISH			
Hoplostethus atlanticus			
Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In buffer area only
Nannoperca obscura			
Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prototroctes maraena			
Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Seriolella brama			
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii			
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
FROG			
Litoria raniformis			
Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
INSECT			
Synemon plana			
Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area	In buffer area only
MAMMAL			
Antechinus minimus maritimus			
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In buffer area only
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area	In buffer area only
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area	In buffer area only
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat may occur within area	In buffer area only
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area	In buffer area only
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In buffer area only
PLANT			
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dianella amoena Matted Flax-lily [64886]	Endangered	Species or species habitat known to occur within area	In buffer area only
Dodonaea procumbens Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lachnagrostis adamsonii Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area	In buffer area only
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area	In buffer area only
Pimelea spinescens subsp. spinescens Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Poa sallacustris Salt-lake Tussock-grass [24424]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Prasophyllum suaveolens Fragrant Leek-orchid [64956]	Endangered	Species or species habitat may occur within area	In buffer area only
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Rutidosis leptorhynchoides Button Wrinklewort [67251]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In buffer area only
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thelymitra orientalis Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eulamprus tympanum marnieae Corangamite Water Skink, Dreeite Water Skink [64487]	Endangered	Species or species habitat may occur within area	In buffer area only
Lissolepis coventryi Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area	In buffer area only
SHARK			
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Centrophorus uyato Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In buffer area only
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Migratory Marine Species

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera bonaerensis			
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In buffer area only
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caperea marginata			
Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isurus oxyrinchus			
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lagenorhynchus obscurus			
Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus			
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae			
Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca			
Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus			
Sperm Whale [59]		Species or species habitat may occur within area	In buffer area only
Migratory Terrestrial Species			
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Monarcha melanopsis			
Black-faced Monarch [609]		Species or species habitat may occur within area	In buffer area only
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In buffer area only
Myiagra cyanoleuca			
Satin Flycatcher [612]		Breeding known to occur within area	In buffer area only
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area	In buffer area only
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Limosa lapponica			
Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus			
Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In buffer area only
Numenius phaeopus			
Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pandion haliaetus			
Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Pluvialis fulva			
Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Thalasseus bergii			
Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Tringa brevipes			
Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola			
Wood Sandpiper [829]		Roosting known to occur within area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
Tringa stagnatilis			
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In buffer area only
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris as Puffinus tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Breeding likely to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area	In buffer area only
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area	In buffer area only
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In buffer area only
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In buffer area only
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Recurvirostra novaehollandiae			
Red-necked Avocet [871]		Roosting known to occur within area overfly marine area	In buffer area only
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Stercorarius antarcticus as Catharacta skua			
Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata			
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sternula albifrons as Sterna albifrons			
Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri			
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov.			
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche chrysostoma			
Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini			
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thalasseus bergii as Sterna bergii			
Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Thinornis cucullatus as Thinornis rubricollis			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa brevipes as Heteroscelus brevipes			
Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola			
Wood Sandpiper [829]		Roosting known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area	In buffer area only
Fish			
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Stigmatopora nigra			
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus			
Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris			
Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer			
Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi			
Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus			
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri			
Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus			
Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat likely to occur within area	In feature area
Neophoca cinerea			
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata			
Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis			
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In buffer area only
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Berardius arnuxii			
Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In buffer area only
Caperea marginata			
Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Delphinus delphis			
Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In buffer area only
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In buffer area only
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In buffer area only
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In buffer area only
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In buffer area only
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In buffer area only
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In buffer area only
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area	In buffer area only

Current Scientific Name	Status	Type of Presence	Buffer Status
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In buffer area only
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In buffer area only
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In buffer area only
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In buffer area only
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In buffer area only

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Bay of Islands Coastal Park	Conservation Park	VIC	In buffer area only
Brucknell Creek F.F.R	Nature Conservation Reserve	VIC	In buffer area only
Carpendeit	Reference Area	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Carpendeit B.R.	Natural Features Reserve	VIC	In buffer area only
Cobrico Swamp W.R	Natural Features Reserve	VIC	In buffer area only
Cooriemungle	Reference Area	VIC	In buffer area only
Cooriemungle Creek F.R	Nature Conservation Reserve	VIC	In buffer area only
Coradjil B.R.	Natural Features Reserve	VIC	In buffer area only
Coradjil N.C.R.	Natural Features Reserve	VIC	In buffer area only
Crinoline Creek	Reference Area	VIC	In buffer area only
Curdie Vale N.C.R.	Natural Features Reserve	VIC	In buffer area only
Ecklin South Swamp N.C.R.	Natural Features Reserve	VIC	In buffer area only
Framlingham Forest	Indigenous Protected Area	VIC	In buffer area only
Great Otway	National Park	VIC	In buffer area only
Hopkins Falls S.R.	Natural Features Reserve	VIC	In buffer area only
Hopkins River, Framlingham SS.R.	Natural Features Reserve	VIC	In buffer area only
Jancourt N.C.R.	Natural Features Reserve	VIC	In buffer area only
Johanna Falls S.R.	Natural Features Reserve	VIC	In buffer area only
Lake Gillear W.R	Natural Features Reserve	VIC	In buffer area only
Latrobe B.R.	Natural Features Reserve	VIC	In buffer area only
Merri	Marine Sanctuary	VIC	In buffer area only
Nullawarre F.R.	Nature Conservation Reserve	VIC	In buffer area only
Port Campbell	National Park	VIC	In buffer area only
Princetown W.R	Natural Features Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
The Arches	Marine Sanctuary	VIC	In buffer area only
Timboon I1 B.R	Natural Features Reserve	VIC	In buffer area only
Tomahawk Creek	Reference Area	VIC	In buffer area only
Tower Hill W.R	Natural Features Reserve	VIC	In buffer area only
Twelve Apostles	Marine National Park	VIC	In buffer area only
Unnamed P0126	Private Nature Reserve	VIC	In buffer area only
Woolsthorpe N.C.R.	Natural Features Reserve	VIC	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In buffer area only

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Cobden-Terang Volcanic Craters	VIC	In buffer area only
Lower Merri River Wetlands	VIC	In buffer area only
Princetown Wetlands	VIC	In buffer area only
Tower Hill	VIC	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Hexham Wind Farm	2022/09287		Assessment	In buffer area only
Marine Route Survey for Subsea Fibre Optic Data Cable System - Australia East	2024/09795		Completed	In buffer area only
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In buffer area only
Spinifex Offshore Surveys	2022/09359		Completed	In buffer area only

Controlled action

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval	In buffer area only
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Mortlake Wind Farm	2008/4128	Controlled Action	Post-Approval	In buffer area only
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed	In buffer area only
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed	In feature area
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval	In buffer area only
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Alteration of Grass Maintenance Regime within Powling St Wetlands	2012/6527	Not Controlled Action	Completed	In buffer area only
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed	In buffer area only
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed	In buffer area only
Ellerslie Timber Bridge Partial Restoration	2009/4734	Not Controlled Action	Completed	In buffer area only
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In buffer area only
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In feature area
Gas Field Development	2006/2635	Not Controlled Action	Completed	In feature area
Gas Fields Development	2011/5879	Not Controlled Action	Completed	In buffer area only
Gas Pipeline Installation	2005/2495	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed	In buffer area only
Hawkesdale Wind Farm	2005/2140	Not Controlled Action	Completed	In buffer area only
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In buffer area only
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Kelly Swamp Boardwalk Construction	2010/5371	Not Controlled Action	Completed	In buffer area only
Maintenance of Access Track and Weed Removal	2009/4973	Not Controlled Action	Completed	In buffer area only
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Mortlake South Wind Farm, 5 km south of Mortlake, Vic	2017/8137	Not Controlled Action	Completed	In buffer area only
Naroghid Wind Farm	2004/1542	Not Controlled Action	Completed	In buffer area only
Newfield wind farm	2007/3226	Not Controlled Action	Completed	In buffer area only
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed	In buffer area only
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed	In feature area
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Railway Bridge (H0151) Partial Demolition, Merri River	2010/5534	Not Controlled Action	Completed	In buffer area only
Salt Creek Wind Farm transmission line, Vic	2016/7763	Not Controlled Action	Completed	In buffer area only
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed	In buffer area only
The Sisters Wind Farm	2008/4268	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In feature area
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In buffer area only
Water pipelines, Mortlake Power Station	2006/2881	Not Controlled Action	Completed	In buffer area only
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed	In buffer area only
Wind farm development	2005/1960	Not Controlled Action	Completed	In buffer area only
Wind Farm Development	2004/1929	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Gas Pipeline Crossing at Mount Emu Creek	2009/4913	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Residential Development and Associated Infrastructure at Port Fairy	2012/6687	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station Project - Water Supply Pipeline	2009/5091	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Bonney Coast Upwelling	South-east	In buffer area only
West Tasmania Canyons	South-east	In buffer area only

Biologically Important Areas [Resource Information]

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In buffer area only
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Likely to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur	In buffer area only

Scientific Name	Behaviour	Presence	Buffer Status
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur	In buffer area only
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In buffer area only
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Australian Government
Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 14-Aug-2024

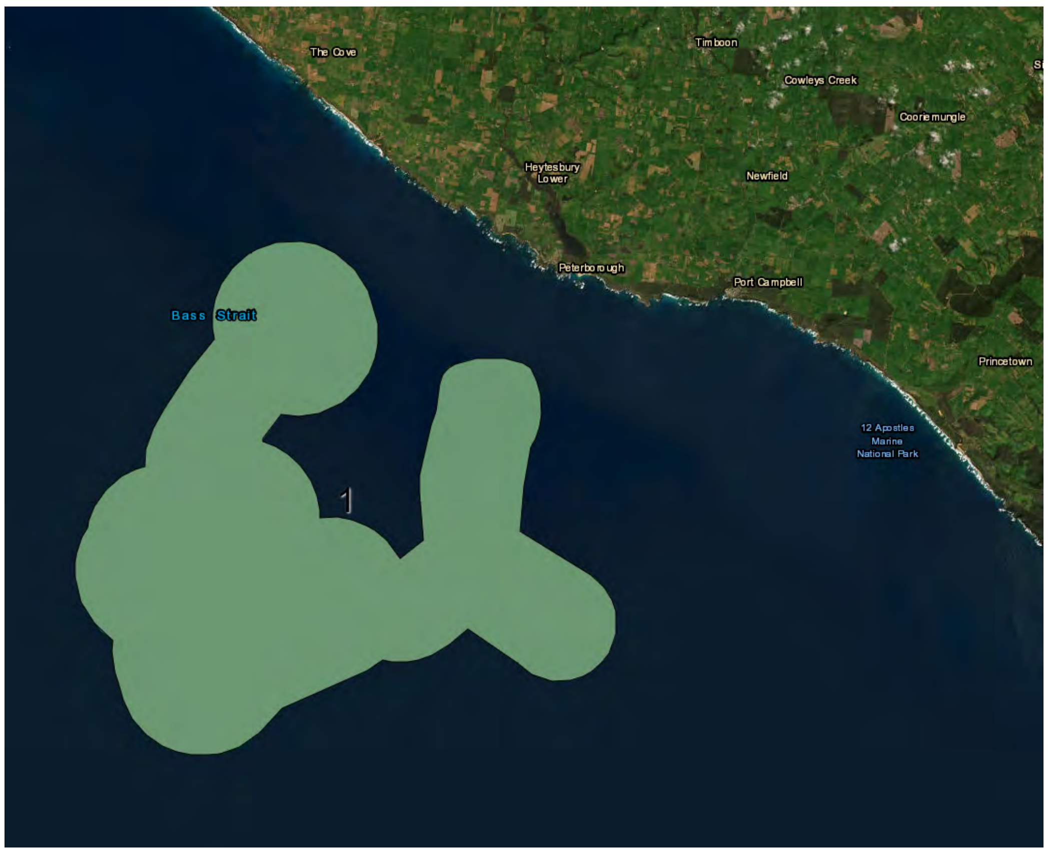


Figure 1: Operational Area

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	39
Listed Migratory Species:	38

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	63
Whales and Other Cetaceans:	14
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	24
Key Ecological Features (Marine):	None
Biologically Important Areas:	10
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche salvini		
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
FISH		
Prototroctes maraena		
Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Seriolella brama		
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
MAMMAL		
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Neophoca cinerea		
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
REPTILE		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Migration route known to occur within area
Galeorhinus galeus		
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna grisea		
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Migration route known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Eubalaena australis as Balaena glacialis australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isurus oxyrinchus		
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus		
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]		Species or species habitat likely to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area
Sterna striata White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Fish		
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptile		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Whales and Other Cetaceans

[Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area

Current Scientific Name	Status	Type of Presence
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Otway Development	2002/621	Controlled Action	Post-Approval
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed
Not controlled action			
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed
Gas Field Development	2006/2635	Not Controlled Action	Completed
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed
Not controlled action (particular manner)			
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed

Biologically Important Areas

[Resource Information]

Scientific Name	Behaviour	Presence
Seabirds		
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Likely to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Figure: East Coast Project Ecological EMBA

Report created: 20-Nov-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	9
Listed Threatened Species:	118
Listed Migratory Species:	72

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	5
Commonwealth Heritage Places:	None
Listed Marine Species:	118
Whales and Other Cetaceans:	30
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	3
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	34
Regional Forest Agreements:	3
Nationally Important Wetlands:	4
EPBC Act Referrals:	96
Key Ecological Features (Marine):	3
Biologically Important Areas:	25
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places		[Resource Information]
Name	State	Legal Status
Historic		
Great Ocean Road and Scenic Environs	VIC	Listed place

Wetlands of International Importance (Ramsar Wetlands)	[Resource Information]
Ramsar Site Name	Proximity
Port phillip bay (western shoreline) and bellarine peninsula	Within 10km of Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community may occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
River-flat eucalypt forest on coastal floodplains of southern New South Wales and eastern Victoria	Critically Endangered	Community may occur within area

Community Name	Threatened Category	Presence Text
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus lathami lathami South-eastern Glossy Black-Cockatoo [67036]	Vulnerable	Species or species habitat may occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area
Dasyornis brachypterus Eastern Bristlebird [533]	Endangered	Species or species habitat known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Pycnoptilus floccosus Pilotbird [525]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area
CRUSTACEAN		
Euastacus bidawalus Bidhawal Crayfish, Bidawal Crayfish, East Gippsland Spiny Crayfish [83136]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Euastacus bispinosus Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat likely to occur within area
FISH		
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Endangered	Species or species habitat may occur within area
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area
Nannoperca obscura Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area
FROG		
Heleioporus australiacus Giant Burrowing Frog [1973]	Vulnerable	Species or species habitat may occur within area
Litoria aurea Green and Golden Bell Frog [1870]	Vulnerable	Species or species habitat likely to occur within area
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
Uperoleia martini Martin's Toadlet [1873]	Endangered	Species or species habitat known to occur within area
INSECT		

Scientific Name	Threatened Category	Presence Text
Synemon plana Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area
MAMMAL		
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat may occur within area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
PLANT		
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat likely to occur within area
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area
Caladenia orientalis Eastern Spider Orchid [83410]	Endangered	Species or species habitat likely to occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Cryptostylis hunteriana Leafless Tongue-orchid [19533]	Vulnerable	Species or species habitat likely to occur within area
Dodonaea procumbens Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area
Grevillea infecunda Anglesea Grevillea [22026]	Vulnerable	Species or species habitat likely to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Ixodia achillaeoides subsp. arenicola Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat known to occur within area
Lachnagrostis adamsonii Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area
Leiocarpa gatesii Wrinkled Buttons [76212]	Vulnerable	Species or species habitat may occur within area
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat known to occur within area
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Pimelea spinescens subsp. spinescens		
Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat likely to occur within area
Prasophyllum frenchii		
Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat likely to occur within area
Prasophyllum litorale listed as Prasophyllum littorale		
Coastal Leek Orchid [55234]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum spicatum		
Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area
Pterostylis chlorogramma		
Green-striped Greenhood [56510]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis cucullata		
Leafy Greenhood [15459]	Vulnerable	Species or species habitat known to occur within area
Pterostylis tenuissima		
Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area
Senecio macrocarpus		
Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat likely to occur within area
Senecio psilocarpus		
Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area
Thelymitra epipactoides		
Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area
Thelymitra matthewsii		
Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Thelymitra orientalis		
Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat may occur within area
Xerochrysum palustre		
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Delma impar		
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding likely to occur within area
Lissolepis coventryi		
Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area
Tympanocryptis pinguicolla		
Victorian Grassland Earless Dragon [66727]	Critically Endangered	Species or species habitat likely to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Centrophorus uyato		
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area
Galeorhinus galeus		
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat likely to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area
Ardenna grisea		
Sooty Shearwater [82651]		Species or species habitat likely to occur within area
Ardenna tenuirostris		
Short-tailed Shearwater [82652]		Breeding known to occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche eremita Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharhinus longimanus		
Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding likely to occur within area
Eubalaena australis as Balaena glacialis australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isurus oxyrinchus		
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area

Scientific Name	Threatened Category	Presence Text
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Defence	
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC
Unknown	
Commonwealth Land - [21498]	VIC
Commonwealth Land - [21583]	VIC
Commonwealth Land - [21492]	VIC
Commonwealth Land - [21497]	VIC

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Ardenna tenuirostris as Puffinus tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni as Diomedea gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat likely to occur within area overfly marine area
Morus capensis Cape Gannet [59569]		Breeding known to occur within area
Morus serrator Australasian Gannet [1020]		Breeding known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pelecanoides urinatrix Common Diving-Petrel [1018]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pterodroma cervicalis White-necked Petrel [59642]		Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area overfly marine area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Stercorarius antarcticus as Catharacta skua		
Brown Skua [85039]		Species or species habitat may occur within area
Sterna striata		
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area
Sternula albifrons as Sterna albifrons		
Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri		
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov.		
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri		
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta		
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma		
Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche eremita		
Chatham Albatross [64457]	Endangered	Foraging, feeding or related behaviour may occur within area
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area overfly marine area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area
Fish		

Scientific Name	Threatened Category	Presence Text
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus minotaur Bullneck Seahorse [66705]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys mollisoni Mollison's Pipefish [66260]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptile		

Scientific Name	Threatened Category	Presence Text
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding likely to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Current Scientific Name	Status	Type of Presence
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area

Current Scientific Name	Status	Type of Presence
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks [Resource Information]

Park Name	Zone & IUCN Categories
Apollo	Multiple Use Zone (IUCN VI)
Zeehan	Multiple Use Zone (IUCN VI)
Zeehan	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State
Aire River	Heritage River	VIC
Aire River W.R.	Natural Features Reserve	VIC
Anglesea B.R.	Natural Features Reserve	VIC
Anser Island	Reference Area	VIC
Bay of Islands Coastal Park	Conservation Park	VIC
Breamlea F.F.R.	Nature Conservation Reserve	VIC
Cape Nelson	State Park	VIC
Croajingolong	National Park	VIC
Discovery Bay Coastal Park	Conservation Park	VIC
Edna Bowman N.C.R.	Natural Features Reserve	VIC
Great Otway	National Park	VIC
Johanna Falls S.R.	Natural Features Reserve	VIC

Protected Area Name	Reserve Type	State
Lady Julia Percy Island W.R.	Nature Conservation Reserve	VIC
Lake Gillear W.R	Natural Features Reserve	VIC
Lawrence Rocks W.R.	Nature Conservation Reserve	VIC
Marengo N.C.R.	Nature Conservation Reserve	VIC
Marengo Reefs	Marine Sanctuary	VIC
Merri	Marine Sanctuary	VIC
Parker River	Reference Area	VIC
Point Addis	Marine National Park	VIC
Point Hicks	Marine National Park	VIC
Port Campbell	National Park	VIC
Portland H47 B.R.	Natural Features Reserve	VIC
Princetown W.R	Natural Features Reserve	VIC
Southern Wilsons Promontory	Remote and Natural Area - Schedule 6, National Parks Act	VIC
Stony Creek (Otways)	Reference Area	VIC
The Arches	Marine Sanctuary	VIC
Twelve Apostles	Marine National Park	VIC
Unnamed P0176	Private Nature Reserve	VIC
Wild Dog Creek SS.R.	Natural Features Reserve	VIC
Wilsons Promontory	National Park	VIC
Wilsons Promontory	Marine National Park	VIC
Wilsons Promontory Islands	Remote and Natural Area - Schedule 6, National Parks Act	VIC
Yambuk F.F.R.	Nature Conservation Reserve	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State
East Gippsland RFA	Victoria
Gippsland RFA	Victoria
West Victoria RFA	Victoria

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Aire River	VIC
Lower Aire River Wetlands	VIC
Lower Merri River Wetlands	VIC
Princetown Wetlands	VIC

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Apollo Bay to Skenes Creek Coastal Trail	2022/09274		Assessment
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed
Southern Winds Offshore Wind Project	2022/09435		Assessment
Southern Winds Offshore Wind Project Initial Marine Field Investigations	2022/09436		Completed
Spinifex Offshore Surveys	2022/09359		Completed
Controlled action			
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval
City Of Greater Geelong Mosquito Control Program 2021-2030, Vic	2020/8782	Controlled Action	Further Information Request
Establishment of plantation for use of effluent water	2003/1063	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Mosquito Control	2005/2132	Controlled Action	Post-Approval
Otway Development	2002/621	Controlled Action	Post-Approval
Pacific Hydro (Portland) Wind Farm SW Victoria	2000/18	Controlled Action	Post-Approval
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval
VIC Offshore Windfarm	2021/8966	Controlled Action	Assessment Approach
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed
Not controlled action			
Alteration of Grass Maintenance Regime within Powling St Wetlands	2012/6527	Not Controlled Action	Completed
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed
Apollo Bay Water Storage Basin, VIC	2012/6484	Not Controlled Action	Completed
Biodiversity Impacts Audit	2011/6191	Not Controlled Action	Completed
Communications tower extension	2003/1099	Not Controlled Action	Completed
Construction and operation of Barwon Water biosolids treatment facility	2008/4345	Not Controlled Action	Completed
Construction of Barwon Heads Bridge	2005/2375	Not Controlled Action	Completed
construction of pump station for pump diversion from the Barham River	2003/1242	Not Controlled Action	Completed
Construction of the Edgars Road Extension, from Childs Road, Lalor to Cooper Street, Epping	2003/1135	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Drilling of Callister-1 exploration well in VIC/P51	2004/1633	Not Controlled Action	Completed
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed
Gas Field Development	2006/2635	Not Controlled Action	Completed
Gas Fields Development	2011/5879	Not Controlled Action	Completed
Gas Pipeline Installation	2005/2495	Not Controlled Action	Completed
Golflinks Road Residential Development & Water Storage Facility at Barwon Heads	2004/1793	Not Controlled Action	Completed
Grevillea infecunda tip cuttings and soil samples	2005/1979	Not Controlled Action	Completed
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Installation of a 35 metre telecommunications facility at Jirrahlinga Animal San	2003/1151	Not Controlled Action	Completed
Kelly Swamp Boardwalk Construction	2010/5371	Not Controlled Action	Completed
Maintenance of Access Track and Weed Removal	2009/4973	Not Controlled Action	Completed
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Portland Landfill Borehole Installation, Vic	2017/7886	Not Controlled Action	Completed
Redevelopment Project to Upgrade and Extend the Portland Trawler Wharf	2008/4317	Not Controlled Action	Completed
Residential/Resort/Golf Course development	2002/907	Not Controlled Action	Completed
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed
Torquay Sewerage Strategy - pipe replacement between Torquay and the Black Rock	2004/1704	Not Controlled Action	Completed
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed
Victorian Generator Project	2005/1984	Not Controlled Action	Completed
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed
Not controlled action (particular manner)			
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey in VIC/P50 and VIC/P46	2004/1810	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey VIC/P50	2005/2313	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
3D Marine Seismic Survey within Torquay Sub-basin off sthn Victoria	2012/6256	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval
Fuelbreak construction	2009/4915	Not Controlled Action (Particular Manner)	Post-Approval
Geelong Bypass Section 3	2005/2099	Not Controlled Action (Particular Manner)	Post-Approval
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval
OTE10 2D Marine Seismic Survey	2009/5223	Not Controlled Action (Particular Manner)	Post-Approval
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval
Residential Development and Associated Infrastructure at Port Fairy	2012/6687	Not Controlled Action (Particular Manner)	Post-Approval
Santos 2D Seismic Survey VIC/P44 & VIC/P51	2003/1213	Not Controlled Action (Particular Manner)	Post-Approval
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval
Southern Margins T/35P and T/36P 3D Seismic Surveys	2007/3817	Not Controlled Action (Particular Manner)	Post-Approval
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval
Surface Geochemical Exploration Program, TAS	2010/5780	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval
Torquay Sub-basin (VIC/P62) OTE12-3D Seismic Survey	2012/6655	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
3D Marine Seismic Survey	2011/6156	Referral Decision	Completed
All actions taken in response to the current severe bushfires in Victoria.	2009/4787	Referral Decision	Completed
Portland Wave Energy Project	2008/3946	Referral Decision	Completed
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Referral decision			
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Bonney Coast Upwelling	South-east
Upwelling East of Eden	South-east
West Tasmania Canyons	South-east

Biologically Important Areas

Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Breeding	Known to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Morus serrator Australasian Gannet [1020]	Aggregation	Known to occur
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur
Pelagodroma marina White-faced Storm-petrel [1016]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Pelecanoides urinatrix Common Diving-petrel [1018]	Breeding	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Sharks		
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present

Scientific Name	Behaviour	Presence
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Known Foraging Area	Known to occur

Bioregional Assessments

SubRegion	BioRegion	Website
Gippsland	Gippsland Basin	BA website

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

Department of Climate Change, Energy, the Environment and Water
GPO Box 3090
Canberra ACT 2601 Australia
+61 2 6274 1111

Appendix 2. Environmental Survey – Otway Basin

COOPER ENERGY

Project:	**Otway Pipeline / Umbilical Route Survey**
Vendor:	Fugro
Company Doc No:	VOB-EN-REP-4900-0001
Company Rev:	1
Vendor Doc No:	157827-52-REP-002
Vendor Rev:	1
Document Title:	Environmental Survey Report

REVIEW CODE		
Code	**Description**	**Tick**
1	No Comment. Work may proceed.	☑
2	Revise as noted and re-submit final. Work may proceed.	☐
3	Revise as directed and re-submit. Work may NOT proceed.	☐
4	Information Only. Re-submission not required	☐
5	As-Built	☐

Signed	**Dated**
Shane Taraborrelli	Digitally signed by Shane Taraborrelli Date: 2020.06.09 12:06:37 +08'00'

Contractor remains responsible for the due and proper performance in accordance with the Contract. Comments shall not be construed as authorisation of variations.

Intended for
Fugro Australia Pty Ltd

Document type
Report

Date
June 2020

OP3D ENVIRONMENTAL SURVEY
COOPER ENERGY

Bright ideas. Sustainable change.

OP3D ENVIRONMENTAL SURVEY
COOPER ENERGY

Project name	**Cooper Energy OP3D Environmental Survey**
Project no.	**318000966**
Recipient	**Lee Findlay, Fugro Marine Australia Pty Ltd**
Document type	**Report**
Version	**Rev 1**
Date	**03/06/2020**
Prepared by	**E Jones, S Lemmens**
Checked by	**D McClary**
Approved by	**J Miragliotta**
Description	**Results of the environmental survey for the Cooper Energy OP3D project**

Ramboll
41 St Georges Terrace
Perth, WA 6000
Australia

T +61 8 9225 5199
F +61 2 9954 8150
https://ramboll.com

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1. INTRODUCTION

1.1 Background

This report presents the results of the environmental survey carried out from 3 to 17 April 2020 in the Otway Basin off southwest Victoria, in support of the Otway Phase 3 Development (OP3D) geophysical survey Project for Cooper Energy (CH) Pty Ltd (Cooper Energy).

As part of this project, Fugro Australia Marine Pty Ltd (Fugro) carried out offshore geophysical and geotechnical surveys and Ramboll Australia Pty Ltd (Ramboll) were contracted by Fugro to carry out the environmental survey. These activities were located in Commonwealth waters approximately approximately 30 km southwest of Port Campbell and in water depths ranging from 60 m to 70 m.

1.2 Objectives

The key objective of the survey in Otway Basin was to confirm or amend intended field layouts and associated pipeline or flowline and electro-hydraulic umbilical (EHU) seabed routes, with additional video and photographs taken along the routes to provide benthic analysis data.

The objectives of environmental sampling as part of the Otway pipeline/umbilical surveys were to obtain:

- Approximately eight video transects along Route 1 and two video transects along Route 5 with enough good quality video footage from which the environmental scientists could determine the type of seabed fauna and substrate along the routes; and
- Grab samples (for geophysical data ground-truthing) for analysis of benthic organisms.

The environmental scientist on board was also responsible for keeping watch for marine mammals (MMO).

Fugro was responsible for the operation of equipment to collect the samples from the seabed, with Ramboll taking responsibility for the analytical processes on retrieval of the sampling equipment onboard the survey vessel.

1.3 Report Scope

The scope of the environmental survey carried out in Otway Basin included investigations of:

- Benthic epifauna from seabed video footage;
- Benthic infauna (greater than 1 cm) in seabed sediment samples; and
- Marine mammal sightings during survey operations.

The seabed video transects acquired during the survey were assessed with the intention of identifying the conspicuous macrobiota present and noting, in particular, if any EPBC Act habitats or species were present. Other gross physical features of relevance to epifaunal communities were described. The conspicuous benthic fauna in sediment collected by grab sampler were assessed to describe the benthic fauna assemblage. This information is presented in the context of the known benthic communities present in the wider Otway Basin offshore region.

As summary of marine mammal sightings made by the onboard environmental scientists during the survey operations is also provided.

2. SURVEY LOCATIONS

These investigations were based around the “Casino-Henry-Netherby” gas fields (Figure 1). Cooper Energy is the titleholder for Production Licences VIC/L24 (“Casino”) and VIC/L31 (‘Henry’ and “Netherby”) which contain the “Casino-Henry-Netherby” (CHN) gas fields, approximately 30 km southwest from Port Campbell off Victoria’s southwest coast in Bass Strait.

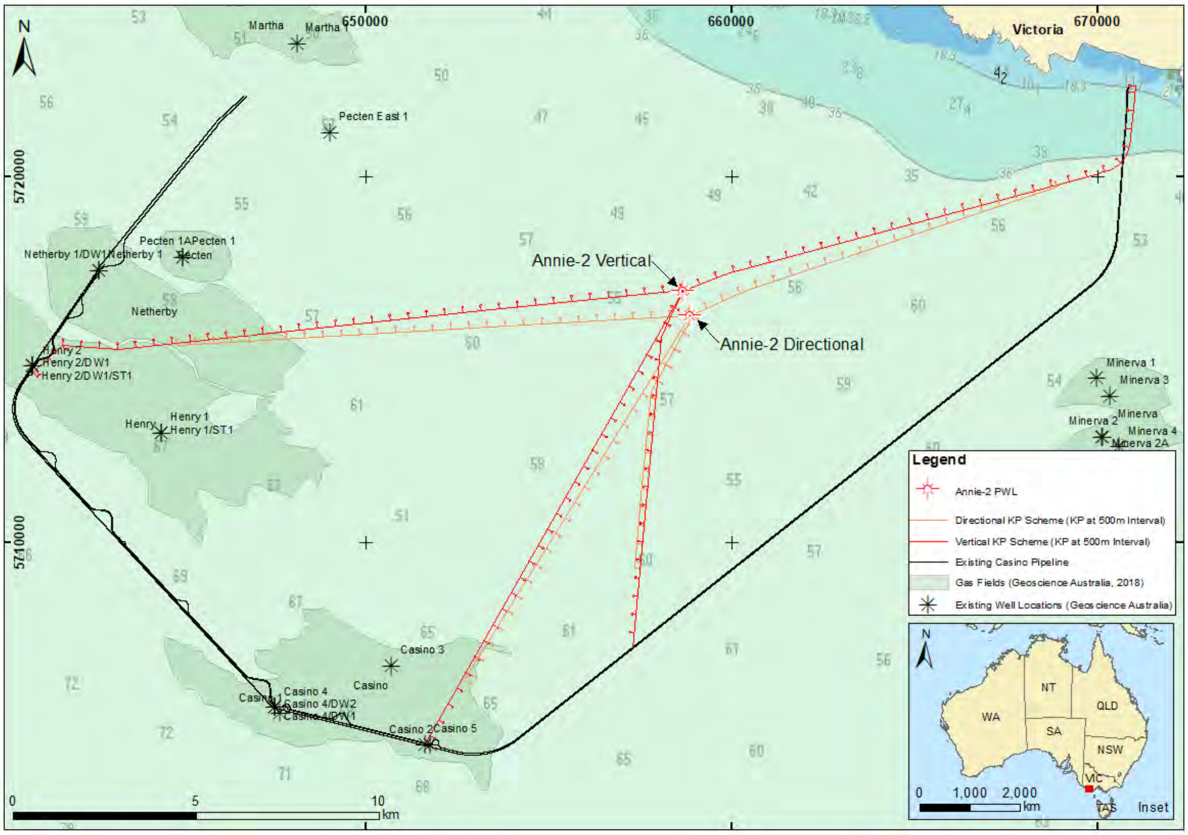

Figure 1 Plan of survey area and relevant gas fields in Otway Basin. Provided by Fugro, April 2020.

Cooper Energy is also the titleholder for Pipeline Licences VIC/PL37 and VIC/PL37(V) (“Casino” Gas Pipeline) and VIC/PL42 (“Casino-Pecten-East” Gas Pipeline) which is used to transport gas and condensate from the CHN wells to the Iona Gas Plant (IGP) for gas processing.

The offshore CHN facilities include:

- The “Casino”-4, “Casino”-5, ‘Henry’-2 and “Netherby”-1 gas production wells;
- A 32.6 km subsea pipeline, the “Casino” pipeline, connecting the “Casino” wells to the Iona Gas Plant;
- A 22 km subsea pipeline, the “Casino” to “Pecten East” pipeline, tying in to the “Casino” pipeline, carrying gas from the ‘Henry’-2 and “Netherby”-1 wells, with an additional section to a potential production well in the “Pecten” reservoir;
- A 31.2 km EHU cable connecting the “Casino” wells to the onshore Iona Gas Plant; and
- A 22 km EHU cable, which is an extension of the umbilical above, connecting the ‘Henry’ and “Netherby” wells to the Iona Gas Plant.

The survey extent within the basin, including the production and exploration wells, is shown in Figure 2. Cetacean sightings were made thoughout all areas of the survey.

The video transects were taken along:

- Route 1: ~31.21 km pipeline route from 'Henry' 3 via "Annie 2" to "Minerva HDD" tail.
- Route 2: ~1.09 km EHU route from 'Henry' 3 to 'Henry' 2.
- Route 3: ~14.31km EHU route from Annie 2 (vertical) to Casino 5
- Route 5: ~9.97km flowline route from Annie 2 (vertical) to Black Watch Tee

Transect coordinates are presented in Table 1 and shown in Figure 2.

Table 1 Location of video transects in Otway Basin, 3-17 April 2020 (GDA94 UTM 54 S).

Transect Name	Start/Finish	GDA94 UTM 54 S		WGS84	
		Easting	Northing	Longitude	Latitude
P1A	Start	657978	5712262	142° 49' 2.2752430"	38° 43' 27.085505"
	Finish	656519	5713393	142° 48' 0.9617290"	38° 42' 51.345949"
P1B	Start	655696	5712190	142° 47' 27.873277"	38° 43' 30.878338"
	Finish	655858	5710812	142° 47' 35.696538"	38° 44' 15.459179"
P1C	Start	653230	5707854	142° 45' 49.252549"	38° 45' 53.033315"
	Finish	653377	5706765	142° 45' 56.211596"	38° 46' 28.254080"
P2A	Start	641462	5715598	142° 37' 36.123637"	38° 41' 48.975994"
	Finish	641864	5715222	142° 37' 53.036101"	38° 42' 0.9376470"
P2B	Start	657584	5707257	142° 48' 50.072720"	38° 46' 9.6309500"
	Finish	657167	5708373	142° 48' 31.886794"	38° 45' 33.711336"
P3A	Start	667729	5719658	142° 55' 39.442486"	38° 39' 20.806927"
	Finish	668304	5719465	142° 56' 3.3877260"	38° 39' 26.672187"
P3B	Start	666440	5719246	142° 54' 46.495910"	38° 39' 35.041176"
	Finish	667017	5719058	142° 55' 10.519786"	38° 39' 40.745961"
P3C	Start	662449	5718148	142° 52' 2.3746350"	38° 40' 13.312010"
	Finish	663111	5717737	142° 52' 30.103301"	38° 40' 26.200633"
P3D	Start	659729	5717428	142° 50' 10.467841"	38° 40' 38.440411"
	Finish	660450	5717355	142° 50' 40.353247"	38° 40' 40.338038"
P3E	Start	652552	5715586	142° 45' 15.034932"	38° 41' 42.729649"
	Finish	653163	5716448	142° 45' 39.631267"	38° 41' 14.397254"
HDD Exit	Start	670950	5722638	142° 57' 49.994210"	38° 37' 41.967425"
	Finish	670741	5720969	142° 57' 42.830772"	38° 38' 36.227806"
Crossing	Start	670602	5719949	142° 57' 37.985604"	38° 39' 9.3964610"
	Finish	670985	5720964	142° 57' 52.922941"	38° 38' 36.220568"

Grab samples were taken along all routes, with sample site coordinates presented in Table 2 and shown in Figure 3.

Table 2 Location of video transects and sediment sampling suites relative to Cooper Otway well locations (GDA94 UTM 54 S).

Grab Sample Site Code	GDA94 UTM 54 S		WGS84	
	Easting	Northing	Longitude	Latitude
GS_01	668,383	5,719,641	142° 56' 06.50" E	38° 39' 20.91" S
GS_02	668,145	5,719,575	142° 55' 56.71" E	38° 39' 23.21" S
GS_03	658,743	5,716,776	142° 49' 30.21" E	38° 41' 00.22" S
GS_04	658,168	5,715,914	142° 49' 07.13" E	38° 41' 28.54" S
GS_05	657,713	5,712,656	142° 48' 50.98" E	38° 43' 14.48" S
GS_06	656,388	5,713,030	142° 47' 55.83" E	38° 43' 03.20" S
GS_07	655,041	5,716,090	142° 46' 57.61" E	38° 41' 24.82" S
GS_08	657,330	5,707,360	142° 48' 39.46" E	38° 46' 06.45" S
GS_09	651,982	5,704,866	142° 44' 59.93" E	38° 47' 30.70" S
GS_10	642,046	5,715,338	142° 38' 00.48" E	38° 41' 57.07" S

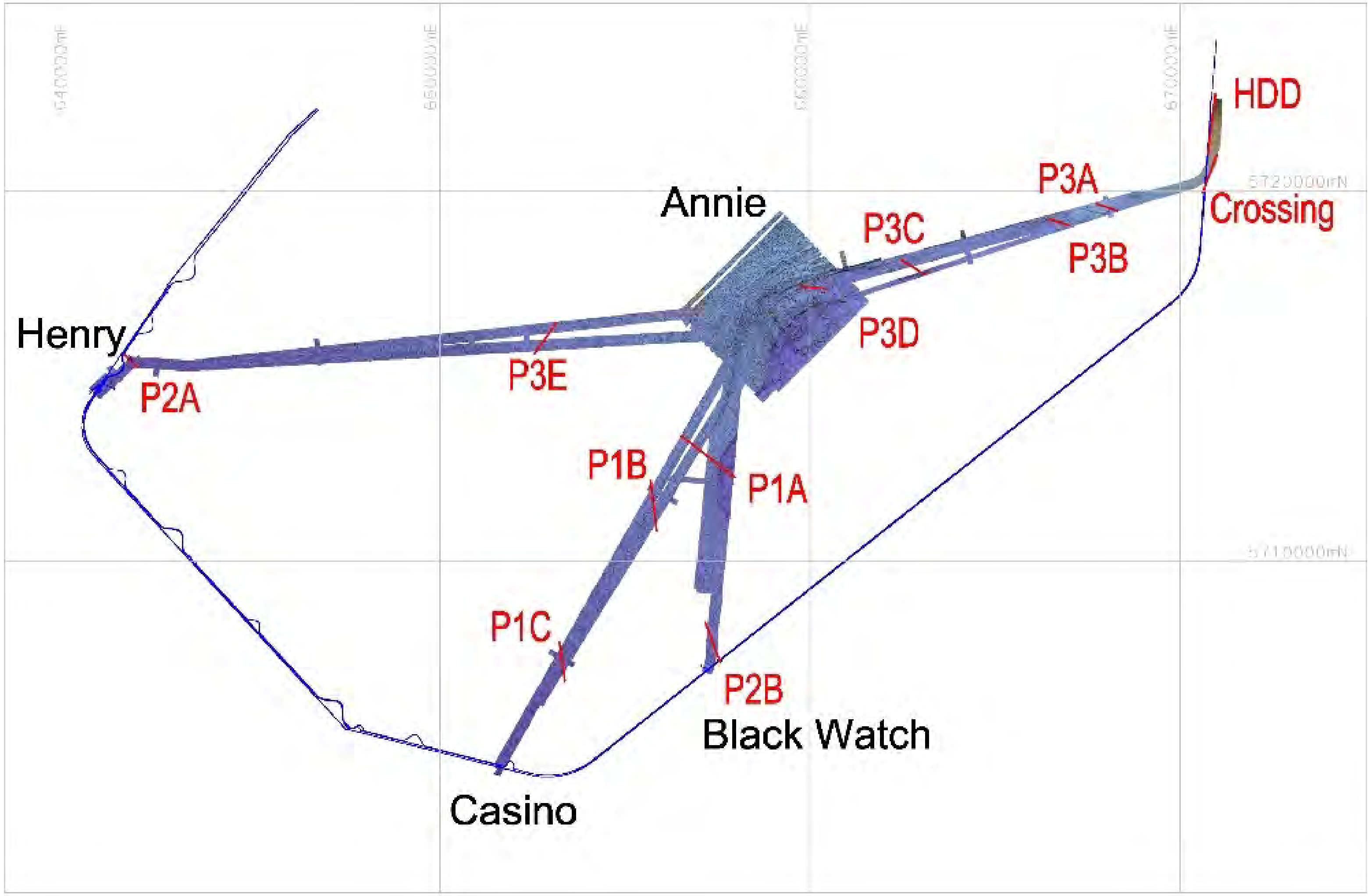

Figure 2 Bathymetric maps of Cooper Otway well locations (black text), video transect locations. Provided by Fugro, May 2020.

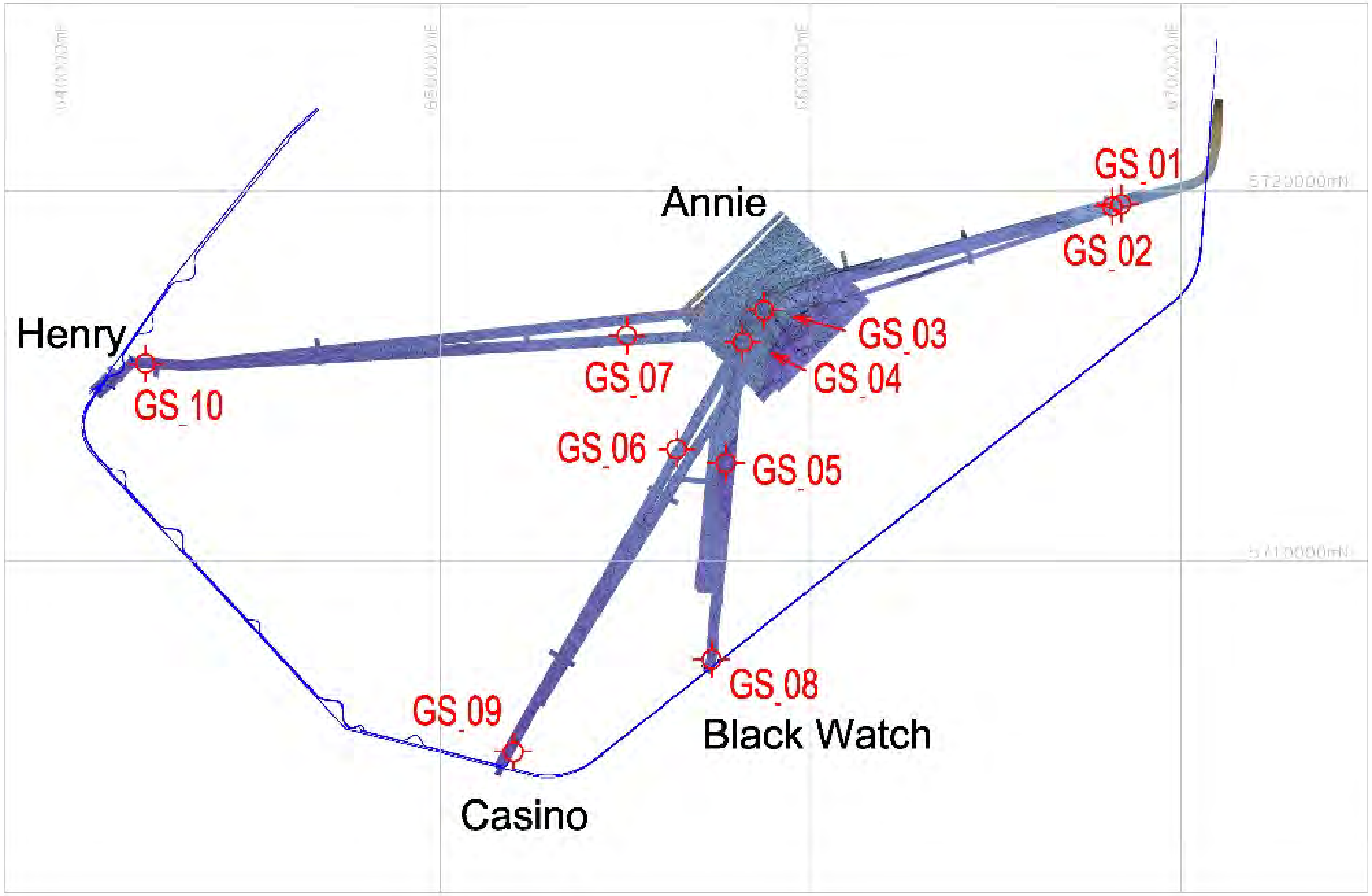

Figure 3 Bathymetric maps of Cooper Otway well locations (black text), sediment sample sites. Provided by Fugro, May 2020.

3. METHOD

3.1 Survey Operations

The environmental survey was undertaken between 3 and 17 April 2020 from the vessel MSV *Silver Star*. The vessel mobilised from Lakes Entrance, Victoria on 6 April after waiting out a storm in port on 4 to 5 April. The vessel arrived onsite on 7 April after approximately 36 hours of transit time.

Due to an incoming storm, the vessel headed to Portsea on 10 April for shelter and returned to the survey location on 12 April. Survey activity recommenced late on 12 April and was completed by early morning on 15 April. The vessel arrived at the home port in the late afternoon of 16 April for demobilisation on 17 April.

Figure 4 MSV *Silver Star*.

3.1.1 Noise Mitigation Measures

The survey activity was not deemed to be a 'Petroleum Activity' as defined in the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 and the survey tools operated during this survey do not strictly fall within the definition of the 'EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales' (DEWHA, 2008). However, Cooper Energy chose to apply their noise mitigation measures during the survey activities as a precautionary approach.

The noise mitigation measures are presented in Figure 5. Multibeam echosounder and sidescan sonar activities occurred continuously over 24 hours, therefore night time operations were undertaken in accordance with EPBC Act Policy Statement 2.1 (Figure 6).

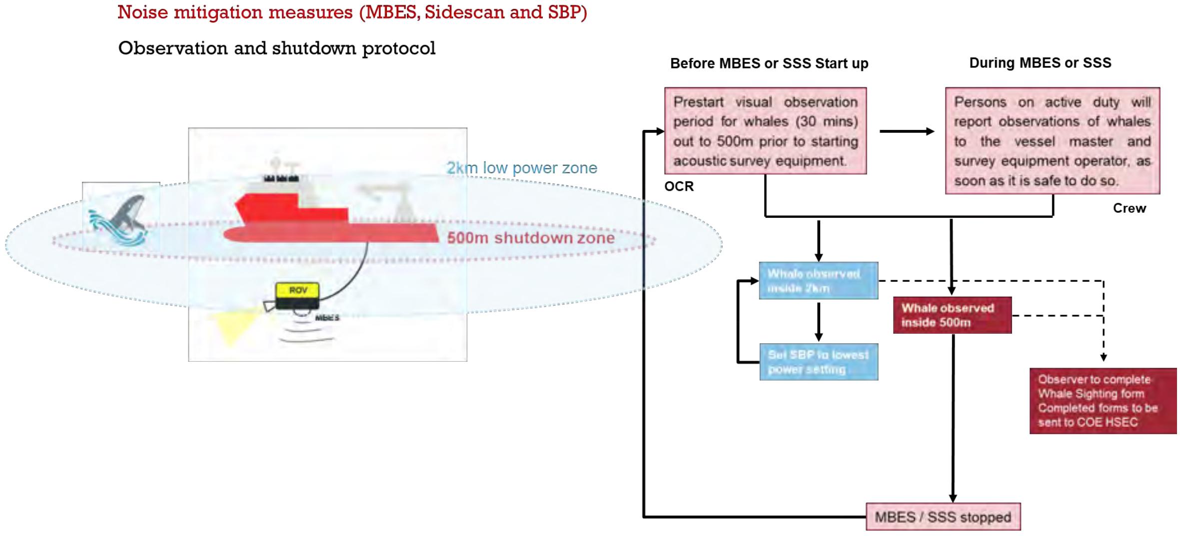

Figure 5 Noise mitigation measures employed during the survey when using the multibeam echosounder (MBES), sidescan sonar (SSS) and sub-bottom profiler (SBP). Provided by Fugro, April 2020.

A.3.6 Night-time and Low Visibility Procedures

At **night-time** or at other times of **low-visibility** (when observations cannot extend to 3km from the acoustic source, e.g. during fog or periods of high winds), the following measures apply for start up and operations:

Start up may be commenced according to A.3.2 Soft-Start Procedure:

- provided that there have not been 3 or more whale instigated power-down or shut-down situations during the preceding 24 hour period; or
- if operations were not previously underway during the preceding 24 hours, the vessel (and/or a spotter vessel or aircraft) has been in the vicinity (approximately 10km) of the proposed start up position for at least 2 hours (under good visibility conditions) within the preceding 24 hour period, and no whales have been sighted.

Operations may proceed provided that there have not been 3 or more whale instigated power-down or shut-down situations during the preceding 24 hour period.

During **low visibility**, where conditions allow, continuous observations to spot whales should be maintained with a particular focus on the *Low power* and *Shut-down* zones. If whales are detected then the procedures outlined in A.3.5 Stop Work Procedures should apply.

If sightings of whales have been frequent or are higher than were anticipated during the planning of the survey, the proponent should contact the Department to discuss appropriate night-time provisions and whether additional management measures should be employed for day and/or night-time operations.

Figure 6 Extract from EPBC Act Policy Statement 2.1 requirements for night-time operations.

3.2 Marine Mammal Observation Procedures

Observations for marine mammals were made by the onboard environmental scientist and adhereing to the processes described in Section 3.1.1. Observations were undertaken from the bridge, from first light until sunset. The species, abundance, sighting confidence, location, date, time and any relevant notes were recorded.

3.3 Digital Imagery Sampling and Processing Procedures

A STR SeaSpyder system (Figure 7) fitted with a digital stills camera and low latency live video was deployed to collect seabed imagery and video transects. The SeaSpyder Telemetry system is designed for operation in water depths up to 1000 m using standard coaxial sonar umbilicals. The stills camera is fitted with a high quality 18 mega pixel digital SLR camera offering full control of all photographic parameters including manual focus, shutter speed and aperture. The stills camera is housed within a 1000 m rated aluminium enclosure, along with the video camera. All data is transferred directly to the surface unit for live interpretation.

Figure 7 STR SeaSypder Telemetry system. (Source: https://www.str-subsea.com/str-seaspyder-telemetry-drop-camera-system).

The camera system is fitted with a Sonodyne Ranger USBL positioning system to accurately track locations during deployment. The SeaSpyder is equipped with twin lasers, aimed within the camera field of view with calibrated separation distances to permit accurate recording of the image scale.

The camera system recorded continuous high-definition video and high-resolution still images when triggered by the attending environmental scientist. A real-time video feed to the surface enabled representative photographs of epibenthic fauna to be taken along the video transect as an aid in the identification of species during video footage analysis.

The drop camera was deployed via a winch over the stern of the vessel. All data was transferred directly to the surface unit and saved onto a dedicated Fugro server. The camera system was lowered to the seafloor at the first transect site and then towed by the vessel along the transect routes. The camera system remained submerged for the duration of video footage collection and was towed underwater between transect locations.

Each video transect was approximately 30 to 45 minutes covering 1.0 50 1.5 naultical miles (approximately 1.8 to 2.8 km) of seabed. When assessing the video footage, the environmental scientist recorded the following attributes approximately every 30 seconds along the transect route:

- A high-level description of the epifauna composition;
- Coverage of epifauna;
- An estimate of individual fauna (i.e., singular, mobile species);
- The type pf sediment present; and
- Coverage of sediment (not covered by epifauna).

Representative photographs of the seabed were used to elaborate on the description of the epifauna observed in video transects.

3.4 Sediment Grab Sampling and Benthic Fauna Assessment Procedures

Seabed sediment samples were collected using a Van Veen grab sampler (Figure 8). These types of samplers are designed for sampling the top layer of consolidated sediment consisting of silt and/or sand.

Figure 8 Van Veen grab sampler. Provided by Fugro, March 2020.

On retrieval at the surface, the grab sample was inspected and comments made in the field data sheet on whether:

- The jaws of the grab are closed;
- The surface of the sediment sample covers at least 70% of the grab;
- The surface of the sediment sample is undisturbed;
- There is evidence of the sample being washed out.

Once the grab sample contents had been used for geophysical ground truthing, the remaining sediment was examined for conspicuous benthic fauna. The following information was collected and recorded on the field data sheet:

1. Sample name, site/location, time
2. Gross sediment texture (mud, sand, gravel, or combination of)
3. Sediment colour
4. Presence of organic fragments and description (i.e., dead coral fragments, shells)
5. Identification and abundance of conspicuous benthic biota greater than 1 cm in size.

For each grab sample, a photograph was taken of the sample surface with sample name, site, date and time shown on a label plate.

To aid in the identification and enumeration of biota, the sediment sample contents was spread out in a sorting tray. Organisms of 1 cm or greater were identified to at least the level of higher order taxonomic group. Where possible, different species within these groups were recorded (i.e., sp. 1, sp. 2 and so on). It is often not possible to count the number of individuals for encrusting and sessile epifauna, such as bryozoan or hydroids. In this instance, their presence or absence was simply noted. However, comments of general abundance were noted if, for example, a particular organism is high abundant and a predominant feature of the epifauna. Physical samples of benthic fauna were not retained after onboard analysis.

4. RESULTS

4.1 Marine Mammal Observations

Marine mammal observation activities are recorded in Table 3 and sightings made during field activities are recorded in Table 4 and Appendix 1. Common bottlenose dolphins were regularly observed bow riding, both during transit to site and during MBES/SSS operations. On one occasion, a large school of dolphins was observed to starboard of the vessel. No evasive action was required, however a large group split off and headed towards the vessel to continue bow riding for an extended period. During survey operations, vessel speed was around 4 knots, except during video transects which were undertaken at about 2 knots. Cruising speed of the vessel was approximately 8 knots.

Table 3 Marine mammal observation activities during multibeam echosounder and sidescan sonar operations in Otway Basin, 3-17 April 2020.

Date	Reason for firing*	Time (UTC+10)								Mitigating action required?	Comments
		pre-shooting search	Search end	Ramp-up	Full Power	Start of line	End of line	Reduced Output	Source stopped		
8/04/2020	t	6:45	8:05	N/A	8:05	8:10	9:10	9:10	N/A	n	Boomer, X-Star (Chirp), SSS, MBES
8/04/2020	l	9:15	18:30					N/A	N/A	n	Continuous operations. MFO during daylight
9/04/2020	l	6:35	18:45					N/A	N/A	n	Large school of dolphins along vessel. Many riding bow.
10/04/2020	l	6:45					9:45	9:45	N/A	n	Retreived probes. Heading to port
11/04/2020	l	N/A					N/A	N/A	N/A	n	In Port (Portland)
12/04/2020	l	15:45	18:45					N/A	N/A	n	Survey lines continuing during night
13/04/2020	l	6:45	15:30					N/A	N/A	n	End of lines. All gear back on board 4 pm
14/04/2020	l	16:15	18:35	N/A	17:47			N/A	N/A		Start extra lines after sediment & video transects
15/04/2020		6:45	8:15				8:00	8:00	N/A		Gear retrieved 8:15 am. Heading to port

* Reason for firing: l = survey line, t = test

Table 4 Marine mammal observations made during multibeam echosounder and sidescan sonar operations in the Otway Basin, 3-17 April 2020.

Date (UTC)	Time (UTC)	Latitude	Longitude	Species (Confidence*)	Abundance (Confidence*)	Number of Adults	Number of Calves	Identification	Behaviour	Comment
9/04/20	18:48	38.6570	142.9317	Common bottlenose dolphin (C)	50 (C)	?	?	Dorsal fin	Milling	Large school. Estimate around 50, but possiby many more. Adults and young. Feeding on fish. Many heading to vessel, riding bow wave.
12/04/20	5:20	38.7030	142.6322	Common bottlenose dolphin (D)	6 (D)	0	6	Dorsal fin	Bow Riding	
13/04/20	0:55	38.6474	142.9621	Common bottlenose dolphin (D)	10 (C)	4	6	Dorsal fin	Bow Riding	
13/04/20	02:40	38.6532	142.9425	Common bottlenose dolphin (D)	20 (C)	7	13	Dorsal fin	Bow Riding	
14/04/20	6:40	38.6464	142.9610	Common bottlenose dolphin (D)	4 (C)	3	1	Dorsal fin	Bow Riding	

* Confidence: C=Certain; D=Definitive

4.2 Sediment and Benthic Ecology

A total of ten sediment samples were collected using the grab sampler. A record of the field data sheets complied by the geotechnical and environmental scientists during the survey is included in Appendix 2. On a number occasions, repeat samples were collected because the grab had failed to trigger or had triggered early, or where insufficient sediment material was collected. A summary of the sediment composition and fauna (greater than 1 cm) observed in the samples is presented in Table 5.

It is noted that there was very little conspicuous fauna found in the samples, which likely reflects the relatively coarse nature of the sediment collected. This result is notably different to the observations of abundant epibiota noted during video transects. These differences are most likely due to the sampling methods such that epifauna is typically attached to hard substratum which would not be penetrated by a grab sampler. Microscopic analysis of seabed sediment would be required to provide a more detailed description of seabed fauna for statistical analysis. No organisms of significance under the EPBC Act were noted during this assessment of the grab samples.

Table 5 Sediment type and benthic fauna observed in grab samples collected in Otway Basin, 3-17 April 2020.

Grab Sample Site Code	Sediment Description	Benthic Fauna Description
GS_01b	Fine-grained carbonate sand with silt. Sand is pale yellowish orange, well sorted, fine grained and composed primarily of mixed carbonates.	Polychaete tubes visible.
GS_02	Cobble-sized limestone fragments.	Limestone fragments covered with crustose coralline algae (Rhodophyta). Also colonial tunicates (ascidians) visible (Botryllinae, possibly *Botryllus stewardensis*). Presence of calcified tube worm casings (Serpulidae, possibly *Galeolaria caespitosa*) and colonial hydroids (possibly *Leptothecata*).
GS_03d	Fine-medium carbonate sand. Sand is dark yellowish orange, well sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.	Few pieces of red algae (Rhodophyta, possibly *Hemineura frondosa*).
GS_04	Coarse gravelly carbonate sand. Sand fraction varies from white to reddish olive-brown, poorly sorted, medium to coarse grained and composed primarily of mixed carbonates. Major fraction shell fragments.	No fauna present.
GS_05	Fine-medium carbonate sand. Sand is light yellowish orange, moderately sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.	No fauna present.
GS_06	Carbonate sand and gravels. Sand is light yellowish orange, fine to coarse grained and composed primarily of mixed carbonates. Gravels are reddish brown and poorly sorted with sand and shell fragments. Minor fraction of shell pieces.	Single live Brittle star (Ophiuridae, Genus Ophionereis, possibly *Ophionereis schayeri*).
GS_07, 7a, 7b, 7c	Four attempts were made, however no sample was recovered. Small limestone rock caught in grab on first attempt, prohibiting grab from closing, but not retained.	No sample for assessment.
GS_08	Carbonate sand and gravels. Sand is light yellowish orange, fine to medium grained and composed primarily of mixed carbonates. Moderately sorted with shell fragments. Fraction of shell pieces and lacy bryozoan fragments (Phidoloporidae).	No fauna present.

Grab Sample Site Code	Sediment Description	Benthic Fauna Description
GS_09a	Carbonate gravels and sand. Gravels are light gray to grayish orange in color, very poorly sorted amongst fine to coarse grained sands composed primarily of mixed carbonates. Large fraction of shells, shell pieces and lacy bryozoan fragments (Phidoloporidae).	No fauna present.
GS_10	Fine-medium Carbonate sand. Sand is dark yellowish orange, well sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.	No fauna present.

4.3 Epibenthic Ecology

The substrate observed in the video transects was recorded as:

- Gravelly/shelly sand
- Sand
- Mud or silt
- Hard platform; or
- Rubble.

The general abundance of epifauna ranged from (Figure 9):

- Highly abundant; 75-100% coverage;
- Abundant; 50-75% coverage;
- Frequent; 25-50% abundance;
- Occasional; <25% coverage; or
- No fauna or flora

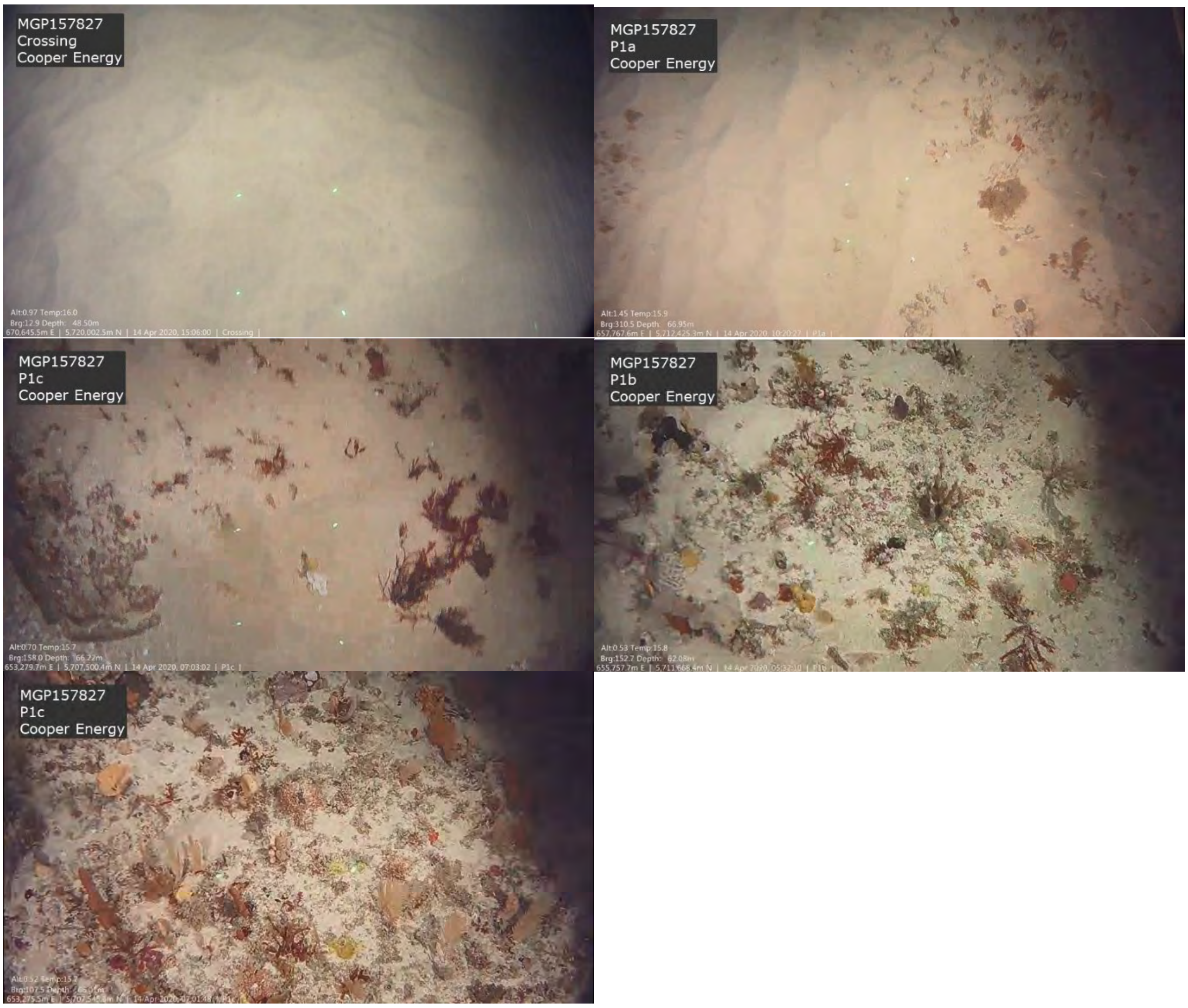

Figure 9 Examples of epifauna coverage: no fauna or flora (top left); occasional (top right): frequent (middle left); abundant (middle right); and highly abundant (bottom left).

Where an epifauna component was observed in video transects, this was recorded at a broad scale as either:

- Erect and encrusting/prostrate epifauna (e.g., upright sponges, low lying hydroids); or
- Prostrate epifauna, low lying hydroids, bryozoans, and macroalgae.

These compositions were made using representative photographs of the seabed.

The occurrence of habitat that could be considered as follows was noted:

- Areas of high relief
- Reefs
- Sponge beds
- Wrecks

The video assessment log of observations is included in Appendix 3. A description of the observations follows.

4.3.1 Overview Observations

As an overview, no areas of high relief, reefs, sponge beds or ship wrecks were noted throughout the video transects. While sponges (as part of "erect and encrusting epifauna") were present, they were not so highly abundant and morphological diverse as a taxonomic group to be considered as a sponge bed, rather sponges were interspersed throughout the patchy epifaunal covering that also included bryozoans and hydroids as shown in Figure 10. Similarly, while hard platform (i.e., consolidated substrate) was noted for some transects, this was not considered to be an example of "high relief" and was typically no more than a 2-5 cm projection above the adjacent sandy seafloor, and in most instances was at the same level as the unconsolidated seabed substrates. Examples of hard platform are shown in Figure 11.

The patchy epifauna and presence of hard platform is consistent with the description of a key ecological feature (KEF) of the South-East bioregion, that is, shelf rocky reefs and hard substrates. This KEF is described as (Commonwealth of Australia, 2015):

"High productivity, aggregations of marine life

Rocky reefs and hard grounds are located in all areas of the South-east Marine Region continental shelf including Bass Strait, from the sub-tidal zone shore to the continental shelf break. The continental shelf break generally occurs in 50 m to 150–220 m water depth. The shallowest depth at which the rocky reefs occur in Commonwealth waters is approximately 50 m.

On the continental shelf, rocky reefs and hard grounds provide attachment sites for macroalgae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity".

Hard ground was patchy and scattered throughout most of the transects as described below, providing attachment opportunities for epifauna. Epifauna was also noted to occur on unconsolidated substrates (sand and gravel) and amongst biogenic rubble. The hard ground observed during the video transects was low-lying and did not provide a reef-type structure of high relief.

Figure 10 Examples of typical epifauna observed within the study area, at transect P1B, April 2020.

Figure 11 Examples of hard platform with encrusting / prostrate epifauna along transect P1A.

4.3.2 Transect P2A

Starting at the beginning of Route 1 in the vicinity of the “Henry” well sites, the epifauna was generally prostrate epifauna with some occasional patches of erect epifauna throughout the entire transect P2A. The abundance of epifauna ranged from occasional to frequent coverage with three instances of highly abundant fauna. Two crinoids (feather stars) and one teleost fish were noted.

4.3.3 Transect P2B

The epifauna type, abundance and patchiness of transect P2B, between the ‘Henry’ well sites and “Annie 2”, was largely similar to that described for transect P2A, with the exception that no hard platform was present. Observations included several snapper, file fish, other teleost fish and starfish. Man-made pipes were observed on the seabed surface, covered in epifauna. These pipes are known, existing infrastructure – the pipe at E 657550, N 5707334 is the CHN to HDD ECU (umbilical), and the pipe at E 657567, N 5707316 is the CHN to HDD 12PP (pipeline).

4.3.4 Transects P3C and P3D

The epifauna in closest proximity to “Annie 2”, at transect P3D, was less abundant covering <25% of the seabed and was only present as prostrate epifauna. Occasional teleost fish were observed. The epifauna at transect P3C, between “Annie 2” and “HDD/Iona”, was very similar.

4.3.5 Transects P3A and P3B

A greater abundance of erect epifauna was noted along transects P3B and P3A, between “Annie 2” and “HDD/Iona”, but generally epifauna remained patchy as for other transects. Rubble substrate was often associated with erect epifauna, which would be providing attachment opportunities for such fauna.

4.3.6 Transects “Crossing” and “HDD Exit”

At the end of this route, near “HDD/Iona”, within transects labelled as “Crossing” and “HDD Exit”, there was a notable lack of epifauna compared to other transects described along this route. No epifauna was observed along the “Crossing” transect or and very occasional patches of prostrate epifauna was noted along the “HDD Exit” transect. Sand was the predominant substrate type in these transects.

4.3.7 Transects P1A, P1B and P1C

Between “Casino” and “Annie 2” well sites, in transects P1A, P1B (Figure 10) and P1C, the epifauna was present for most of each transect with only small patches (1-2 m length) where epifauna was absent. Epifauna was various prostrate and erect with not specific pattern or relationship to the sediment. The sediment was more varied along these transects than those described above, including hard platform (usually with a covering of sand), rubble, and gravel or shell gravel.

4.3.8 Transect P1B

Epifauna in the vicinity of the “Black Watch” tee site, in transect P1B, was highly to frequently abundant and was both prostrate and erect, over a sediment bed consisting largely of sand with some hard platform.

5. DISCUSSION

The survey was conducted in the Otway Basin covering five survey routes and four well sites. The survey areas were located in State and Commonwealth waters approximately 30 km southwest of Port Campbell and in water depths ranging from 20 m to 70 m.

The sandy, gravelly/rubble and hard platform substrates described throughout the survey areas are consistent with the reported description for the area of unconsolidated seabed sediments made up of carbonate sands (Barton et al., 2012; Murray-Wallace and Woodroffe, 2014). The sediment quality results were also consistent with Jones and Davies (1983) who described the grain size distribution as sand and gravel covering the entire shelf except for areas of silty sand in central Bass Strait and other locations more remote from the survey area. The authors noted a regional trend of 'reverse grading' whereby sediment tended to become coarser with distance from shore.

Fine sand was reported to be the predominant sediment type along the inner shelf of Victoria and off much of Tasmania, grading seawards into medium-grain sand, and locally into coarse sand at the edge of the shelf (Jones and Davies, 1983). This feature was observed in the differences in sediment composition between the transects closer to the well sites (gravel, shell and rubble) compared to the sand substrates observed near the "HDD/Iona" site.

The Otway Basin is part of the Southeast Marine Bioregion which extends from the far south coast of New South Wales to Kangaroo Island (Commonwealth of Australia, 2015). Significant variation in seafloor features and water depth contribute to the high level of species diversity in the Region and the shelf habitats are reported to support a diverse range of species from a broad range of taxonomic groups (Commonwealth of Australia, 2015). However, there is no readily-available literature describing the seabed fauna of Otway Basin, meaning it is not possible to make a comparison of infauna and epifauna communities detected to prior studies. Most descriptions of the ecological values of the Basin or the Bioregion are at a broad scale and focus of key features such as cetaceans, birds, fisheries and macroalgae habitats (Commonwealth of Australia, 2015). However, the patchy epifauna and presence of hard platform is consistent with the description of a key ecological feature (KEF) of the South-East bioregion, that is, shelf rocky reefs and hard substrates. Hard ground was patchy and scattered throughout most of the transects, providing attachment opportunities for epifauna. The hard ground observed during the video transects was low-lying and did not provide a reef-type structure of high relief. Epifauna was also noted to occur on unconsolidated substrates (sand and gravel) and amongst biogenic rubble.

Based on the assessment of epifauna using seabed video transects and photographs, the general impression of the seafloor is of an unmodified marine environment that supports a patchy complex of prostrate and branching or erect epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering between 25 and 100% of the available substrate. The most notable change in epifauna abundance was the lack of epifauna in the 'Crossing' transect and the very low abundance of epifauna in the '"HDD/Iona"' transect. No areas of high relief, reefs, sponge beds or ship wrecks were noted throughout the video transects. While sponges were present, they were not so highly abundant or morphological diverse as a taxonomic group to be considered as a sponge bed, rather sponges were interspersed throughout the patchy epifaunal covering.

By comparison, there was a very low abundance and diversity of fauna observed in grab samples, which likely reflects the coarse nature of the substrate. It could be expected that, given the abundance of epifauna observed in video transects, that some of this epifauna would be recovered from the seafloor. However, the Van Veen grab sampler used is not ideal for obtaining undisturbed epifauna samples and would be less likely to work effectively at obtaining a sample from the hard substratum preferred by epifauna. Therefore, the grab samples are not considered to be a good representation of the benthic fauna present within the survey area and the video footage should be relied on in this instance. However, the grab samples provided an adequate example of the nature of the seabed sediment which was also observed in the video transects, and was variously gravelly or rubble with some sand.

In summary, the epibiota on the seabed in the survey area is representative of what is expected within the Otway Basin based on the sediment type and water depth. No species or ecological communities listed as threatened under the Environmental Protection and Biodiversity Conservation Act 1999 (the EPBC Act) were observed. No areas of high relief, reefs, sponge beds or ship wrecks were noted throughout the video transects.

6. REFERENCES

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APPENDIX 1
MARINE MAMMAL SIGHTING REGISTER

First name	Last name	Email address	Species Category	Species	How confident are you in the species?	How many in group?	Group size confidence level	Total adults	Total calves	Sighting cue	Behaviour	Date (UTC)	Time (UTC)	Sighted from	Vessel name	Jurisdiction	Latitude	Longitude	Location description	Sighting notes
Sjaak	Lemmens	sjaak@Enigmatic-group.com.au	Dolphin or porpoise	Bottlenose dolphin - Common	Definitive	50	Certain			Dorsal fin	Milling	9/04/2020	6:48:00 PM	Vessel	Silver Star	Victoria	38.6570	142.9317	Open water off 12 Apostles	Large school. Estimate around 50, but possiby many more. Adults & young. Feeding on fish. Many heading to vessel,riding bow wave.
Sjaak	Lemmens	sjaak@Enigmatic-group.com.au	Dolphin or porpoise	Bottlenose dolphin - Common	Definitive	6	Definitive	0	6	Dorsal fin	Bow ride	12/04/2020	5:20:00 AM	Vessel	Silver Star	Victoria	38.7030	142.6322	Open water off 12 Apostles	
Sjaak	Lemmens	sjaak@Enigmatic-group.com.au	Dolphin or porpoise	Bottlenose dolphin - Common	Definitive	10	Certain	4	6	Dorsal fin	Bow ride	13/04/2020	12:55:00 AM	Vessel	Silver Star	Victoria	38.6474	142.9621	Open water off 12 Apostles	
Sjaak	Lemmens	sjaak@Enigmatic-group.com.au	Dolphin or porpoise	Bottlenose dolphin - Common	Definitive	20	Certain	7	13	Dorsal fin	Bow ride	13/04/2020	2:40:00 AM	Vessel	Silver Star	Victoria	38.6532	142.9425	Open water off 12 Apostles	
Sjaak	Lemmens	sjaak@Enigmatic-group.com.au	Dolphin or porpoise	Bottlenose dolphin - Common	Definitive	4	Definitive	3	1	Dorsal fin	Bow ride	14/04/2020	6:40:00 AM	Vessel	Silver Star	Victoria	38.6464	142.9610	Open water off 12 Apostles	

APPENDIX 2
GRAB SAMPLE FIELD RECORDS

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_01b
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	16:55	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	10%
Vessel	MV Silver Star	**Water Depth (m)**	56.1	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	668383.50	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5719641.58	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo

Sample Description

Fine-grained CARBONATE SAND with silt

Sand is pale yellowish orange, well sorted, fine grained and composed primarily of mixed carbonates. Buried *Polychaete tubes visible*.

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_02
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	17:05	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	5 %
Vessel	MV Silver Star	**Water Depth (m)**	55.4	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	668145.29	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5719575.17	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo

Sample Description

Cobble-sized limestone fragments

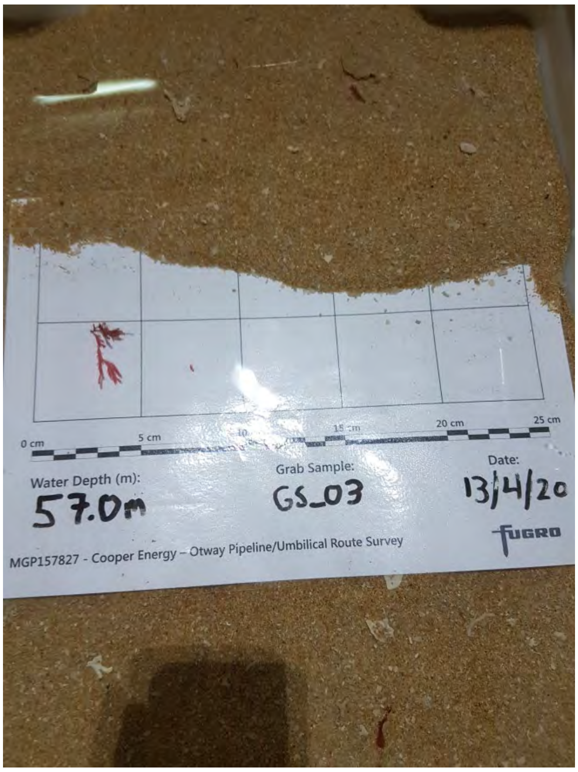
Limestone fragments covered with *Crustose coralline algae (Rhodophyta)*. Alsocolonial tunicates (ascidians) visible (Botryllinae, possibly *Botryllus stewardensis*).

Presence of calcified tube worm casings (Serpulidae, possibly *Galeolaria caespitosa*) and colonial hydroids (possibly Leptothecata).

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_03d
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	18:38	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	20 %
Vessel	MV Silver Star	**Water Depth (m)**	58.2	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	658744.87	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5716775.62	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo



Sample Description

Fine-medium CARBONATE SAND

Sand is dark yellowish orange, well sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces. Few pieces of red algae (Rhodophyta, possibly *Hemineura frondosa*).

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_04
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	18:55	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	20 %
Vessel	MV Silver Star	**Water Depth (m)**	58.8	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	658167.99	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5715913.97	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo

Sample Description

Coarse gravelly CARBONATE SAND

Sand fraction varies from white to reddish olive-brown, poorly sorted, medium to coarse grained and composed primarily of mixed carbonates. Major fraction shell fragments.

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_05
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	19:25	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	20 %
Vessel	MV Silver Star	**Water Depth (m)**	67.2	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	657713.25	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5712656.07	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo

Sample Description

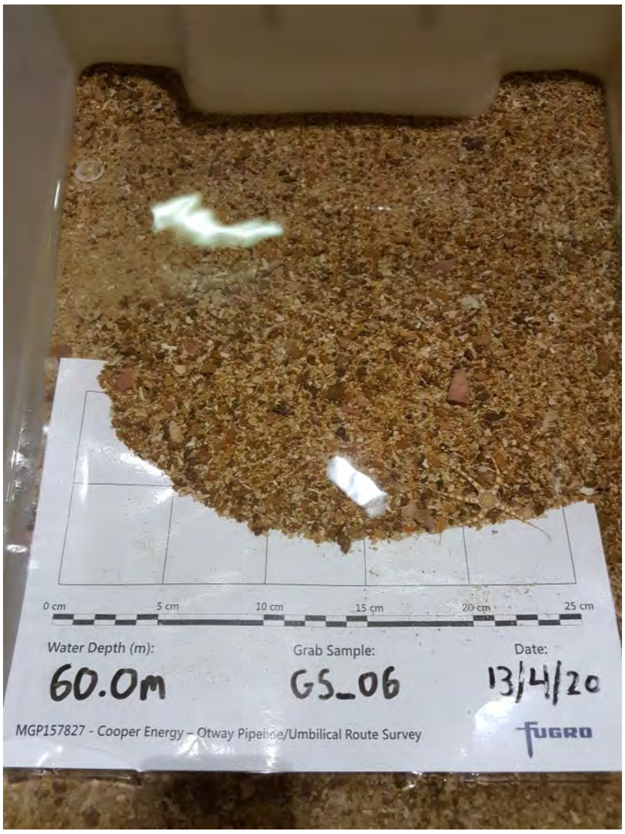
Fine-medium CARBONATE SAND

Sand is light yellowish orange, moderately sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_06
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	19:38	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	20 %
Vessel	MV Silver Star	**Water Depth (m)**	58.6	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	656388.40	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5713029.78	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo



Sample Description

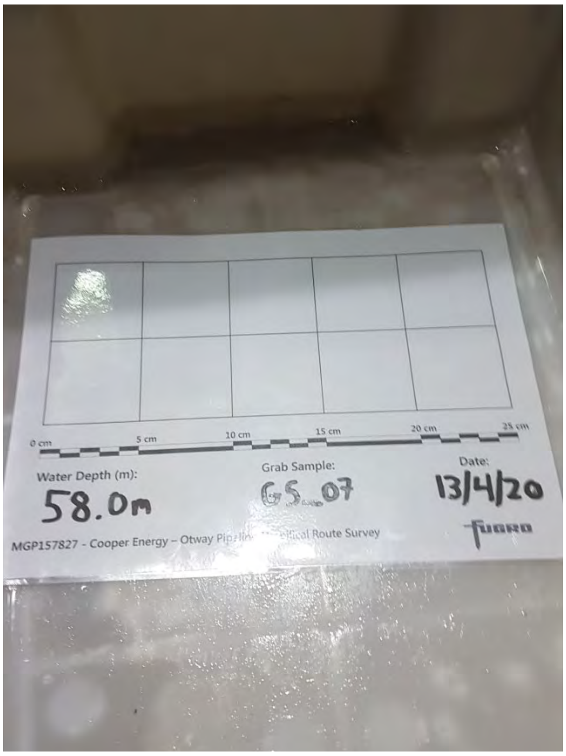
CARBONATE SAND and GRAVELS

Sand is light yellowish orange, fine to coarse grained and composed primarily of mixed carbonates. Gravels are reddish brown and poorly sorted with sand and shell fragments. Minor fraction of shell pieces. Single live Brittle star (Ophiuridae, Genus *Ophionereis, possibly Ophionereis schayeri*).

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_07c
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	20:24	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	0 %
Vessel	MV Silver Star	**Water Depth (m)**	59.5	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	655036.16	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5716083.73	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo



Sample Description

Four attempts were made, however no sample was recovered. Small limestone rock caught in grab on first attempt, prohibiting grab from closing, but not retained.

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_08
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	21:35	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	20 %
Vessel	MV Silver Star	**Water Depth (m)**	63.2	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	657330.48	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5707359.54	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo

Sample Description

CARBONATE SAND and GRAVELS

Sand is light yellowish orange, fine to medium grained and composed primarily of mixed carbonates. Moderately sorted with shell fragments. Fraction of shell pieces and lacy bryozoan fragments (Phidoloporidae).

Grab Sample Log

Project No	MGP157827	**Date (local)**	13/04/2020	**Sample No**	GS_09a
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	22:29	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	30 %
Vessel	MV Silver Star	**Water Depth (m)**	68.4	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	651976.17	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5704863.93	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo

Sample Description

CARBONATE GRAVELS and SAND

Gravels are light gray to grayish orange in color, very poorly sorted amongst fine to coarse grained sands composed primarily of mixed carbonates. Large fraction of shells, shell pieces and lacy bryozoan fragments (Phidoloporidae).

Grab Sample Log

Project No	MGP157827	**Date (local)**	14/04/2020	**Sample No**	GS_10
Project Name	Otway Pipeline/Umbilical Route Survey	**Time (local)**	00:14	**Sampler Capacity**	0.1 m^3
Client	Cooper Energy	**Time Zone**	GMT+10	**Recovery**	10 %
Vessel	MV Silver Star	**Water Depth (m)**	65.4	**Grab Sampler**	Van Veen
Geo	Ryan M. Vitas	**Vertical Datum**	Lowest Astronomical Tide (LAT)		
Easting (m)	642045.82	**Projection**	Universal Transverse Mercator UTM Z54 (S)		
Northing (m)	5715337.53	**Horizontal Datum**	International Terrestrial Reference Frame 2014 (ITRF 2014)		

Sample Photo

Sample Description

Fine-medium CARBONATE SAND

Sand is dark yellowish orange, well sorted, fine to medium grained and composed primarily of mixed carbonates. Minor fraction of shell pieces.

APPENDIX 3
VIDEO TRANSECT ASSESSMENT LOG

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
Crossing	2020_04_14_050424902	00:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424903	01:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424904	01:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424905	02:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424906	02:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424907	03:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424908	03:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424909	04:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424910	04:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424911	05:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424912	05:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424913	06:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424914	06:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424915	07:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424916	07:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424917	08:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424918	08:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424919	09:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424920	09:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424921	10:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424922	10:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424923	11:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424924	11:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424925	12:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424926	12:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424927	13:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424928	13:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424929	14:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424930	14:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424931	15:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424932	15:30	No Fauna		75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
Crossing	2020_04_14_050424933	16:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424934	16:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424935	17:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424936	17:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424937	18:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424938	18:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424939	19:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424940	19:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424941	20:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424942	20:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424943	21:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424944	21:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424945	22:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424946	22:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424947	23:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424948	23:30	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424949	24:00	No Fauna		75-100%	Sand	
Crossing	2020_04_14_050424950	24:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150956	00:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150957	01:00	Occasional	Prostrate epifauna	75-100%	Sand	
HDD_Exit	2020_04_14_055150958	01:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150959	02:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150960	02:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150961	03:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150962	03:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150963	04:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150964	04:30	Occasional	Prostrate epifauna	75-100%	Sand	
HDD_Exit	2020_04_14_055150965	05:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150966	05:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150967	06:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150968	06:30	No Fauna		75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
HDD_Exit	2020_04_14_055150969	07:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150970	07:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150971	08:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150972	08:30	Frequent	Prostrate epifauna	50-75%	Sand	
HDD_Exit	2020_04_14_055150973	09:00	Frequent	Prostrate epifauna	50-75%	Sand	
HDD_Exit	2020_04_14_055150974	09:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150975	10:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150976	10:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150977	11:00	Frequent	Prostrate epifauna	75-100%	Sand	
HDD_Exit	2020_04_14_055150978	11:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150979	12:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150980	12:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150981	13:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150982	13:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150983	14:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150984	14:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150985	15:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150986	15:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150987	16:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150988	16:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150989	17:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150990	17:30	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150991	18:00	No Fauna		75-100%	Sand	
HDD_Exit	2020_04_14_055150992	18:30	No Fauna		75-100%	Sand	
P1a	2020_04_14_001345689	00:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345690	01:00	Abundant	Prostrate epifauna	50-75%	Sand	
P1a	2020_04_14_001345691	01:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345692	02:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345693	02:30	No Fauna		75-100%	Sand	
P1a	2020_04_14_001345694	03:00	No Fauna		75-100%	Sand	Asteroidea, Teleost (gurnard/cod-like)
P1a	2020_04_14_001345695	03:30	No Fauna		75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1a	2020_04_14_001345696	04:00	No Fauna		75-100%	Sand	
P1a	2020_04_14_001345697	04:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345698	05:00	Frequent	Prostrate epifauna	50-75%	Sand	
P1a	2020_04_14_001345699	05:30	Highly Abundant	Erect epifauna	<25%	Sand	
P1a	2020_04_14_001345700	06:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345701	06:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345702	07:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345703	07:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345704	08:00	Frequent	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345705	08:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345706	09:00	Occasional	Erect epifauna	75-100%	Sand	
P1a	2020_04_14_001345707	09:30	No Fauna		75-100%	Sand	
P1a	2020_04_14_001345708	10:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345709	10:30	No Fauna		75-100%	Gravelly (shelly) sand	
P1a	2020_04_14_001345710	11:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345711	11:30	No Fauna		75-100%	Sand	
P1a	2020_04_14_001345712	12:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P1a	2020_04_14_001345713	12:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345714	13:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	Teleost
P1a	2020_04_14_001345715	13:30	No Fauna		75-100%	Gravelly (shelly) sand	
P1a	2020_04_14_001345716	14:00	Frequent	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345717	14:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345718	15:00	Abundant	Prostrate epifauna	50-75%	Hard Platform/Sand	Asteroidea
P1a	2020_04_14_001345719	15:30	Occasional	Prostrate epifauna	75-100%	Sand	Asteroidea
P1a	2020_04_14_001345720	16:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345721	16:30	Occasional	Erect epifauna	75-100%	Sand	
P1a	2020_04_14_001345722	17:00	Frequent	Prostrate epifauna	75-100%	Hard Platform/Sand	
P1a	2020_04_14_001345723	17:30	Frequent	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345724	18:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345725	18:30	Frequent	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345726	19:00	Occasional	Prostrate epifauna	75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1a	2020_04_14_001345727	19:30	Abundant	Prostrate epifauna	<25%	Sand	
P1a	2020_04_14_001345728	20:00	Frequent	Prostrate epifauna	50-75%	Sand	
P1a	2020_04_14_001345729	20:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345730	21:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345731	21:30	Occasional	Prostrate epifauna	75-100%	Sand	2 teleost
P1a	2020_04_14_001345732	22:00	Abundant	Erect epifauna	<25%	Sand	
P1a	2020_04_14_001345733	22:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345734	23:00	Abundant	Prostrate epifauna	25-50%	Sand	
P1a	2020_04_14_001345735	23:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345736	24:00	Abundant	Prostrate epifauna	25-50%	Sand	
P1a	2020_04_14_001345737	24:30	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P1a	2020_04_14_001345738	25:00	Frequent	Prostrate epifauna	50-75%	Sand	
P1a	2020_04_14_001345739	25:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345740	26:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345741	26:30	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P1a	2020_04_14_001345742	27:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345743	27:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345744	28:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345745	28:30	Frequent	Prostrate epifauna	75-100%	Hard Platform/Sand	6 teleost
P1a	2020_04_14_001345746	29:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345747	29:30	No Fauna		75-100%	Sand	
P1a	2020_04_14_001345748	30:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345749	30:30	Highly Abundant	Erect epifauna	<25%	Sand	
P1a	2020_04_14_001345750	31:00	Abundant	Erect epifauna	50-75%	Sand	
P1a	2020_04_14_001345751	31:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345752	32:00	No Fauna		75-100%	Sand	
P1a	2020_04_14_001345753	32:30	Occasional	Erect epifauna	75-100%	Sand	
P1a	2020_04_14_001345754	33:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P1a	2020_04_14_001345755	33:30	Abundant	Prostrate epifauna	25-50%	Hard Platform/Sand	
P1a	2020_04_14_001345756	34:00	Occasional	Prostrate epifauna	75-100%	Sand	Teleost
P1a	2020_04_14_001345757	34:30	Occasional	Prostrate epifauna	75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1a	2020_04_14_001345758	35:00	Abundant	Prostrate epifauna	25-50%	Sand	
P1a	2020_04_14_001345759	35:30	Abundant	Erect epifauna	<25%	Sand	
P1a	2020_04_14_001345760	36:00	Frequent	Prostrate epifauna	50-75%	Sand	Brittle star
P1a	2020_04_14_001345761	36:30	Highly Abundant	Erect epifauna	<25%	Sand	
P1a	2020_04_14_001345762	37:00	Highly Abundant	Prostrate epifauna	25-50%	Sand	Asteroidea
P1a	2020_04_14_001345763	37:30	Frequent	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345764	38:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345765	38:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345766	39:00	Frequent	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345767	39:30	Occasional	Erect epifauna	75-100%	Sand	
P1a	2020_04_14_001345768	40:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P1a	2020_04_14_001345769	40:30	Frequent	Prostrate epifauna	50-75%	Sand	
P1a	2020_04_14_001345770	41:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1a	2020_04_14_001345771	41:30	Abundant	Prostrate epifauna	25-50%	Sand	
P1a	2020_04_14_001345772	42:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P1a	2020_04_14_001345773	42:30	Frequent	Erect epifauna	50-75%	Sand	
P1a	2020_04_14_001345774	43:00	Abundant	Prostrate epifauna	<25%	Sand	
P1a	2020_04_14_001345775	43:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P1b	2020_04_13_191653134	00:30	No Fauna		75-100%	Sand with Gravel	Teleost
P1b	2020_04_13_191653134	01:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	Teleost
P1b	2020_04_13_191653134	01:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1b	2020_04_13_191653134	02:00	Occasional	Prostrate epifauna	50-75%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	02:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	03:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	03:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	04:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	04:30	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	05:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	Asteroidea
P1b	2020_04_13_191653134	05:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	06:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	06:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1b	2020_04_13_191653134	07:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	07:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	08:00	Frequent	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	08:30	Frequent	Erect epifauna	50-75%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	09:00	Frequent	Erect epifauna	50-75%	Sand with Gravel	
P1b	2020_04_13_191653134	09:30	No Fauna		75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	10:00	No Fauna		75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	10:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	11:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	11:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	12:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	12:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	13:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	13:30	No Fauna		75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	14:00	Abundant	Erect epifauna	<25%	Sand	
P1b	2020_04_13_191653134	14:30	Abundant	Prostrate epifauna	25-50%	Sand with Gravel	
P1b	2020_04_13_191653134	15:00	Abundant	Prostrate epifauna	25-50%	Sand	
P1b	2020_04_13_191653134	15:30	Abundant	Prostrate epifauna	25-50%	Sand	
P1b	2020_04_13_191653134	16:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	16:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	17:00	Frequent	Prostrate epifauna	50-75%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	17:30	Frequent	Erect epifauna	50-75%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	18:00	No Fauna		75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	18:30	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P1b	2020_04_13_191653134	19:00	No Fauna		75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	19:30	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	20:00	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P1b	2020_04_13_191653134	20:30	Frequent	Prostrate epifauna	50-75%	Sand	
P1b	2020_04_13_191653134	21:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	21:30	Frequent	Erect epifauna	50-75%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	22:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1b	2020_04_13_191653134	22:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	23:00	Occasional	Erect epifauna	75-100%	Gravelly (shelly) sand	Teleost
P1b	2020_04_13_191653134	23:30	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	24:00	No Fauna		75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	24:30	No Fauna		75-100%	Gravelly (shelly) sand	4 teleost (big head bullet-like)
P1b	2020_04_13_191653134	25:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	Asteroidea (2 diff spp), 1 teleost
P1b	2020_04_13_191653134	25:30	No Fauna		75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	26:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	26:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1b	2020_04_13_191653134	27:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	27:30	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P1b	2020_04_13_191653134	28:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	28:30	Abundant	Erect epifauna	25-50%	Sand	Stingray
P1b	2020_04_13_191653134	29:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	29:30	Frequent	Prostrate epifauna	50-75%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	30:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	30:30	Frequent	Prostrate epifauna	75-100%	Sand	Teleost
P1b	2020_04_13_191653134	31:00	Frequent	Erect epifauna	50-75%	Sand	
P1b	2020_04_13_191653134	31:30	Abundant	Prostrate epifauna	25-50%	Sand	
P1b	2020_04_13_191653134	32:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	32:30	Frequent	Erect epifauna	50-75%	Sand	
P1b	2020_04_13_191653134	33:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	Cephalopod
P1b	2020_04_13_191653134	33:30	Occasional	Erect epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	34:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	34:30	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1b	2020_04_13_191653134	35:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	Teleost
P1b	2020_04_13_191653134	35:30	Frequent	Erect epifauna	50-75%	Gravelly (shelly) sand	Teleost
P1b	2020_04_13_191653134	36:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	Teleost
P1b	2020_04_13_191653134	36:30	No Fauna		75-100%	Gravelly (shelly) sand	Teleost
P1b	2020_04_13_191653134	37:00	No Fauna		75-100%	Gravelly (shelly) sand	
P1b	2020_04_13_191653134	37:30	No Fauna		75-100%	Gravelly (shelly) sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1b	2020_04_13_191653134	38:00	Frequent	Erect epifauna	50-75%	Sand with Gravel	
P1b	2020_04_13_191653134	38:30	No Fauna		75-100%	Gravelly (shelly) sand	
P1c	2020_04_13_205235711	00:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	01:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1c	2020_04_13_205235711	01:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	02:00	Highly Abundant	Erect epifauna	<25%	Sand	
P1c	2020_04_13_205235711	02:30	Abundant	Prostrate epifauna	25-50%	Sand	Nudibranchia eggs
P1c	2020_04_13_205235711	03:00	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P1c	2020_04_13_205235711	03:30	Occasional	Prostrate epifauna	50-75%	Sand with Gravel	Asteroidea
P1c	2020_04_13_205235711	04:00	Abundant	Prostrate epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	04:30	Abundant	Erect epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	05:00	Frequent	Prostrate epifauna	50-75%	Sand	
P1c	2020_04_13_205235711	05:30	Frequent	Prostrate epifauna	50-75%	Sand	
P1c	2020_04_13_205235711	06:00	Occasional	Prostrate epifauna	75-100%	Sand	1 crinoid
P1c	2020_04_13_205235711	06:30	Highly Abundant	Erect epifauna	<25%	Sand	
P1c	2020_04_13_205235711	07:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1c	2020_04_13_205235711	07:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	08:00	Abundant	Erect epifauna	50-75%	Hard Platform/Sand	
P1c	2020_04_13_205235711	08:30	Frequent	Erect epifauna	50-75%	Sand	
P1c	2020_04_13_205235711	09:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P1c	2020_04_13_205235711	09:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P1c	2020_04_13_205235711	10:00	Frequent	Erect epifauna	50-75%	Hard Platform/Sand	
P1c	2020_04_13_205235711	10:30	Frequent	Prostrate epifauna	50-75%	Sand	
P1c	2020_04_13_205235711	11:00	Frequent	Prostrate epifauna	75-100%	Sand	3 crinoid
P1c	2020_04_13_205235711	11:30	Frequent	Erect epifauna	50-75%	Hard Platform/Sand	
P1c	2020_04_13_205235711	12:00	Abundant	Prostrate epifauna	25-50%	Hard Platform/Sand	
P1c	2020_04_13_205235711	12:30	Abundant	Prostrate epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	13:00	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P1c	2020_04_13_205235711	13:30	Occasional	Erect epifauna	75-100%	Sand with Gravel	
P1c	2020_04_13_205235711	14:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	14:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1c	2020_04_13_205235711	15:00	Abundant	Prostrate epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	15:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	16:00	Abundant	Prostrate epifauna	25-50%	Sand	Teleost
P1c	2020_04_13_205235711	16:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P1c	2020_04_13_205235711	17:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P1c	2020_04_13_205235711	17:30	Abundant	Erect epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	18:00	Abundant	Erect epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	18:30	Frequent	Prostrate epifauna	50-75%	Sand	
P1c	2020_04_13_205235711	19:00	Abundant	Erect epifauna	25-50%	Hard Platform/Sand	
P1c	2020_04_13_205235711	19:30	Frequent	Prostrate epifauna	50-75%	Sand	A
P1c	2020_04_13_205235711	20:00	Highly Abundant	Erect epifauna	<25%	Sand	
P1c	2020_04_13_205235711	20:30	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	1crinoid
P1c	2020_04_13_205235711	21:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	21:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	22:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	22:30	Highly Abundant	Erect epifauna	<25%	Sand	
P1c	2020_04_13_205235711	23:00	Frequent	Prostrate epifauna	50-75%	Sand	3 crinoid
P1c	2020_04_13_205235711	23:30	No Fauna		75-100%	Gravelly (shelly) sand	
P1c	2020_04_13_205235711	24:00	Abundant	Prostrate epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	24:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P1c	2020_04_13_205235711	25:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	25:30	Abundant	Prostrate epifauna	25-50%	Sand	
P1c	2020_04_13_205235711	26:00	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	26:30	Occasional	Prostrate epifauna	75-100%	Sand	
P1c	2020_04_13_205235711	27:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P1c	2020_04_13_205235711	27:30	Frequent	Prostrate epifauna	50-75%	Gravelly (shelly) sand	
P1c	2020_04_13_205235711	28:00	Frequent	Prostrate epifauna	50-75%	Sand	
P1c	2020_04_13_205235711	28:30	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P1c	2020_04_13_205235711	29:00	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P1c	2020_04_13_205235711	29:30	Frequent	Erect epifauna	50-75%	Sand	
P1c	2020_04_13_205235711	30:00	Frequent	Prostrate epifauna	50-75%	Sand	4 teleost

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P1c	2020_04_13_205235711	30:30	N/A	N/A	N/A	N/A	Drop cam not close enough to seabed
P2a	2020_04_13_152130731	00:30	N/A	N/A	N/A	N/A	Drop cam not close enough to seabed
P2a	2020_04_13_152130731	01:00	N/A	N/A	N/A	N/A	Drop cam not close enough to seabed
P2a	2020_04_13_152130731	01:30	N/A	N/A	N/A	N/A	Drop cam not close enough to seabed
P2a	2020_04_13_152130731	02:00	N/A	N/A	N/A	N/A	Drop cam not close enough to seabed
P2a	2020_04_13_152130731	02:30	N/A	N/A	N/A	N/A	Drop cam not close enough to seabed
P2a	2020_04_13_152130731	03:00	Occasional	Prostrate epifauna	75-100%	Sand	
P2a	2020_04_13_152130731	03:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2a	2020_04_13_152130731	04:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2a	2020_04_13_152130731	04:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2a	2020_04_13_152130731	05:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2a	2020_04_13_152130731	05:30	Frequent	Erect epifauna	50-75%	Sand	1 crinoid
P2a	2020_04_13_152130731	06:00	Occasional	Prostrate epifauna	75-100%	Sand	
P2a	2020_04_13_152130731	06:30	Frequent	Prostrate epifauna	50-75%	Sand	Teleost (triplefin-like)
P2a	2020_04_13_152130731	07:00	Occasional	Prostrate epifauna	75-100%	Sand	
P2a	2020_04_13_152130731	07:30	Occasional	Erect epifauna	75-100%	Sand	
P2a	2020_04_13_152130731	08:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2a	2020_04_13_152130731	08:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2a	2020_04_13_152130731	09:00	Occasional	Prostrate epifauna	75-100%	Sand	
P2a	2020_04_13_152130731	09:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2a	2020_04_13_152130731	10:00	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P2a	2020_04_13_152130731	10:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2a	2020_04_13_152130731	11:00	Frequent	Erect epifauna	50-75%	Sand	
P2a	2020_04_13_152130731	11:30	Frequent	Prostrate epifauna	50-75%	Sand	Cone shell
P2a	2020_04_13_152130731	12:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2a	2020_04_13_152130731	12:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2a	2020_04_13_152130731	13:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2a	2020_04_13_152130731	13:30	Abundant	Prostrate epifauna	25-50%	Sand	1 crinoid
P2a	2020_04_13_152130731	14:00	Highly Abundant	Erect epifauna	<25%	Sand	
P2a	2020_04_13_152130731	14:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2a	2020_04_13_152130731	15:00	No Fauna		75-100%	Sand with Gravel	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P2b	2020_04_13_223043238	00:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	01:00	Highly Abundant	Prostrate epifauna	<25%	Hard Platform/Sand	1 filefish
P2b	2020_04_13_223043238	01:30	Frequent	Prostrate epifauna	50-75%	Sand	4 filefish
P2b	2020_04_13_223043238	02:00	Abundant	Prostrate epifauna	25-50%	Sand	Man-made wide diameter pipe structure - acting as artificial reef - Refer to Section 4.3.3 for comment
P2b	2020_04_13_223043238	02:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2b	2020_04_13_223043238	03:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2b	2020_04_13_223043238	03:30	Abundant	Prostrate epifauna	25-50%	Sand	Man-made thin diameter pipe structure - acting as artificial reef - Refer to Section 4.3.3 for comment
P2b	2020_04_13_223043238	04:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	04:30	Abundant	Prostrate epifauna	25-50%	Hard Platform/Sand	
P2b	2020_04_13_223043238	05:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2b	2020_04_13_223043238	05:30	Abundant	Erect epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	06:00	Abundant	Prostrate epifauna	25-50%	Hard Platform/Sand	
P2b	2020_04_13_223043238	06:30	Highly Abundant	Erect epifauna	<25%	Sand	
P2b	2020_04_13_223043238	07:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	07:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	08:00	Frequent	Erect epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	08:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	09:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2b	2020_04_13_223043238	09:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	10:00	Frequent	Erect epifauna	50-75%	Sand	Teleost
P2b	2020_04_13_223043238	10:30	Frequent	Prostrate epifauna	50-75%	Sand	Teleost
P2b	2020_04_13_223043238	11:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	11:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	12:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	12:30	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P2b	2020_04_13_223043238	13:00	Frequent	Prostrate epifauna	50-75%	Sand	2/3 snapper, stingray
P2b	2020_04_13_223043238	13:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	14:00	Occasional	Prostrate epifauna	75-100%	Sand	Asteroidea
P2b	2020_04_13_223043238	14:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	15:00	Frequent	Erect epifauna	50-75%	Sand	2 crinoid, snapper

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P2b	2020_04_13_223043238	15:30	Frequent	Erect epifauna	50-75%	Gravelly (shelly) sand	
P2b	2020_04_13_223043238	16:00	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P2b	2020_04_13_223043238	16:30	Frequent	Prostrate epifauna	50-75%	Sand	Snapper
P2b	2020_04_13_223043238	17:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	17:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	18:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2b	2020_04_13_223043238	18:30	Highly Abundant	Erect epifauna	<25%	Sand	
P2b	2020_04_13_223043238	19:00	Highly Abundant	Prostrate epifauna	Not Visible		
P2b	2020_04_13_223043238	19:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	20:00	Frequent	Erect epifauna	50-75%	Sand with Gravel	
P2b	2020_04_13_223043238	20:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	21:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P2b	2020_04_13_223043238	21:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	22:00	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P2b	2020_04_13_223043238	22:30	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P2b	2020_04_13_223043238	23:00	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P2b	2020_04_13_223043238	23:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	24:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	24:30	Occasional	Erect epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	25:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	25:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	26:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	26:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	27:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2b	2020_04_13_223043238	27:30	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	28:00	Highly Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	28:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P2b	2020_04_13_223043238	29:00	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	29:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	30:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P2b	2020_04_13_223043238	30:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P2b	2020_04_13_223043238	31:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P2b	2020_04_13_223043238	31:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	32:00	Frequent	Erect epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	32:30	Frequent	Erect epifauna	50-75%	Sand	5 snapper
P2b	2020_04_13_223043238	33:00	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	33:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	34:00	No Fauna		75-100%	Sand	
P2b	2020_04_13_223043238	34:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P2b	2020_04_13_223043238	35:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P2b	2020_04_13_223043238	35:30	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	36:00	Occasional	Erect epifauna	75-100%	Sand	Asteroidea
P2b	2020_04_13_223043238	36:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	37:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	37:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P2b	2020_04_13_223043238	38:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	38:30	Abundant	Prostrate epifauna	25-50%	Sand	Snapper
P2b	2020_04_13_223043238	39:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	39:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P2b	2020_04_13_223043238	40:00	Frequent	Prostrate epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	40:30	Frequent	Prostrate epifauna	50-75%	Sand with Gravel	
P2b	2020_04_13_223043238	41:00	Abundant	Erect epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	41:30	Frequent	Erect epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	42:00	Abundant	Erect epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	42:30	Occasional	Prostrate epifauna	75-100%	Sand	
P2b	2020_04_13_223043238	43:00	Frequent	Erect epifauna	25-50%	Sand	Asteroidea
P2b	2020_04_13_223043238	43:30	Frequent	Erect epifauna	50-75%	Sand	
P2b	2020_04_13_223043238	44:00	Abundant	Prostrate epifauna	25-50%	Sand	
P2b	2020_04_13_223043238	44:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P3a	2020_04_14_042325042	00:30	Highly Abundant	Prostrate epifauna	<25%	Sand	
P3a	2020_04_14_042325043	01:00	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3a	2020_04_14_042325044	01:30	Occasional	Prostrate epifauna	75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P3a	2020_04_14_042325045	02:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3a	2020_04_14_042325046	02:30	Highly Abundant	Prostrate epifauna	<25%	Sand	1crinoid
P3a	2020_04_14_042325047	03:00	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3a	2020_04_14_042325048	03:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3a	2020_04_14_042325049	04:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3a	2020_04_14_042325050	04:30	Frequent	Erect epifauna	50-75%	Sand	
P3a	2020_04_14_042325051	05:00	Frequent	Erect epifauna	50-75%	Sand	
P3a	2020_04_14_042325052	05:30	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3a	2020_04_14_042325053	06:00	Abundant	Prostrate epifauna	25-50%	Sand	
P3a	2020_04_14_042325054	06:30	Occasional	Prostrate epifauna	75-100%	Rubble	
P3a	2020_04_14_042325055	07:00	Abundant	Erect epifauna	25-50%	Sand with Rubble	
P3a	2020_04_14_042325056	07:30	Occasional	Erect epifauna	75-100%	Rubble	
P3a	2020_04_14_042325057	08:00	Occasional	Erect epifauna	75-100%	Rubble	
P3a	2020_04_14_042325058	08:30	Occasional	Erect epifauna	75-100%	Rubble	
P3a	2020_04_14_042325059	09:00	Occasional	Prostrate epifauna	75-100%	Rubble	
P3a	2020_04_14_042325060	09:30	Occasional	Prostrate epifauna	75-100%	Rubble	
P3a	2020_04_14_042325061	10:00	Occasional	Prostrate epifauna	75-100%	Rubble	
P3a	2020_04_14_042325062	10:30	Occasional	Erect epifauna	75-100%	Sand with Rubble	
P3a	2020_04_14_042325063	11:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3a	2020_04_14_042325064	11:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3b	2020_04_14_035718866	00:30	No Fauna		75-100%	Hard Platform/Sand	
P3b	2020_04_14_035718867	01:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3b	2020_04_14_035718868	01:30	Occasional	Erect epifauna	75-100%	Sand	
P3b	2020_04_14_035718869	02:00	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3b	2020_04_14_035718870	02:30	Occasional	Erect epifauna	75-100%	Sand	
P3b	2020_04_14_035718871	03:00	Occasional	Erect epifauna	75-100%	Sand with Rubble	
P3b	2020_04_14_035718872	03:30	Occasional	Erect epifauna	75-100%	Sand with Rubble	
P3b	2020_04_14_035718873	04:00	Occasional	Erect epifauna	75-100%	Rubble	
P3b	2020_04_14_035718874	04:30	Occasional	Erect epifauna	75-100%	Sand with Rubble	Stingray
P3b	2020_04_14_035718875	05:00	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P3b	2020_04_14_035718876	05:30	Abundant	Prostrate epifauna	25-50%	Hard Platform/Sand	
P3b	2020_04_14_035718877	06:00	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3b	2020_04_14_035718878	06:30	Frequent	Prostrate epifauna	50-75%	Sand	
P3b	2020_04_14_035718879	07:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3b	2020_04_14_035718880	07:30	Occasional	Prostrate epifauna	75-100%	Sand	
P3b	2020_04_14_035718881	08:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3b	2020_04_14_035718882	08:30	Occasional	Prostrate epifauna	75-100%	Sand	
P3b	2020_04_14_035718883	09:00	Occasional	Erect epifauna	75-100%	Sand	Teleost
P3b	2020_04_14_035718884	09:30	Highly Abundant	Prostrate epifauna	<25%	Sand with Rubble	Teleost
P3b	2020_04_14_035718885	10:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3b	2020_04_14_035718886	10:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3b	2020_04_14_035718887	11:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3c	2020_04_14_025448837	00:30	Occasional	Erect epifauna	75-100%	Sand	
P3c	2020_04_14_025448838	01:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3c	2020_04_14_025448839	01:30	No Fauna		75-100%	Sand with Rubble	1 crinoid
P3c	2020_04_14_025448840	02:00		Prostrate epifauna	75-100%	Sand	
P3c	2020_04_14_025448841	02:30	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3c	2020_04_14_025448842	03:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3c	2020_04_14_025448843	03:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3c	2020_04_14_025448844	04:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3c	2020_04_14_025448845	04:30	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3c	2020_04_14_025448846	05:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3c	2020_04_14_025448847	05:30	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3c	2020_04_14_025448848	06:00	N/A	N/A	N/A	N/A	Drop cam too far from seabed to classify, poor vis and moving too quicly
P3c	2020_04_14_025448849	06:30	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P3c	2020_04_14_025448850	07:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3c	2020_04_14_025448851	07:30	Occasional	Prostrate epifauna	75-100%	Rubble	
P3c	2020_04_14_025448852	08:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3c	2020_04_14_025448853	08:30	Occasional	Prostrate epifauna	75-100%	Sand	
P3c	2020_04_14_025448854	09:00	Occasional	Prostrate epifauna	75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P3c	2020_04_14_025448855	09:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3c	2020_04_14_025448856	10:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3c	2020_04_14_025448857	10:30	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	Teleost
P3c	2020_04_14_025448858	11:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3c	2020_04_14_025448859	11:30	Frequent	Prostrate epifauna	50-75%	Hard Platform/Sand	
P3c	2020_04_14_025448860	12:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	Teleost
P3c	2020_04_14_025448861	12:30	Abundant	Prostrate epifauna	25-50%	Hard Platform/Sand	
P3c	2020_04_14_025448862	13:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3c	2020_04_14_025448863	13:30	Occasional	Prostrate epifauna	75-100%	Sand	Teleost
P3c	2020_04_14_025448864	14:00	Occasional	Erect epifauna	75-100%	Sand with Rubble	
P3c	2020_04_14_025448865	14:30	Occasional	Prostrate epifauna	75-100%	Sand	
P3c	2020_04_14_025448866	15:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	Teleost
P3d	2020_04_14_021010789	00:30	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3d	2020_04_14_021010790	01:00	Frequent	Prostrate epifauna	50-75%	Sand with Rubble	
P3d	2020_04_14_021010791	01:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3d	2020_04_14_021010792	02:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3d	2020_04_14_021010793	02:30	Abundant	Prostrate epifauna	25-50%	Sand	
P3d	2020_04_14_021010794	03:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3d	2020_04_14_021010795	03:30	Frequent	Prostrate epifauna	50-75%	Sand	
P3d	2020_04_14_021010796	04:00	Frequent	Prostrate epifauna	50-75%	Sand with Rubble	
P3d	2020_04_14_021010797	04:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	Teleost
P3d	2020_04_14_021010798	05:00	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3d	2020_04_14_021010799	05:30	No Fauna		75-100%	Sand with Rubble	
P3d	2020_04_14_021010800	06:00	Abundant	Prostrate epifauna	25-50%	Sand	Teleost
P3d	2020_04_14_021010801	06:30	Occasional	Prostrate epifauna	75-100%	Sand	
P3d	2020_04_14_021010802	07:00	Occasional	Erect epifauna	75-100%	Sand with Rubble	
P3d	2020_04_14_021010803	07:30	No Fauna		75-100%	Hard Platform/Sand	Teleost
P3d	2020_04_14_021010804	08:00	Frequent	Prostrate epifauna	50-75%	Sand	
P3d	2020_04_14_021010805	08:30	Frequent	Prostrate epifauna	50-75%	Sand	Teleost
P3d	2020_04_14_021010806	09:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3d	2020_04_14_021010807	09:30	Occasional	Prostrate epifauna	75-100%	Sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P3d	2020_04_14_021010808	10:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3d	2020_04_14_021010809	10:30	Abundant	Erect epifauna	25-50%	Sand	
P3d	2020_04_14_021010810	11:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3d	2020_04_14_021010811	11:30	Frequent	Prostrate epifauna	50-75%	Sand	
P3d	2020_04_14_021010812	12:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3d	2020_04_14_021010813	12:30	Occasional	Prostrate epifauna	75-100%	Sand	
P3d	2020_04_14_021010814	13:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3d	2020_04_14_021010815	13:30	Frequent	Prostrate epifauna	50-75%	Sand with Rubble	
P3d	2020_04_14_021010816	14:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	00:30	Occasional	Erect epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	01:00	Frequent	Prostrate epifauna	50-75%	Sand	
P3e	2020_04_13_172701675	01:30	Occasional	Prostrate epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	02:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	02:30	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3e	2020_04_13_172701675	03:00	Occasional	Prostrate epifauna	75-100%	Sand with Gravel	
P3e	2020_04_13_172701675	03:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3e	2020_04_13_172701675	04:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	04:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3e	2020_04_13_172701675	05:00	No Fauna		75-100%	Sand	
P3e	2020_04_13_172701675	05:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	06:00	Occasional	Prostrate epifauna	75-100%	Gravel and Rubble	
P3e	2020_04_13_172701675	06:30	Occasional	Prostrate epifauna	75-100%	Hard Platform with Gravel	
P3e	2020_04_13_172701675	07:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	07:30	Frequent	Prostrate epifauna	50-75%	Sand with Rubble	
P3e	2020_04_13_172701675	08:00	Highly Abundant	Prostrate epifauna	<25%	Sand	
P3e	2020_04_13_172701675	08:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	
P3e	2020_04_13_172701675	09:00	Abundant	Erect epifauna	25-50%	Sand	
P3e	2020_04_13_172701675	09:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	1 crinoid
P3e	2020_04_13_172701675	10:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	Teleost
P3e	2020_04_13_172701675	10:30	Occasional	Erect epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	11:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P3e	2020_04_13_172701675	11:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	12:00	No Fauna		75-100%	Gravelly (shelly) sand	1 crinoid
P3e	2020_04_13_172701675	12:30	Occasional	Erect epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	13:00	Occasional	Erect epifauna	75-100%	Hard Platform with Grav	2 teleost, 1 crinoid
P3e	2020_04_13_172701675	13:30	No Fauna		75-100%	Gravelly (shelly) sand	Stingray
P3e	2020_04_13_172701675	14:00	Frequent	Erect epifauna	50-75%	Sand with Rubble	
P3e	2020_04_13_172701675	14:30	Occasional	Prostrate epifauna	75-100%	Hard Platform/Sand	
P3e	2020_04_13_172701675	15:00	Occasional	Prostrate epifauna	75-100%	Gravel and Rubble	
P3e	2020_04_13_172701675	15:30	Frequent	Erect epifauna	50-75%	Sand	
P3e	2020_04_13_172701675	16:00	Occasional	Prostrate epifauna	75-100%	Hard Platform with Gravel	
P3e	2020_04_13_172701675	16:30	Occasional	Prostrate epifauna	75-100%	Sand with Rubble	Asteroidea
P3e	2020_04_13_172701675	17:00	Frequent	Prostrate epifauna	50-75%	Sand	
P3e	2020_04_13_172701675	17:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	18:00	No Fauna		75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	18:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	19:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	19:30	No Fauna		75-100%	Hard Platform with Grav	Teleost
P3e	2020_04_13_172701675	20:00	No Fauna		75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	20:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	21:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	21:30	Occasional	Prostrate epifauna	75-100%	Sand	Asteroidea
P3e	2020_04_13_172701675	22:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Gravel	
P3e	2020_04_13_172701675	22:30	Occasional	Prostrate epifauna	75-100%	Gravel and Rubble	
P3e	2020_04_13_172701675	23:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Gravel	
P3e	2020_04_13_172701675	23:30	Occasional	Prostrate epifauna	75-100%	Hard Platform/Gravel	
P3e	2020_04_13_172701675	24:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	24:30	Frequent	Prostrate epifauna	50-75%	Sand with Rubble	
P3e	2020_04_13_172701675	25:00	Occasional	Erect epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	25:30	Occasional	Erect epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	26:00	No Fauna		75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	26:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	

Transect Name	Video Name	Video Time Log (mm:ss)	Epifauna		Substrate		Comments
			Abundance	Composition	Coverage	Composition	
P3e	2020_04_13_172701675	27:00	Frequent	Erect epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	27:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	28:00	Occasional	Erect epifauna	75-100%	Gravelly (shelly) sand	Teleost
P3e	2020_04_13_172701675	28:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	29:00	Occasional	Prostrate epifauna	75-100%	Sand	
P3e	2020_04_13_172701675	29:30	Occasional	Erect epifauna	75-100%	Hard Platform/Sand	
P3e	2020_04_13_172701675	30:00	No Fauna		75-100%	Sand	
P3e	2020_04_13_172701675	30:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	31:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	31:30	No Fauna		75-100%	Gravelly (shelly) sand	Asteroidea
P3e	2020_04_13_172701675	32:00	Occasional	Prostrate epifauna	75-100%	Hard Platform/Gravel	
P3e	2020_04_13_172701675	32:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	33:00	Frequent	Erect epifauna	50-75%	Sand with Rubble	
P3e	2020_04_13_172701675	33:30	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	
P3e	2020_04_13_172701675	34:00	Occasional	Prostrate epifauna	75-100%	Gravelly (shelly) sand	

Appendix 3. Oil Spill Trajectory Modelling

EAST COAST GAS SUPPLY

Oil Spill Modelling

MAQ1314J
East Coast Gas Supply
Oil Spill Modelling
Rev2
10 January 2024

rpsgroup.com

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Rev0	Draft report issued for client's review	Jeremie Bernard Dr Larissa Perez	Jeremie Bernard Dr Ryan Dunn	Dr. Sasha Zigic	3 November 2023
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Prepared by:

RPS

Jeremie Bernard
Senior Coastal Engineer

Lakeside Corporate Space, Suite 425
Level 2, 34-38 Glenferrie Drive
Robina, QLD, 4226, Australia

T +61 7 5553 6900
E Jeremie.Bernard@rpsconsulting.com

Prepared for:

Cooper Energy

Amy Henstock
Environment Advisor

Level 15, 123 St Georges Tce
Perth WA 6000 Australia

T +61 08 6556 2101
E amy.henstock@cooperenergy.com.au

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TERMS AND ABBREVIATIONS

AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
API	American Petroleum Institute gravity. A measure of how heavy or light a petroleum liquid is compared to water.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASTM	American Society for Testing and Materials
BIA	Biologically Important Area
Bonn Agreement	An agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances, 1983, includes: Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union.
BP	Boiling point. The temperature at which the vapor pressure of the liquid is equal to the pressure exerted on it by the surrounding atmosphere
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CFSR	Climate Forecast System Reanalysis
Decay	The process where oil components are changed either chemically or biologically (biodegradation) to another compound. It includes breakdown to simpler organic carbon compounds by bacteria and other organisms, photo-oxidation by solar energy, and other chemical reactions.
Deterministic oil spill modelling	Oil spill modelling involving a computer simulation of a single hypothetical oil spill event subject to a single sequence of wind, current and other sea conditions over time. Single oil spill modelling, also referred to as “deterministic modelling” provides a simulation of one possible outcome of a given spill scenario, subject to the metocean conditions that are imposed. Single oil spill modelling is commonly used to consider the fate and effects of ‘worst-case’ oil spill scenarios that are carefully selected in consideration of the nature and scale of the offshore petroleum activity and the local environment (NOPSEMA, 2017). Because the outcomes of a single oil spill simulation can only represent the outcome of that scenario under one sequence of metocean conditions, worst-case conditions are often identified from stochastic modelling. It is impossible to calculate the likelihood of any outcome from a single oil spill simulation. Single oil spill modelling is generally used for response planning, preparedness planning and for supporting oil spill response operations in the event of an actual spill
Dynamic viscosity	The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds.
Floating oil exposure	Contact by floating oil on the sea surface at concentrations equal to or exceeding defined threshold concentrations. The consequence will vary depending on the threshold and the receptors
GODAE	Global Ocean Data Assimilation Experiment
HYCOM	Hybrid Coordinate Ocean Model. A data-assimilative, three-dimensional ocean model
HYDROMAP	Advanced ocean/coastal tidal model used to predict tidal water levels, current speed and current direction.
IMCRA	Integrated marine and coastal regionalisation areas
IOA	Index of Agreement
ITOPF	International Tanker Owners Pollution Federation Limited
KEF	Key Ecological Feature
LGA	Local Government Areas
MAE	Mean Absolute Error
MAHs	Monoaromatic Hydrocarbons
MNP	Marine National Park

MP	Marine Park
NASA	National Aeronautics and Space Administration (USA)
NCEP	National Centres for Environmental Prediction (USA)
NOAA	National Oceanic and Atmospheric Administration (USA)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NP	National Park
NR	Nature Reserve
PAH	Polynuclear Aromatic Hydrocarbons
Pour Point	The pour point of a liquid is the temperature below which the liquid loses its flow characteristics
ppb	Parts per billion (concentration)
psu	Practical salinity units
Ramsar site	A site listed under the Ramsar Convention on wetlands which is an international intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources.
RSB	Reefs, Shoals and Banks
Shoreline accumulation	Arrival of oil at or near shorelines at on-water concentrations equal to or exceeding defined threshold concentrations. Shoreline contact is judged for floating oil arriving within a 2 km buffer zone from any shoreline as a conservative measure
SIMAP	Spill Impact Model Application Package. SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for surface or subsea releases
SRTM	Shuttle Radar Topography Mission
State Waters	Low water mark seaward for three nautical miles
STB	Standard Barrel
Stochastic oil spill modelling	Stochastic oil spill modelling is created by overlaying and statistically analysing the outcomes of many single oil-spill simulations of a defined spill scenario, where each simulation was subject to a different sequence of metocean conditions, selected objectively (typically by random selection) from a long sequence of historic conditions for the study area. Analysis of this larger set of simulations provides a more accurate indication of the area of hydrocarbon exposure and indicates which locations are more likely to be exposed (as well as other statistics). Stochastic oil spill modelling avoids biases that affect single oil spill modelling (due to the reliance on only one possible sequence of conditions). However, when interpreting stochastic modelling, which is based on a wide range of potential conditions that might happen to occur, it is essential to understand that calculations will encompass a much larger area than could be exposed in any single spill event, where a more limited set of conditions will occur. Consequently, it is misleading to imply that the region derived from stochastic modelling indicate the outcomes expected from a single spill event (NOPSEMA, 2017) Stochastic modelling is generally used for risk assessment and preparedness planning by indicating locations that could be exposed and may require response or subsequent impact assessment
Sub-LGA	Sub-Local Government Areas
TOPEX/Poseidon	A joint satellite mission between NASA and CNES to map ocean surface topography using an array of satellites equipped with detailed altimeters
US EPA	United States Environmental Protection Agency
World Ocean Atlas	A collection of physicochemical parameters (e.g. temperature, salinity, oxygen, phosphate, silicate, and nitrate) based on profile data from the World Ocean Database (NCEI, 2021) established by NOAA's National Centers for Environmental Information (NCEI)
WGS 1984	World Geodetic System 1984 (WGS84); reference coordinate system

EXECUTIVE SUMMARY

Background

Cooper Energy (Cooper) is progressing plans to drill the Elanora-1 ST1, Pecten East-2 and Annie-2 wells in the Otway Basin, Victoria.

In order to inform the offshore environmental impact and risk assessments Cooper commissioned RPS to conduct a detailed oil spill modelling study assessing the following hypothetical scenarios:

- **Scenario 1**: A 105,289 bbl (16,740 m^3) subsurface release of condensate over 102 days following a loss of well control (LOWC) incident at Elanora-1 ST1.
- **Scenario 2**: An 83,273 bbl (13,239 m^3) subsurface release of condensate over 102 days following a LOWC incident at Pecten East-2; and
- **Scenario 3**: A 66,430 bbl (10,562 m^3) subsurface release of condensate over 104 days following a LOWC incident at Annie-2.

Note, the 104-day model duration for Scenario 3 relates to slightly more conservative response time for the relief well to kill Annie-2. This duration was carried over from the specifications of the original Annie-2 modelling.

The modelling assessment was undertaken on a seasonal basis (summer – November to April, and winter – May to October), with 100 modelling simulations completed for each season.

The purpose of the modelling is to provide an understanding of a conservative 'outer envelope' of the potential area of exposure in the unlikely event of hydrocarbon spill. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill. Therefore, the modelling results represent the maximum extent of hydrocarbon exposure.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Model Application Program (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

Methodology

The modelling study was carried out in several stages. Firstly, a 10-year wind and current dataset (2010–2019) was generated and the currents included the combined influence of three-dimensional large-scale ocean currents and tidal currents. Secondly, the currents, winds and detailed condensate characteristics were used as inputs in the three-dimensional oil spill model (SIMAP) to simulate the drift, spread, weathering and fate of the spilled oil.

As spills can occur during any set of wind and current conditions, modelling was conducted using a stochastic (random or non-deterministic) approach, which involved running 100 randomly selected single trajectory simulations per season, per scenario, with each simulation having the same spill information (location, spill volume, duration and composition of hydrocarbons) but varying start times. This ensured that each spill simulation was subject to a unique set of wind and current conditions.

The SIMAP system, the methods and analysis presented herein, use modelling algorithms which have been anonymously peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the ASTM Standard F2067-22 "*Standard Practice for Development and Use of Oil Spill Models*".

Condensate Properties

An exploration well has been drilled within the Annie field with hydrocarbon properties being known for that location. Annie condensate has a higher residuals profile when compared with other offset fields representing a more conservative analogue and therefore Annie condensate was selected for all scenarios modelled in this assessment. While a comprehensive oil assay for Annie-1 condensate was provided by the client (Core Lab RFL201903231), it should be noted that essential data pertaining to the pour point, dynamic viscosity, and aromatic content for distinct boiling point ranges were absent from the dataset. Consequently, a pragmatic approach was adopted to supplement these missing values by sourcing relevant information from the Minerva condensate assay data. Minerva condensate is found in a nearby reservoir.

The Annie-2 condensate has an API of 41.0, density of 820.0 kg/m^3 (at 16 ºC), with low viscosity (1.063 cP at 20 ºC) classifying it as a Group II (light-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2020) and US EPA/USCG classifications. The condensate comprises a significant portion of volatiles and semi- to low-volatiles (82.5% total) with 17.5% residual components. This means the condensate will evaporate readily when on the water surface, with the persistent components to remain on the water surface or in the water column over time.

Results

Scenario: 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1

- The maximum distance and corresponding direction from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) floating oil exposure zones was 75.7 km (east, winter) and 11.7 km (east-southeast, summer), respectively. There was no floating oil exposure predicted above the high (>50 g/m^2) threshold.
- The probability of accumulation to any shoreline at, or above, the low (10 g/m^2) threshold was 100%. The minimum time before oil accumulation at, or above, the low threshold was 1.83 days whilst the maximum total volume ashore for a single spill trajectory was 251.0 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 295.0 km, 48.0 km and 1.0 km, respectively, all occurring during winter.
- Excluding the BIAs that the release location resides within, the highest probabilities of low (10 ppb) dissolved hydrocarbon exposure were 15% (Southern Right Whale – Aggregation BIA, summer) and 21% (Short-tailed Shearwater – Foraging BIA, winter).
- Except for the receptors the release location is located within, during summer the highest probability of low (10 ppb) entrained hydrocarbon exposure was 100% recorded for Southern Right Whale – Aggregation BIA. Additional receptors including LGAs, sub-LGAs, and AMPs were predicted with entrained hydrocarbon exposure (refer to Table 11.9). During winter, several receptors, including the Apollo AMP, Southern Right Whale – Aggregation and White-faced Storm-petrel - Foraging BIAs revealed 100% probability of low entrained hydrocarbon exposure.

Scenario: 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2

- The maximum distance and corresponding direction from the release location to the low and moderate exposure zones was 74.4 km (east-southeast, winter) and 15.2 km (east-southeast, winter), respectively. There was no floating oil exposure observed above the high threshold.
- The probability of accumulation to any shoreline at, or above, the low threshold was 100%. The minimum time before oil accumulation at, or above, the low threshold was 1.17 days whilst the maximum total volume ashore for a single spill trajectory was 406.6 m^3, and the maximum length of shoreline accumulation at the low, moderate and high thresholds were 269.0 km (summer), 75.0 km (summer) and 6.0 km (winter), respectively.
- Excluding the BIAs that the release location resides within, the highest probability of low dissolved hydrocarbon exposure was 21% during summer (Short-tailed Shearwater - Foraging) and 59% during winter (Short-tailed Shearwater - Foraging).
- The highest probability of low entrained hydrocarbon exposure was recorded at 100% for receptors that the release location doesn't reside within, including Southern Right Whale – Aggregation BIA and

Warrnambool Plain IBRA. Additional receptors including sub-LGAs, and AMPs were predicted with entrained hydrocarbon exposure.

Scenario: 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2

- The maximum distance and corresponding direction from the release location to the low and moderate exposure zones was 55.7 km (east, winter) and 3.2 km (east, winter), respectively. There was no floating oil exposure predicted above the high threshold.
- The probability of accumulation to any shoreline at, or above, the low threshold was 100%. The minimum time before oil accumulation at, or above, the low threshold was 0.96 day whilst the maximum total volume ashore for a single spill trajectory was 312.1 m^3, and the maximum length of shoreline accumulation at the low, moderate and high thresholds were 224.0 km (winter), 62.0 km (winter) and 6.0 km (winter), respectively.
- Excluding the BIAs that the release location resides within, the highest probability of low dissolved hydrocarbon exposure was 10% during summer and 33% during winter at the Short-tailed Shearwater – Foraging BIA receptor.
- The highest probability of low entrained hydrocarbon exposure was recorded at 100% for receptors that the release location doesn’t reside within, including Short-tailed Shearwater – Foraging, Southern Right Whale – Aggregation BIAs and Warrnambool Plain IBRA. Additional receptors including sub-LGAs, and AMPs were predicted with entrained hydrocarbon exposure.

1 INTRODUCTION

1.1 Background

Cooper Energy (Cooper) is progressing plans to drill the Elanora-1 ST1, Pecten East-2 and Annie-2 wells in the Otway Basin (Figure 1.1).

In order to inform the offshore environmental impact and risk assessments Cooper commissioned RPS to conduct a detailed oil spill modelling study assessing the following hypothetical scenarios:

- **Scenario 1**: A 105,289 bbl (16,740 m^3) subsurface release of condensate over 102 days following a loss of well control (LOWC) incident at Elanora-1 ST1;
- **Scenario 2**: An 83,273 bbl (13,239 m3) subsurface release of condensate over 102 days following a LOWC incident at Pecten East-2; and
- **Scenario 3**: A 66,430 bbl (10,562 m^3) subsurface release of condensate over 104 days following a LOWC incident at Annie-2.

Note, the 104-day model duration for Scenario 3 relates to slightly more conservative response time for the relief well to kill Annie-2. This duration was carried over from the specifications of the original Annie-2 modelling.

The coordinates for the release location used for the above mentioned scenarios are presented in Table 1.1 and are illustrated in Figure 1.1.

The modelling assessment was undertaken on a seasonal basis (summer – November to April, and winter – May to October), with 100 simulations completed for each season.

The purpose of the modelling is to provide an understanding of a conservative ‘outer envelope’ of the potential area of exposure in the unlikely event of hydrocarbon spill. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill, except well kill via a relief well at the specified modelled days. Therefore, the modelling results represent the maximum extent of hydrocarbon exposure.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Model Application Program (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

Note that the oil spill model, the method and analysis presented herein uses modelling algorithms which have been anonymously peer reviewed and published in international journals. Furthermore, RPS warrants that this work meets and exceeds the American Society for Testing and Materials (ASTM) Standard F2067-22 “*Standard Practice for Development and Use of Oil Spill Models*”.

Table 1.1 Coordinates of the release locations.

Infrastructure	Latitude	Longitude	Water Depth (m)
Elanora-1 ST1	38° 47' 41.5" S	142° 37' 56.5" E	75
Pecten East-2	38° 37' 59.7" S	142° 40' 9.7" E	55
Annie-2	38° 41' 1.68" S	142° 49' 28.56" E	56

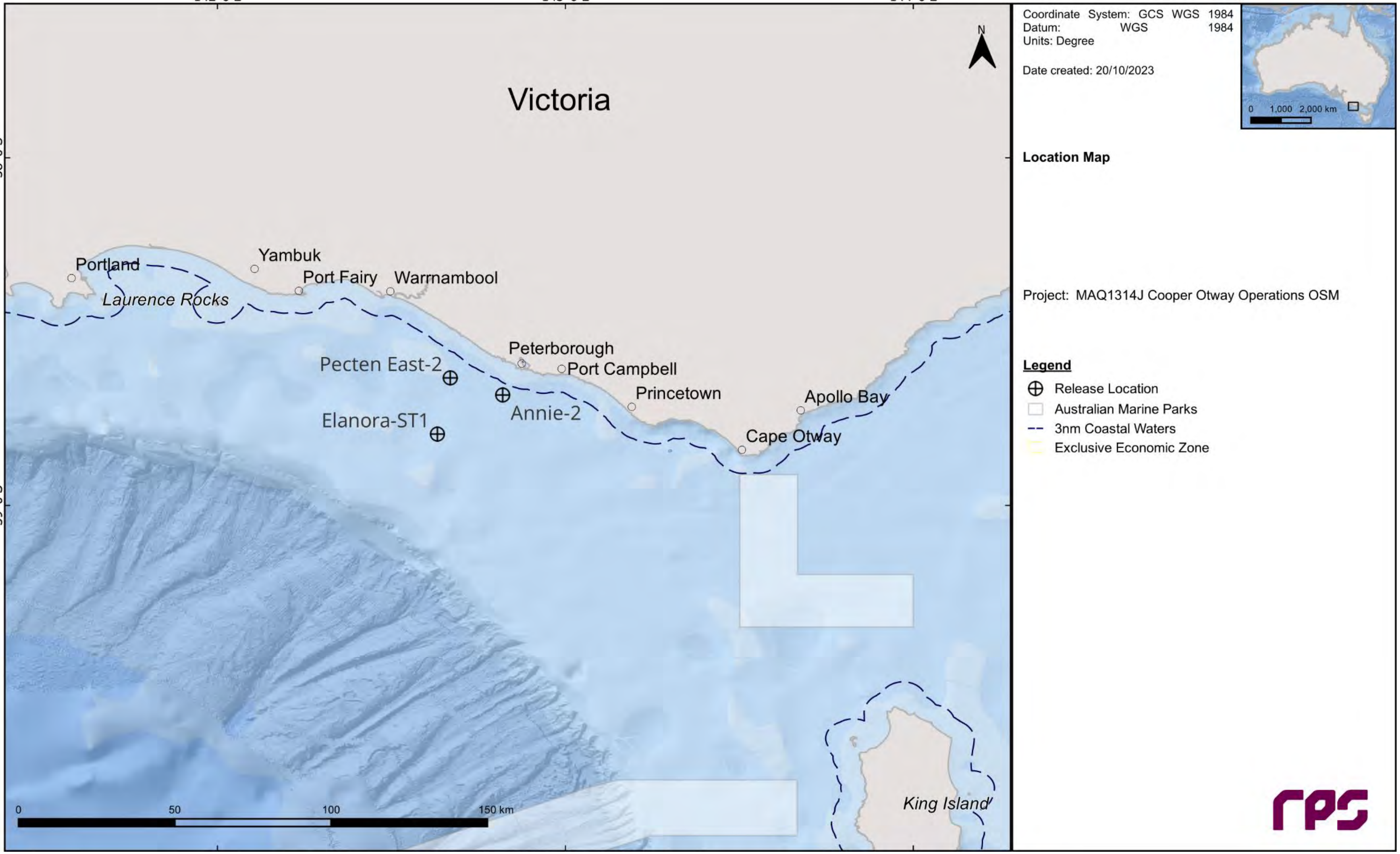


Figure 1.1 Map of the Elanora-1 ST1, Pecten East-2 and Annie-2 release locations.

1.2 What is Oil Spill Modelling?

Oil spill modelling is a valuable tool widely used for risk assessment, emergency response and contingency planning where it can be particularly helpful to proponents and decision makers. By modelling a series of the most likely oil spill scenarios, decisions concerning suitable response measures and strategic locations for deploying equipment and materials can be made, and the locations at most risk can be identified. The two types of oil spill modelling often used are stochastic (Section 1.2.1) and deterministic (Section 1.2.2) modelling.

1.2.1 Stochastic Modelling (Multiple Spill Simulations)

Stochastic oil spill modelling is created by overlaying a great number (often hundreds) of individual, computer-simulated hypothetical spills (NOPSEMA, 2018; Figure 1.2).

Stochastic modelling is a common means of assessing the potential risks from oil spills related to new projects and facilities. Stochastic modelling typically utilises hydrodynamic data for the location in combination with historic wind data. Typically, 100 iterations of the model will be run utilising the data that is most relevant to the season or timing of the project.

The outcomes are often presented as a probability of exposure and is primarily used for risk assessment purposes in view to understand the range of environments that may be affected or impacted by a spill. Elements of the stochastic modelling can also be used in oil spill preparedness and planning.

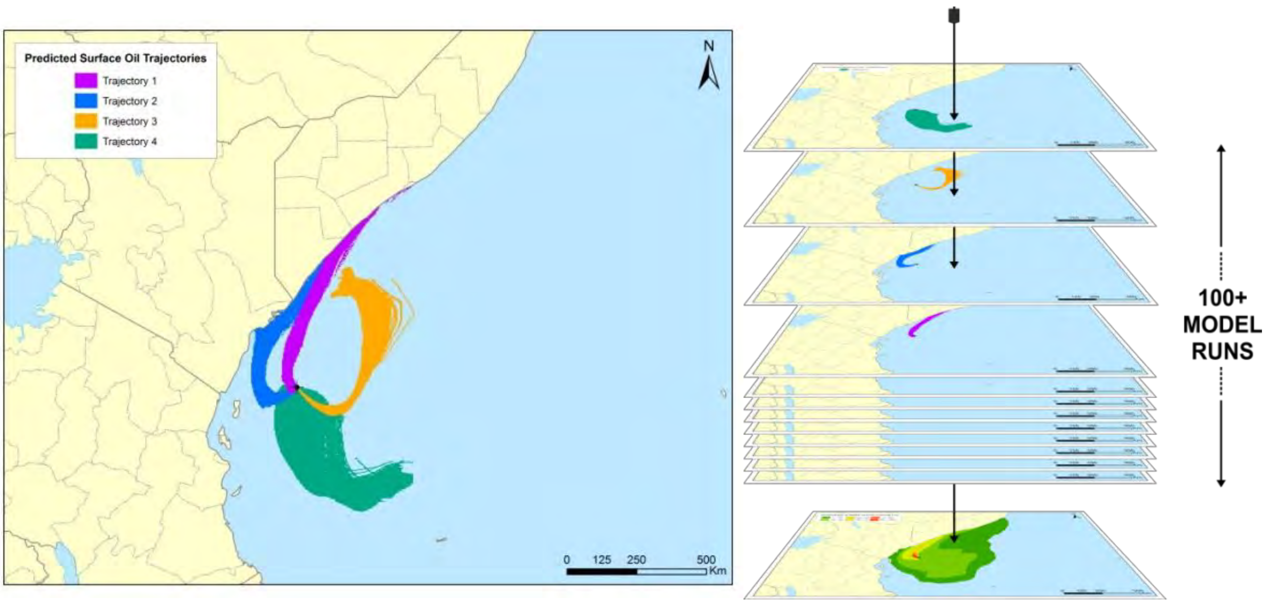


Figure 1.2 Examples of four individual spill trajectories (four replicate simulations) predicted by SIMAP for a spill scenario. The frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability.

1.2.2 Deterministic Modelling (Single Spill Simulation)

Deterministic modelling is the predictive modelling of a single incident subject to a single sample of wind and weather conditions over time (NOPSEMA, 2018; Figure 1.3).

Deterministic modelling is often paired with stochastic modelling to place the large stochastic footprint into perspective. This deterministic analysis is generally a single run selected from the stochastic analysis and serves as the basis for developing the plans and equipment needs for a realistic spill response. Deterministic spills can be selected on several basis such as minimum time to shoreline, largest swept area, maximum volume ashore, longest length of shoreline contacted by oil or largest area of entrained or dissolved hydrocarbons.

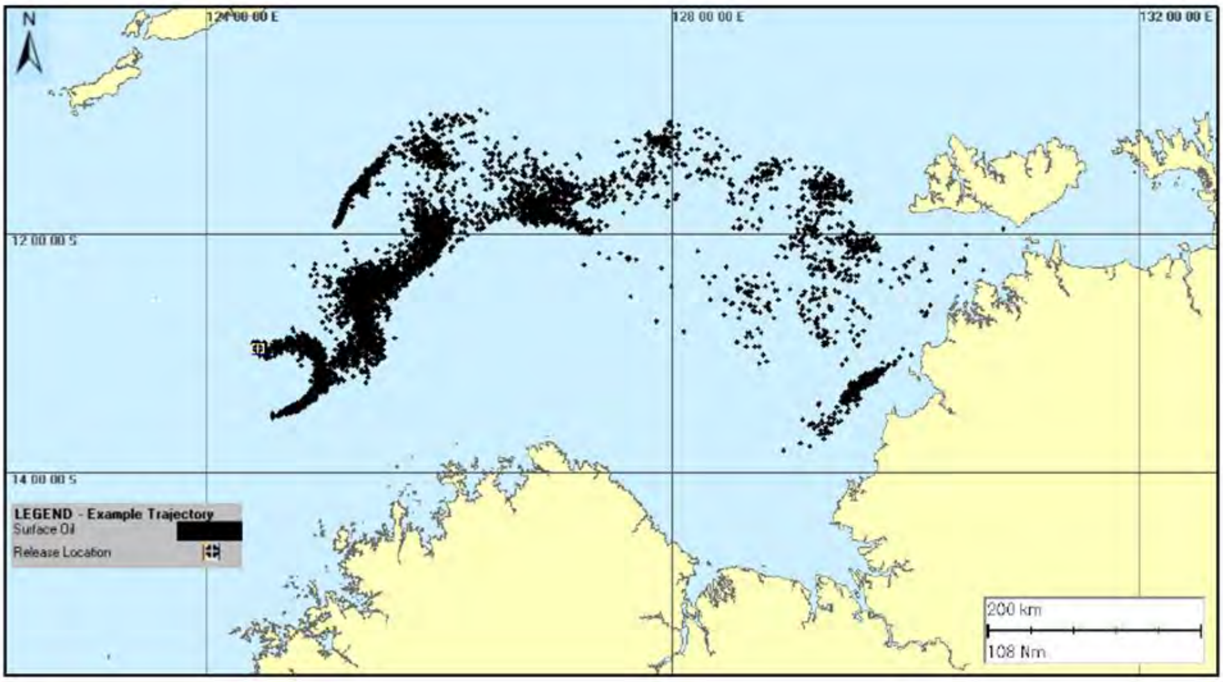


Figure 1.3 Example of an individual spill trajectory predicted by SIMAP for a spill scenario. Note, this image represents surface oil as spillets and do not take any thresholds into consideration.

2 SCOPE OF WORK

The scope of work included the following components:

- Generate 10 years of winds and three-dimensional currents from 2010 to 2019 (inclusive). The currents included the combined influence of tidal and ocean currents;
- Include the wind and current data and characteristics of the condensate as input into the three-dimensional oil spill model (SIMAP), to model the movement, spreading, weathering and shoreline contact by hydrocarbons over time;
- Use SIMAP's stochastic model (also known as a probability model) to calculate exposure to surrounding waters and shorelines. This involved running 100 randomly selected single trajectory simulations per scenario (per season), with each simulation having the same spill information (spill volume, duration and composition of hydrocarbons) but varying start times. This ensured that each spill simulation was subject to a unique set of wind and current conditions;
- Results were assessed to determine the exposure to surrounding waters and contact to shorelines based upon the thresholds outlined in the NOPSEMA Oil Spill Modelling Bulletin (NOPSEMA, 2019); and
- The stochastic modelling results were reviewed, and the "worst case" deterministic runs were identified and presented based on the following criteria (if applicable):
    a. Largest swept area for surface oil above 10 g/m^2;
    b. Largest volume of oil ashore;
    c. Longest length of shoreline with oil accumulation above 100 g/m^2;
    d. Largest area of entrained hydrocarbon exposure above 100 ppb; and
    e. Largest area of dissolved hydrocarbon exposure above 50 ppb.

3 REGIONAL CURRENTS

The Bass Strait is a body of water separating Tasmania from the southern Australian mainland, specifically the state of Victoria. The strait is a relatively shallow area of the continental shelf, connecting the southeast Indian Ocean with the Tasman Sea. Currents within the straight are primarily driven by tides, winds, incident continental shelf waves and density driven flows; high winds and strong tidal currents are frequent within the area (Jones, 1980).

The varied geography and bathymetry of the region, in addition to the forcing of the south-eastern Indian Ocean and local meteorology lead to complex shelf and slope circulation patterns (Middleton & Bye, 2007). Figure 3.1 displays seasonal current trends within the Bass Strait. During winter there is a strong eastward water flow due to the strengthening of the South Australian Current (fed by the Leeuwin Current in the Northwest Shelf), which bifurcates with one extension moving though the Bass Strait, and another forming the Zeehan Current off western Tasmania (Sandery & Kämpf, 2007). During summer, water flow reverses off Tasmania, King Island and the Otway Basin travelling eastward, as the coastal current develops due to south-easterly winds.

To accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with surface tidal currents developed by RPS. The following sections provide a summary of the hybrid regional dataset.

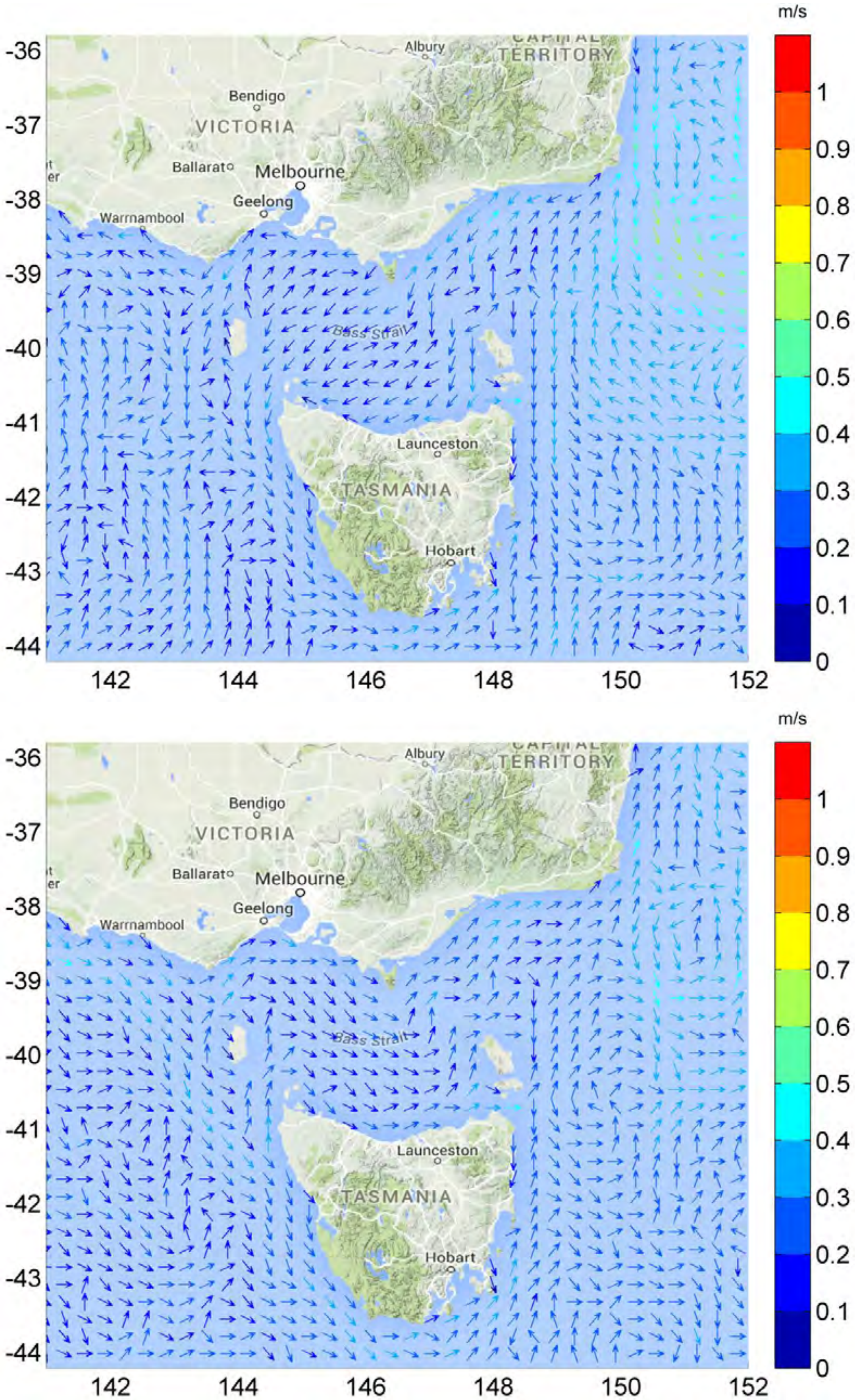


Figure 3.1 HYCOM averaged seasonal surface drift currents during summer (upper image) and winter (lower image).

3.1 Tidal currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world for more than 30 years (Isaji & Spaulding, 1984; Isaji, et al., 2001; Zigic, et al., 2003). HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) pollutant spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of interest to a study.

The numerical solution methodology follows that of Davies (1977a and 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji and Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

The tidal model domain is sub-gridded to a resolution of 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of 8 km. The finer grids are progressively allocated in a step-wise fashion to more accurately resolve flows along the coastline, around islands and over regions with more complex bathymetry. Figure 3.2 shows the tidal model grid covering the study domain.

A combination of datasets was used and merged to describe the shape of the seabed within the grid domain (Figure 3.3). These included spot depths and contours which were digitised from nautical charts released by the hydrographic offices as well as Geoscience Australia database and depths extracted from the Shuttle Radar Topography Mission (SRTM30_PLUS) Plus dataset (see Becker et al., 2009).

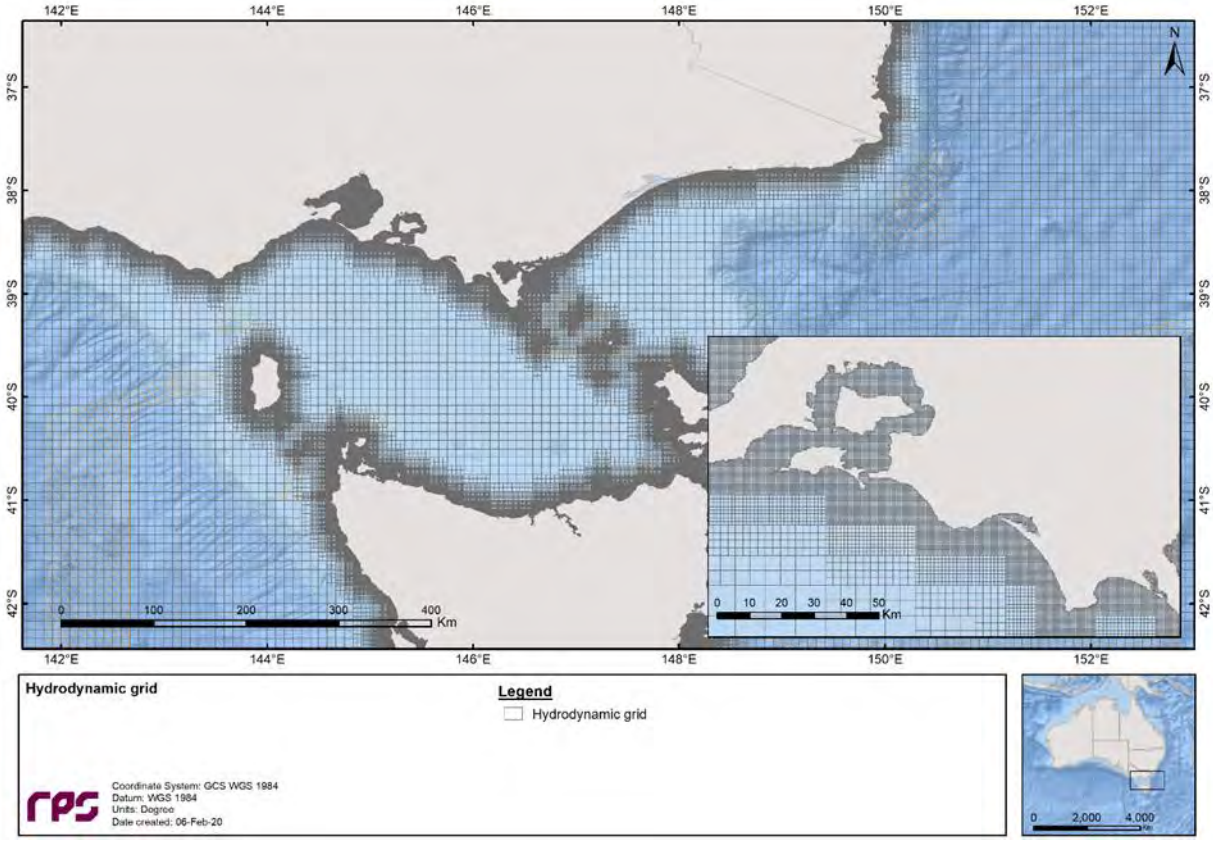


Figure 3.2 Sample of the model grid used to generate the tidal currents for the study region. Higher resolution areas are shown by the denser mesh.

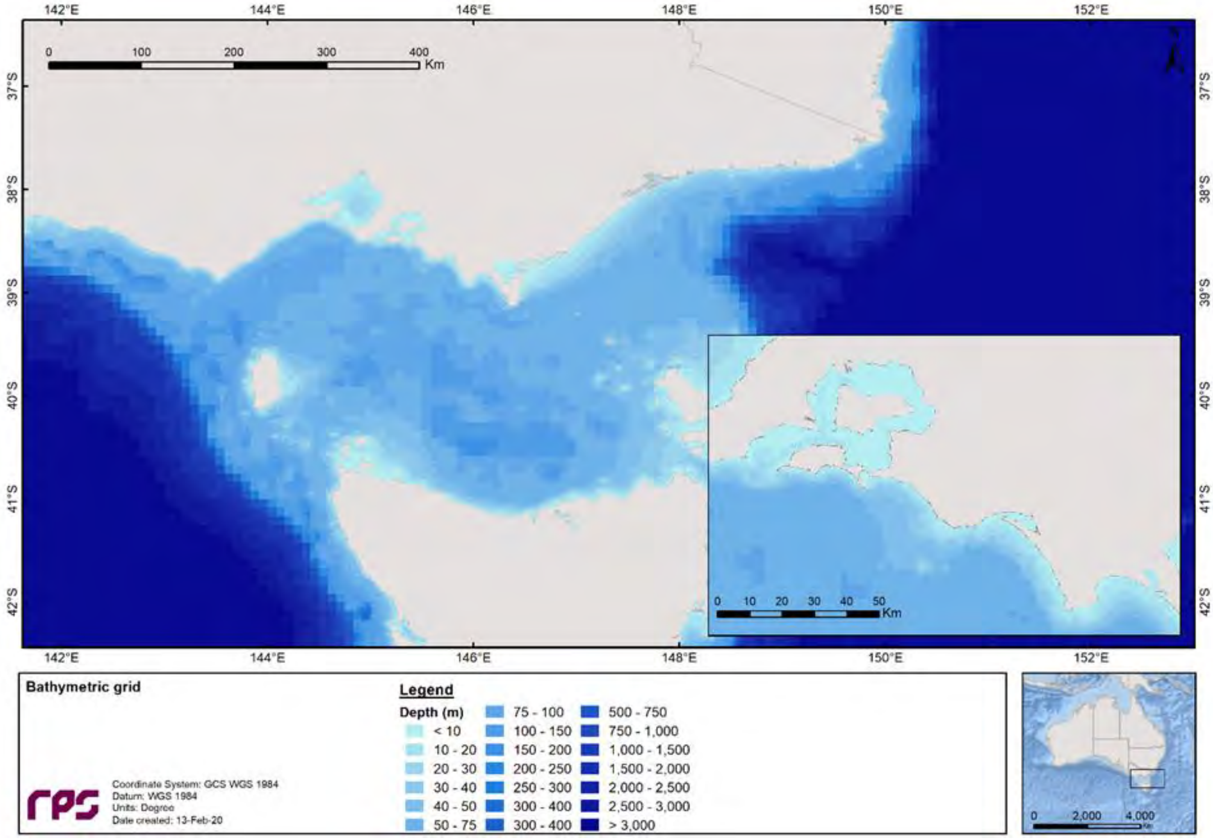


Figure 3.3 Bathymetry defined throughout the tidal model domain.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 8.0) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, time series surface heights were calculated along the open boundaries for the simulation period.

The Topex/Poseidon satellite data has a resolution of 0.25 degrees globally, with higher resolution in coastal regions, and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The data capturing satellites, equipped with two altimeters capable of taking sea level measurements accurate to less than ± 5 cm, measured oceanic surface elevations (and the resultant tides) for the period 1992–2005. In total these satellites carried out 62,000 orbits of the planet. The Topex/Poseidon tidal data has been widely used amongst the oceanographic community, being refereced in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk & Tangdong, 2004; Qiu & Chen 2010). The Topex/Poseidon tidal data is considered suitably accurate for this study.

3.1.3 Surface Elevation Validation

To ensure that tidal predictions were accurate, predicted surface elevations were compared to data observed at a location situated within the study area (Figure 3.4).

To provide a statistical measure of the model performance, the Index of Agreement (IOA – Willmott, 1981) and the Mean Absolute Error (MAE – Willmott, 1982; Willmott & Matsuura, 2005) were used.

The MAE (Eq.1) is simply the average of the absolute values of the difference between the model-predicted (P) and observed (O) variables. It is a more natural measure of the average error (Willmott & Matsuura, 2005) and more readily understood. The MAE is determined by:

$$MAE = N^{-1} \sum_{i=1}^{N} |P_i - O_i| \qquad \text{Eq.1}$$

Where: N = Number of observations

P_i = Model predicted surface elevation

O_i = Observed surface elevation

The Index of Agreement (IOA; Eq. 2) in contrast, gives a non-dimensional measure of model accuracy or performance. A perfect agreement between the model predicted and observed surface elevations exists if the index gives an agreement value of 1, and complete disagreement between model and observed surface elevations will produce an index measure of 0 (Wilmott, 1981). Willmott et al. (1985) also suggests that values larger than 0.5 may represent good model performance. The IOA is determined by:

$$IOA = 1 - \frac{\sum |X_{model} - X_{obs}|^2}{\sum (|X_{model} - \overline{X_{obs}}| + |X_{obs} - \overline{X_{obs}}|)^2} \qquad \text{Eq.2}$$

Where: X_{model} = Model predicted surface elevation

X_{obs} = Observed surface elevation

Clearly, a greater IOA and lower MAE represent a better model performance.

Figure 3.5 and Figure 3.6 illustrate a comparison of the predicted and observed surface elevations in February 2017. As shown on the graph, the model accurately reproduced the phase and amplitudes throughout the spring and neap tidal cycles.

Table 3.1 shows the IOA and MAE values for the selected tide station locations indicating that the model is performing well.

Table 3.1 Statistical comparison between the observed and HYDROMAP predicted surface elevations.

Tide Station	IOA	MAE (m)
Gabo Island	0.98	0.08
Port MacDonnell	0.98	0.05
Port Welshpool	0.92	0.30
Portland	0.97	0.07
Stack Island	0.96	0.22

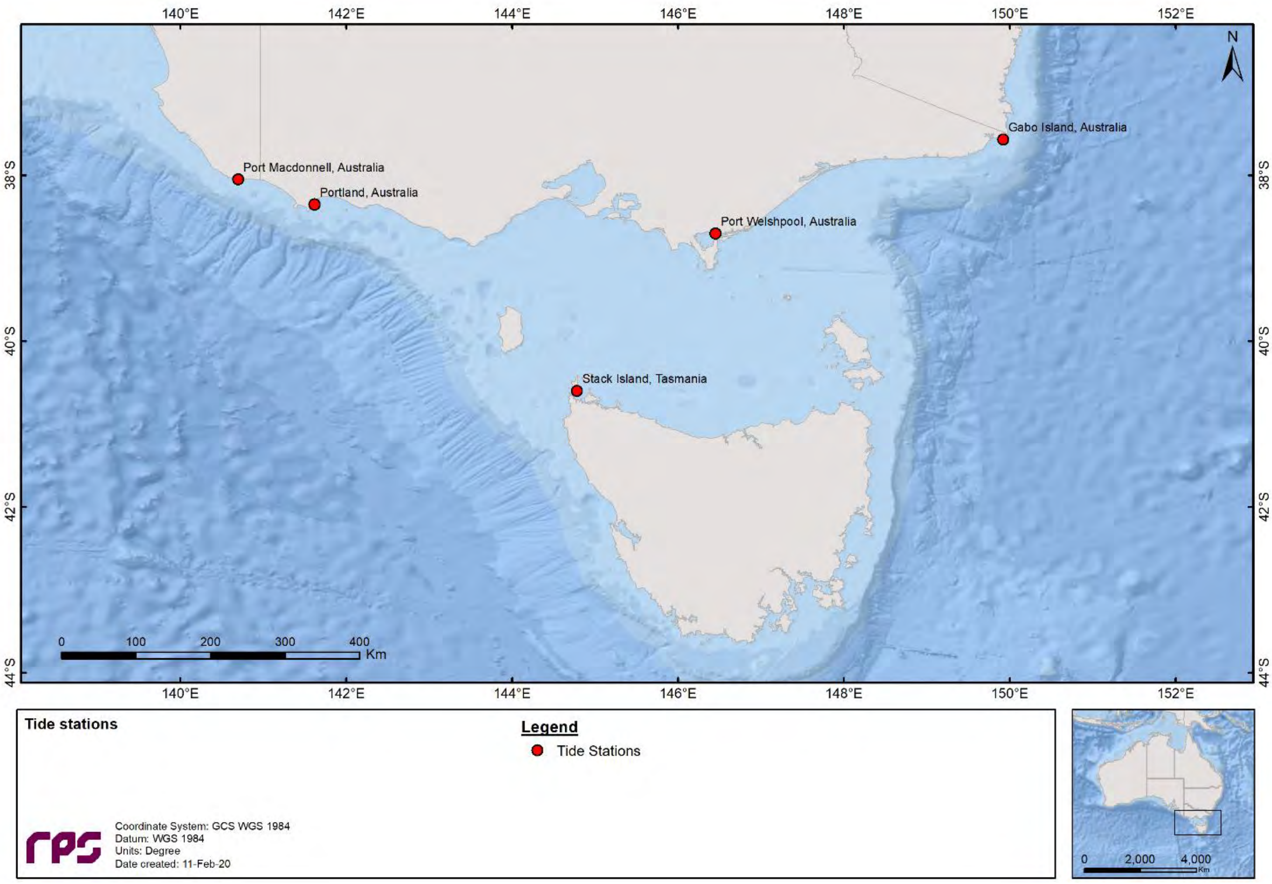


Figure 3.4 Location of the tide stations used in the surface elevation validation.

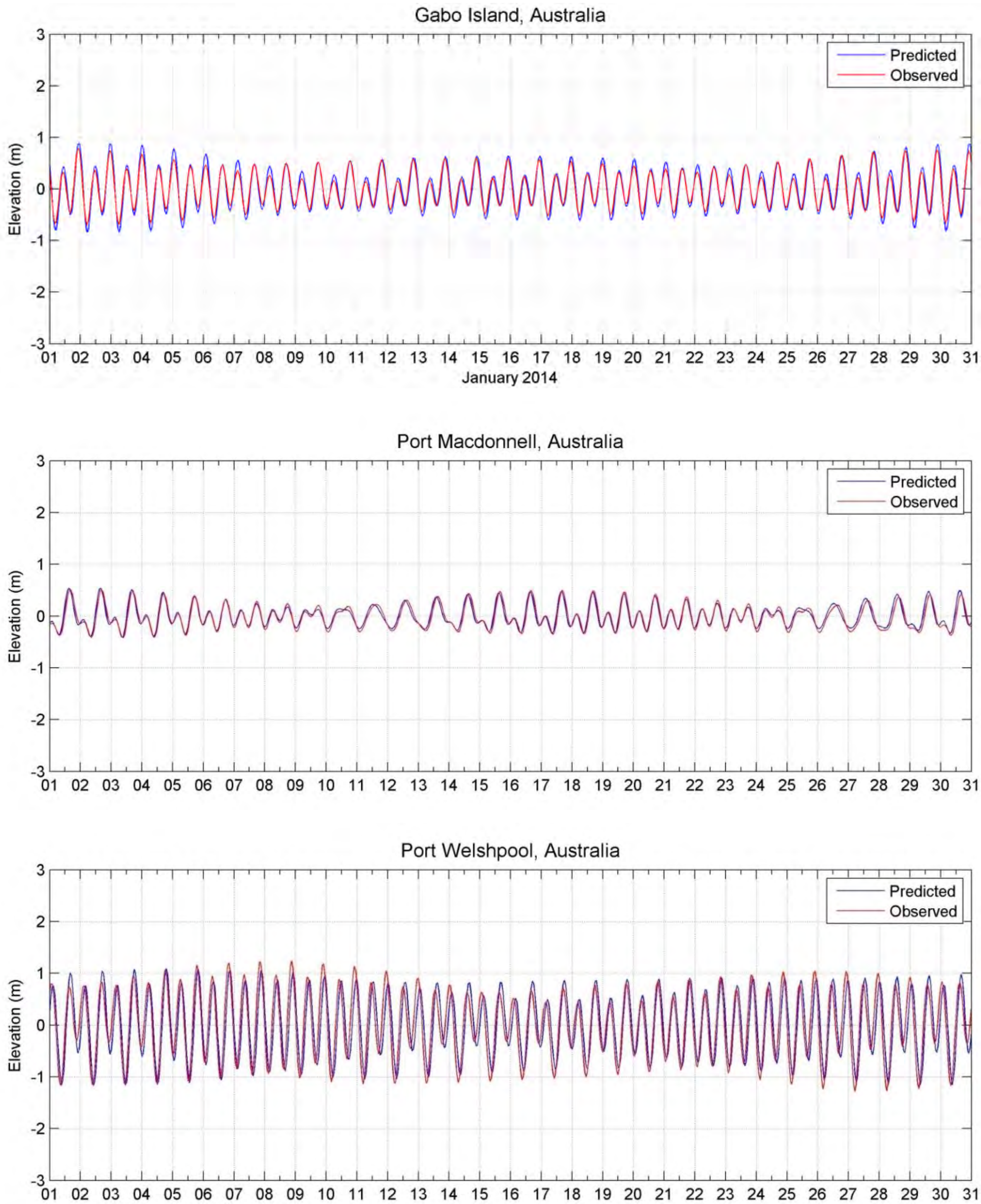
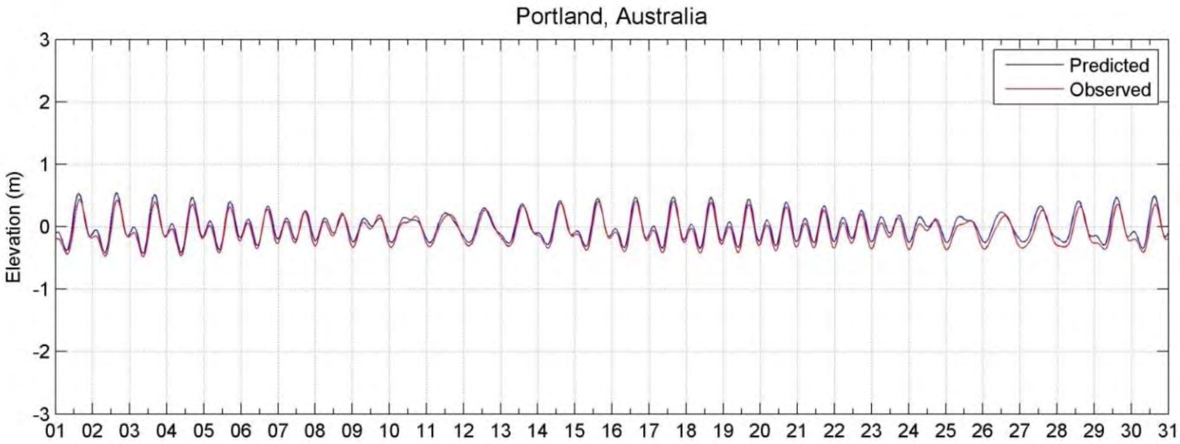


Figure 3.5 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Gabo Island (upper image), Port MacDonnell (middle image) and Port Welshpool (lower image).



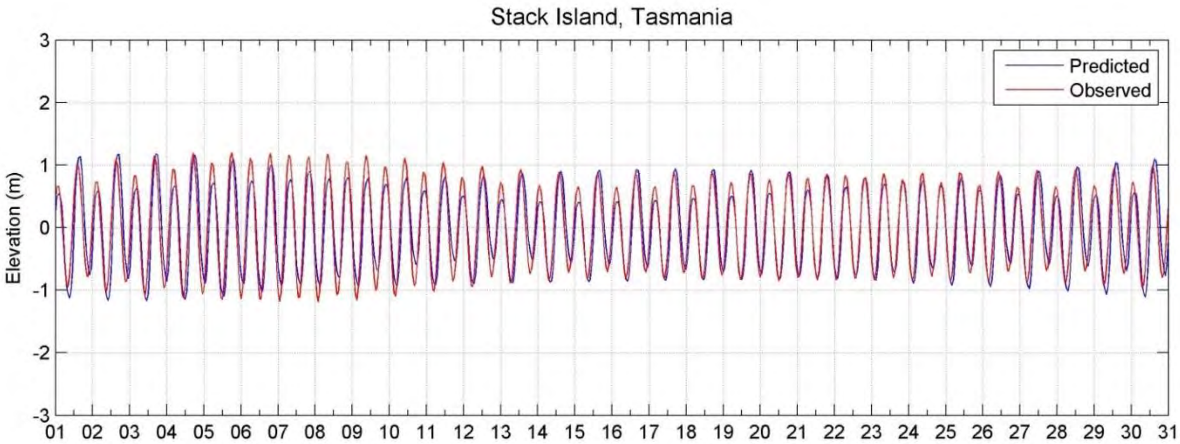


Figure 3.6 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Portland (upper image) and Stack Island (lower image).

3.2 Ocean Currents

Data describing the flow of ocean currents for the years 2010 to 2019 (inclusive) was obtained from HYCOM (Hybrid Coordinate Ocean Model, Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of once per day. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain-following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas.

3.3 Surface Currents

Table 3.2 to Table 3.4 present the average and maximum surface current speeds nearby the Elanora-1 ST1 (Isabella), Pecten East-2 and Annie-2 wells by combining the ocean and tidal currents.

Near the Elanora-1 ST1 well current speeds varied throughout the year with maximum current speeds ranging between approximately 0.68 m/s (January) and 1.07 m/s (July). The dominant surface current direction was identified as easterly (towards the east) during the whole year, except for January and February.

Nearby Pecten-East 2, maximum current speeds ranged between 0.66 m/s (February) and 1.08 m/s (September). Current direction varied throughout the year, flowing mostly towards the east-southeast during winter months.

Close to Annie-2, maximum current speeds varied between 0.72 m/s (February) and 1.10 m/s (September). Similar to Pecten-East 2, current directions predominantly flowed east-southeast during winter months.

Figure 3.7 to Figure 3.12 show the monthly and total surface current rose distributions for the selected locations.

Note the convention for defining current direction is the direction the current flows towards, which is used to reference current direction throughout this report. Each branch of the rose represents the currents flowing to that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are predominantly used in these current roses. The length of each coloured segment is relative to the proportion of currents flowing within the corresponding speed and direction.

Table 3.2 Predicted monthly average and maximum surface current speeds for Elanora-1 ST1 well. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.16	0.68	West
February	0.16	0.71	West
March	0.16	0.93	East
April	0.15	0.87	East
May	0.19	0.96	East
June	0.20	1.05	East
July	0.24	1.07	East
August	0.23	1.05	East
September	0.20	1.01	East
October	0.19	0.91	East
November	0.17	0.75	East
December	0.18	0.75	East
Minimum	**0.15**	**0.68**	-
Maximum	**0.24**	**1.07**	

Table 3.3 Predicted monthly average and maximum surface current speeds for Pecten East-2 well. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.17	0.68	West-northwest
February	0.19	0.66	West-northwest
March	0.18	0.86	West
April	0.15	0.75	East
May	0.19	0.91	East-southeast
June	0.19	1.05	East-southeast
July	0.24	0.99	East-southeast
August	0.23	1.02	East-southeast
September	0.20	1.08	East-southeast
October	0.19	0.92	East
November	0.17	0.74	East
December	0.18	0.80	East
Minimum	**0.15**	**0.66**	-
Maximum	**0.24**	**1.08**	

Table 3.4 Predicted monthly average and maximum surface current speeds for Annie-2 well. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.17	0.77	West
February	0.19	0.72	West
March	0.18	0.92	West
April	0.15	0.83	East
May	0.19	0.90	East-southeast
June	0.19	1.07	East-southeast
July	0.24	1.05	East-southeast
August	0.23	1.05	East-southeast
September	0.20	1.10	East
October	0.20	0.88	East
November	0.18	0.82	East
December	0.18	0.92	East
Minimum	**0.15**	**0.72**	-
Maximum	**0.24**	**1.10**	

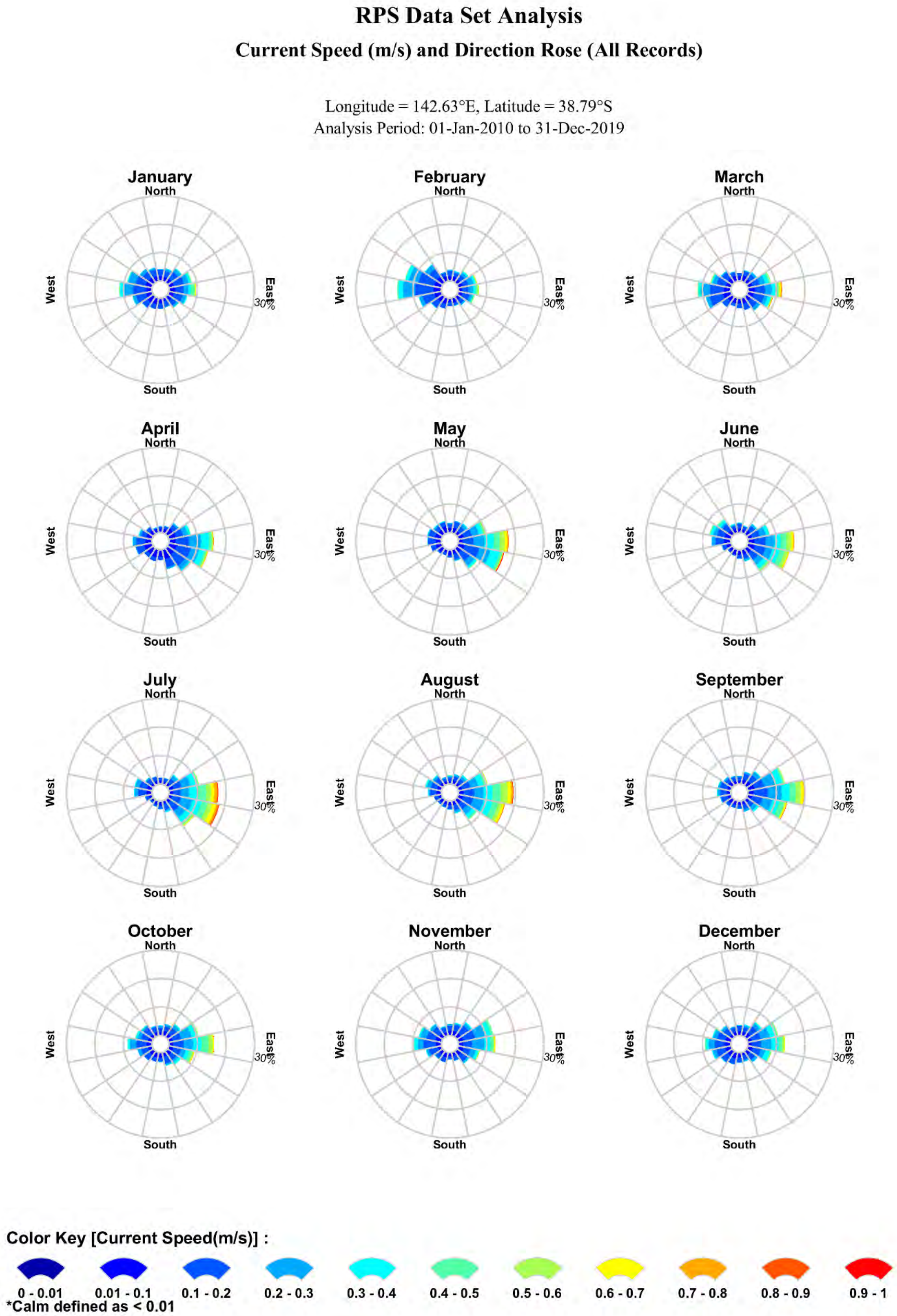


Figure 3.7 Monthly surface current rose plots nearby the Elanora-1 ST1 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

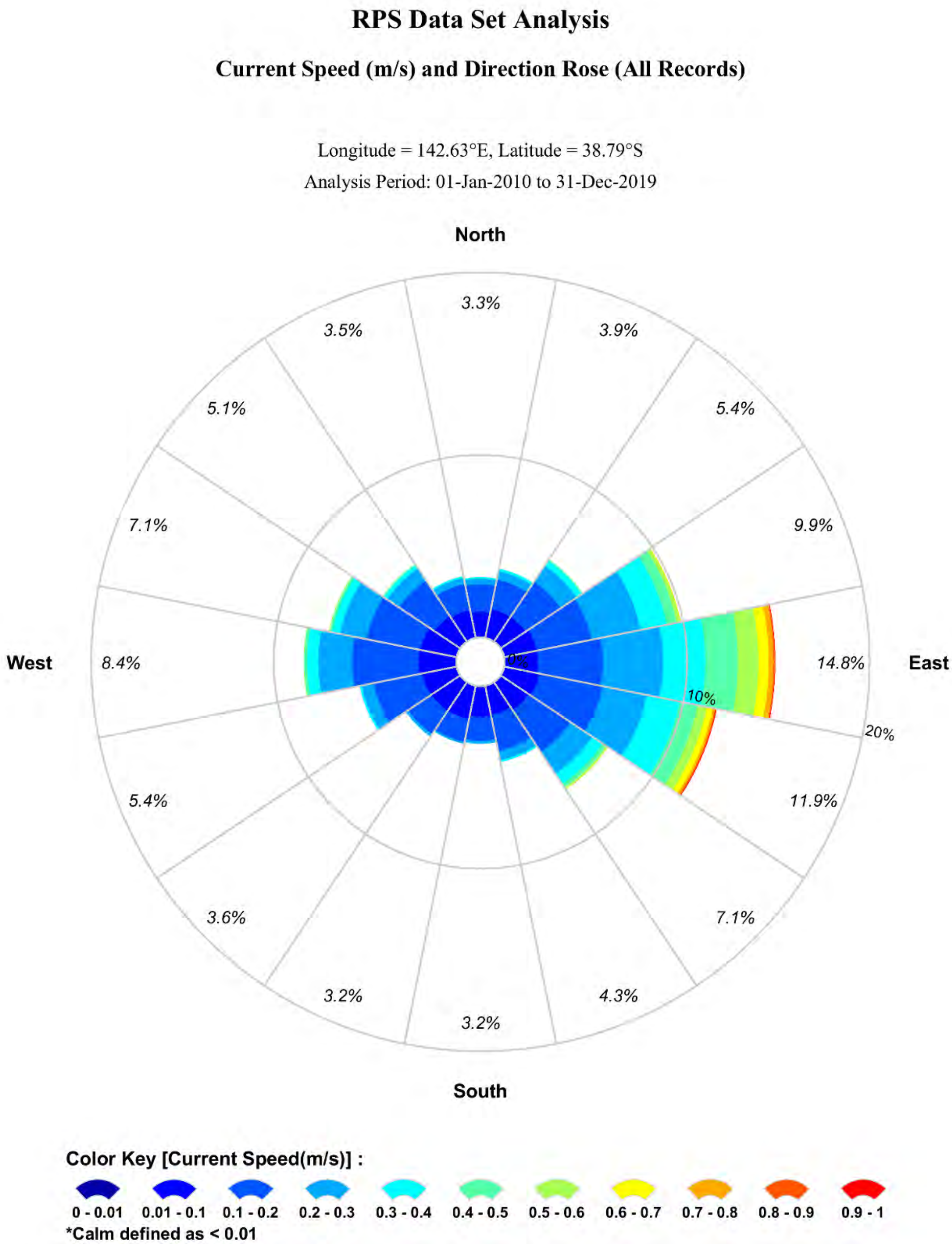


Figure 3.8 Total surface current rose plot nearby the Elanora-1 ST1 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

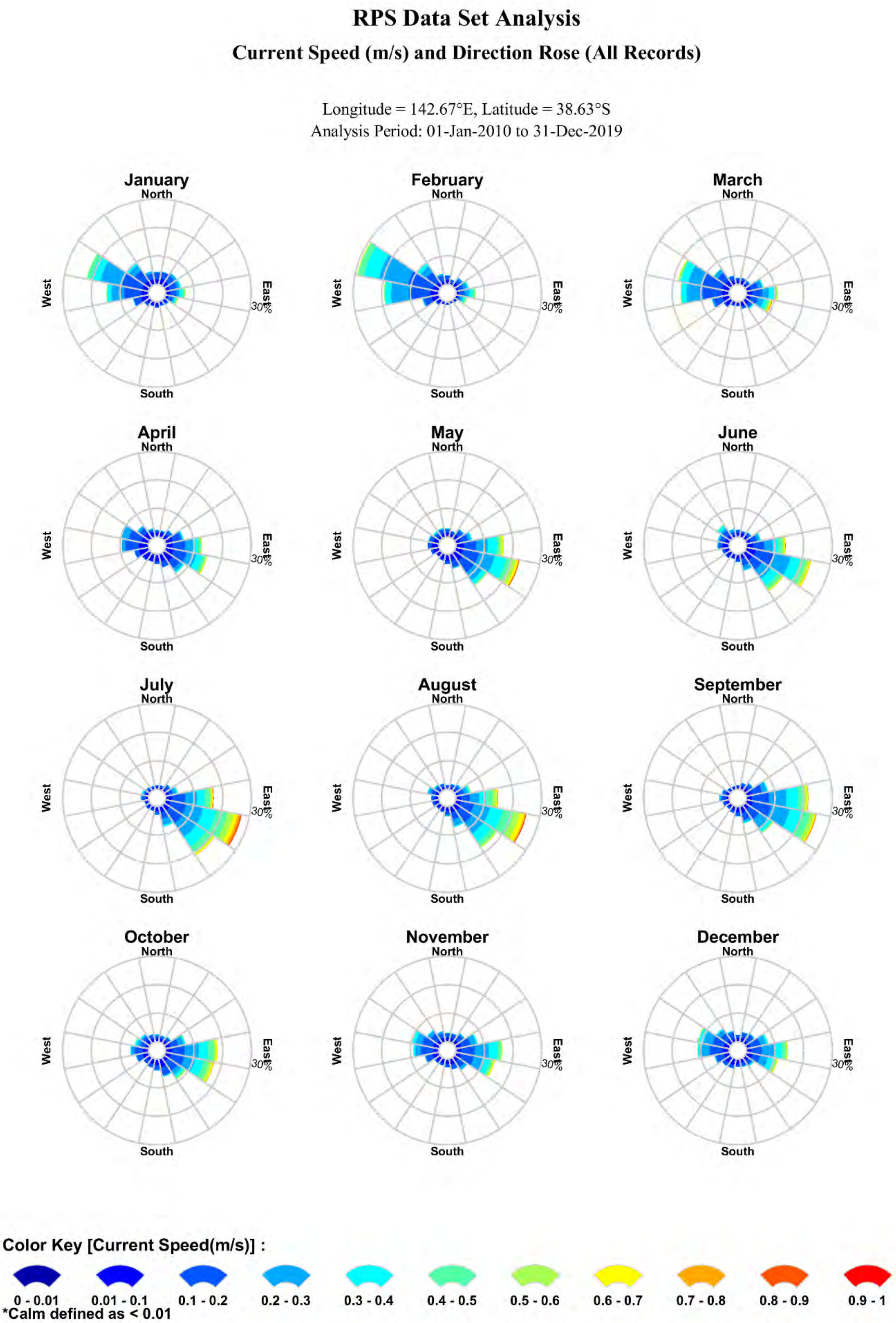


Figure 3.9 Monthly surface current rose plots nearby the Pecten East-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

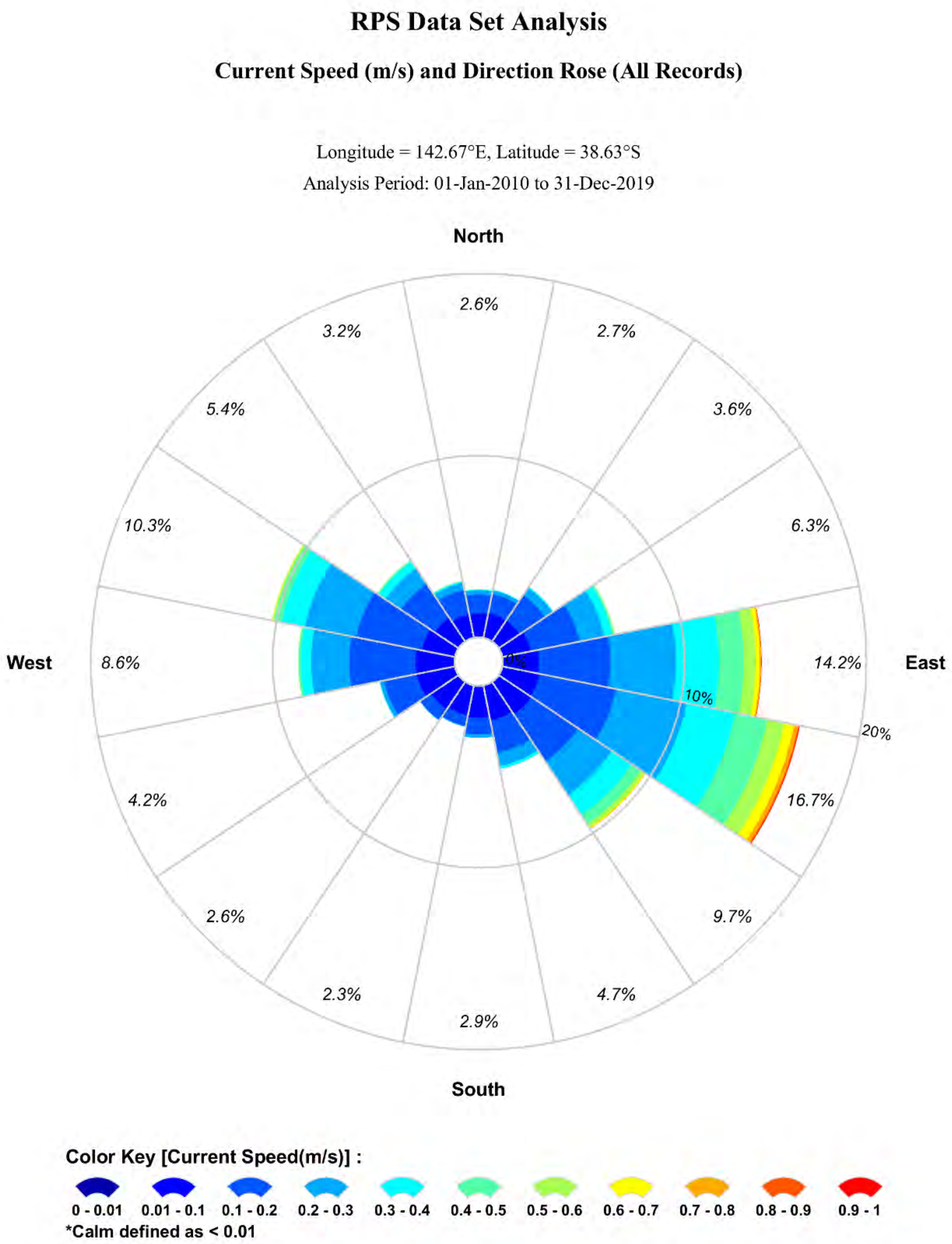


Figure 3.10 Total surface current rose plot nearby the Pecten East-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

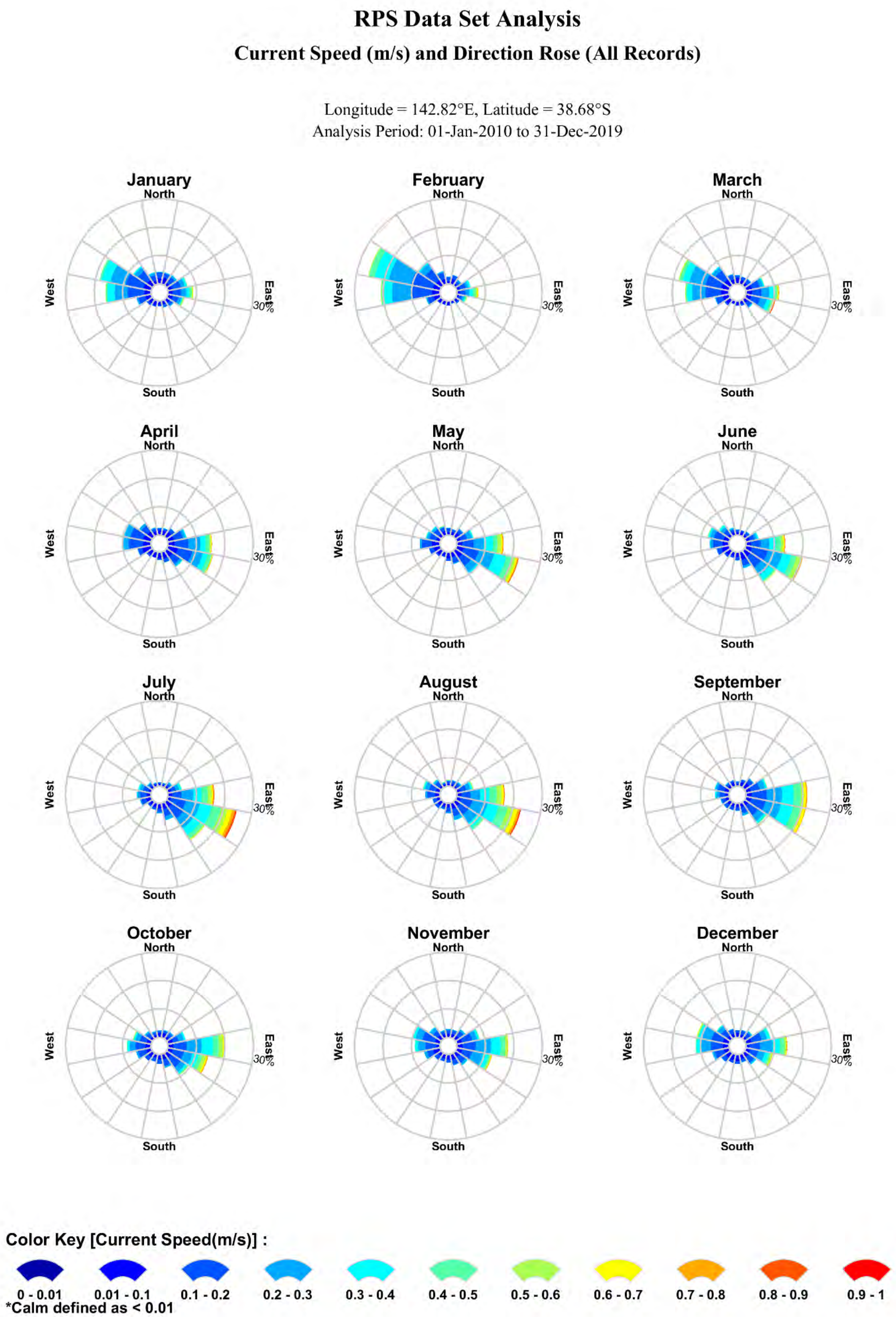


Figure 3.11 Monthly surface current rose plots nearby the Annie-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

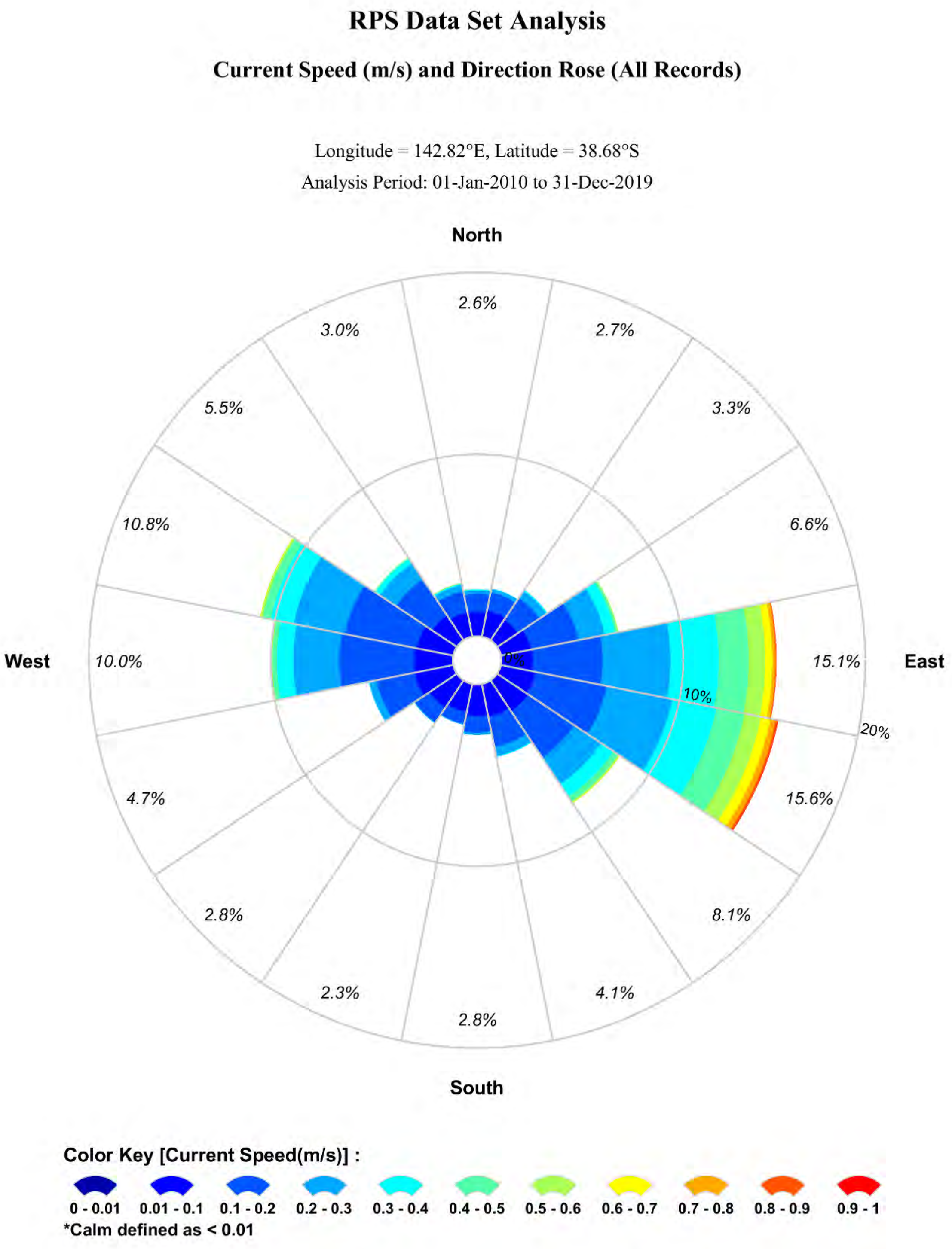


Figure 3.12 Total surface current rose plot nearby the Annie-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

3.4 Currents at 50 m below Surface

Table 3.5 to Table 3.7 present the average and maximum current speeds (at 50m below surface) nearby the Elanora-1 ST1, Pecten East-2 and Annie-2 wells by combining the ocean and tidal currents.

Near the Elanora-1 ST1 well current speeds varied throughout the year with maximum current speeds ranging between approximately 0.36 m/s (January) and 0.59 m/s (July).

Nearby Pecten-East 2, maximum current speeds ranged between 0.21 m/s (February) and 0.36 m/s (July).

Close to Annie-2, maximum current speeds varied between 0.28 m/s (November) and 0.39 m/s (July). Similar to Pecten-East 2.

Figure 3.13 to Figure 3.18 show the monthly and total current rose distributions for the selected locations.

Table 3.5 Predicted monthly average and maximum current speeds (at 50m below surface) for Elanora-1 ST1 well. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.10	0.36	West
February	0.09	0.39	West
March	0.10	0.41	East-southeast
April	0.09	0.52	East-southeast
May	0.10	0.52	East-southeast
June	0.11	0.47	East-southeast
July	0.12	0.59	East-southeast
August	0.11	0.53	East-southeast
September	0.10	0.50	East-southeast
October	0.10	0.46	East-southeast
November	0.09	0.40	East-southeast
December	0.10	0.40	East-southeast
Minimum	**0.09**	**0.36**	-
Maximum	**0.12**	**0.59**	

Table 3.6 Predicted monthly average and maximum surface current speeds (at 50m below surface) for Pecten East-2 well. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.06	0.27	East and west
February	0.06	0.21	East and west
March	0.06	0.31	East and west
April	0.06	0.27	East and west
May	0.06	0.31	East and west
June	0.06	0.29	East and west
July	0.07	0.36	East and west
August	0.07	0.31	East and west
September	0.06	0.33	East and west
October	0.06	0.26	East and west
November	0.06	0.24	East and west
December	0.06	0.27	East and west
Minimum	**0.06**	**0.21**	-
Maximum	**0.07**	**0.36**	

Table 3.7 Predicted monthly average and maximum surface current speeds (at 50m below surface) for Annie-2 well. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.09	0.35	West-northwest and east-southeast
February	0.09	0.29	
March	0.09	0.37	
April	0.09	0.30	
May	0.09	0.39	
June	0.09	0.35	
July	0.09	0.39	
August	0.09	0.36	
September	0.09	0.34	
October	0.09	0.30	
November	0.09	0.28	
December	0.09	0.30	
Minimum	**0.09**	**0.28**	-
Maximum	**0.09**	**0.39**	

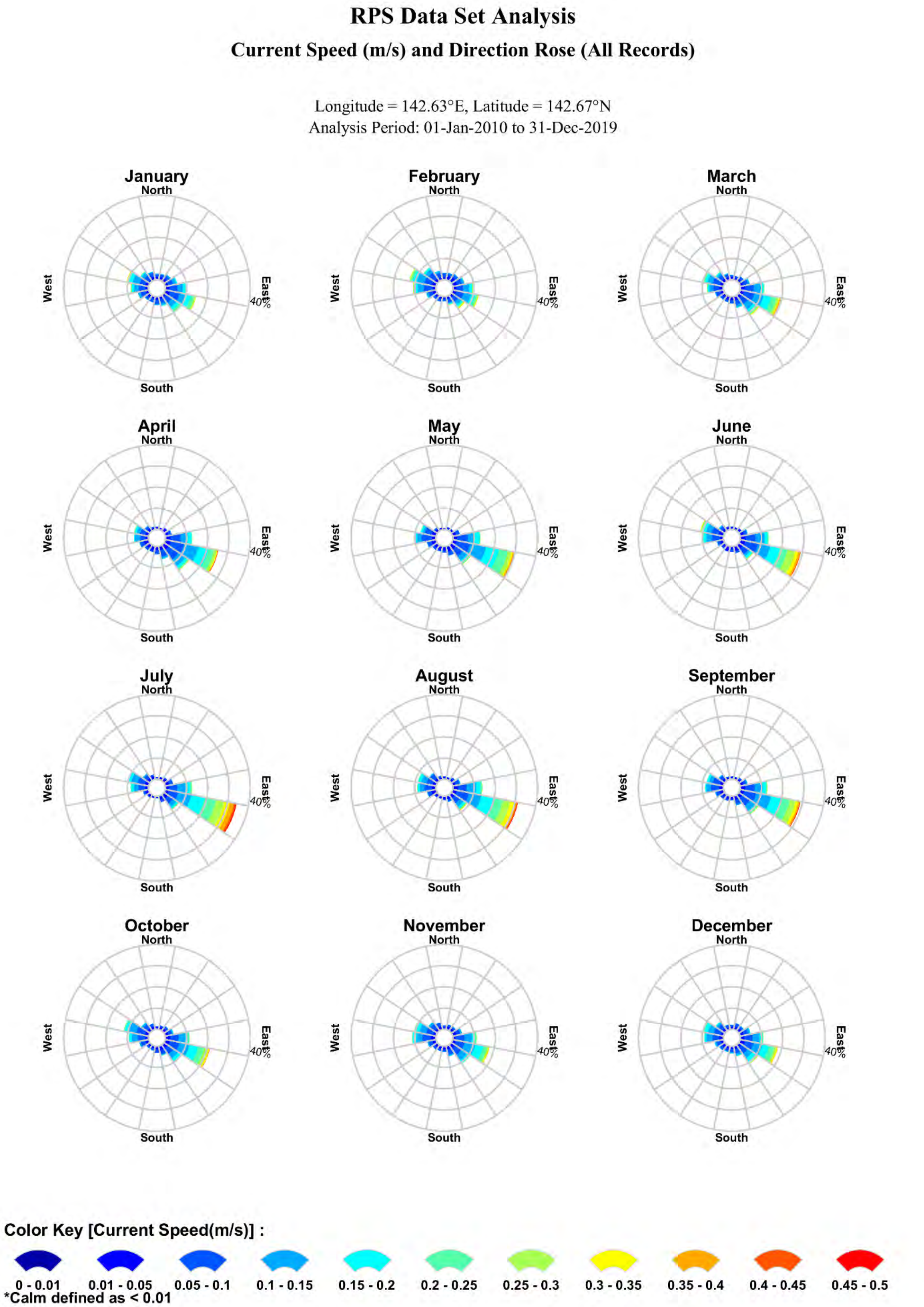


Figure 3.13 Monthly current rose plots (at 50m below surface) nearby the Elanora-1 ST1 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

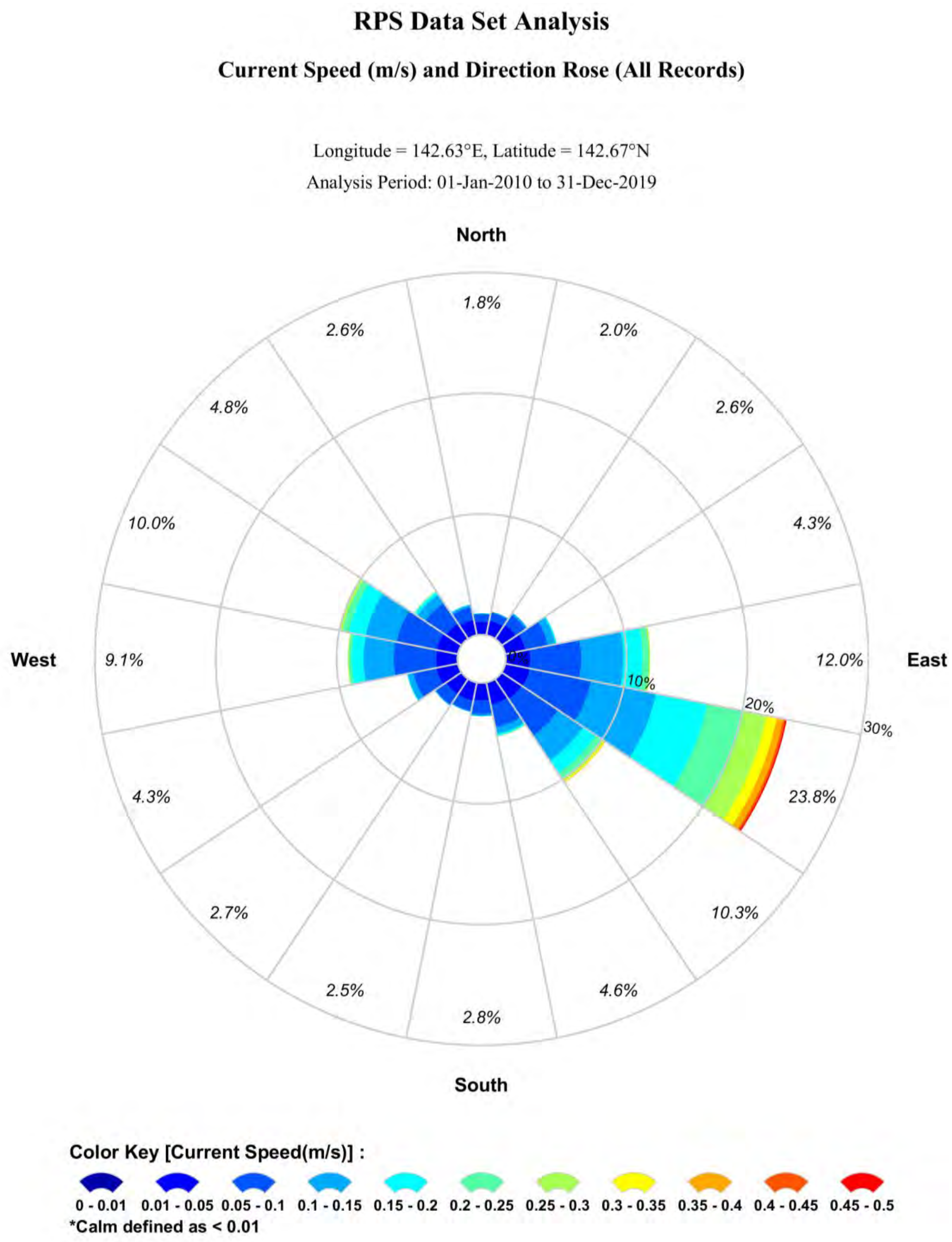


Figure 3.14 Total surface current rose plot (at 50m below surface) nearby the Elanora-1 ST1 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

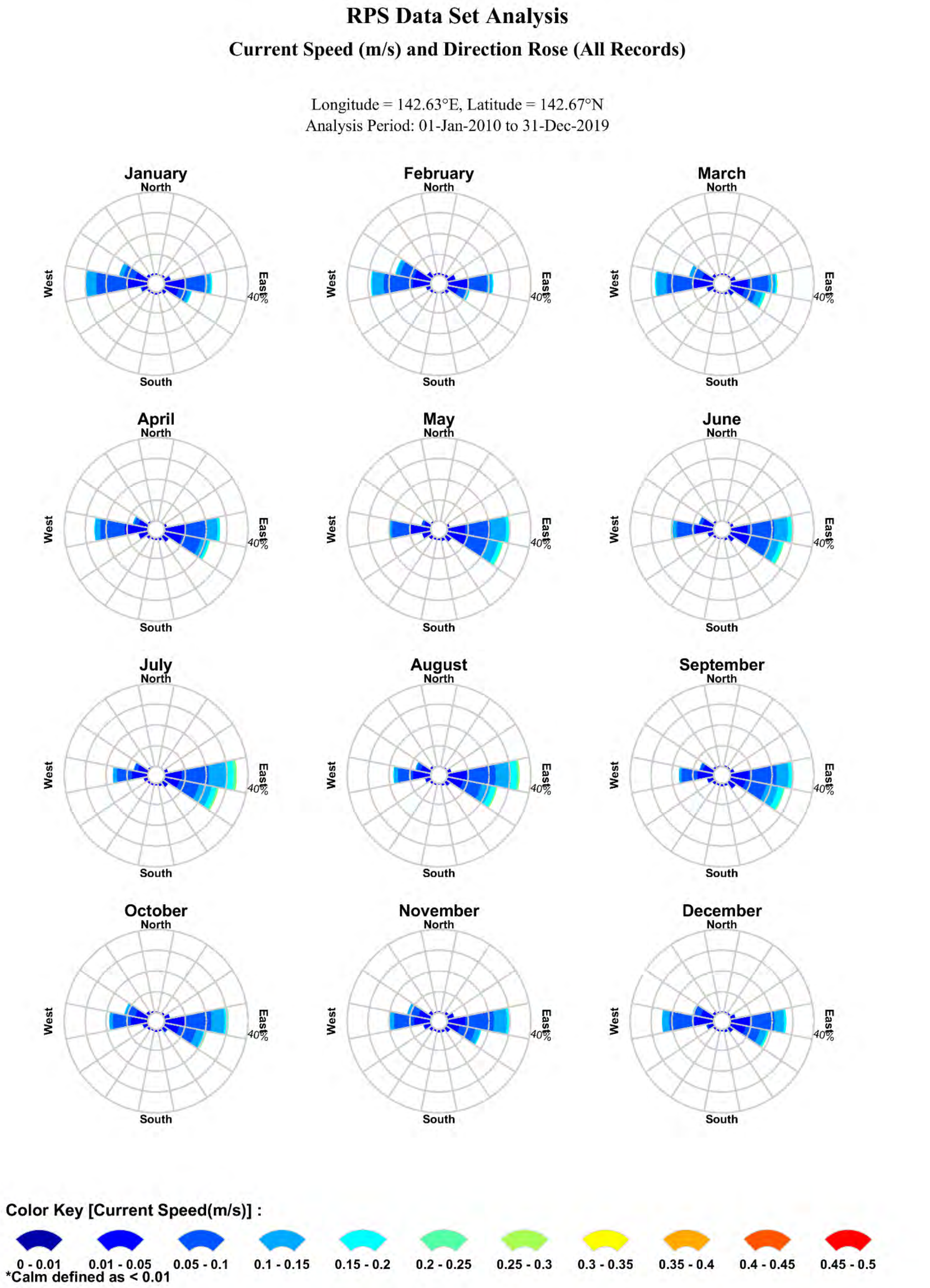


Figure 3.15 Monthly surface current rose plots (at 50m below surface) nearby the Pecten East-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

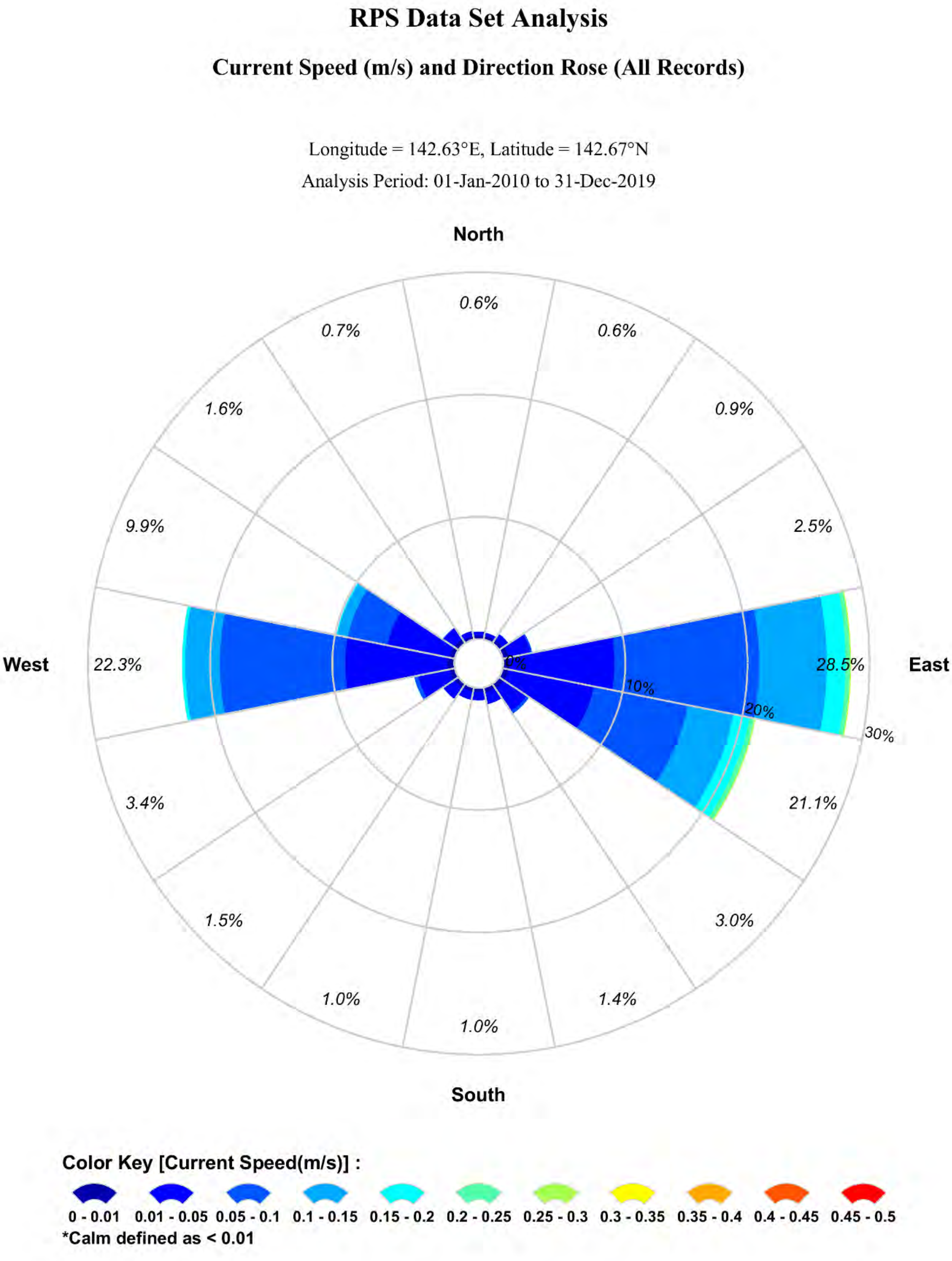


Figure 3.16 Total surface current rose plot (at 50m below surface) nearby the Pecten East-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

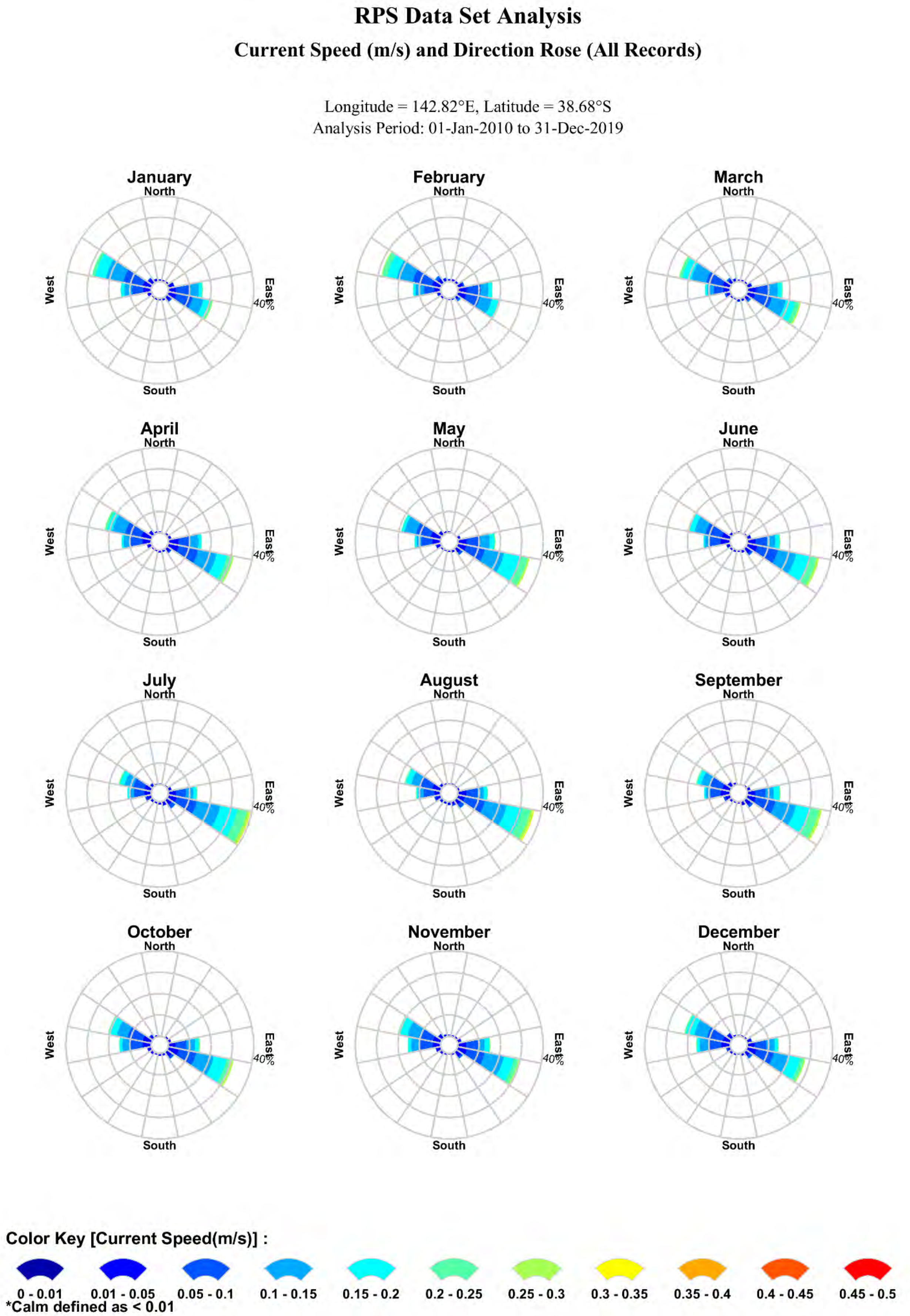


Figure 3.17 Monthly surface current rose plots (at 50m below surface) nearby the Annie-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

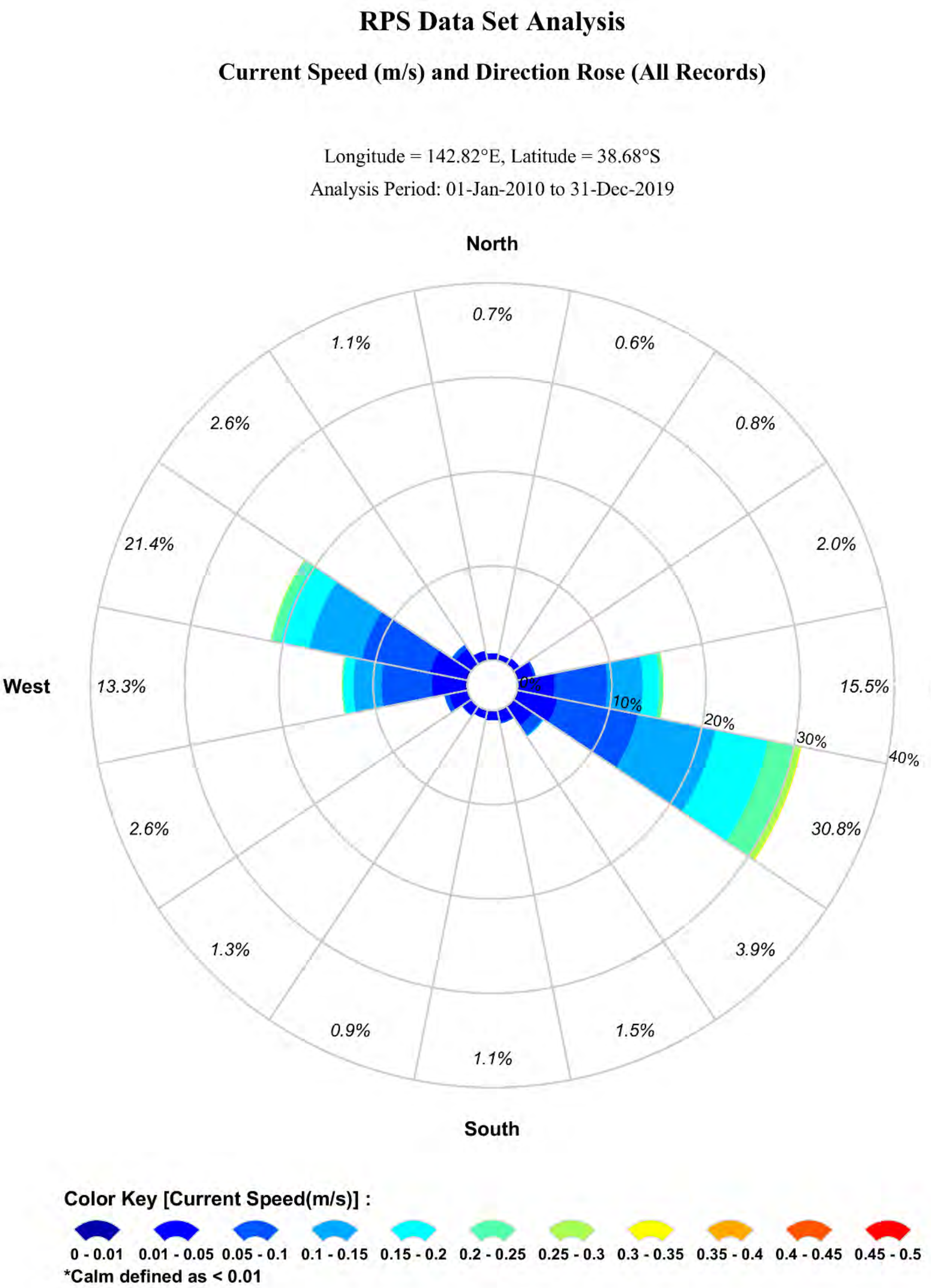


Figure 3.18 Total surface current rose plot (at 50m below surface) nearby the Annie-2 well derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

4 WIND DATA

High resolution wind data for the years 2010 to 2019 (inclusive) was sourced from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis dataset (CFSR; see Saha et al., 2010). The CFSR wind model is a fully coupled, data-assimilative hindcast model representing the interaction between the earth's oceans, land, and atmosphere. The gridded wind data output is available at ¼ of a degree resolution (~33 km) and 1-hourly time intervals. Figure 4.1 shows the spatial resolution of the wind field used as input into the oil spill model.

Table 4.1 to Table 4.3 present the monthly average and maximum winds derived from a CFSR wind node nearby the Elanora-1 ST1, Pecten East-2 and Annie-2 wells. The wind data demonstrated average monthly wind speeds ranging from 14 knots during summer months to 19 knots during winter months at Elanora-1 ST1 (Isabella), whilst near Pecten East-2 and Annie-2 seasonal wind speeds were 10 knots and 13 knots respectively (same wind node). Maximum monthly speeds ranged between 39 knots (January) and 53 knots (June) at Elanora-ST1 and 30 knots (January and November) and 42 knots (June) nearby Pecten East-2 and Annie-2. The dominant wind direction varied throughout the year, though westerly winds tended to dominate nearby all release locations during September to November.

Figure 4.2 to Figure 4.7 show the monthly and total wind rose distributions derived from the CFSR data for the selected node nearby the release locations.

Note that the atmospheric convention for defining wind direction, that is, the direction the wind blows from, is used to reference wind direction throughout this report. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent wind speed ranges from that direction. Speed ranges of 5 knots are typically used in these wind roses. The length of each segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction.

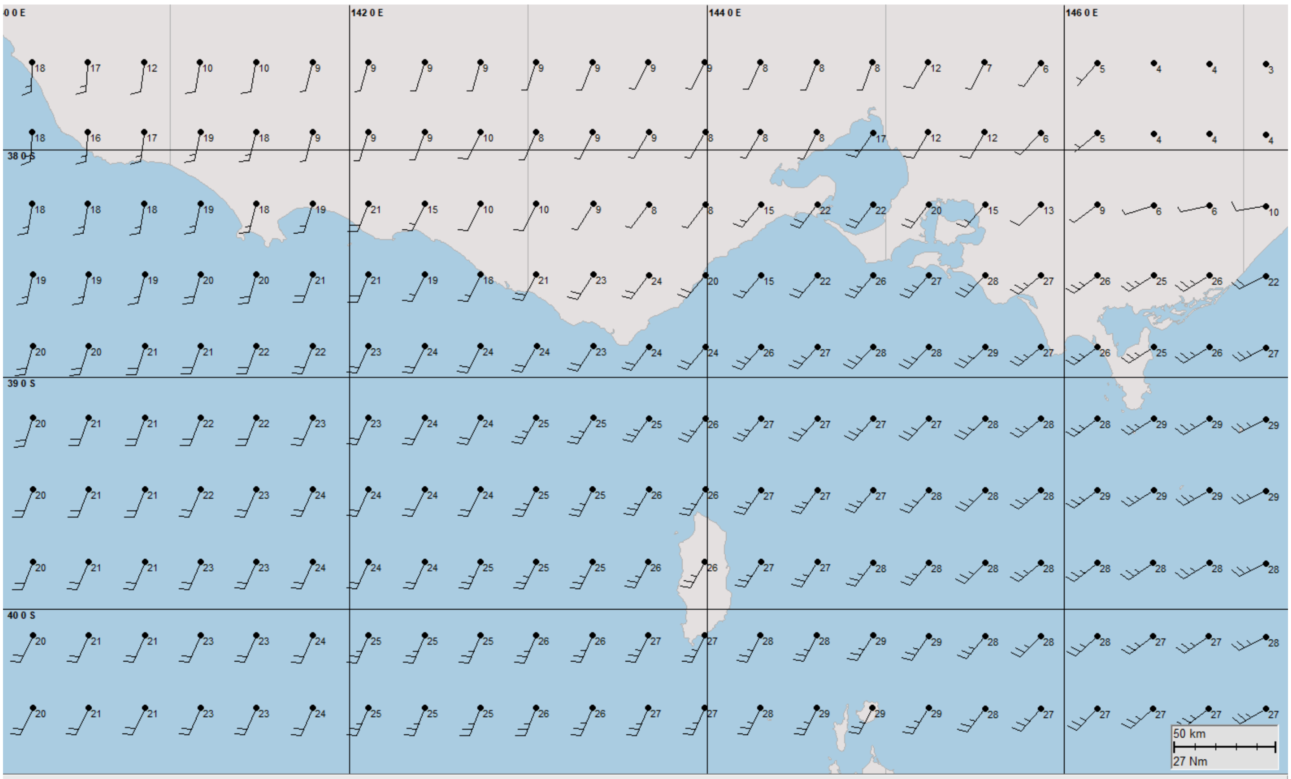


Figure 4.1 Spatial resolution of the CFSR modelled wind data used as input into the oil spill model.

Table 4.1 Predicted average and maximum winds representative for the selected node nearby the Elanora-1 ST1 well. Data derived from CFSR hindcast model from 2010–2019 (inclusive).

Month	Average wind speed (knots)	Maximum wind speed (knots)	General direction(s) (From)
January	14	39	South
February	14	42	Southeast
March	14	44	West
April	14	42	West
May	17	45	West
June	17	53	West-northwest
July	19	46	West-northwest
August	19	47	West
September	17	49	West
October	16	45	West
November	15	44	West
December	14	40	West-southwest
Minimum	**14**	**39**	-
Maximum	**19**	**53**	

Table 4.2 Predicted average and maximum winds representative for the selected node nearby the Pecten East-2 well. Data derived from CFSR hindcast model from 2010–2019 (inclusive).

Month	Average wind speed (knots)	Maximum wind speed (knots)	General direction(s) (From)
January	10	30	Southeast
February	10	31	Southeast
March	10	34	Southeast
April	10	33	West
May	11	32	Northwest
June	11	42	North-northwest
July	13	35	North-northwest
August	13	39	Northwest
September	12	41	West
October	11	31	West
November	10	30	West
December	10	31	West
Minimum	**10**	**30**	-
Maximum	**13**	**42**	

Table 4.3 Predicted average and maximum winds representative for the selected node nearby the Annie-2 well. Data derived from CFSR hindcast model from 2010–2019 (inclusive).

Month	Average wind speed (knots)	Maximum wind speed (knots)	General direction(s) (From)
January	10	30	Southeast
February	10	31	Southeast
March	10	34	Southeast
April	10	33	West
May	11	32	Northwest
June	11	42	North-northwest
July	13	35	North-northwest
August	13	39	Northwest
September	12	41	West
October	11	31	West
November	10	30	West
December	10	31	West
Minimum	**10**	**30**	-
Maximum	**13**	**42**	

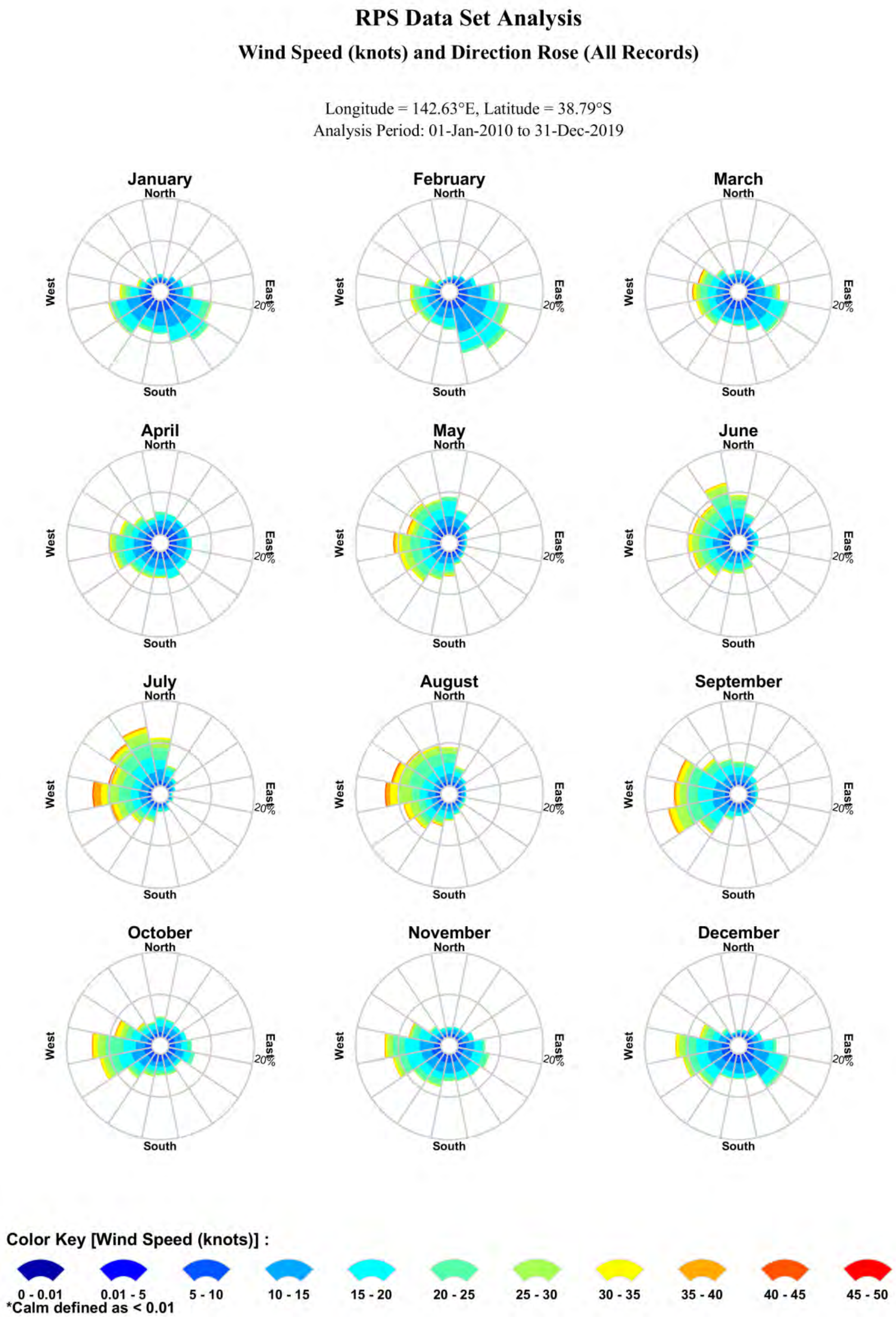


Figure 4.2 Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the Elanora-1 ST1 well.

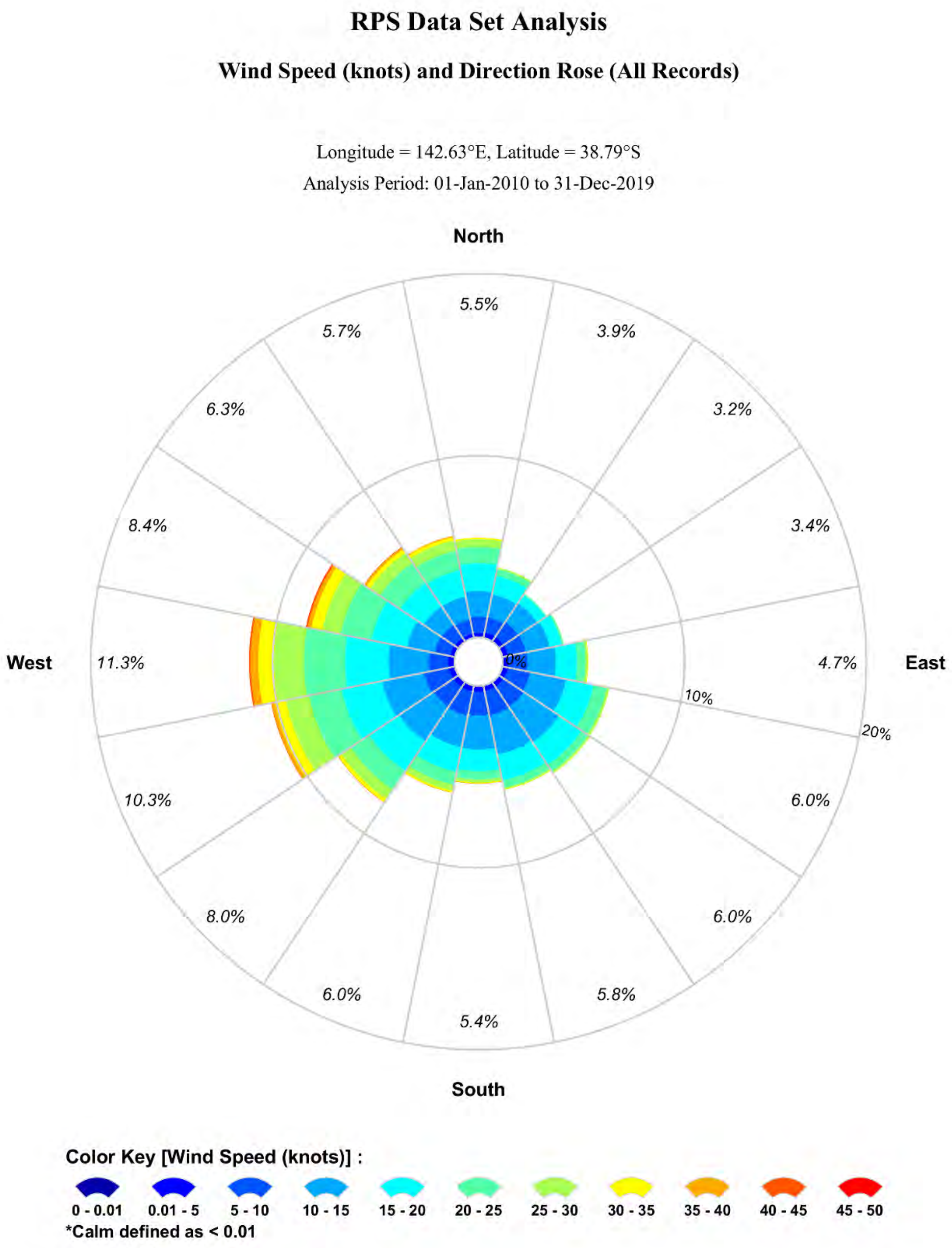


Figure 4.3 Modelled total wind rose distributions from 2010–2019 (inclusive) for the node nearby the Elanora-1 ST1 well.

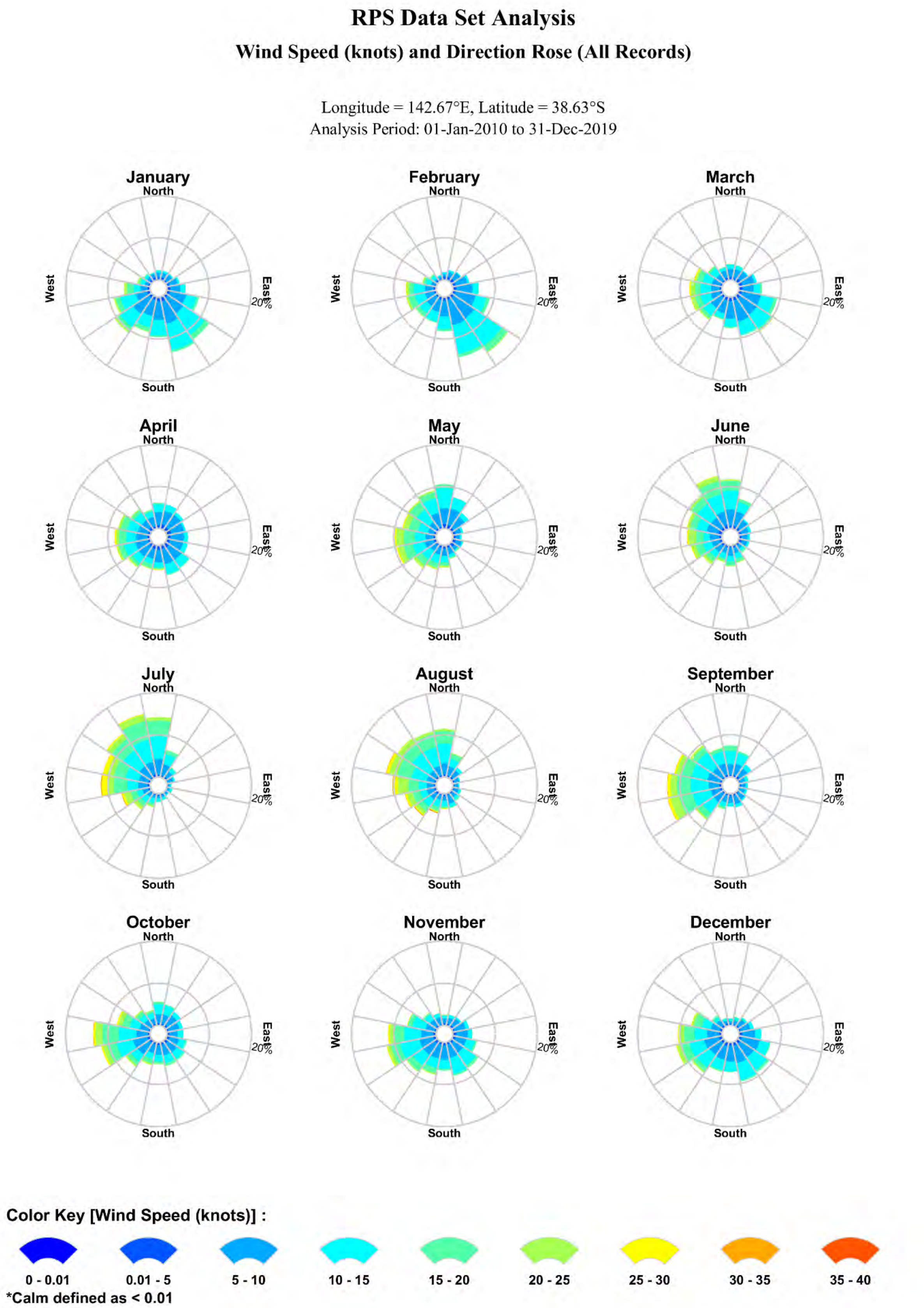


Figure 4.4 Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the Pecten East-2 well.

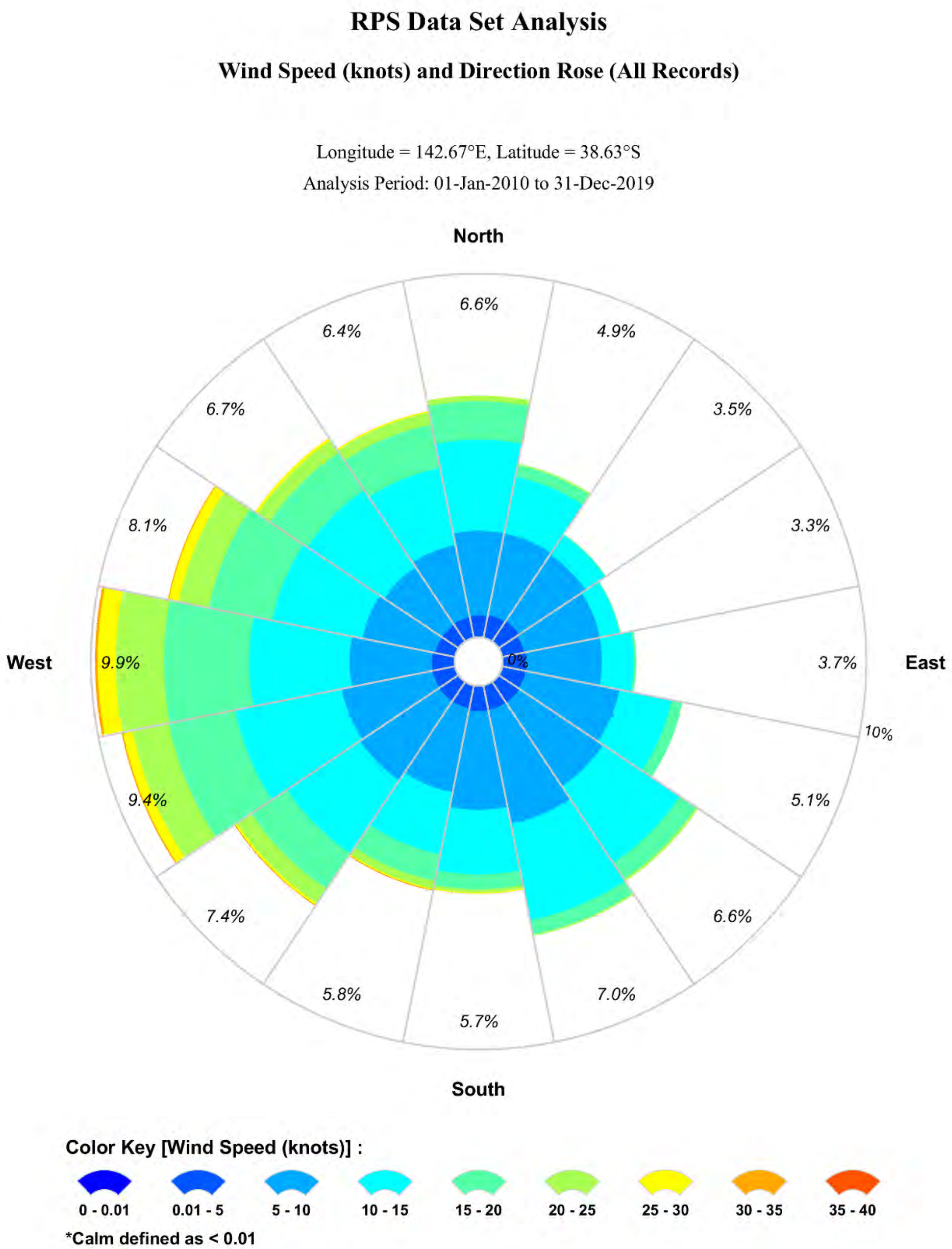


Figure 4.5 Modelled total wind rose distributions from 2010–2019 (inclusive) for the node nearby the Pecten East-2 well.

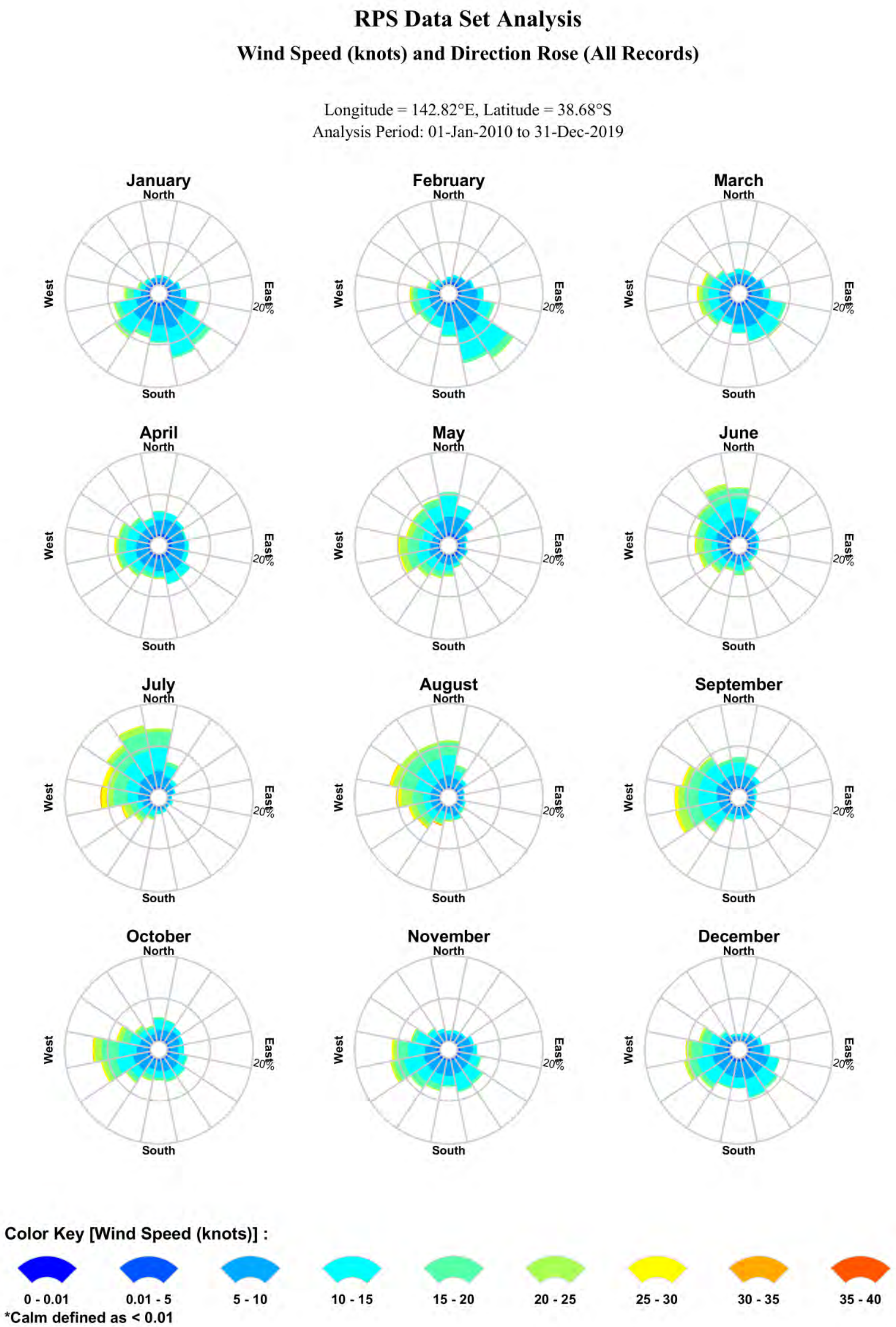


Figure 4.6 Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the Annie-2 well.

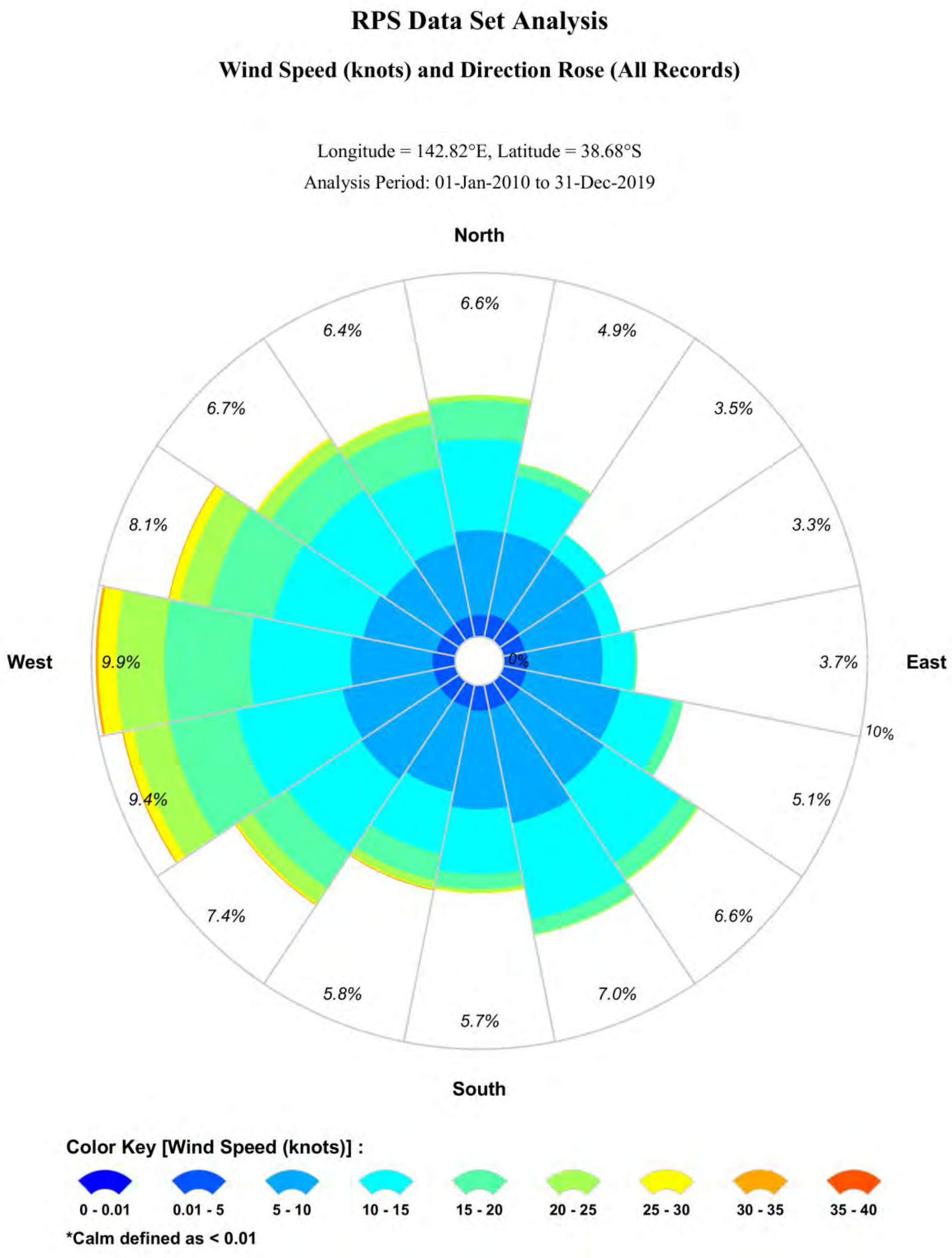


Figure 4.7 Modelled total wind rose distributions from 2010–2019 (inclusive) for the node nearby the Annie-2 well.

5 WATER TEMPERATURE AND SALINITY

The monthly sea temperature and salinity profiles of the water column within the study was obtained from the World Ocean Atlas 2018 database produced by the National Oceanographic Data Centre (National Oceanic and Atmospheric Administration) and its co-located World Data Center for Oceanography (see Levitus et al., 2013). These parameters were used as factors to inform the weathering, movement, and evaporative loss of hydrocarbon spills in the surface and sub-surface layers.

Figure 5.1 to Figure 5.3 illustrate the vertical profile of sea temperature and salinity nearby the release locations.

Table 5.1 to Table 5.3 present the sea temperature and salinity of the surface layer nearby the Elanora-1 ST1, Pecten East-2 and Annie-2 wells, respectively. The monthly average sea surface temperatures ranged between 13.5°C (September) and 18.9°C (February) nearby Elanora-1 ST1, and 13.3°C (September) and 18.3°C (January) nearby Pecten East-2 and 13.3°C (September) and 18.5°C (March) nearby Annie-2. The monthly average surface salinity values remain relatively consistent ranging between 35.3 psu and 35.5 psu across all three release locations.

Table 5.1 Monthly average sea surface temperature and salinity in the Elanora-1 ST1 well area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	18.3	18.9	18.8	17.1	15.8	15.1	14.8	14.1	13.5	13.9	14.7	16.0
Salinity (psu)	35.4	35.4	35.4	35.3	35.4	35.4	35.5	35.5	35.4	35.4	35.4	35.3

Table 5.2 Monthly average sea surface temperature and salinity in the Pecten East-2 well area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	18.3	18.1	18.0	17.1	15.7	14.8	14.4	13.8	13.3	14.0	15.0	16.1
Salinity (psu)	35.4	35.4	35.3	35.3	35.4	35.4	35.5	35.4	35.4	35.4	35.3	35.4

Table 5.3 Monthly average sea surface temperature and salinity in the Annie-2 well area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (°C)	18.3	18.4	18.5	17.1	15.7	14.7	14.2	13.7	13.3	14.0	14.9	16.1
Salinity (psu)	35.4	35.4	35.4	35.3	35.3	35.4	35.5	35.5	35.4	35.5	35.4	35.3

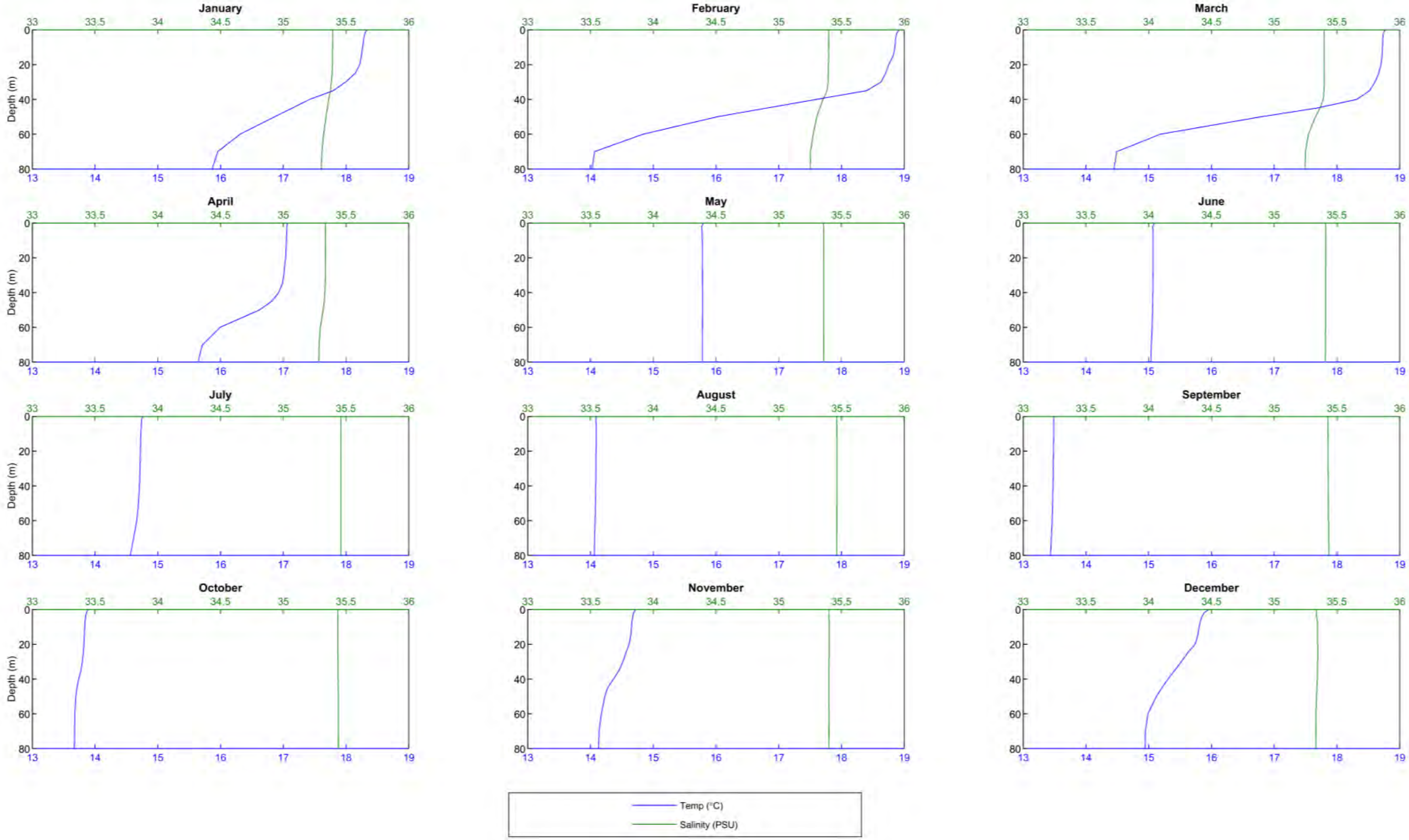


Figure 5.1 Temperature and salinity profiles nearby the Elanora-1 ST1 well.

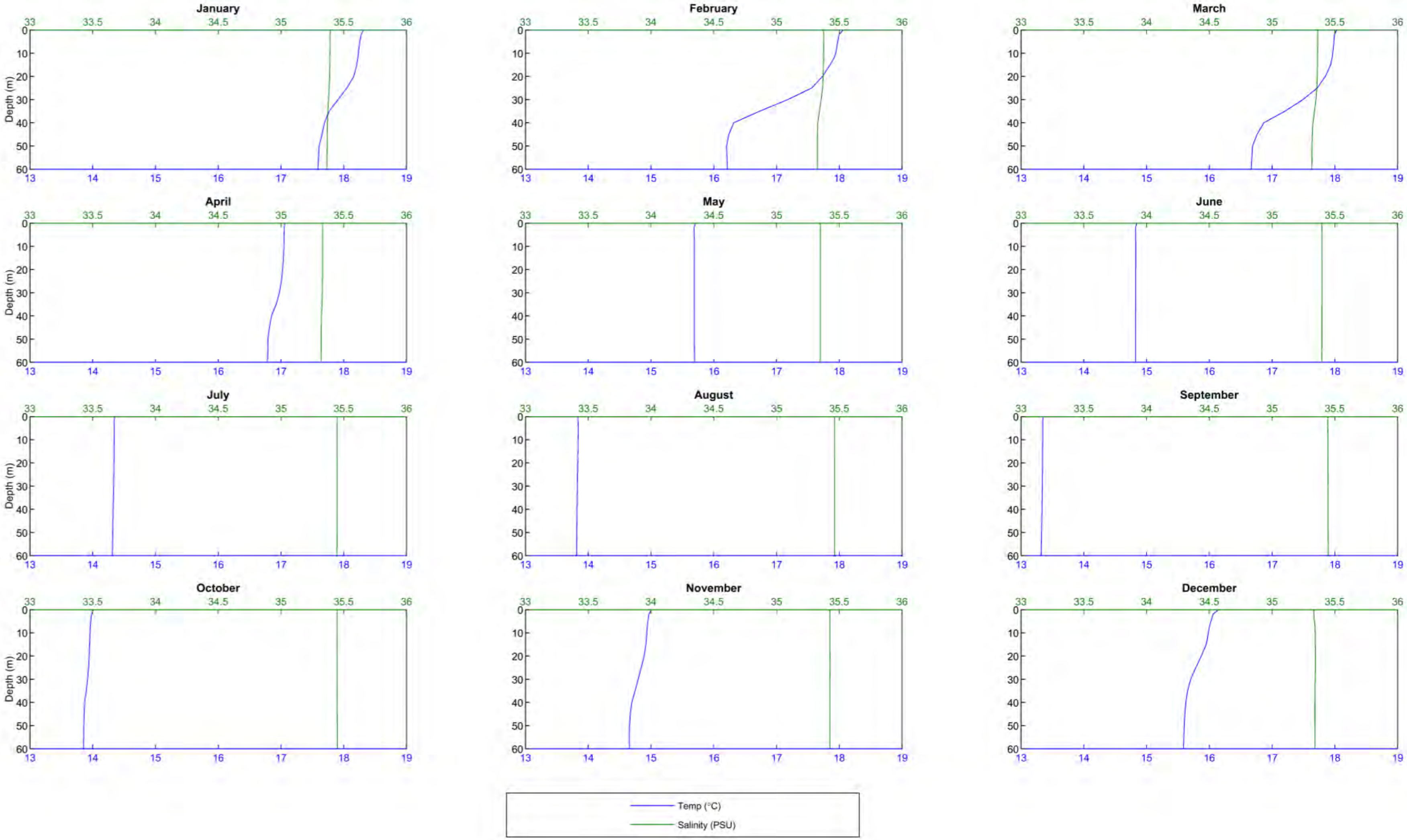


Figure 5.2 Temperature and salinity profiles nearby the Pecten East-2 well.

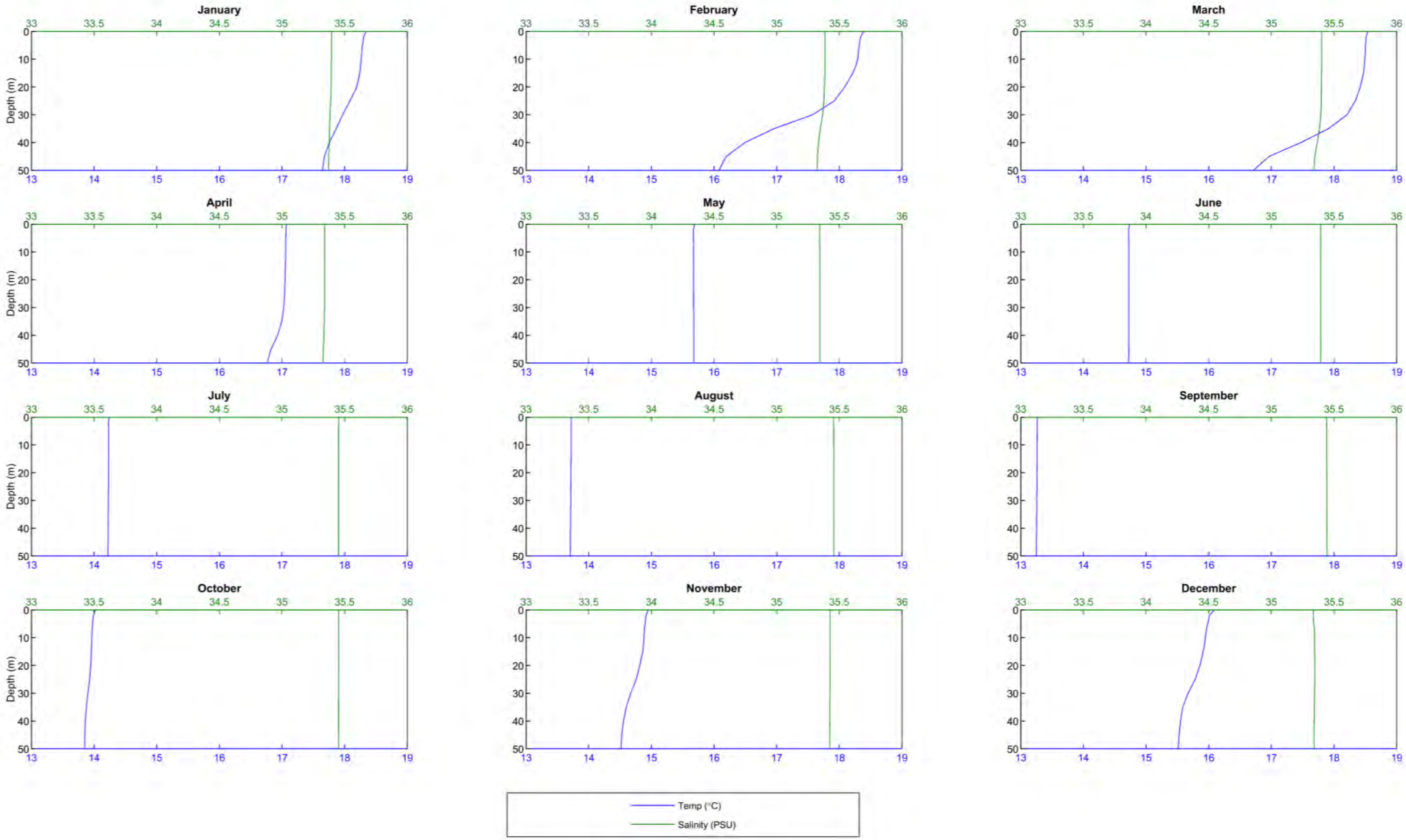


Figure 5.3 Temperature and salinity profiles nearby the Annie-2 well.

6 SUBSEA PLUME MODEL – OILMAP DEEP

In the event of an uncontrolled subsea LOWC, the gas and condensate will initially behave like a jet, which dissipates in the water column over a short distance (<10 m). The escaping condensate shears into small droplets due to turbulence generated by passing through the exit hole and subsequent turbulence generated in the plume jet. The size-distribution of the droplets varies with the exit velocity and viscosity of the condensate. Following this phase, the density and buoyancy difference of the gas and condensate mixture relative to the surrounding waters, forces the plume upward. As the plume rises, the volume of gas will increase due to reduction of water pressure, with gas bubbles dividing into an increasing number of bubbles due to the shearing effect exerted by the water column.

In shallow water (<150 m) the rising plume of gas and condensate will tend to reach the sea surface before deflecting away from the centre of the plume (Spaulding et al., 2000). Figure 6.1 conceptually illustrates the various stages of a subsea release of oil and gas.

OILMAP Deep model (Spaulding et al., 2015) was used to simulate the near-field behaviour of the gas-condensate subsea release in two phases – the initial jet phase and the buoyant plume phase. The initial jet phase is predominately driven by the exit velocity. During this phase, the condensate droplet-size-distributions are calculated for a range of classes or bins. Next, the plume model predicts the rise dynamics of the condensate and gas plumes to calculate at which point gas lift will be lost (i.e. the trapping height).

Outputs which include the plume trapping height, plume diameter and droplet size distribution are used as input to the SIMAP model to simulate the rise and dispersion of the condensate droplets from this point onwards.

More details on the OILMAP-DEEP model, can be found in Spaulding et al. (2015). The model has been validated against observations from Deepwater Horizon as well as small and large-scale laboratory studies on subsurface oil releases (Brandvik et al., 2013, 2014; Belore, 2014; Spaulding et al., 2015; Li et al., 2017).

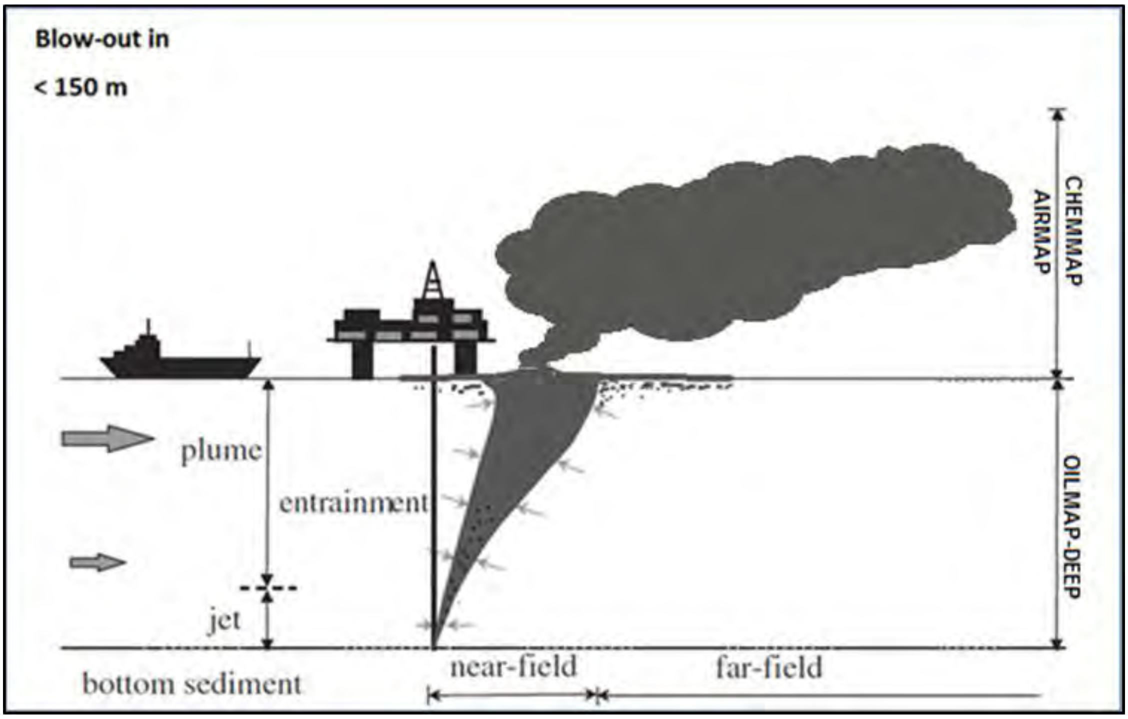


Figure 6.1 Example of a subsea plume and the various stages of the plume in the water column (Source: ASA, 2011).

Table 6.1 presents the input parameters and key results for the subsea plume modelling. Note a depleting release rate was assessed. The subsea modelling showed that in the event of a LOWC, the amalgamated gas and condensate would propel rapidly upward from the seabed and rupture the sea surface at all three locations assessed.

Table 6.1 Input data and key results for the subsea plume modelling.

Input Variable	Value		
Scenario	LOWC at Elanora-1 ST1 (Isabella)	LOWC at Pecten East-2	LOWC at Annie-2
Water depth (m)	56 (from top of the BOP stack)	34 (from top of the BOP stack)	36 (from top of the BOP stack)
Top of release diameter (inch)	18.75	18.75	18.75
Condensate discharge rate (stb/day)	1326 (day 1) depleting to 798 (day 102)	1250 (day 1) depleting to 505 (day 102)	878 (day 1) depleting to 453 (day 104)
Gas rate (MMscf/day)	663 (day 1) depleting to 399 (day 102)	625 (day 1) depleting to 253 (day 102)	438.9 (day 1) depleting to 226.4 (day 104)
Formation water flow rate (stb/day)	356 (day 1) depleting to 293 (day 102)	496 (day 1) depleting to 353 (day 102)	444.9 (day 1) depleting to 298.0 (day 104)
Key results			
Plume execution depth (m BMSL^)	0 (Breach the sea surface)	0 (Breach the sea surface)	0 (Breach the sea surface)
Droplet sizes (μm)	1,399 to 6,044 (day 1) to 1,761 to 7,607 (day 104)	1,268 to 5,479 (day 1) to 1,884 to 8,137 (day 104)	1,584 to 6,843 (day 1) to 2,056 to 8,882 (day 104)

^Below mean sea level

7 OIL SPILL MODEL – SIMAP

Modelling of the fate of oil was performed using the Spill Impact Mapping Analysis Program (SIMAP). SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for both the surface and subsurface releases (Spaulding et al., 1994; French et al., 1999; French-McCay, 2003, 2004; French-McCay et al., 2004).

SIMAP has been used to predict the weathering and fate of oil spills during and after major incidents including: Montara (Australia) well blowout August 2009 in the Timor Sea (Asia-Pacific ASA, 2010); Macondo (USA) well blowout April 2010 in the Gulf of Mexico; Bohai Bay (China) oil spill August 2011; and the pipeline oil spill July 2013 in the Gulf of Thailand.

The SIMAP model calculates the transport, spreading, entrainment, evaporation and decay of surface hydrocarbon slicks as well as the entrained and dissolved oil components in the water column, either from surface slicks or from oil discharged subsea. The movement and weathering of the spilled oil is calculated for specific oil types. Input specifications for oil mixtures include the density, viscosity, pour point, distillation curve (volume lost versus temperature) and the aromatic/aliphatic component ratios within given boiling point (BP) ranges.

SIMAP is a three-dimensional model that allows for various response actions to be modelled including oil removal from skimming, burning, or collection booms, and surface and subsurface dispersant application.

The SIMAP oil spill model includes advanced weathering algorithms, specifically focussed on unique oils that tend to form emulsions and/or tar balls. The weathering algorithms are based on 5 years of extensive research conducted in response to the Deepwater Horizon oil spill in the Gulf of Mexico (French-McCay et al., 2015).

Biodegradation is included in the oil spill model. In the model, SIMAP, degradation is calculated for the surface slick, deposited oil on the shore, the entrained oil and dissolved constituents in the water column, and oil in the sediments. For surface oil, water column oil and sedimented oil a first order degradation rate is specified. Biodegradation rates are relatively high for hydrocarbons in dissolved state or in dispersed small droplets.

7.1 Stochastic Modelling

For the stochastic modelling presented herein, 100 oil spills (per season) were modelled for each scenario using the same spill information (release location, spill volume, duration and oil type) but with varied start dates. During each simulation, the model records whether any grid cells are exposed to any oil concentrations, the concentrations involved and the elapsed time before exposure. The results of all 100 oil spill simulations (per season) were analysed to determine the following statistics for every grid cell:

- Exposure load (concentrations and volumes);
- Minimum time before exposure;
- Probability of contact above defined concentrations;
- Volume of oil that may accumulate on shorelines from any single simulation;
- Concentration that might occur on sections of individual shorelines;
- Exposure to dissolved hydrocarbons in the water column; and
- Exposure to entrained hydrocarbons in the water column.

7.2 Floating, Shoreline and In-Water Thresholds

The thresholds and their relationship to exposure for the sea surface, shoreline and water column (entrained and dissolved hydrocarbons) are presented in Sections 7.2.1 to 7.2.3. Supporting justifications of the adopted thresholds applied during the study and additional context relating to the area of potential exposure are also provided. It is important to note that the thresholds herein are based on NOPSEMA (2019).

7.2.1 Floating Oil Exposure Thresholds

The modelling results can be presented to any levels; therefore, thresholds have been specified (based on scientific literature) to record floating oil exposure to the sea-surface at meaningful levels only, described in the following paragraphs.

The low threshold to assess the potential for floating oil exposure, was 1 g/m^2, which equates approximately to an average thickness of 1 µm, referred to as visible oil. Oil of this thickness is described as rainbow sheen in appearance, according to the Bonn Agreement Oil Appearance Code (Bonn Agreement, 2009; AMSA, 2014) (see Table 7.1). Figure 7.1 shows photographs highlighting the difference in appearance between a silvery sheen, rainbow sheen and metallic sheen. This threshold is considered below levels which would cause environmental harm and it is more indicative of the areas perceived to be affected due to its visibility on the sea surface and potential to trigger temporary closures of areas (i.e. fishing grounds) as a precautionary measure. Table 7.1 provides a description of the appearance in relation to exposure zone thresholds used to classify the zones of floating oil exposure.

Ecological impact has been estimated to occur at 10 g/m^2 (a film thickness of approximately 10 µm or 0.01 mm) according to French et al. (1996) and French-McCay (2009) as this level of fresh oiling has been observed to mortally impact some birds through adhesion of oil to their feathers, exposing them to secondary effects such as hypothermia. The appearance of oil at this average thickness has been described as a metallic sheen (Bonn Agreement, 2009).

Scholten et al. (1996) and Koops et al. (2004) indicated that at oil concentrations on the sea surface of 25 g/m^2 (or greater), would be harmful for all birds that have landed in an oil film due to potential contamination of their feathers, with secondary effects such as loss of temperature regulation and ingestion of oil through preening. The appearance of oil at this thickness is also described as metallic sheen (Bonn Agreement, 2009). For this study the high exposure threshold was set to 50 g/m^2 and above based on NOPSEMA (2019). This threshold can also be used to inform response planning.

Table 7.2 defines the thresholds used to classify the zones of floating oil exposure reported herein.

Table 7.1 The Bonn Agreement Oil Appearance Code.

Code	Description Appearance	Layer Thickness Interval (g/m^2 or µm)	Litres per km^2
1	Sheen (silvery/grey)	0.04 – 0.30	40 – 300
2	Rainbow	0.30 – 5.0	300 – 5,000
3	Metallic	5.0 – 50	5,000 – 50,000
4	Discontinuous True Oil Colour	50 – 200	50,000 – 200,000
5	Continuous True Oil Colour	≥ 200	≥ 200,000

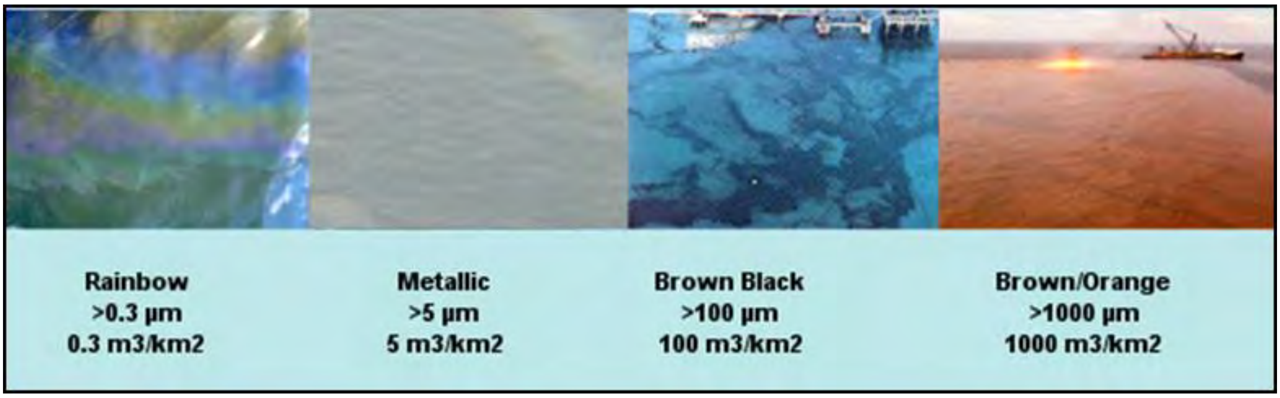


Figure 7.1 Photographs showing the difference between oil colour and thickness on the sea surface (source: adapted from Oil Spill Solutions, 2015).

Table 7.2 Floating oil exposure thresholds used in this report (in alignment with NOPSEMA (2019)).

Threshold level	Floating oil (g/m²)	Description
Low	1	Approximates range of socioeconomic effects and establishes planning area for scientific monitoring
Moderate	10	Approximates lower limit for harmful exposures to birds and marine mammals
High	50	Approximates surface oil slick and informs response planning

7.2.2 Shoreline Accumulation Thresholds

There are many different types of shorelines, ranging from cliffs, rocky beaches, sandy beaches, mud flats and mangroves, and each of these influences the volume of oil that can remain stranded ashore and its thickness before the shoreline saturation point occurs. For instance, a sandy beach may allow oil to percolate through the sand, thus increasing its ability to hold more oil ashore over tidal cycles and various wave actions than an equivalent area of water; hence oil can increase in thickness onshore over time. A sandy beach shoreline was assumed as the default shoreline type for the modelling herein, as it allows for the highest carrying capacity of oil (of the available open/exposed shoreline types). Hence the results contained herein would be indicative of a worst-case scenario, where the highest volume of oil may be stranded on the shoreline (when compared to other shoreline types, such as exposed rocky shores).

In previous risk assessment studies, French-McCay et al. (2005a; 2005b) used a threshold of 10 g/m² to assess the potential for shoreline accumulation. This is a conservative threshold used to define regions of socio-economic impact, such as triggering temporary closures of adjoining fisheries or the need for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.). It would equate to approximately 2 teaspoons of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a stain/film. On that basis, the 10 g/m² shoreline accumulation threshold has been selected to define the zone of potential “low shoreline accumulation”.

French et al. (1996) and French-McCay (2009) define a shoreline oil accumulation threshold of 100 g/m², or above, would potentially harm shorebirds and wildlife (furbearing aquatic mammals and marine reptiles on or along the shore) based on studies for sub-lethal and lethal impacts. This threshold has been used in previous environmental risk assessment studies (see French-McCay, 2003; French-McCay et al., 2004, French-McCay et al., 2011; 2012; NOAA, 2013). Additionally, a shoreline concentration of 100 g/m², or above, is the minimum limit that the oil can be effectively cleaned according to the AMSA (2015) guideline. This threshold equates to approximately ½ a cup of oil per square meter of shoreline accumulation. The appearance is described as a thin oil coat. Therefore, 100 g/m² has been selected to define the zone of potential “moderate shoreline accumulation”.

Observations by Lin & Mendelssohn (1996), demonstrated that loadings of more than 1,000 g/m² of hydrocarbon during the growing season would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing hydrocarbon impacts on mangroves (Grant et al., 1993; Suprayogi & Murray, 1999). Hence, 1,000 g/m² has been selected to define the zone of potential “high shoreline accumulation”. It equates to approximately 1 litre of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a hydrocarbon cover.

It is worth noting that the shoreline accumulation thresholds derived from extensive literature review (outlined in Table 7.3) agree with the commonly used threshold values for oil spill modelling specified in NOPSEMA (2019).

Table 7.3 Thresholds used to assess shoreline accumulation.

Threshold level	Shoreline loading (g/m²)	Description
Low (socioeconomic/sublethal)	10	Predicts potential for some socio-economic impact
Moderate	100	Loading predicts area likely to require clean-up effort
High	> 1,000	Loading predicts area likely to require intensive clean-up effort

7.2.3 In-water Exposure Thresholds

Oil is a mixture of thousands of hydrocarbons of varying physical, chemical, and toxicological characteristics, and therefore, demonstrate varying fates and impacts on organisms. As such, for in-water exposure, the SIMAP model provides separate outputs for dissolved and entrained hydrocarbons from oil droplets. The consequences of exposure to dissolved and entrained components will differ because they have different modes and magnitudes of effect.

Entrained hydrocarbon concentrations were calculated based on oil droplets that are suspended in the water column, though not dissolved. The composition of this oil would vary with the state of weathering (oil age) and may contain soluble hydrocarbons when the oil is fresh. Calculations for dissolved hydrocarbons specifically calculates oil components which are dissolved in water, which are known to be the primary source of toxicity exerted by oil.

7.2.3.1 Dissolved Hydrocarbons

Laboratory studies have shown that dissolved hydrocarbons exert most of the toxic effects of oil on aquatic biota (Carls et al., 2008; Nordtug et al., 2011; Redman, 2015). The mode of action is a narcotic effect, which is positively related to the concentration of soluble hydrocarbons in the body tissues of organisms (French-McCay, 2002). Dissolved hydrocarbons are taken up by organisms directly from the water column by absorption through external surfaces and gills, as well as through the digestive tract. Thus, soluble hydrocarbons are termed “bioavailable”.

Hydrocarbon compounds vary in water-solubility and the toxicity exerted by individual compounds is inversely related to solubility, however bioavailability will be modified by the volatility of individual compounds (Nirmalakhandan & Speece, 1988; Blum & Speece, 1990; McCarty, 1986; McCarty et al., 1992a, 1992b; Mackay et al., 1992; McCarty & Mackay, 1993; Verhaar et al., 1992, 1999; Swartz et al., 1995; French-McCay, 2002; McGrath and Di Toro, 2009). Of the soluble compounds, the greatest contributor to toxicity for water-column and benthic organisms are the lower-molecular-weight aromatic compounds, which are both volatile and soluble in water. Although they are not the most water-soluble hydrocarbons within most oil types, the polynuclear aromatic hydrocarbons (PAHs) containing 2-3 aromatic ring structures typically exert the largest narcotic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant accumulation to occur (Anderson et al., 1974, 1987; Neff & Anderson, 1981; Malins & Hodgins, 1981; McAuliffe, 1987; NRC, 2003). The monoaromatic hydrocarbons (MAHs), including the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes (straight chain hydrocarbons) also contribute to toxicity, but these compounds are highly volatile, so that their contribution will be low when oil is exposed to evaporation and higher when oil is discharged at depth where volatilisation does not occur (French-McCay, 2002).

French-McCay (2002) reviewed available toxicity data, where marine biota was exposed to dissolved hydrocarbons prepared from oil mixtures, finding that 95% of species and life stages exhibited 50% population mortality (LC_{50}) between 6 and 400 ppb total PAH concentration after 96 hrs exposure, with an average of 50 ppb. Hence, concentrations lower than 6 ppb total PAH value should be protective of 97.5% of species and life stages even with exposure periods of days (at least 96 hours). Early life-history stages of fish appear to be more sensitive than older fish stages and invertebrates.

Exceedances of 10, 50 or 400 ppb over a 1 hour timestep (see Table 7.4) was applied to indicate increasing potential for sub-lethal to lethal toxic effects (or low to high), based on NOPSEMA (2019).

7.2.3.2 Entrained Hydrocarbons

Entrained hydrocarbons consist of oil droplets that are suspended in the water column and insoluble. As such, insoluble compounds in oil cannot be absorbed from the water column by aquatic organisms, hence are not bioavailable through absorption of compounds from the water. Exposure to these compounds would require routes of uptake other than absorption of soluble compounds. The route of exposure of organisms to whole oil alone include direct contact with tissues of organisms and uptake of oil by direct consumption, with potential for biomagnification through the food chain (NRC, 2005).

The 10 ppb threshold represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC & ARMCANZ (2000) water quality guidelines. Due to the requirement for relatively long exposure times (>24 hours) for these concentrations to be significant, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes, or when entrained hydrocarbons adhere to organisms or trapped against a shoreline for periods of several days or more.

This exposure zone is not considered to be of significant biological impact and is therefore outside the adverse exposure zone. This exposure zone represents the area contacted by the spill. This area does not define the area of influence as it is considered that the environment will not be affected by the entrained hydrocarbon at this level.

Thresholds of 10 ppb and 100 ppb were applied over a 1-hour time exposure (Table 7.4), to cover the range of thresholds outlined in ANZECC & ARMCANZ (2000) water quality guidelines, the incremental change for greater potential effect and is per NOPSEMA (2019).

A complicating factor that should be considered when assessing the consequence of dissolved and entrained oil distributions is that there will be some areas where both physically entrained oil droplets and dissolved hydrocarbons co-exist. Higher concentrations of each will tend to occur close to the source where sea conditions can force mixing of relatively unweathered oil into the water column, resulting in more rapid dissolution of soluble compounds.

Table 7.4 Dissolved and entrained hydrocarbon exposure values assessed over a 1-hour time step, as per NOPSEMA (2019).

	Exposure level	In-water threshold (ppb)	Description
Dissolved hydrocarbons	Low	10	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
	Moderate	50	Approximates potential toxic effects, particularly sublethal effects to sensitive species
	High	400	Approximates toxic effects including lethal effects to sensitive species
Entrained hydrocarbons	Low	10	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
	High	100	As appropriate given oil characteristics for informing risk evaluation

8 HYDROCARBON PROPERTIES

8.1 Physical Properties

An exploration well has been drilled within the Annie field with hydrocarbon properties being known for that location. Annie condensate has a higher residuals profile when compared with other offset fields representing a more conservative analogue and therefore Annie condensate was selected for all scenarios modelled in this assessment. While a comprehensive oil assay for Annie-1 condensate was provided by the client (Core Lab RFL 201903231), it should be noted that essential data pertaining to the pour point, dynamic viscosity, and aromatic content for distinct boiling point ranges were absent from the dataset. Consequently, a pragmatic approach was adopted to supplement these missing values by sourcing relevant information from the Minerva condensate assay data. Minerva condensate is found in a nearby reservoir.

Table 8.1 and Table 8.2 present the physical properties and boiling point ranges of the condensate used in this study.

The Annie-1 condensate has an API of 41.0, density of 820.0 kg/m^3 (at 16 ºC), with low viscosity (1.063 cP at 20 ºC) classifying it as a Group II (light-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2020) and US EPA/USCG classifications. The condensate comprises a significant portion of volatiles and semi- to low-volatiles (82.5% total) with 17.5% residual components. This means the condensate will evaporate readily when on the water surface, with the persistent components to remain on the water surface over time.

The boiling points (BP) are dictated by the length of the carbon chains, with the longer and more complex compounds having a higher boiling point, and therefore lower volatility and evaporation rate. Typical evaporation times once the hydrocarbons reach the surface and are exposed to the atmosphere are:

- Up to 12 hours for the C_4 to C_{10} compounds (BP <180°C).
- Up to 24 hours for the C_{11} to C_{15} compounds (BP 180-265°C).
- Several days for the C_{16} to C_{20} compounds (BP 265-380°C).
- Not applicable for the residual compounds (BP >380°C), which will resist evaporation, persist in the marine environment for longer periods, and be subject to relatively slow degradation.

Table 8.1 Physical properties.

Characteristic	Annie-1 Condensate
Density (kg/m^3)	820.0 (@ 16 °C)
API	41.0
Dynamic viscosity (cP)	1.063 (@ 20°C)*
Pour point (°C)	-30*
Wax Content (%)	10.0
Hydrocarbon property category	Group II
Hydrocarbon property classification	Light-Persistent

Table 8.2 Boiling point ranges.

Oil Type	Component	Volatile (%)	Semi-volatile (%)	Low-volatility (%)	Residual (%)
	Boiling point (°C)	<180 C_4 to C_{10}	180-265 C_{11} to C_{15}	265-380 C_{16} to C_{20}	>380 $>C_{20}$
Annie-1 condensate	% of total	8.0	46.5	28.0	17.5

** data extracted from Minerva condensate assay*

8.2 Weathering Properties

8.2.1 Annie-1 Condensate

A series of model weathering tests were conducted to illustrate the potential behaviour of the condensate when exposed to idealised and representative environmental conditions:

- A 50 m^3 surface release over 1-hour under calm wind conditions (constant 5 knots), assuming low seasonal water temperature (15 °C) and ambient tidal and drift currents; and
- A 50 m^3 surface release over 1-hour under variable wind conditions (1-23 knots, drawn from representative data files), assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.

Note, a surface release is used in the weathering test to solely focus on the weathering and fates of the hydrocarbons when exposed to atmospheric conditions.

The first case is indicative conditions that would not generate entrainment, while the second case represents conditions that would likely cause entrainment. Both scenarios provide examples of potential behaviour during a spill once the oil is on the sea surface.

The mass balance for the condensate under the constant 5 knot wind case (Figure 8.1) shows that 52.4% of the condensate is expected to evaporate within 24 hours. Under calm conditions, the majority of the remaining condensate on the water surface will weather at a slower rate due to being comprised of the less volatile, longer-chain compounds. Evaporation shall cease when only the residual compounds remain, and they will be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 8.2), where the winds are of greater strength on average, entrainment of condensate into the water column is shown to increase. Approximately 24 hours after the spill, 70.1% of the mass is shown to have entrained and a further 23.8% has evaporated, leaving only a small proportion floating on the water surface (<1%).

The increased level of entrainment in the variable-wind case result in a higher percentage decaying at an approximate rate of ~2.5% per day with 17.8% after 7 days, compared to <0.7% per day and a total of 0.1% after 7 days for the constant-wind case. Given the proportion of entrained condensate and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

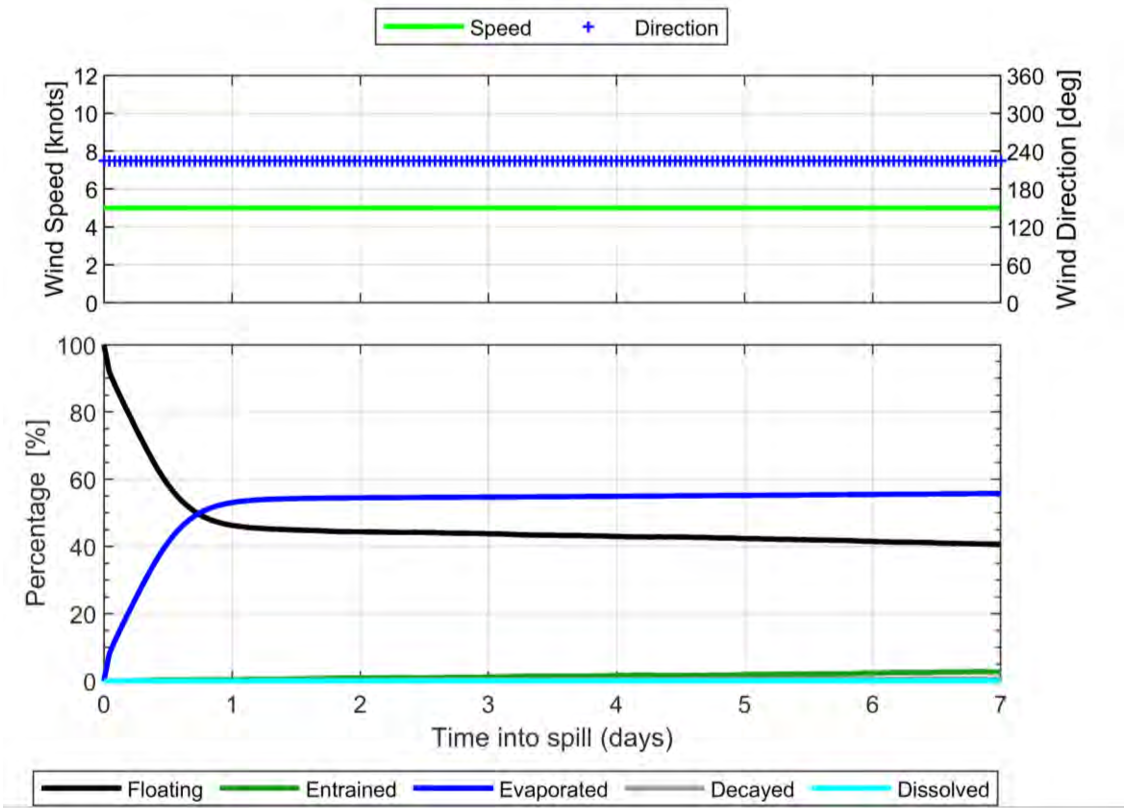


Figure 8.1 Proportional mass balance plot representing the weathering of Annie-1 condensate spilled onto the water surface over 1-hour and subject to a constant 5 knots wind speed at 15°C water temperature.

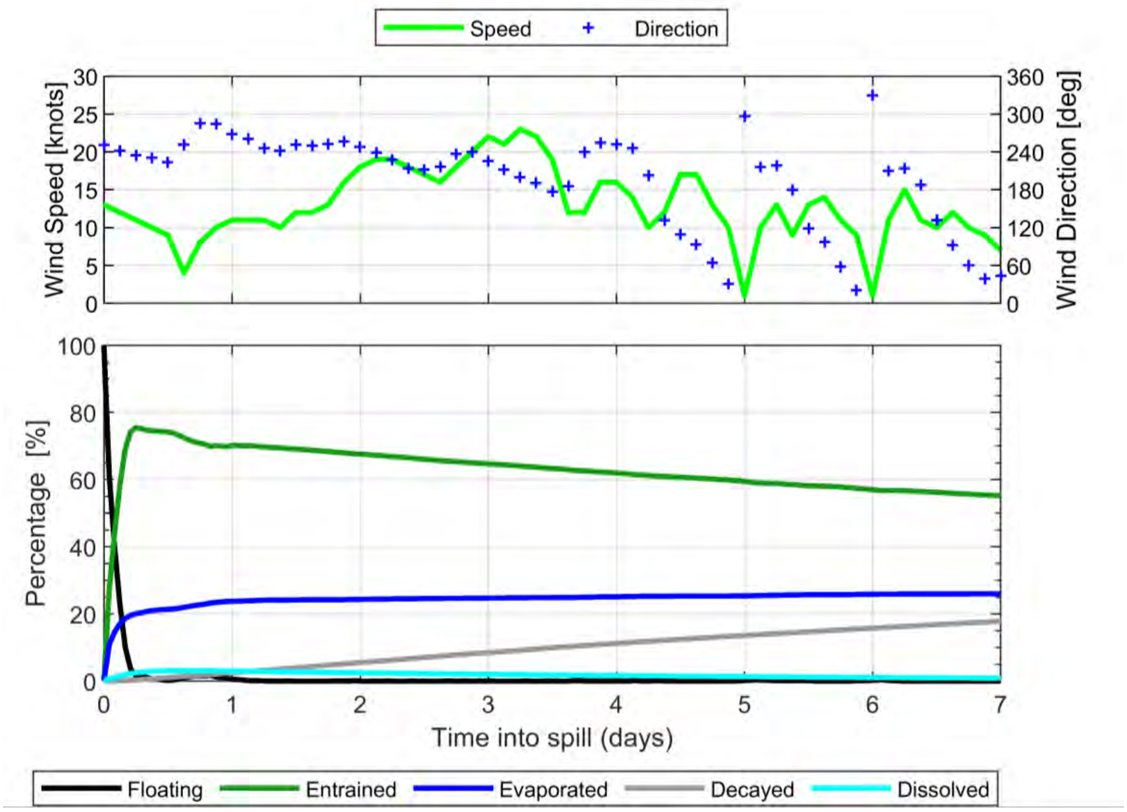


Figure 8.2 Proportional mass balance plot representing the weathering of Annie-1 condensate spilled onto the water over 1-hour and subject to variable wind speeds (1-23 knots) at 15°C water temperature.

9 MODEL SETTINGS

Table 9.1 provides a summary of the oil spill model settings.

Table 9.1 Summary of the oil spill model settings and thresholds used in this assessment.

Parameter	Scenario 1	Scenario 2	Scenario 3
Description	Loss of Well Control at Elanora-1 ST1 (Isabella)	Loss of Well Control at Pecten East-2	Loss of Well Control at Annie-2
Number of randomly selected spill start times	100 per season (200 per scenario)		
Model period	Summer (November to April) Winter (May to October)		
Hydrocarbon type for oil spill modelling only	Annie-1 condensate		
Spill volume	105,289 bbl (16,740 m^3)	83,273 bbl (13,239 m^3)	66,430 bbl (10,562 m^3)
Release type (subsurface, top of BOP stack (depth (m))	54	34	36
Release duration (days)*	102	102	104
Simulation length (days)	116		118
Surface oil concentration thresholds (g/m^2) ^	1 (low); 10 (moderate); 50 (high)		
Shoreline oil accumulation thresholds (g/m^2) ^	10 (low); 100 (moderate); 1,000 (high)		
Dissolved hydrocarbon concentrations (ppb) ^	10 (low); 50 (moderate); 400 (high)		
Entrained hydrocarbon concentrations (ppb) ^	10 (low); 100 (high)		

^Thresholds based on NOPSEMA (2019)

* Note, the 104-day model duration for Scenario 3 relates to slightly more conservative response time for the relief well to kill Annie-2. This duration was carried over from the specifications of the original Annie-2 modelling.

10 PRESENTATION AND INTERPRETATION OF MODEL RESULTS

The results from the modelling study are presented in a number of tables and figures, which aim to provide an understanding of potential sea-surface and water column exposure and shoreline accumulation.

10.1 Annual Analysis

The statistics are based on the following principles:

- The ***greatest distance travelled by a spill trajectory*** – is determined by a) recording the maximum and b) second greatest distance travelled (or 99th percentile) by a single trajectory, within a scenario, from the release location to the identified exposure thresholds;
- The ***probability of oil exposure to a receptor*** – is determined by recording the number of spill trajectories to reach a specified sea surface or subsea threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario;
- The ***minimum time before oil exposure to a receptor*** – is determined by ranking the elapsed time before sea surface exposure, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value;
- The ***maximum residence time for oil exposure within a receptor*** – is determined by recording the longest continuous length of time a grid cell is exposed to either floating, entrained or dissolved hydrocarbon above each threshold, within a receptor;
- The ***probability of oil accumulation at a receptor*** – is determined by recording the number of spill trajectories to reach a specified shoreline accumulation threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario;
- The ***maximum (total) volume of oil ashore*** – is the total volume of oil stranded on the shorelines throughout the duration of the simulation;
- The ***maximum potential oil loading within a receptor*** – is determined by identifying the maximum loading to any grid cell within a receptor polygon, for a scenario; and
- The ***dissolved and entrained hydrocarbon exposure*** – is determined by recording the maximum instantaneous concentrations at each grid cell.

10.2 Deterministic Trajectories

The stochastic modelling results were assessed for each scenario, and the deterministic runs were identified and are presented in the result section based on the following criteria.

a. Largest swept area for surface oil above 10 g/m^2;

b. Largest (total) volume of oil ashore;

c. Longest length of shoreline with oil accumulation above 100 g/m^2;

d. Largest area of entrained hydrocarbon exposure above 100 ppb; and

e. Largest area of dissolved hydrocarbon exposure above 50 ppb.

10.3 Receptors Assessed

A range of environmental receptors and shorelines were assessed for floating oil exposure, shoreline accumulation and water column exposure as part of the study (see Figure 10.1 to Figure 10.11). Receptor categories (see Table 10.1) include sections of shorelines which are defined by local government areas (LGAs), sub-LGAs and offshore islands. All other sensitive receptors other than submerged reefs, shoals and banks (RSB) were sourced from Australian Government Department of Climate Change, Energy, the Environment and Water (https://www.dcceew.gov.au/).

Risks of exposure were separately calculated for each sensitive receptor area and have been tabulated.

Table 10.2 summarises the receptors that the release locations reside within.

RPS have utilised BIAs for the southern right whale that were delineated within the 2011-2021 Conservation Management Plan for the Southern Right Whale. The NCV Atlas now includes updated BIAs for SRW, though the recently drafted National Recovery Plan for the southern right whale has not been published. The updated BIAs have not been used in this report.

Table 10.1 Summary of receptors used to assess floating oil, shoreline and in-water exposure to hydrocarbons.

Receptor Category	Acronym	Hydrocarbon Exposure Assessment			Figure reference
		Water Column	Floating oil	Shoreline	
Australian Marine Park	AMP	✓	✓	×	Figure 10.1
Integrated Marine and Coastal Regionalisation Areas	IMCRA	✓	✓	×	Figure 10.2
Marine National Park	MNP	✓	✓	×	Figure 10.3
Marine Park	MP	✓	✓	×	Figure 10.4
Nature Reserve	NR	✓	✓	×	Figure 10.5
Ramsar	Ramsar	✓	✓	✓	Figure 10.6
Reefs, Shoals and Banks	RSB	✓	✓	×	Figure 10.7
Key Ecological Feature	KEF	✓	✓	×	Figure 10.8
State Waters	State Waters	✓	✓	×	n/a
Local and Sub-Local Government Area	LGA and Sub-LGA	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Shore)	Figure 10.9 to Figure 10.11

Table 10.2 Summary of the receptors that the release locations reside within for each scenario.

Acronym	Receptor Name	Scenario		
		Scenario 1	Scenario 2	Scenario 3
BIA	Antipodean Albatross - Foraging	✓	✓	✓
	Black-browed Albatross - Foraging	✓	✓	✓
	Bullers Albatross - Foraging	✓	✓	✓
	Campbell Albatross - Foraging	✓	✓	✓
	Common Diving-petrel - Foraging	✓	✓	✓
	Indian Yellow-nosed Albatross - Foraging	✓	✓	✓
	Pygmy Blue Whale - Distribution	✓	✓	✓
	Pygmy Blue Whale - Foraging	✓	✓	✓
	Pygmy Blue Whale - Foraging annual high use area	✓	✓	✓
	Shy Albatross - Foraging	✓	✓	✓
	Southern Right Whale - Aggregation	×	✓	×
	Southern Right Whale - Known Core Range	✓	✓	✓
	Wandering Albatross - Foraging	✓	✓	✓
	Wedge-tailed Shearwater - Foraging	✓	✓	✓
	White Shark - Distribution	✓	✓	✓
IMCRA	Otway	✓	✓	✓

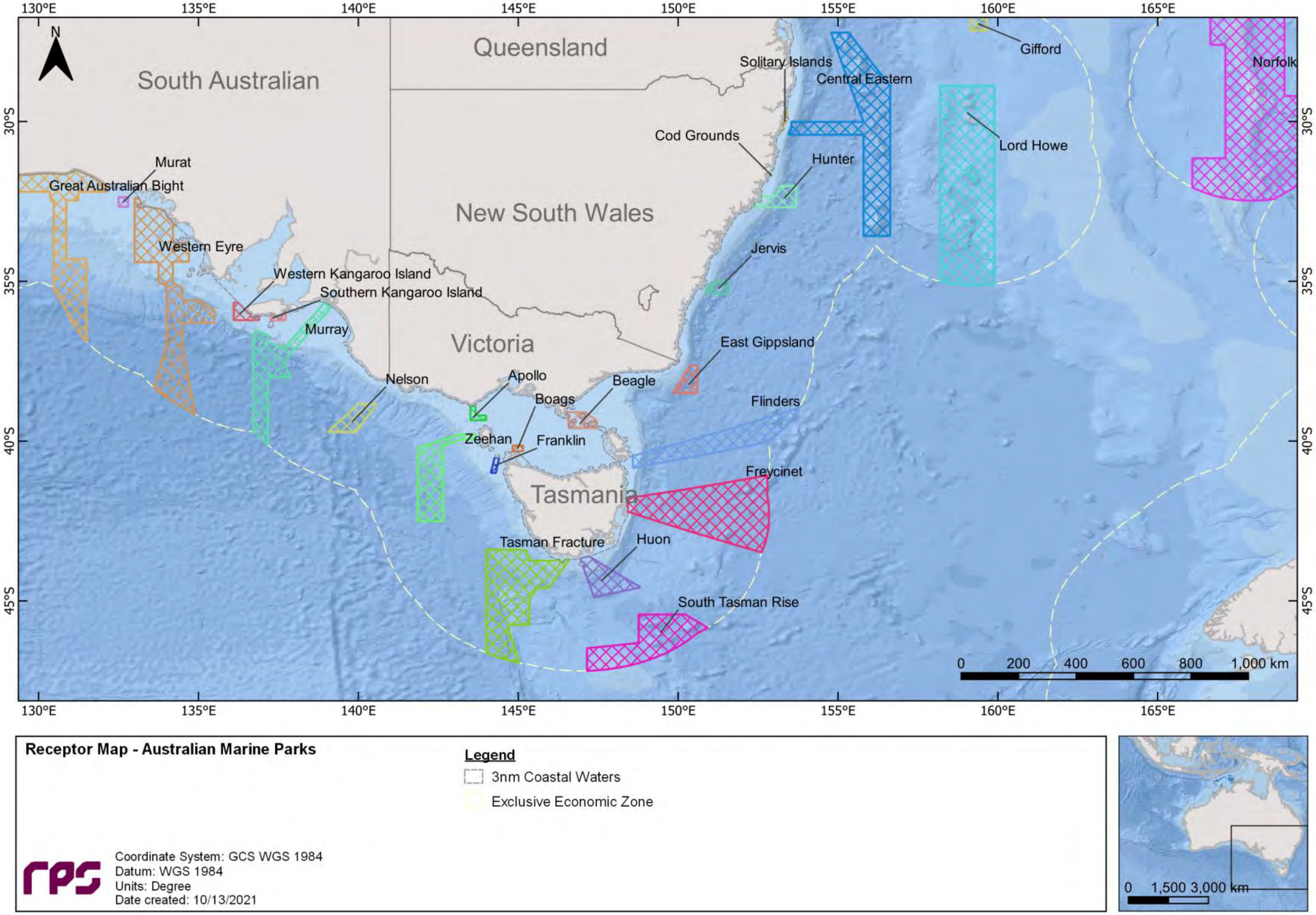


Figure 10.1 Receptor map for Australian Marine Parks (AMP).

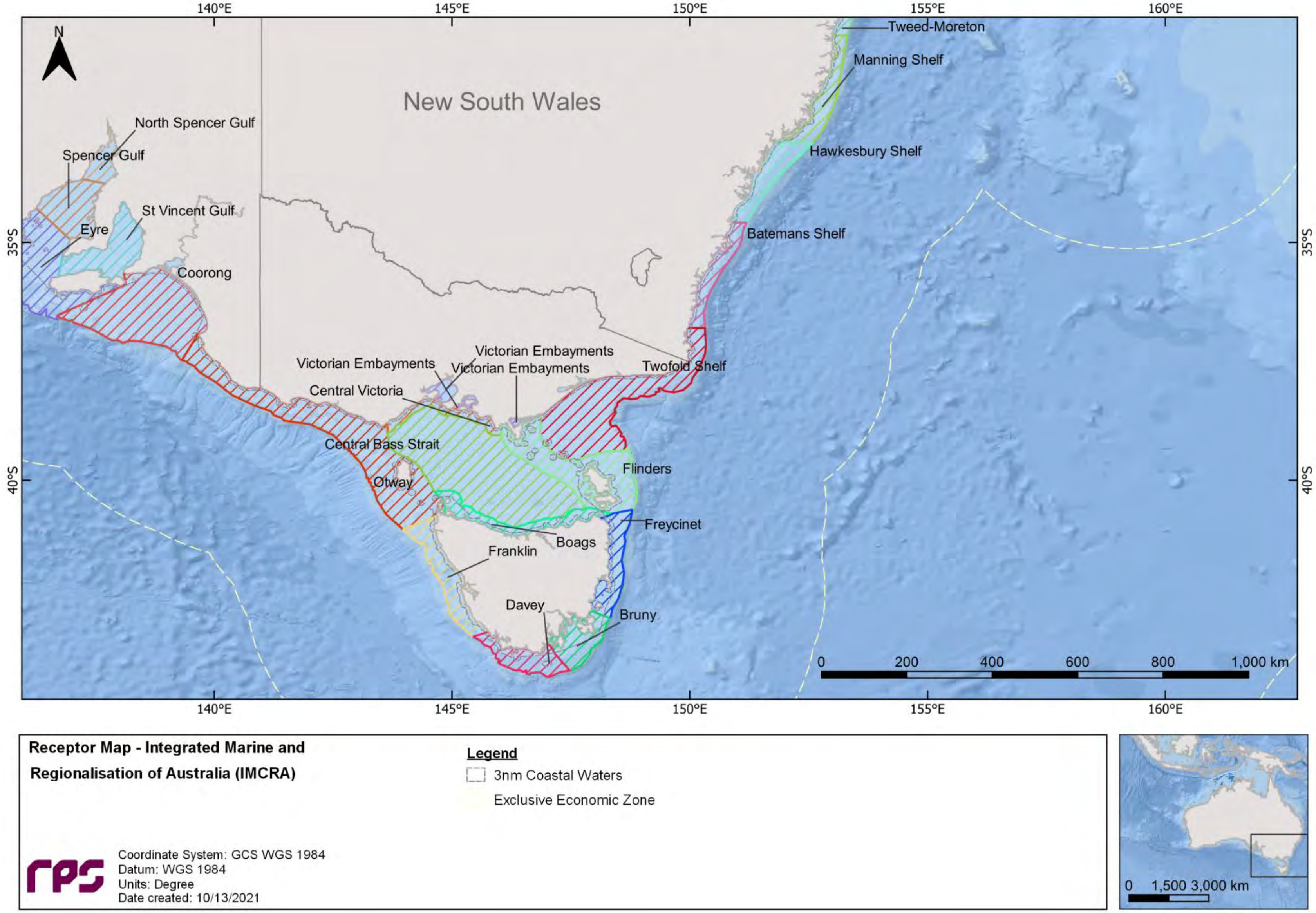


Figure 10.2 Receptor map for integrated marine and coastal regionalisation (IMCRA) areas.

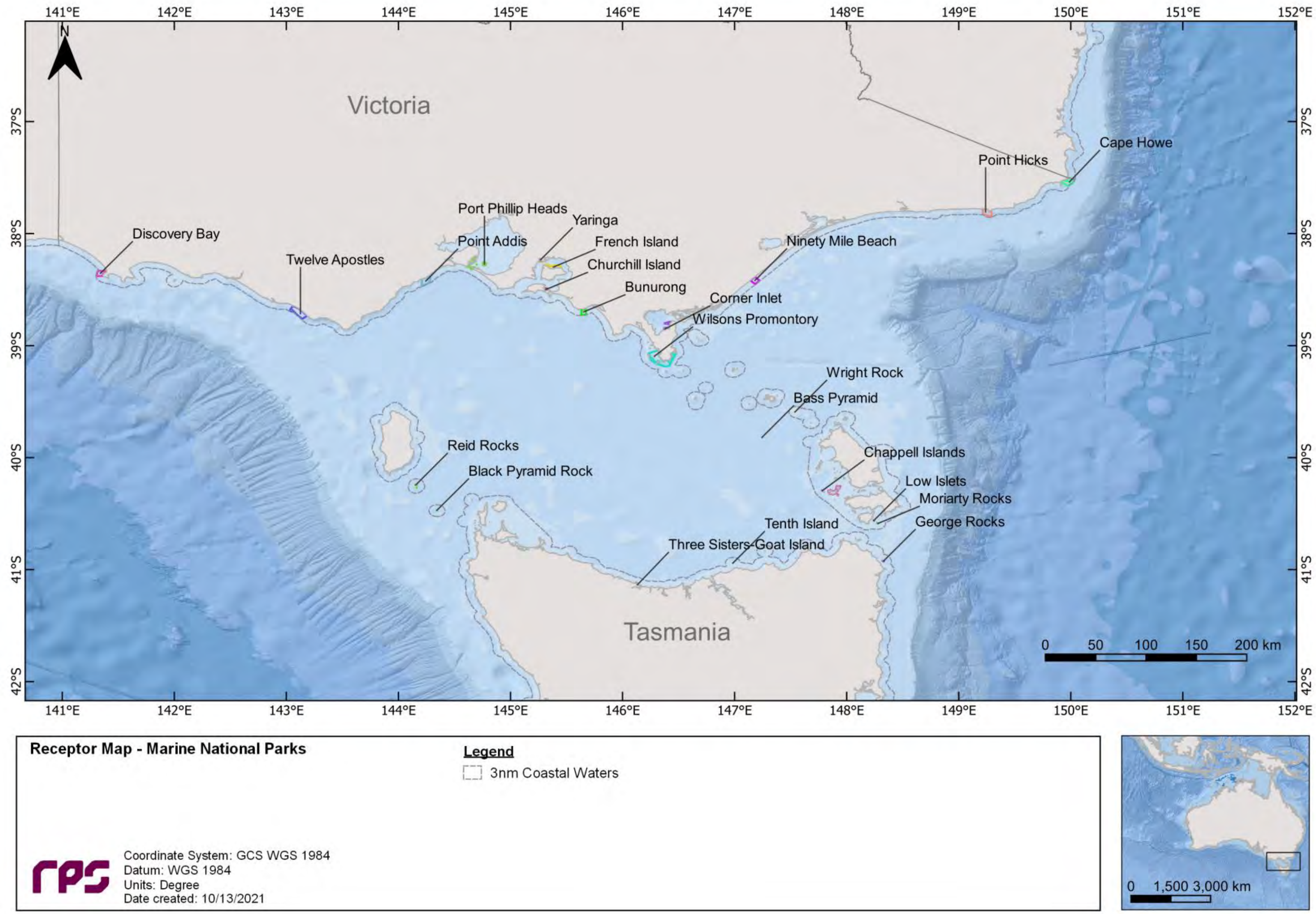


Figure 10.3 Receptor map for Marine National Parks (MNP).

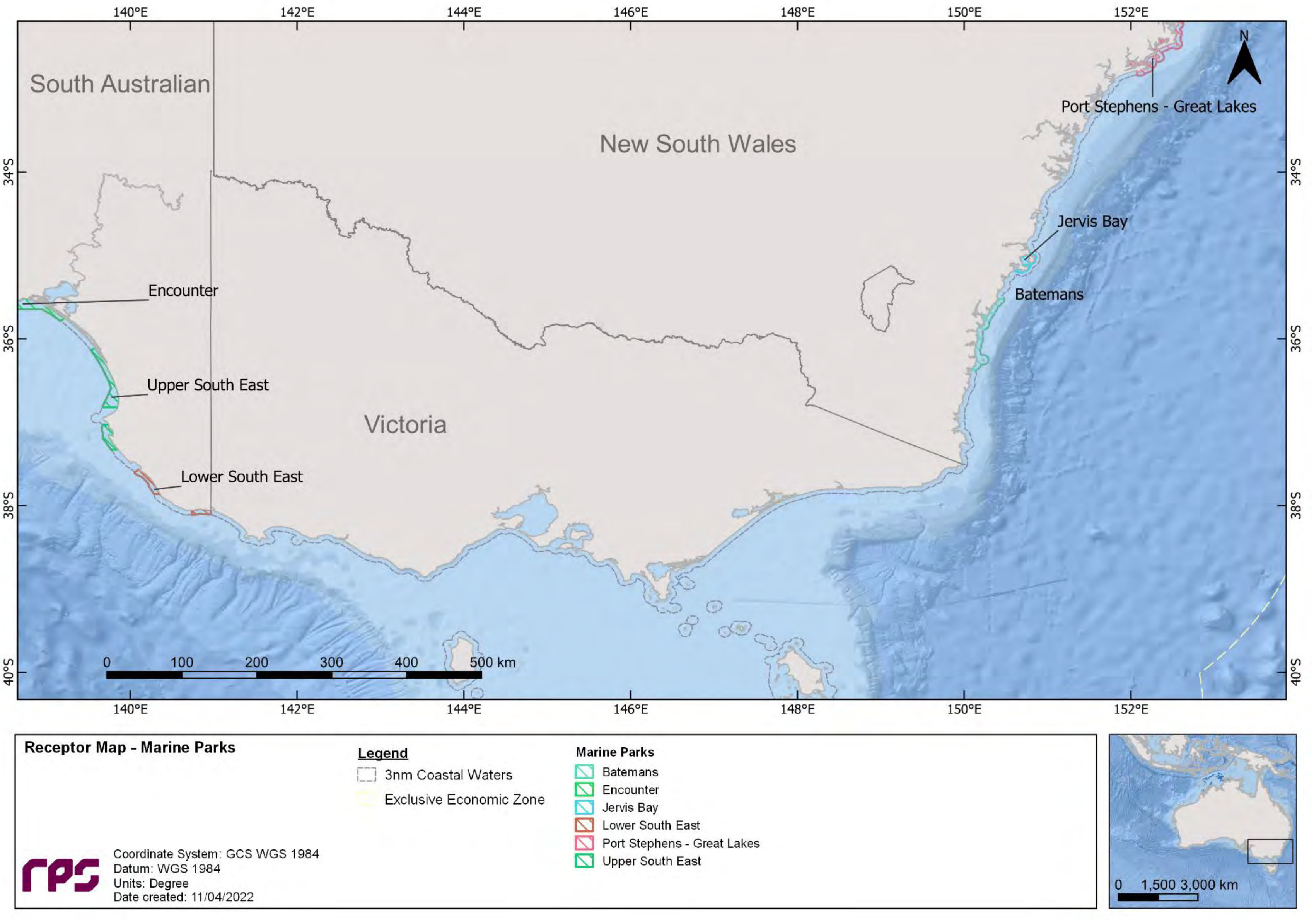


Figure 10.4 Receptor map for Marine Parks (MP).

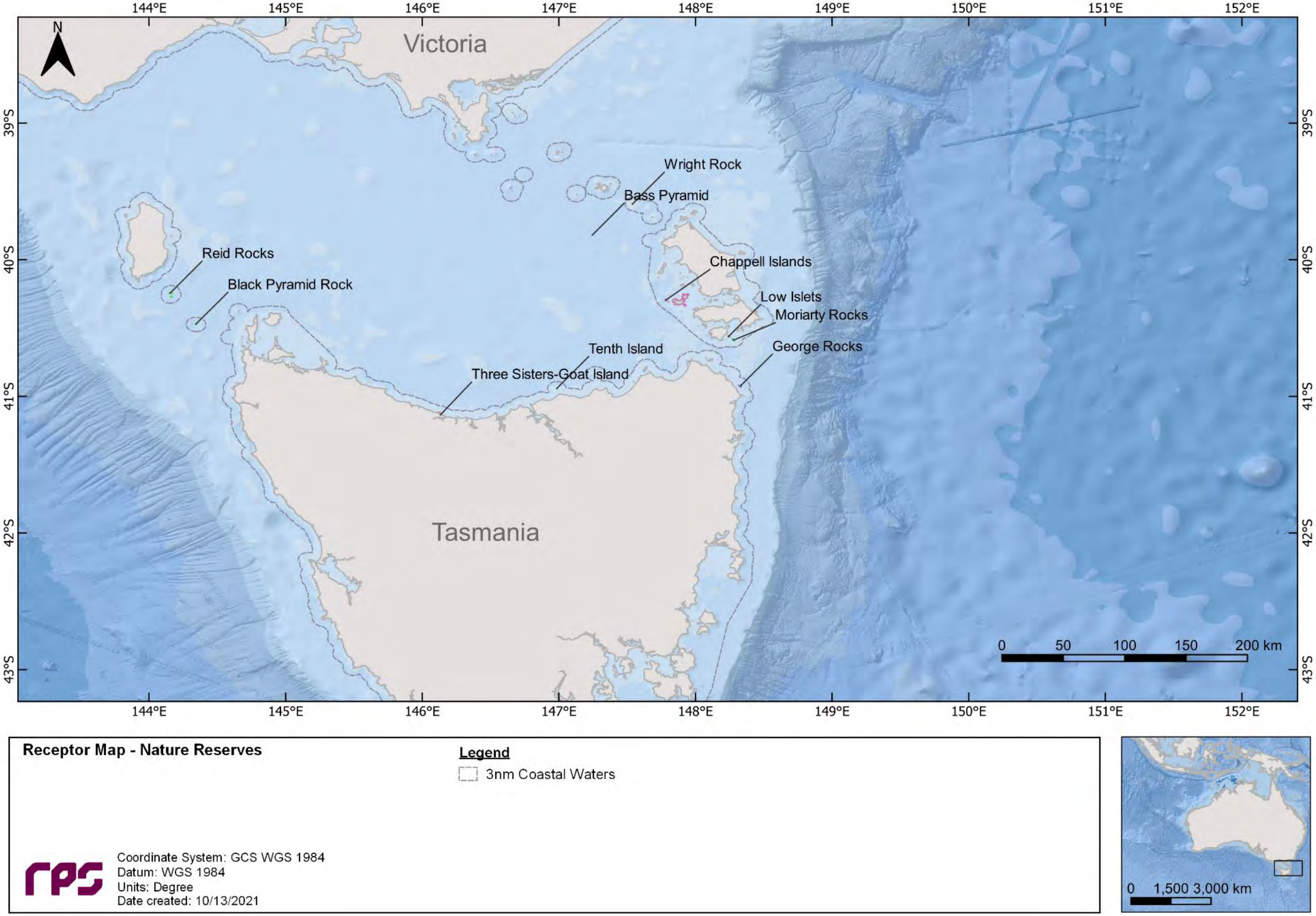


Figure 10.5 Receptor map for Nature Reserves (NR).

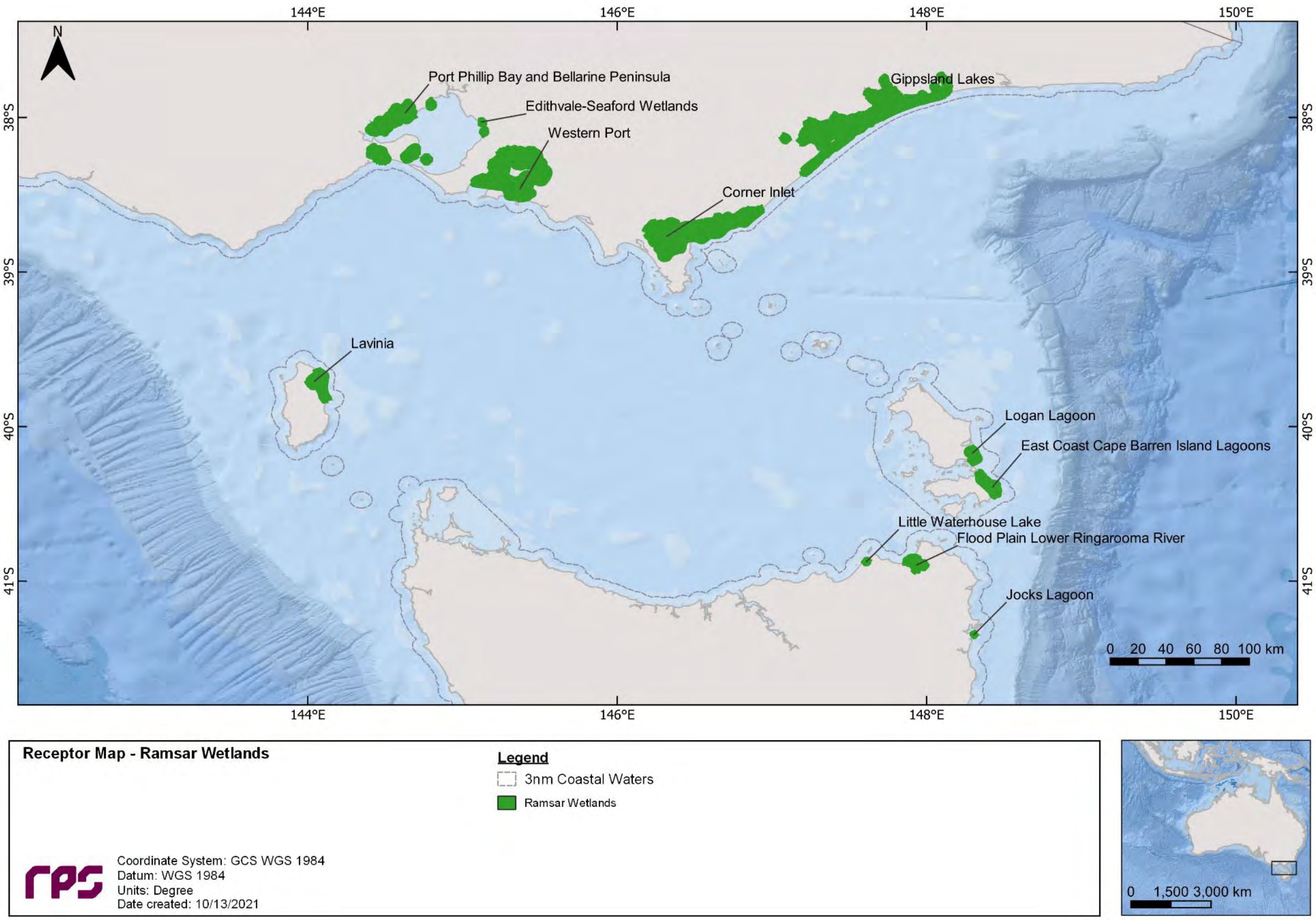


Figure 10.6 Receptor map for Ramsar Sites (Ramsar).

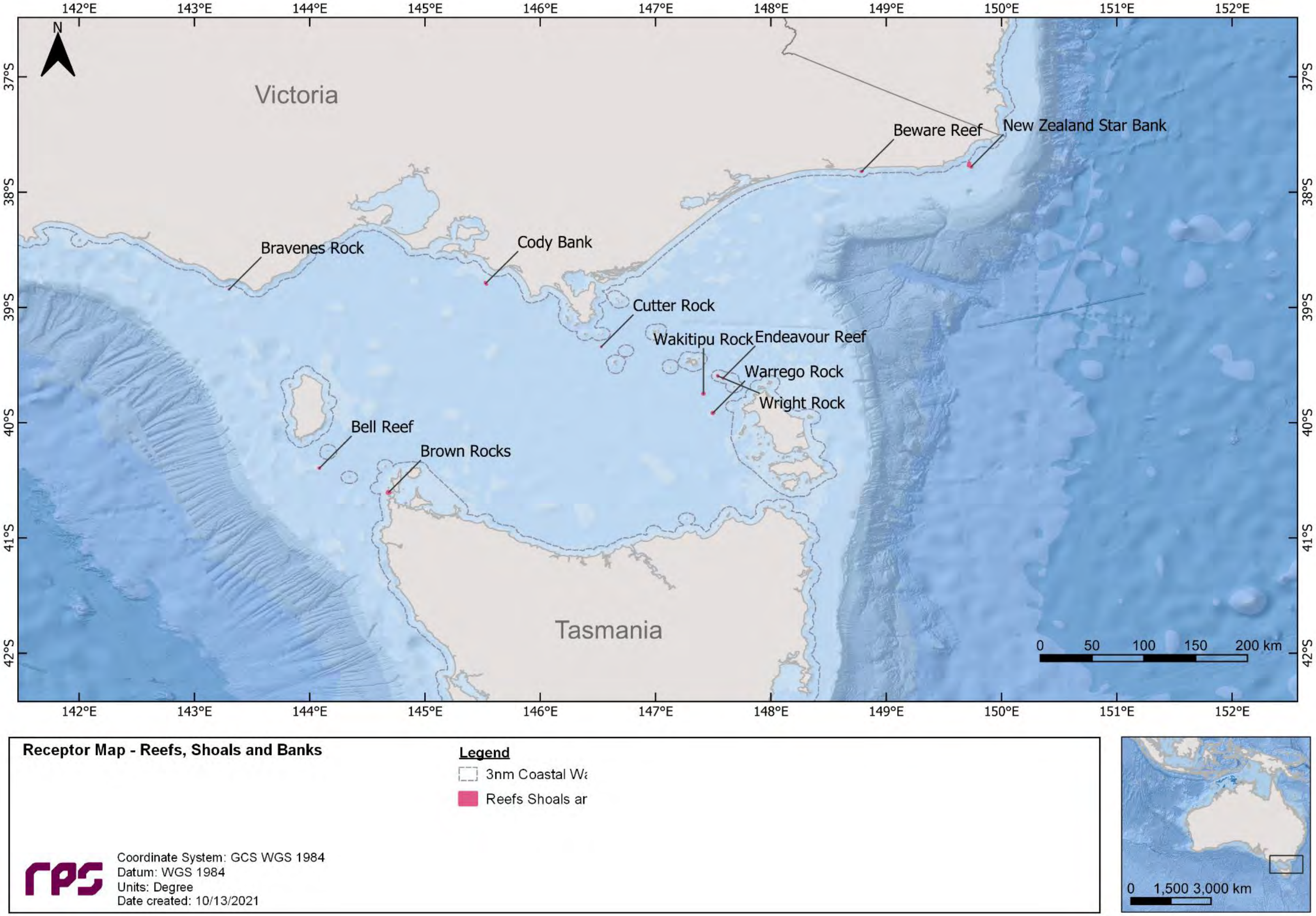


Figure 10.7 Receptor map for Reefs, Shoals and Banks (RSB).

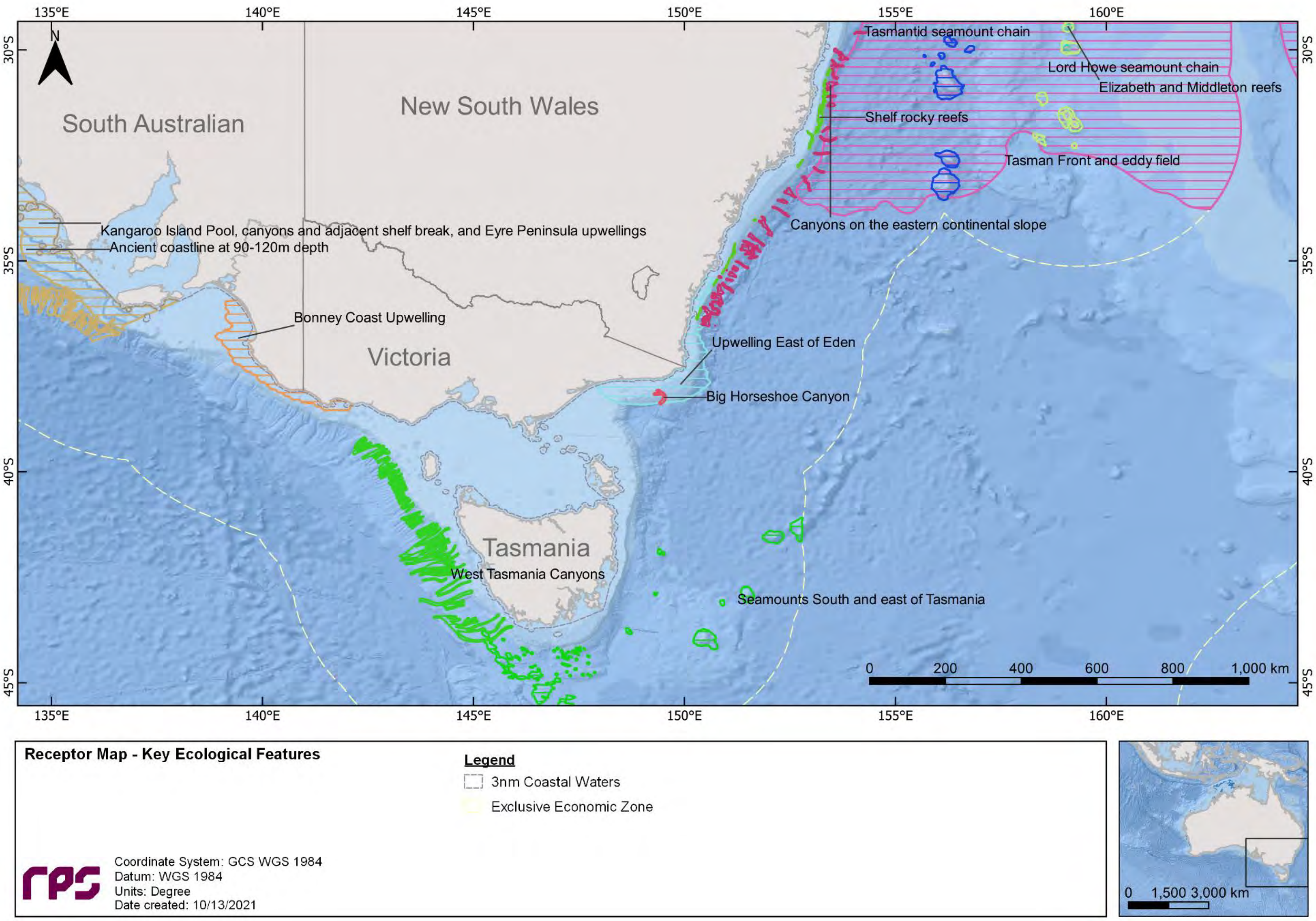


Figure 10.8 Receptor map for Key Ecological Features (KEF).

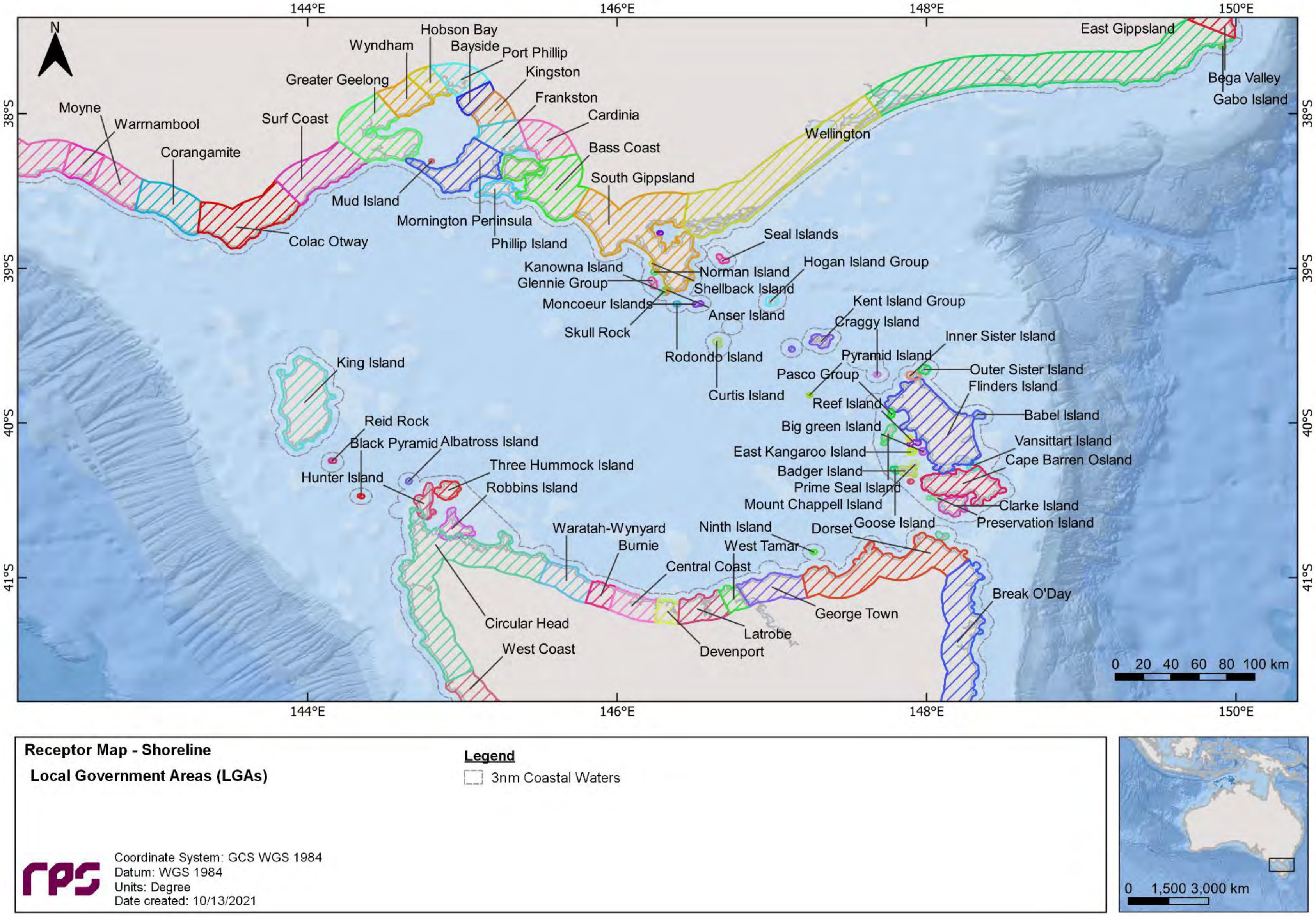


Figure 10.9 Receptor map for shorelines (1 of 3).

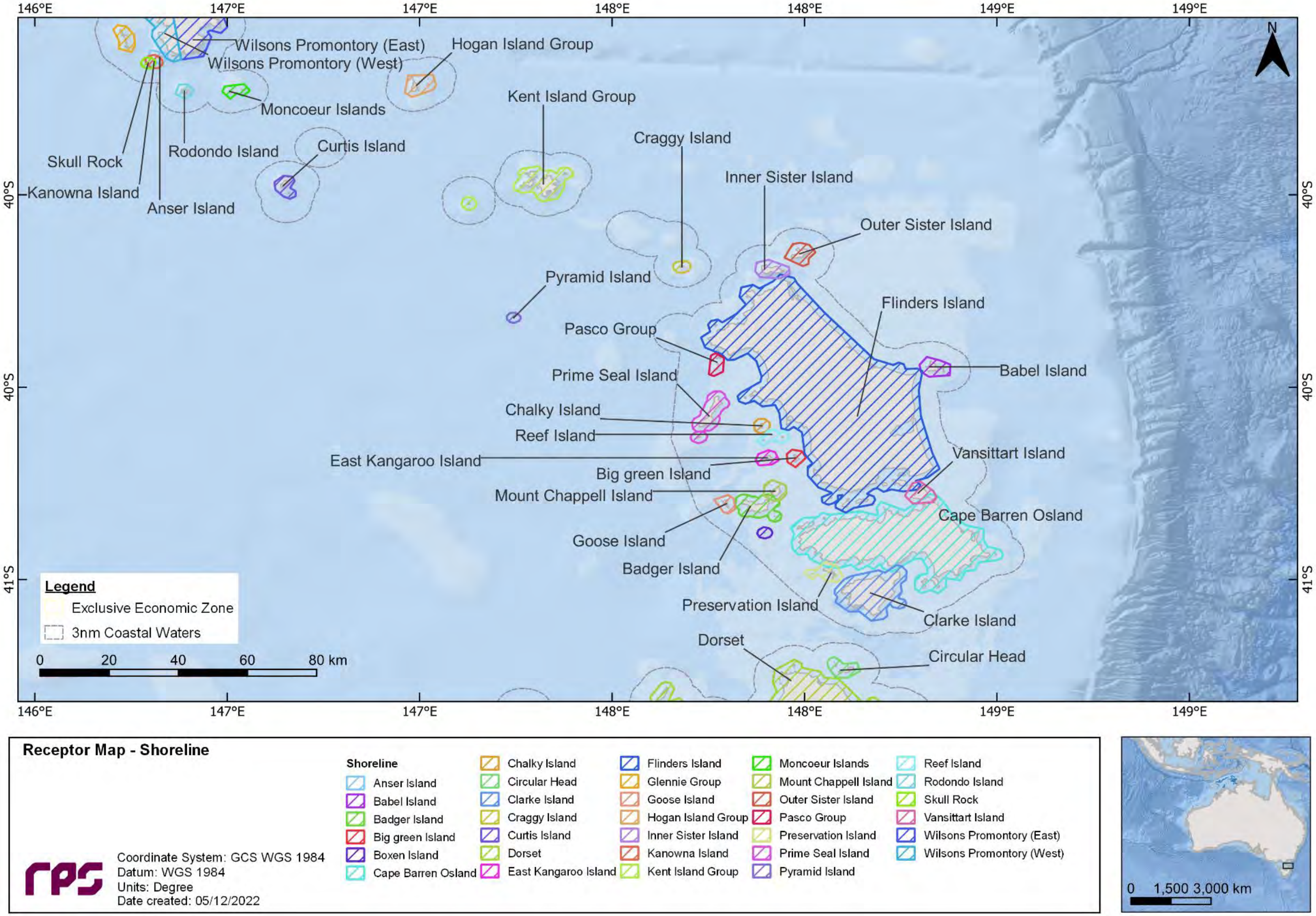


Figure 10.10 Receptor map for shorelines (2 of 3).

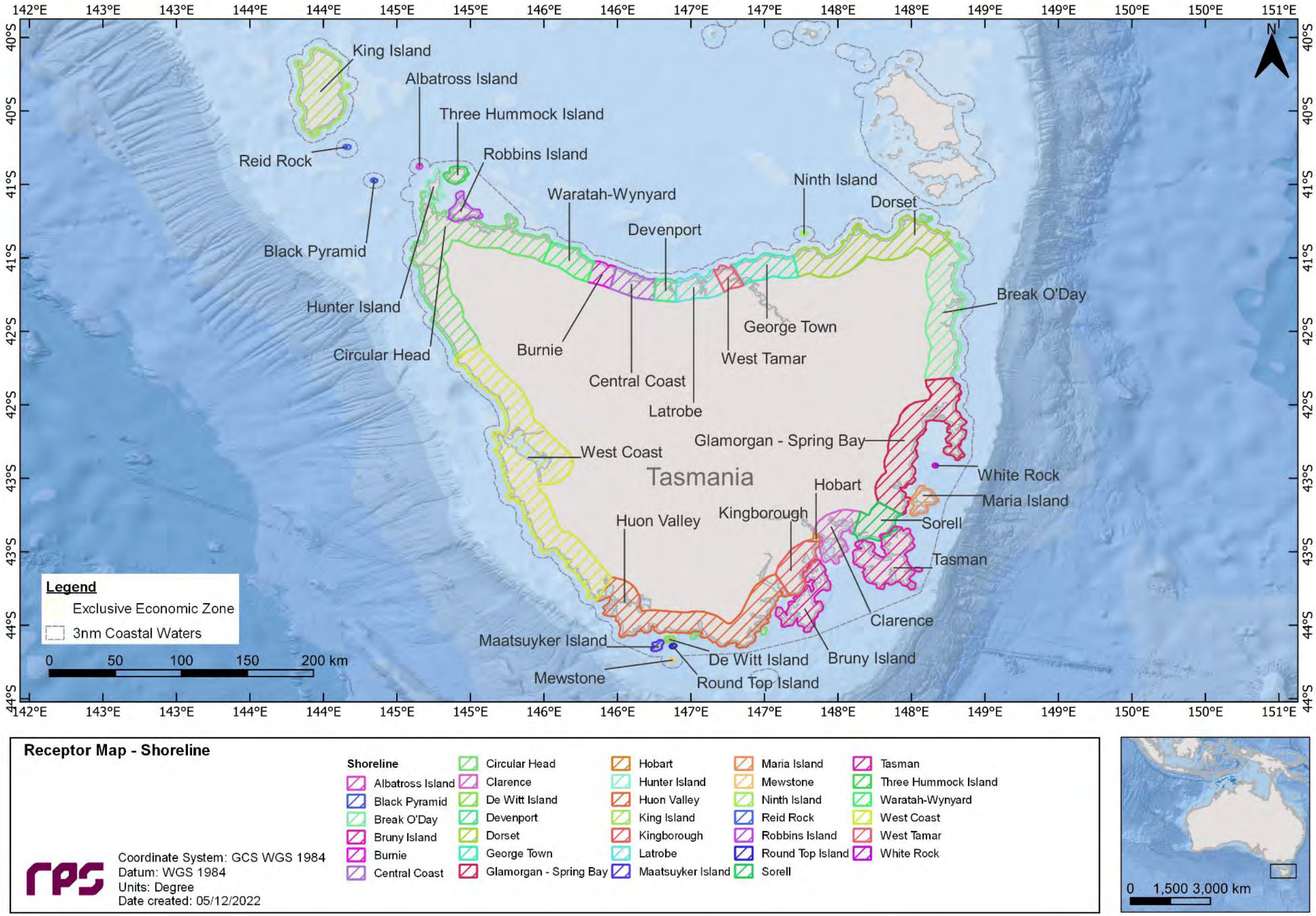


Figure 10.11 Receptor map for shorelines (3 of 3).

11 RESULTS – SCENARIO 1 – 105,289 BBL (16,740 M^3) SUBSURFACE RELEASE FROM A LOSS OF WELL CONTROL AT ELANORA-1 ST1

This scenario examined a 105,289 bbl (16,740 m^3) subsurface release of condensate over 102 days to represent a LOWC scenario at Elanora-1 ST1 well. A total of 100 spill simulations were run per season (summer and winter) and each simulation was tracked for 116 days. The results are presented on a seasonal basis.

Sections 11.1 and 11.2 present the seasonal stochastic analysis and deterministic analysis results, respectively.

11.1 Stochastic Analysis

11.1.1 Floating Oil Exposure

Table 11.1 summarises the maximum distance travelled by floating oil on the sea surface at each threshold. The maximum distance and corresponding direction from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) exposure zones was 75.7 km (east, winter) and 11.7 km (east-southeast, summer), respectively. No high (>50 g/m^2) exposure zones were predicted during either summer or winter conditions.

Table 11.2 summarises the potential floating oil exposure to individual receptors.

During summer, a total of 16 Biologically Important Areas (BIAs) were predicted to be exposed to floating oil at, or above, the low threshold. Excluding the BIAs that the release location resides within (see Section 10.3), the highest probability (40%) of low exposure was predicted at the Southern Right Whale – Aggregation BIA. The minimum time before low exposure to the Southern Right Whale – Aggregation BIA was 3.21 days.

Contrastingly, during winter, excluding the BIAs that the release location resides within (see Section 10.3), the highest probability (54%) of low exposure for any BIA was revealed at the Short-tailed Shearwater - Foraging BIA. Additionally, the minimum time before low exposure to the Southern Right Whale – Aggregation was 1.38 days.

Table 11.3 presents the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor.

Figure 11.1 and Figure 11.2 present the zones of potential floating oil exposure per season whilst Figure 11.3 to Figure 11.6 present the maximum residence time of floating oil exposure for the NOPSEMA thresholds.

Table 11.1 Maximum distance and direction from the release location to the edge of floating oil exposure. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Distance and direction travelled	Zones of potential floating oil exposure					
	Summer			Winter		
	Low	Moderate	High	Low	Moderate	High
Maximum distance (km) from release location	74.0	11.7	-	75.7	9.8	-
Maximum distance (km) from release location (99th percentile)	48.0	11.3	-	68.4	9.3	-
Direction	E	ESE	-	E	NW	-

Table 11.2 Summary of the potential floating oil exposure to individual receptors. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer						Winter					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)		
		Low	Mod.	High	Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
BIA	Antipodean Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Black-browed Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Bullers Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Campbell Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Common Diving-petrel - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Indian Yellow-nosed Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Pygmy Blue Whale - Distribution*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Pygmy Blue Whale - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Pygmy Blue Whale - Foraging annual high use area*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Short-tailed Shearwater - Foraging	21	-	-	4.54	-	-	54	-	-	6.71	-	-
BIA	Shy Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Southern Right Whale – Aggregation	40	-	-	3.21	-	-	47	-	-	1.38	-	-
BIA	Southern Right Whale - Known Core Range*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Wandering Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	Wedge-tailed Shearwater - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
BIA	White Shark - Distribution*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
IBRA	Otway Plain	21	-	-	4.54	-	-	53	-	-	6.71	-	-
IBRA	Otway Ranges	1	-	-	25.21	-	-	8	-	-	12.25	-	-
IBRA	Warrnambool Plain	12	-	-	7.75	-	-	16	-	-	6.92	-	-
IMCRA	Otway*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
MNP	Twelve Apostles	8	-	-	32.92	-	-	8	-	-	6.92	-	-

Receptor		Summer						Winter					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)		
		Low	Mod.	High	Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
Nearshore Waters	Colac Otway	21	-	-	4.54	-	-	54	-	-	6.71	-	-
	Corangamite	12	-	-	7.75	-	-	16	-	-	6.92	-	-
	Moyne	-	-	-	-	-	-	3	-	-	11.13	-	-
	Warrnambool	-	-	-	-	-	-	1	-	-	12.25	-	-
State Waters	Victoria State Waters*	30	-	-	4.54	-	-	56	-	-	6.71	-	-
Nearshore Waters (Sub-LGA)	Bay of Islands	-	-	-	-	-	-	3	-	-	11.13	-	-
	Cape Otway West	21	-	-	4.54	-	-	54	-	-	6.71	-	-
	Childers Cove	-	-	-	-	-	-	1	-	-	12.25	-	-
	Moonlight Head	8	-	-	27.92	-	-	11	-	-	6.92	-	-
	Port Campbell	4	-	-	7.75	-	-	7	-	-	11.17	-	-

*The release location resides within the receptor boundaries.

Table 11.3 Summary of the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer			Winter		
		Maximum residence time of floating oil exposure (days)			Maximum residence time of floating oil exposure (days)		
		Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross - Foraging*	16.21	1.21	-	17.29	1.21	-
	Black-browed Albatross - Foraging*	16.21	1.21	-	17.29	1.21	-
	Bullers Albatross - Foraging*	16.21	1.21	-	17.29	1.21	-
	Campbell Albatross - Foraging*	16.21	1.21	-	17.29	1.21	-
	Common Diving-petrel - Foraging*	16.21	1.21	-	17.29	1.21	-
	Indian Yellow-nosed Albatross - Foraging*	16.21	1.21	-	17.29	1.21	-
	Pygmy Blue Whale - Distribution*	16.21	1.21	-	17.29	1.21	-
	Pygmy Blue Whale - Foraging*	16.21	1.21	-	17.29	1.21	-
	Pygmy Blue Whale - Foraging annual high use area*	16.21	1.21	-	17.29	1.21	-
	Short-tailed Shearwater - Foraging	0.58	-	-	0.83	-	-
	Shy Albatross - Foraging*	16.21	1.21	-	17.29	1.21	-
	Southern Right Whale – Aggregation	0.54	-	-	0.71	-	-
	Southern Right Whale - Known Core Range*	16.21	1.21	-	17.29	1.21	-
	Wandering Albatross - Foraging*	16.21	1.21	-	17.29	1.21	-
	Wedge-tailed Shearwater - Foraging*	16.21	1.21	-	17.29	1.21	-
	White Shark - Distribution*	16.21	1.21	-	17.29	1.21	-
IBRA	Otway Plain	0.58	-	-	0.83	-	-
	Otway Ranges	0.13	-	-	0.21	-	-
	Warrnambool Plain	0.46	-	-	0.63	-	-
IMCRA	Otway*	16.21	1.21	-	17.29	1.21	-
MNP	Twelve Apostles	0.25	-	-	0.5	-	-
Nearshore Waters	Colac Otway	0.58	-	-	0.83	-	-
	Corangamite	0.46	-	-	0.63	-	-
	Moyne	-	-	-	0.46	-	-

Receptor		Summer: Maximum residence time of floating oil exposure (days)			Winter: Maximum residence time of floating oil exposure (days)		
		Low	Moderate	High	Low	Moderate	High
	Warrnambool	-	-	-	0.04	-	-
State Waters	Victoria State Waters*	0.58	-	-	0.83	-	-
Nearshore Waters (Sub-LGA)	Bay of Islands	-	-	-	0.46	-	-
	Cape Otway West	0.58	-	-	0.83	-	-
	Childers Cove	-	-	-	0.04	-	-
	Moonlight Head	0.21	-	-	0.5	-	-
	Port Campbell	0.46	-	-	0.63	-	-

*The release location resides within the receptor boundaries.

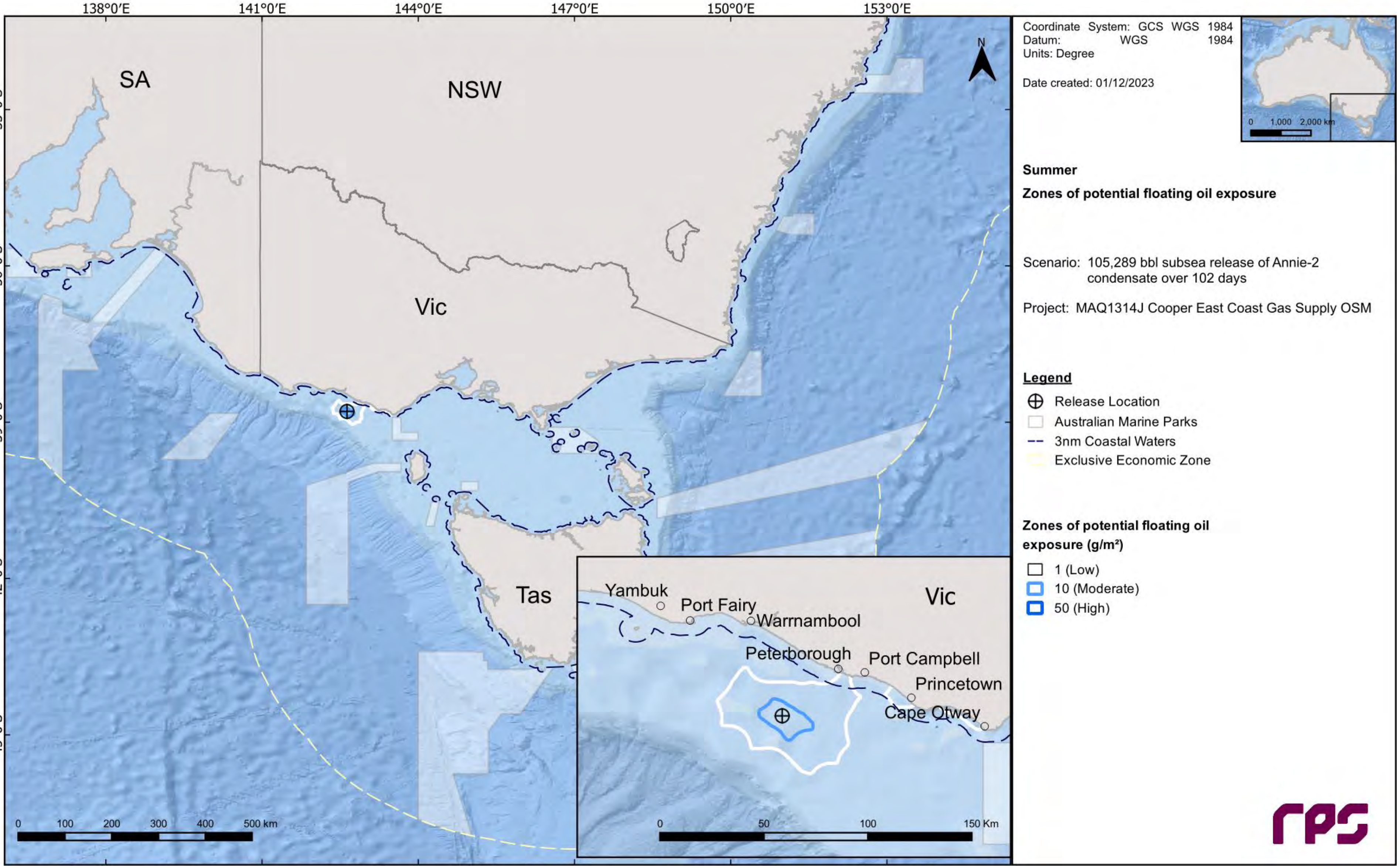


Figure 11.1 Zones of potential floating oil exposure in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

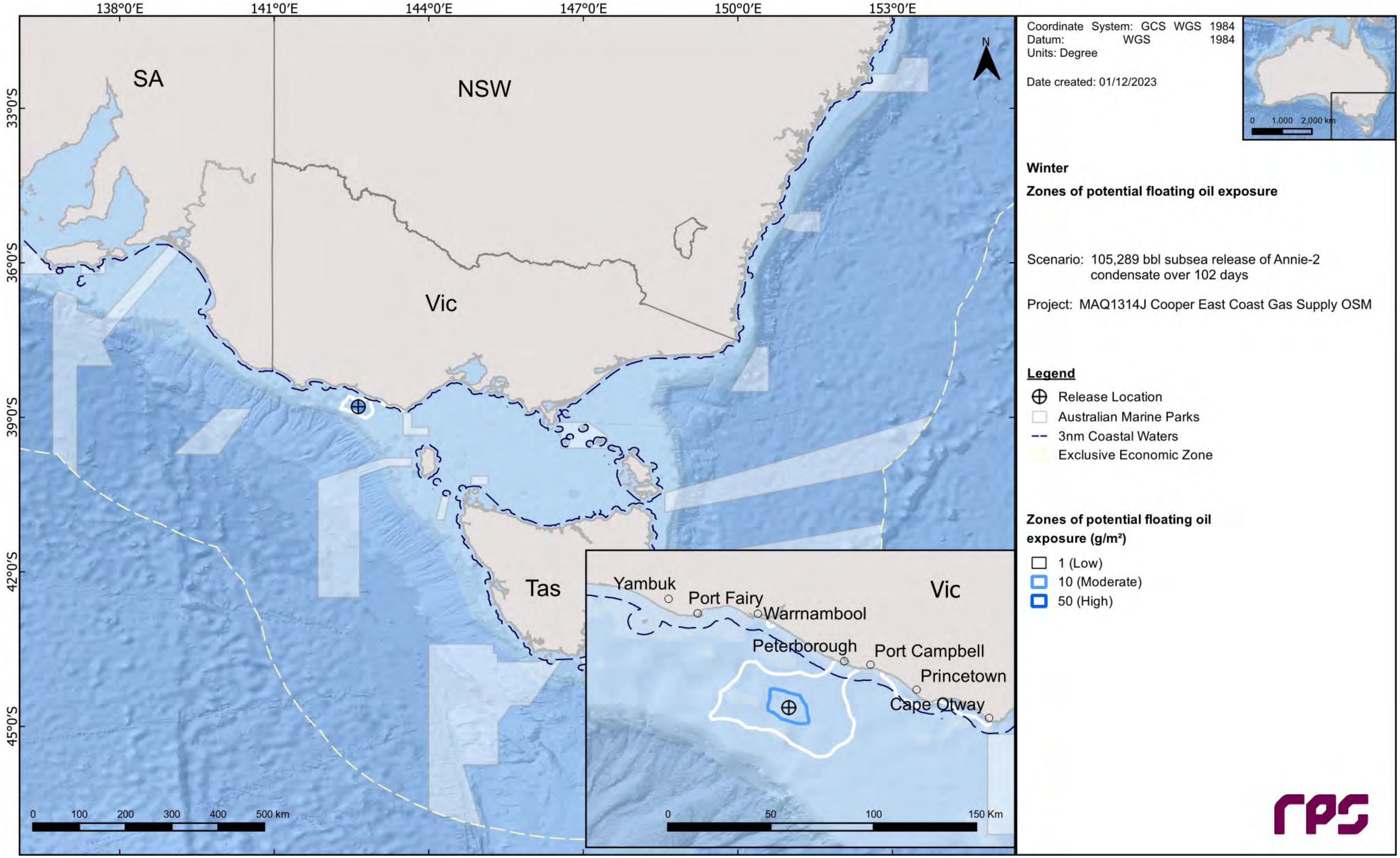


Figure 11.2 Zones of potential floating oil exposure in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

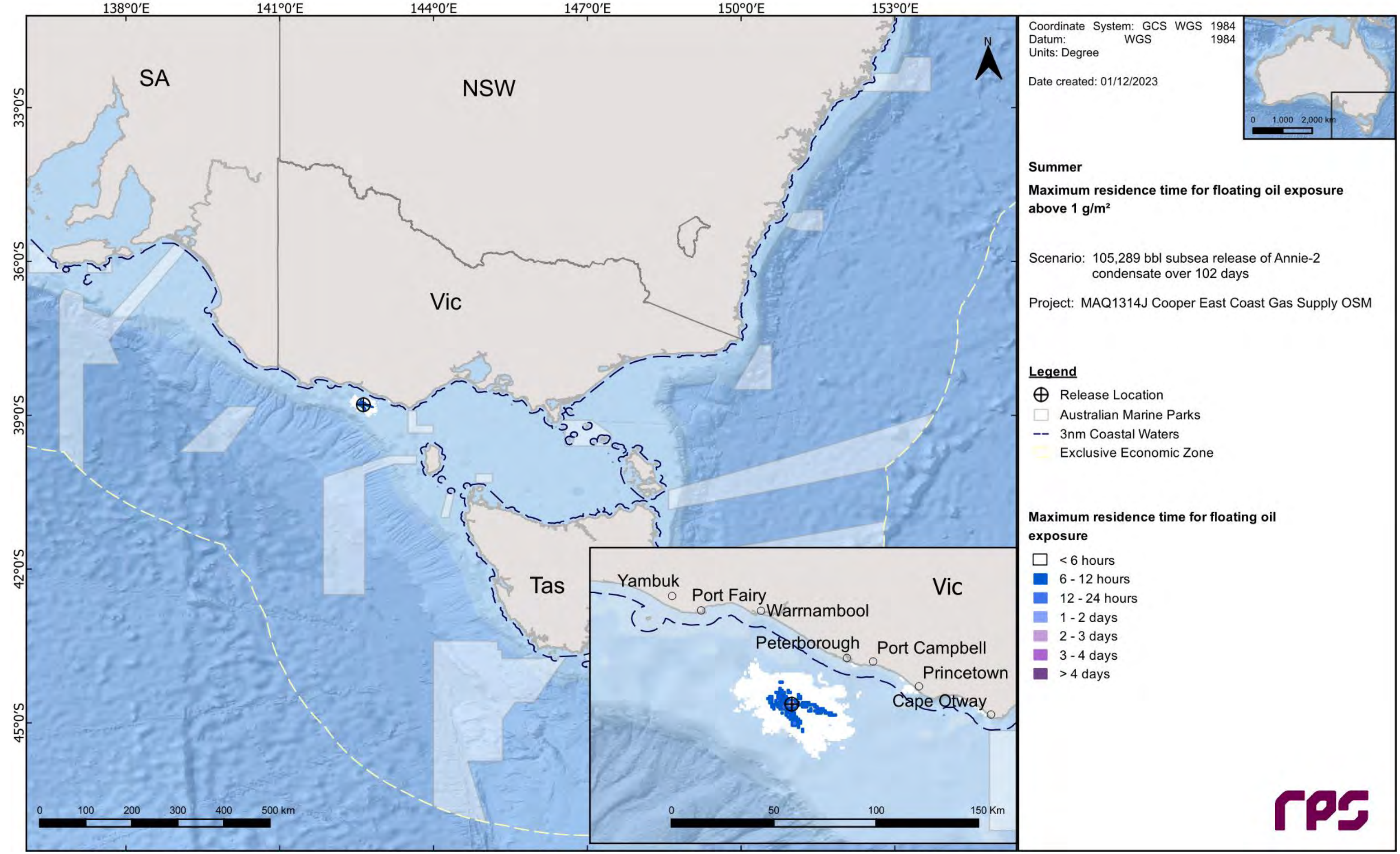


Figure 11.3 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

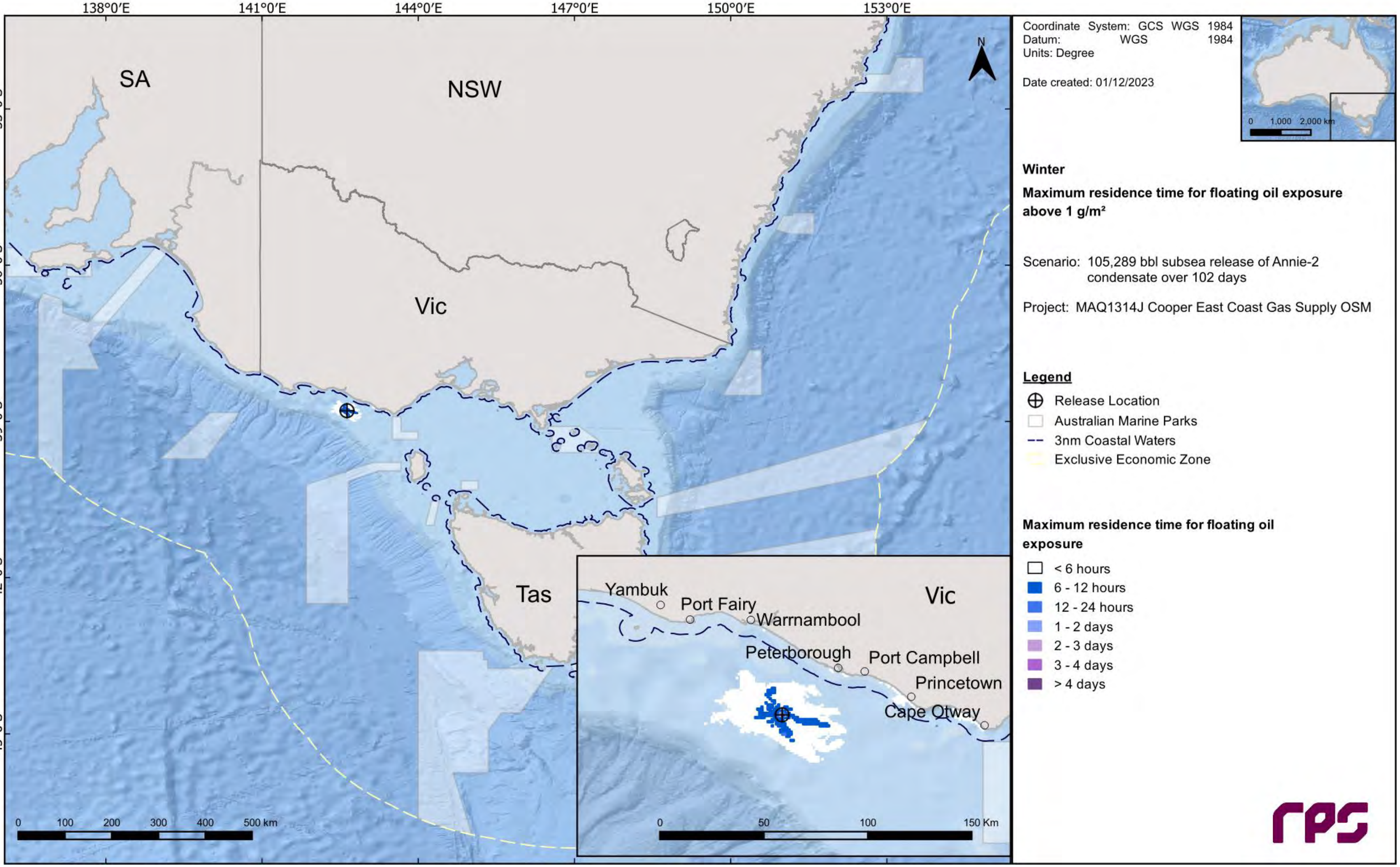


Figure 11.4 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

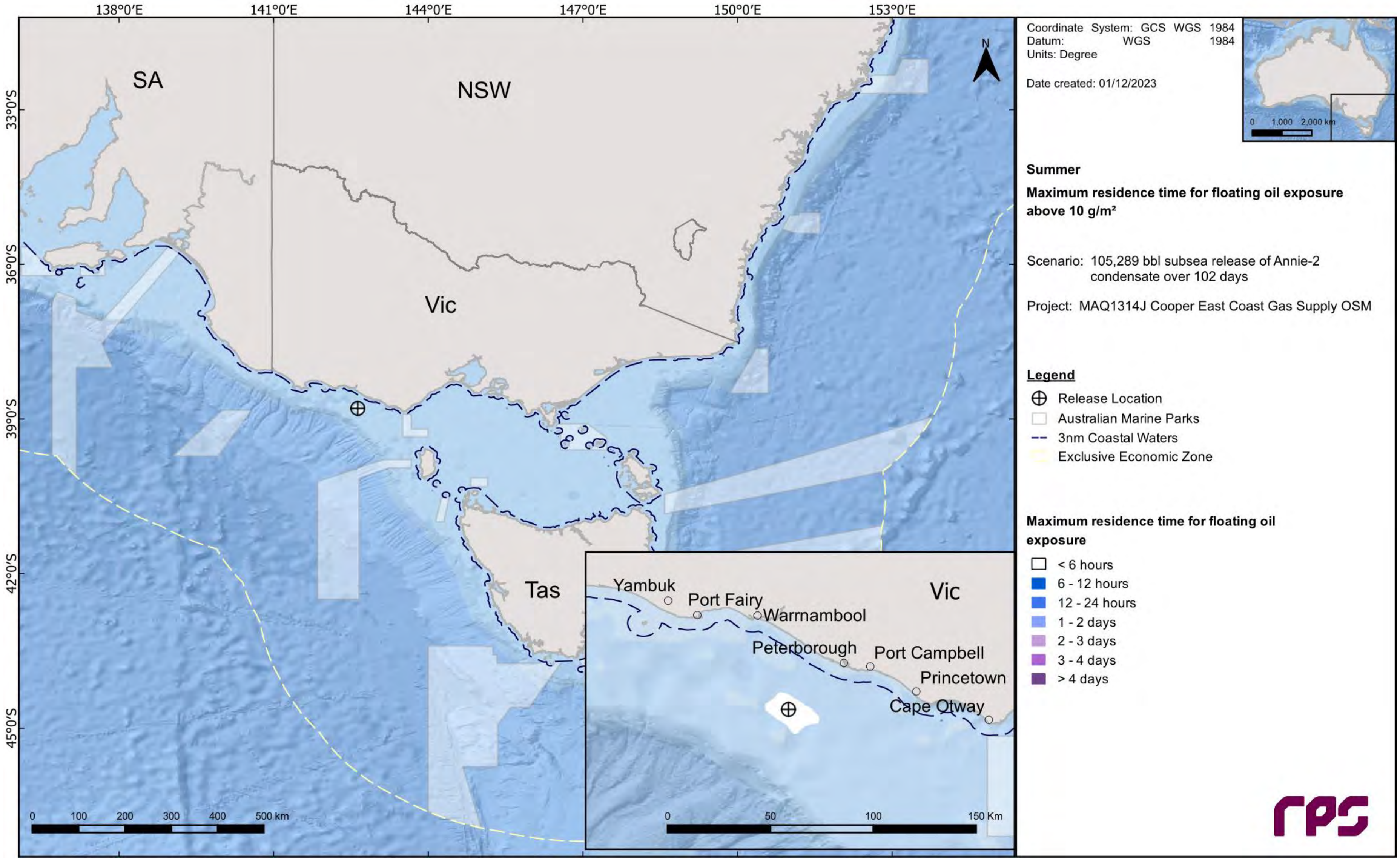


Figure 11.5 Maximum residence time of floating oil exposure above 10 g/m², in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

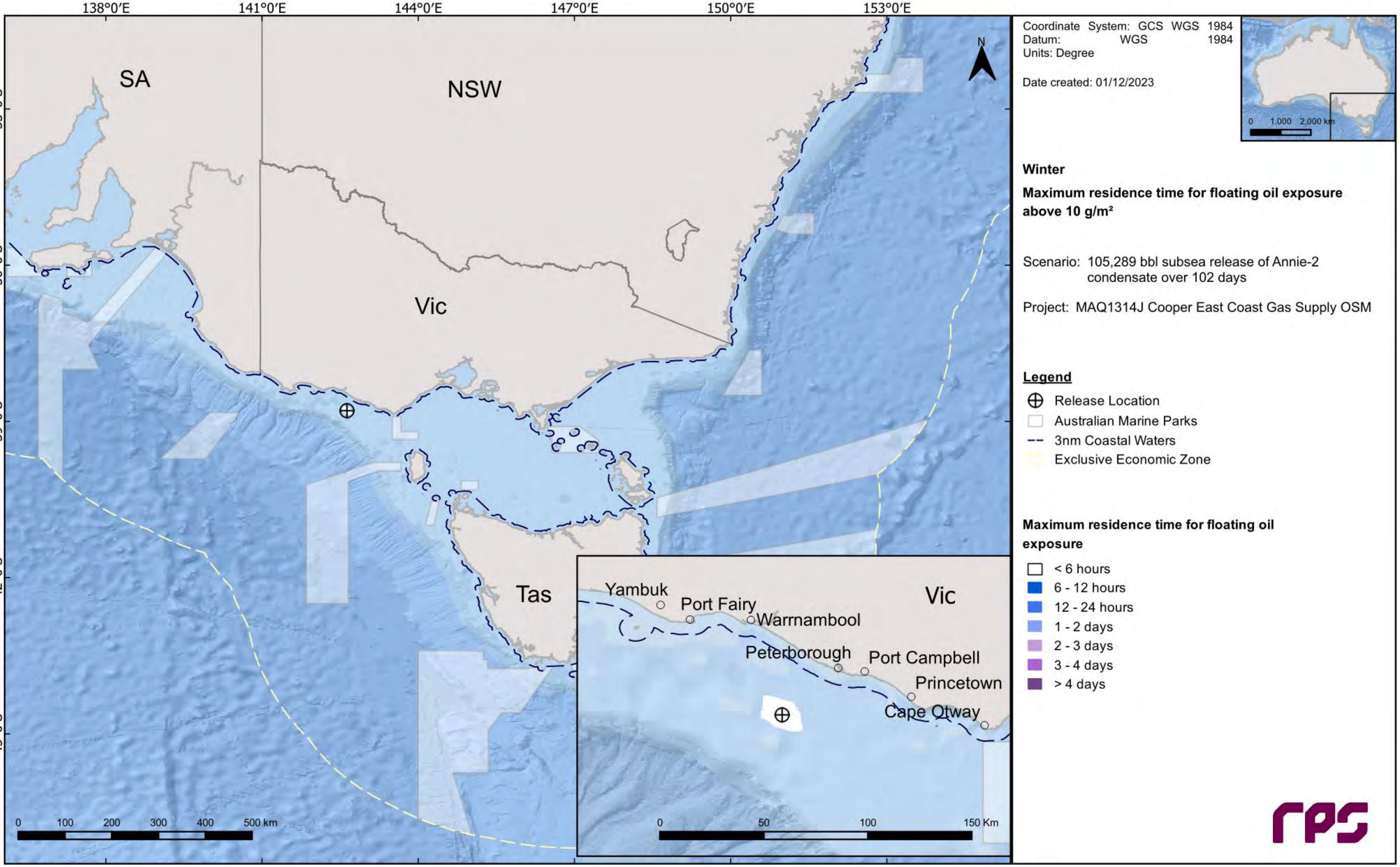


Figure 11.6 Maximum residence time of floating oil exposure above 10 g/m^2, in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.2 Shoreline Accumulation

Table 11.4 presents a summary of the potential shoreline accumulation. The probability of accumulation to any shoreline at, or above, the low (10 g/m^2) threshold was 100% throughout the year. The minimum time before oil accumulation at, or above, the low threshold was 1.83 days (winter). The maximum total volume ashore for a single spill trajectory was 251.0 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 295.0 km, 48.0 km and 1.0 km, respectively, all occurring during winter.

Table 11.5 and Table 11.6 summarises the shoreline accumulation on individual receptors during summer and winter, respectively.

During summer, the shoreline segment of Colac Otway LGA as well as the Cape Otway West sub-LGA had the highest probability of accumulation above the low (99%) and moderate (69%) thresholds. Bay of Islands and Moyne also revealed a 1% probability of accumulation above the high threshold. The minimum time for low threshold shoreline accumulation was 3.38 days for the Corangamite shoreline segment.

Through winter, the shoreline segment of Colac Otway as well as the Cape Otway West sub-LGA had the highest probability of accumulation above the low and moderate thresholds (100% and 85%, respectively). Again, only few receptors revealed a 1% probability of accumulation above the high threshold. The minimum time for low threshold shoreline accumulation was 1.83 days for the Bay of Islands and Moyne shoreline segments.

The maximum potential shoreline loadings above each shoreline thresholds are presented in Figure 11.7 and Figure 11.8 for summer and winter, respectively.

Table 11.4 Summary of oil accumulation across all shorelines. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Shoreline Statistics	Summer	Winter
Probability of accumulation on any shoreline (%)	100	100
Absolute minimum time for visible oil to shore (days)	3.38	1.83
Maximum total volume of hydrocarbons ashore (m^3)	189.6	251.0
Average total volume of hydrocarbons ashore (m^3)	68.0	98.8
Maximum length of the shoreline at **10 g/m^2** (km)	264.0	295.0
Average shoreline length (km) at **10 g/m^2** (km)	109.8	142.2
Maximum length of the shoreline at **100 g/m^2** (km)	37.0	48.0
Average shoreline length (km) at **100 g/m^2** (km)	12.4	18.3
Maximum length of the shoreline at **1,000 g/m^2** (km)	1.0	1.0
Average shoreline length (km) at **1,000 g/m^2** (km)	1.0	1.0

Table 11.5 Summary of oil accumulation on individual shoreline receptors. Results are based on a 105,289 bbl (16,740 m³) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

Shoreline Receptor		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA Shoreline	Anglesea	22	1	-	16.88	67.13	-	5	100	1.4	12.3	5.9	0.9	-	19.1	0.9	-
	Anser Island	20	-	-	18.75	-	-	6	68	0.5	1.8	2.6	-	-	3.6	-	-
	Apollo Bay	90	11	-	5.13	52.54	-	13	167	4.6	18.5	10.7	2.3	-	23.6	4.5	-
	Bass Coast	3	-	-	92.71	-	-	2	22	0.3	1.1	1.2	-	-	1.8	-	-
	Bay of Islands	81	30	1	5.54	17.88	106.67	19	1,068	6.7	69.5	12.9	3	0.9	28.2	10.9	0.9
	Bega Valley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Colac Otway	99	69	-	3.58	6.58	-	24	686	26.8	78.6	35.5	7.1	-	72.7	20	-
	Corangamite	95	55	-	3.38	6.79	-	23	415	16.6	54.5	24.5	5.6	-	49.1	15.4	-
	Curtis Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	East Gippsland	23	-	-	16.29	-	-	3	55	1.3	3.9	3.9	-	-	7.3	-	-
	French Island	10	-	-	19.08	-	-	2	36	0.2	0.8	1.2	-	-	1.8	-	-
	Gabo Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Glenelg	41	-	-	8.08	-	-	5	83	3.9	12.8	10.7	-	-	27.3	-	-
	Glennie Group	25	-	-	16.96	-	-	5	55	0.7	3.4	3.4	-	-	9.1	-	-
	Grant	7	-	-	27.83	-	-	2	18	0.6	1.3	1.2	-	-	1.8	-	-
	Greater Geelong	16	-	-	19.5	-	-	3	80	0.9	4.8	5.6	-	-	15.4	-	-
	Hogan Island Group	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Kanowna Island	13	-	-	18.75	-	-	4	37	0.3	1.7	2.9	-	-	4.5	-	-
	Kent Island Group	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	King Island	29	-	-	17.79	-	-	2	64	1.4	6.9	4.4	-	-	17.3	-	-
	Lady Julia Percy Island	45	1	-	13.13	14.96	-	12	136	1	5.2	3	1.8	-	5.5	1.8	-
	Laurence Rocks	23	-	-	17.67	-	-	8	38	0.3	0.8	1.9	-	-	2.7	-	-
	Moncoeur Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Montague Island	2	-	-	114.75	-	-	3	14	0.1	0.3	0.9	-	-	0.9	-	-
	Mornington Peninsula	25	-	-	16.17	-	-	4	77	2.4	12.8	12.1	-	-	29.1	-	-
	Moyne	85	30	1	5.54	17.88	106.67	12	1,068	9.3	73	18	3.3	0.9	52.7	10.9	0.9
	Norman Island	14	-	-	20.38	-	-	4	31	0.2	0.7	1.4	-	-	1.8	-	-
	Phillip Island	25	-	-	16.25	-	-	3	67	1	5.6	4.1	-	-	10.9	-	-
	Rodondo Island	14	-	-	62.33	-	-	5	48	0.2	1	1.4	-	-	1.8	-	-
	Seal Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Shellback Island	4	-	-	59.17	-	-	4	16	< 0.1	0.3	0.9	-	-	0.9	-	-
	Skull Rock	10	-	-	19.29	-	-	4	37	0.2	0.9	1.3	-	-	1.8	-	-
	South Gippsland	31	6	-	16.63	71.25	-	4	121	2.9	15.5	11.4	1.1	-	28.2	1.8	-
	Surf Coast	30	5	-	9.96	60.79	-	5	136	3.2	30.9	11.1	2.2	-	40.9	4.5	-
	Warrnambool	47	8	-	8.83	41.54	-	9	160	2.7	14.8	8.1	1.7	-	23.6	2.7	-
	Wellington	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-LGA Shoreline	Bega Valley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Conran	6	-	-	53.75	-	-	3	15	0.2	0.4	0.9	-	-	0.9	-	-
	Cape Howe / Mallacoota	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Liptrap (NW)	22	-	-	16.63	-	-	3	72	0.6	3.8	2.8	-	-	6.4	-	-
	Cape Nelson	41	-	-	8.08	-	-	6	83	3.3	10	10	-	-	24.5	-	-
	Cape Otway West	99	69	-	3.58	6.58	-	42	686	20.4	51.8	21.9	6.7	-	35.4	15.4	-
	Cape Patton	51	-	-	8.33	-	-	6	91	1.7	10.1	6.6	-	-	20.9	-	-

Shoreline Receptor	Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
Childers Cove	61	9	-	8.83	41.54	-	10	160	3.1	16.4	7.8	1.9	-	20	3.6	-
Clonmel Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Croajingolong (West)	14	-	-	16.29	-	-	3	55	0.4	1.5	1.9	-	-	3.6	-	-
Discovery Bay (East)	5	-	-	36.42	-	-	2	15	0.3	1	0.9	-	-	0.9	-	-
Discovery Bay (West)	2	-	-	63.04	-	-	2	11	0.3	0.9	0.9	-	-	0.9	-	-
French Island / Crib Point	11	-	-	17.63	-	-	3	43	0.2	0.7	1.2	-	-	1.8	-	-
Kilcunda	2	-	-	92.71	-	-	2	17	0.2	0.7	0.9	-	-	0.9	-	-
Lake Tyers Beach	2	-	-	103.79	-	-	2	25	0.3	1	1.4	-	-	1.8	-	-
Lorne	25	-	-	9.96	-	-	4	58	1.1	5.1	6	-	-	12.7	-	-
Marlo	1	-	-	105.54	-	-	2	23	0.1	0.6	0.9	-	-	0.9	-	-
Moonlight Head	92	53	-	3.38	6.79	-	27	341	10.8	39	13.5	4.8	-	24.5	12.7	-
Mornington Peninsula (S)	16	-	-	16.46	-	-	4	77	0.8	3.8	4.4	-	-	8.2	-	-
Mornington Peninsula (SW)	25	-	-	16.17	-	-	5	59	1.4	7	7.5	-	-	14.5	-	-
New South Wales	2	-	-	114.75	-	-	2	14	0.3	1.3	0.9	-	-	0.9	-	-
Point Hicks	21	-	-	50.79	-	-	4	44	0.6	1.7	2.6	-	-	3.6	-	-
Port Campbell	81	24	-	4.21	8.04	-	18	415	5.9	27.6	13.2	2.2	-	26.4	6.4	-
Port Fairy	42	3	-	7.13	25.25	-	5	124	1.4	6	4.2	0.9	-	13.6	0.9	-
Port Phillip (Queenscliff)	16	-	-	19.5	-	-	3	30	0.5	2.5	2.6	-	-	9.1	-	-
Port Phillip (Sorrento Shore)	8	-	-	16.58	-	-	3	15	0.3	0.7	1.4	-	-	2.7	-	-
Port Welshpool	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Portland Bay (East)	2	-	-	24.54	-	-	2	22	0.2	2.4	5	-	-	9.1	-	-
Portland Bay (West)	6	-	-	15	-	-	2	19	0.3	1.6	2	-	-	3.6	-	-
Snake Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Australia State Waters	7	-	-	27.83	-	-	2	18	0.6	1.6	1.2	-	-	1.8	-	-
Tasmania State Waters	29	-	-	17.79	-	-	2	64	1.8	8.2	4.4	-	-	17.3	-	-
Torquay	15	5	-	16.33	60.79	-	6	136	2	19.8	9.8	2	-	24.5	3.6	-
Venus Bay	2	-	-	104.5	-	-	2	22	0.2	0.9	0.9	-	-	0.9	-	-
Victoria State Waters	100	82	1	3.38	6.58	106.67	14	1,068	66.1	186.8	98.4	11.3	0.9	239.9	33.6	0.9
Waratah Bay	4	-	-	16.88	-	-	2	19	0.1	0.5	0.9	-	-	0.9	-	-
Warrnambool	39	1	-	15	49.54	-	6	117	1.5	7.4	5.3	0.9	-	15.4	0.9	-
Westernport	8	-	-	17.38	-	-	2	24	0.3	1.3	2.5	-	-	3.6	-	-
Wilsons Promontory (East)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wilsons Promontory (West)	30	6	-	16.88	71.25	-	6	121	2.3	12.7	9.6	1.1	-	23.6	1.8	-

Table 11.6 Summary of oil accumulation on individual shoreline receptors. Results are based on a 105,289 bbl (16,740 m³) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

Shoreline Receptor		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA Shoreline	Anglesea	31	-	-	13.79	-	-	4	68	0.9	6.7	4.3	-	-	13.6	-	-
	Anser Island	57	-	-	16.42	-	-	10	76	0.8	2.6	2.3	-	-	4.5	-	-
	Apollo Bay	100	20	-	4.17	15.42	-	14	265	5.3	18.3	11	1.4	-	21.8	3.6	-
	Bass Coast	17	-	-	13.42	-	-	2	33	0.6	2.6	2	-	-	5.5	-	-
	Bay of Islands	87	25	-	1.83	11.38	-	20	398	6.8	23.1	11.8	3.2	-	25.4	5.5	-
	Bega Valley	30	-	-	32.96	-	-	3	58	0.8	3.3	1.9	-	-	4.5	-	-
	Colac Otway	100	85	-	3.75	6.63	-	35	912	42	88	44.1	10.2	-	65.4	20	-
	Corangamite	98	69	1	1.88	9.46	82.29	33	1,008	25.3	130.1	30.4	6.4	0.9	57.2	22.7	0.9
	Curtis Island	1	-	-	52.08	-	-	2	12	0.1	0.5	1.8	-	-	1.8	-	-
	East Gippsland	60	5	-	32.04	56.96	-	4	125	2.6	8.5	4.2	1.1	-	10.9	1.8	-
	French Island	7	-	-	13.71	-	-	2	15	0.1	0.5	1.2	-	-	1.8	-	-
	Gabo Island	13	-	-	49.83	-	-	5	35	0.2	1	2.1	-	-	3.6	-	-
	Glenelg	24	3	-	11.92	29.25	-	5	181	4.3	24.5	13.1	1.5	-	45.4	1.8	-
	Glennie Group	59	-	-	13.63	-	-	9	87	1.4	5.2	4.5	-	-	10.9	-	-
	Grant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Greater Geelong	12	-	-	14.38	-	-	3	88	0.6	4.1	5.2	-	-	14.5	-	-
	Hogan Island Group	4	-	-	45.75	-	-	2	16	0.2	0.6	0.9	-	-	0.9	-	-
	Kanowna Island	43	-	-	19.46	-	-	6	50	0.5	1.6	2.3	-	-	4.5	-	-
	Kent Island Group	3	-	-	62.33	-	-	2	27	0.2	1.2	1.8	-	-	2.7	-	-
	King Island	22	-	-	23.71	-	-	2	74	1.4	8.4	6.4	-	-	20.9	-	-
	Lady Julia Percy Island	31	7	-	15.42	29.54	-	16	199	1.4	6.4	3.3	2.1	-	6.4	2.7	-
	Laurence Rocks	17	-	-	11.5	-	-	9	33	0.3	1	1.5	-	-	2.7	-	-
	Moncoeur Islands	6	-	-	27.5	-	-	3	14	0.2	0.6	0.9	-	-	0.9	-	-
	Montague Island	11	-	-	43.04	-	-	6	37	0.3	1.4	2.8	-	-	3.6	-	-
	Mornington Peninsula	38	-	-	11.58	-	-	3	59	2	11.6	7.2	-	-	24.5	-	-
	Moyne	87	30	-	1.83	11.38	-	14	398	9.6	42.6	18.4	3	-	77.2	6.4	-
	Norman Island	38	-	-	13.00	-	-	6	29	0.3	1	2	-	-	4.5	-	-
	Phillip Island	55	-	-	11.63	-	-	4	67	1.7	7	5.7	-	-	16.4	-	-
	Rodondo Island	47	-	-	18.13	-	-	8	94	0.4	2	1.7	-	-	2.7	-	-
	Seal Islands	2	-	-	46.46	-	-	2	13	< 0.1	0.3	0.9	-	-	0.9	-	-
	Shellback Island	16	-	-	22.17	-	-	5	34	0.1	0.6	1.1	-	-	1.8	-	-
	Skull Rock	38	-	-	19.46	-	-	7	31	0.3	0.7	1.3	-	-	1.8	-	-
	South Gippsland	64	17	-	11.88	41.63	-	8	204	6	18.9	14	1.6	-	30	1.8	-
	Surf Coast	51	1	-	12.79	16.88	-	4	110	2.3	21.6	7.4	1.8	-	34.5	1.8	-
	Warrnambool	44	5	-	4.25	5.92	-	11	207	3.2	11.2	8.2	1.6	-	20.9	3.6	-
	Wellington	3	-	-	47.63	-	-	2	27	0.4	4	2.1	-	-	2.7	-	-
Sub-LGA Shoreline	Bega Valley	30	-	-	32.96	-	-	3	58	0.8	3.3	1.9	-	-	4.5	-	-
	Cape Conran	3	-	-	55.38	-	-	2	14	0.1	0.7	0.9	-	-	0.9	-	-
	Cape Howe / Mallacoota	15	-	-	46.63	-	-	3	38	0.2	1.6	1.6	-	-	4.5	-	-
	Cape Liptrap (NW)	52	-	-	12.21	-	-	6	76	1.1	4	3.3	-	-	7.3	-	-
	Cape Nelson	24	3	-	11.92	29.25	-	6	181	2.9	16.1	8.5	1.5	-	26.4	1.8	-
	Cape Otway West	100	85	-	3.75	6.63	-	68	912	33.9	80.5	26.2	9.9	-	35.4	20	-
	Cape Patton	80	-	-	8.13	-	-	7	99	2.6	8.4	7.6	-	-	19.1	-	-

Shoreline Receptor	Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
Childers Cove	48	4	-	4.67	5.92	-	12	207	3.6	14.7	10.2	1.8	-	18.2	4.5	-
Clonmel Island	2	-	-	53.71	-	-	2	26	0.2	1.3	1.4	-	-	1.8	-	-
Croajingolong (West)	35	-	-	37.83	-	-	4	67	0.5	2	1.7	-	-	4.5	-	-
Discovery Bay (East)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Discovery Bay (West)	1	-	-	104.75	-	-	2	15	0.2	0.7	0.9	-	-	0.9	-	-
French Island / Crib Point	9	-	-	12.83	-	-	2	25	0.1	0.6	1.1	-	-	1.8	-	-
Kilcunda	14	-	-	13.42	-	-	3	24	0.3	1.3	1.6	-	-	2.7	-	-
Lake Tyers Beach	1	-	-	59.88	-	-	2	10	0.2	0.9	0.9	-	-	0.9	-	-
Lorne	48	-	-	12.79	-	-	4	49	1.1	3.8	4.4	-	-	11.8	-	-
Marlo	14	-	-	46.58	-	-	2	51	0.2	1.2	1.1	-	-	1.8	-	-
Moonlight Head	98	62	1	3.54	9.46	82.29	43	1,008	17.4	97.5	17.4	5.6	0.9	30	15.4	0.9
Mornington Peninsula (S)	29	-	-	11.71	-	-	4	59	0.6	3.9	2.8	-	-	9.1	-	-
Mornington Peninsula (SW)	26	-	-	11.58	-	-	4	57	0.9	5.5	5	-	-	13.6	-	-
New South Wales	31	-	-	32.96	-	-	3	58	1	4.1	2.8	-	-	7.3	-	-
Point Hicks	56	5	-	32.04	56.96	-	10	125	1.3	4.9	2.7	1.1	-	5.5	1.8	-
Port Campbell	89	31	-	1.88	9.5	-	23	305	8.1	33.7	13.8	3.1	-	26.4	8.2	-
Port Fairy	32	5	-	15.50	17.29	-	6	122	1.8	9.1	5.3	0.9	-	23.6	0.9	-
Port Phillip (Queenscliff)	10	-	-	34.46	-	-	3	28	0.3	2.4	3.2	-	-	7.3	-	-
Port Phillip (Sorrento Shore)	14	-	-	12.13	-	-	3	40	0.3	1.7	2.3	-	-	4.5	-	-
Port Welshpool	3	-	-	69.00	-	-	2	14	0.1	0.6	1.2	-	-	1.8	-	-
Portland Bay (East)	7	-	-	18.13	-	-	3	28	0.7	3.9	6.5	-	-	11.8	-	-
Portland Bay (West)	7	-	-	26.25	-	-	6	70	2.1	8	14.9	-	-	18.2	-	-
Snake Island	3	-	-	47.63	-	-	2	27	0.1	1.2	1.2	-	-	1.8	-	-
South Australia State Waters	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tasmania State Waters	24	-	-	23.71	-	-	2	74	1.6	8.9	6.3	-	-	20.9	-	-
Torquay	28	1	-	13.75	16.88	-	4	110	1	16.9	5.4	1.8	-	23.6	1.8	-
Venus Bay	12	-	-	13.67	-	-	2	33	0.3	1.3	1.1	-	-	2.7	-	-
Victoria State Waters	100	88	1	1.83	5.92	82.29	17	1,008	96.6	248.8	126.8	16.6	0.9	268.1	43.6	0.9
Waratah Bay	6	-	-	31.75	-	-	2	29	0.2	2.2	1.8	-	-	4.5	-	-
Warrnambool	31	5	-	4.25	8.63	-	7	161	2	12.5	7.7	1.1	-	23.6	1.8	-
Westernport	11	-	-	12.54	-	-	2	24	0.3	1.4	1.9	-	-	3.6	-	-
Wilsons Promontory (East)	2	-	-	40.08	-	-	2	14	0.2	1.7	1.4	-	-	1.8	-	-
Wilsons Promontory (West)	63	17	-	11.88	41.63	-	11	204	4.6	14.3	11.2	1.6	-	21.8	1.8	-

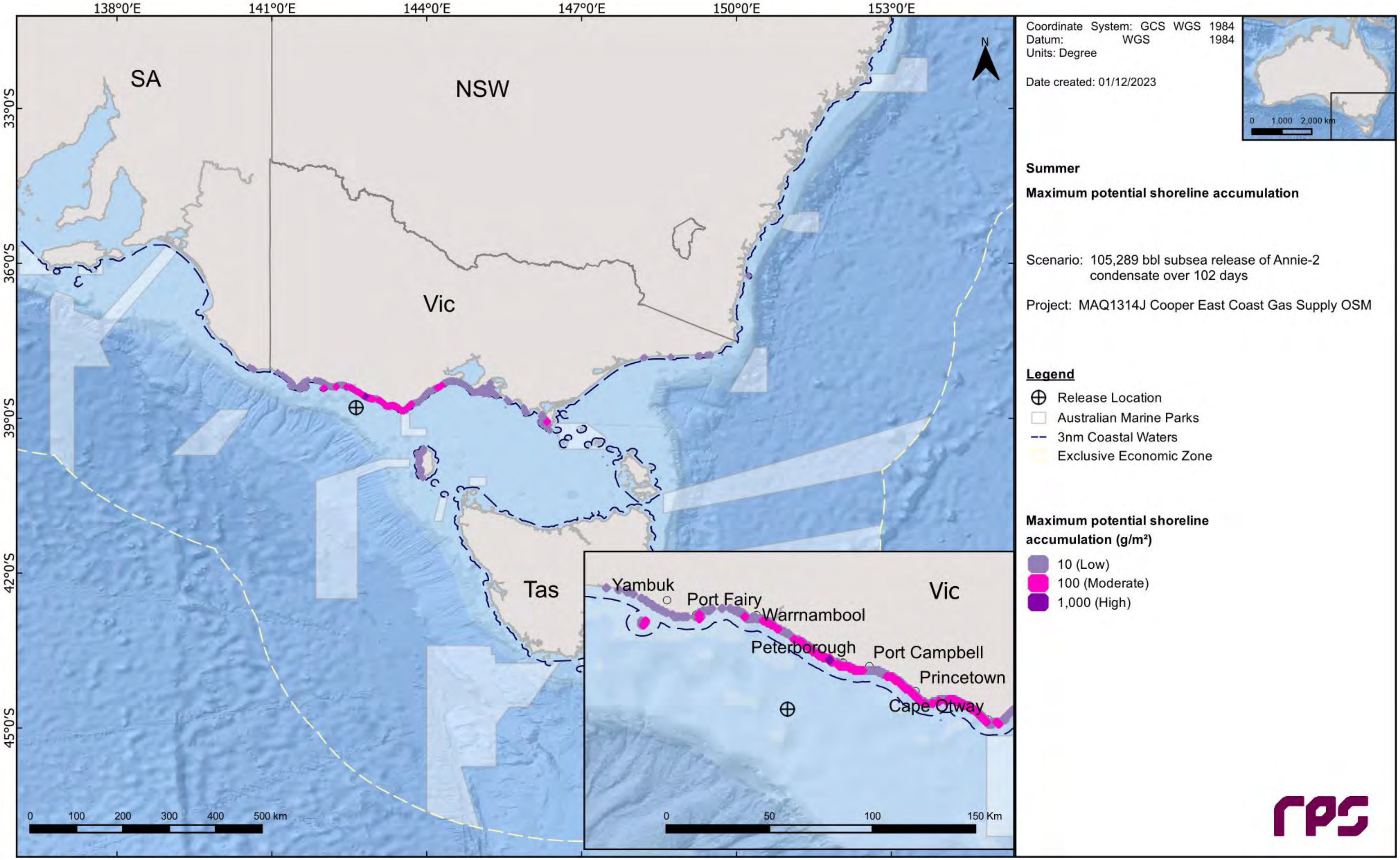


Figure 11.7 Maximum potential shoreline accumulation in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

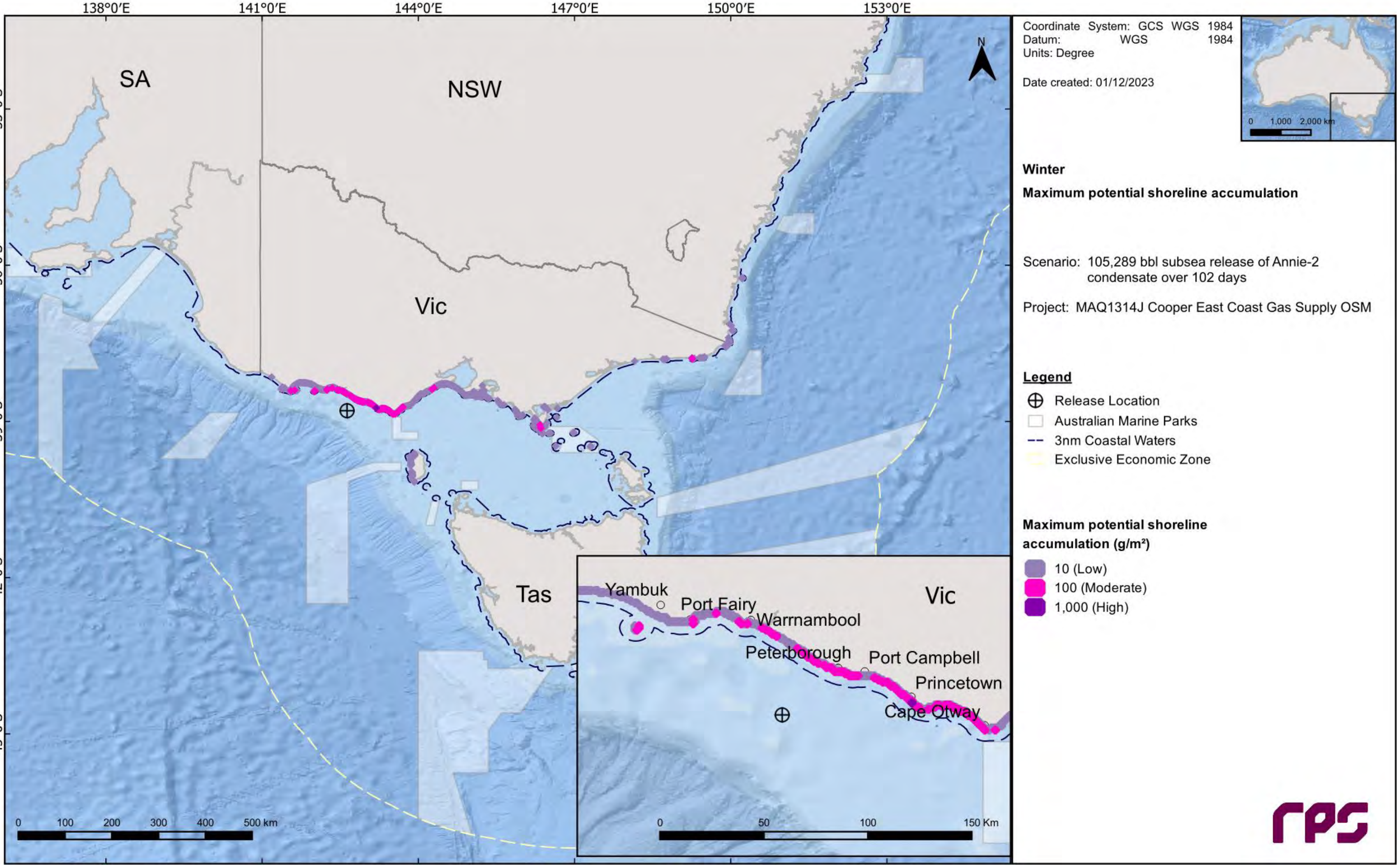


Figure 11.8 Maximum potential shoreline accumulation in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.3 In-water exposure

11.1.3.1 Dissolved Hydrocarbons

Table 11.7 summarises the potential in-water exposure to individual receptors from dissolved hydrocarbons in the 0-10 m layer.

During summer conditions, a total of 20 BIAs were predicted to be exposed to dissolved hydrocarbon at, or above, the low threshold. Excluding the BIAs that the release location resides within (see Section 10.3), the highest probability of low exposure ranged between 2% (Australasian Gannet - Foraging) and 15% (Southern Right Whale - Aggregation).

Alternatively, during winter, excluding the BIAs that the release location resides within (see Section 10.3), the probability of low exposure ranged between 1% (Australasian Gannet - Foraging) and 21% (Short-tailed Shearwater - Foraging).

The maximum dissolved hydrocarbon concentration at any given receptor(s) was shown to be 51.8 ppb and 60.2 ppb for summer and winter conditions, respectively.

Table 11.8 presents the predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors, in the 0-10 m depth layer, for all thresholds assessed.

Figure 11.9 and Figure 11.10 present the zones of potential dissolved hydrocarbon exposure for the 0-10 m depth layer for each season whilst Figure 11.11 Figure 11.12 present the maximum residence time of dissolved hydrocarbon exposure for the NOPSEMA thresholds.

Table 11.7 Probability of dissolved hydrocarbons exposure to marine based receptors in the 0–10 m depth. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer				Winter			
		Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)			Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	19.1	5	-	-	44.3	10	-	-
BIA	Antipodean Albatross - Foraging*	51.8	40	1	-	60.2	66	1	-
	Australasian Gannet - Foraging	17.9	2	-	-	14.3	1	-	-
	Black-browed Albatross - Foraging*	51.8	40	1	-	60.2	66	1	-
	Bullers Albatross - Foraging*	51.8	40	1	-	60.2	66	1	-
	Campbell Albatross - Foraging*	51.8	40	1	-	60.2	66	1	-
	Common Diving-petrel - Foraging*	51.8	40	1	-	60.2	66	1	-
	Indian Yellow-nosed Albatross - Foraging*	51.8	40	1	-	60.2	66	1	-
	Pygmy Blue Whale - Distribution*	51.8	40	1	-	60.2	66	1	-
	Pygmy Blue Whale - Foraging*	51.8	40	1	-	60.2	66	1	-
	Pygmy Blue Whale - Foraging annual high use area*	51.8	40	1	-	60.2	66	1	-
	Pygmy Blue Whale - Known Foraging Area	26.8	4	-	-	44.3	8	-	-
	Short-tailed Shearwater - Foraging	36.5	11	-	-	49.6	21	-	-
	Shy Albatross - Foraging*	51.8	40	1	-	60.2	66	1	-
	Southern Right Whale – Aggregation	34.9	15	-	-	30	17	-	-
	Southern Right Whale - Known Core Range* ^	51.8	40	1	-	60.2	66	1	-
	Wandering Albatross - Foraging*	51.8	40	1	-	60.2	66	1	-
	Wedge-tailed Shearwater - Foraging*	51.8	40	1	-	60.2	66	1	-
	White Shark - Distribution*	51.8	40	1	-	60.2	66	1	-
	White Shark - Foraging	18.8	3	-	-	25.4	4	-	-
	White-faced Storm-petrel - Foraging	26.8	4	-	-	33.9	7	-	-
IBRA	Otway Plain	23.3	4	-	-	34.4	16	-	-
	Otway Ranges	18.9	2	-	-	23.9	3	-	-
	Warrnambool Plain	30.7	5	-	-	25.1	5	-	-
IMCRA	Central Bass Strait	26.8	4	-	-	33.9	7	-	-
	Central Victoria	26.6	4	-	-	44.3	10	-	-

Receptor		Summer Maximum dissolved hydrocarbon exposure (ppb)	Summer Probability of dissolved hydrocarbon exposure (%) Low	Moderate	High	Winter Maximum dissolved hydrocarbon exposure (ppb)	Winter Probability of dissolved hydrocarbon exposure (%) Low	Moderate	High
	Otway*	51.8	40	1	-	60.2	66	1	-
KEF	Bonney Coast Upwelling	8.6	-	-	-	14.3	1	-	-
	West Tasmania Canyons	13.4	1	-	-	13.1	1	-	-
MNP	Twelve Apostles	30.7	6	-	-	21.5	6	-	-
RSB	Bravenes Rock	9.8	-	-	-	14.9	4	-	-
Nearshore Waters	Colac Otway	23.3	4	-	-	34.4	16	-	-
	Corangamite	30.7	5	-	-	25.1	5	-	-
	Moyne	23.8	1	-	-	15.6	3	-	-
	Warrnambool	3.9	-	-	-	16.3	1	-	-
State Waters	Victoria State Waters*	34.9	10	-	-	34.4	21	-	-
Nearshore Waters (Sub-LGA)	Apollo Bay	12.1	1	-	-	23.9	2	-	-
	Bay of Islands	23.8	1	-	-	15.6	3	-	-
	Cape Otway West	24.8	4	-	-	34.4	16	-	-
	Cape Patton	10.3	1	-	-	11.4	1	-	-
	Childers Cove	7.4	-	-	-	16.3	1	-	-
	Moonlight Head	30.7	5	-	-	25.1	5	-	-
	Port Campbell	11.6	1	-	-	12.6	2	-	-
	Warrnambool	3.8	-	-	-	11.5	1	-	-

*The release location resides within the receptor boundaries.

^ RPS have utilised BIA's for the southern right whale that were delineated within the 2011-2021 Southern Right Whale. The NCV Atlas now includes updated BIA's for SRW, though the recently drafted National Recovery Plan for the southern right whale has not been published. The updated BIA's have not been used in this report.

Table 11.8 Predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer						Winter					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
AMP	Apollo	3.50	-	-	0.13	-	-	2.54	-	-	0.13	-	-
BIA	Antipodean Albatross - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Australasian Gannet - Foraging	7.29	-	-	0.08	-	-	11.25	-	-	0.04	-	-
	Black-browed Albatross - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Bullers Albatross - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Campbell Albatross - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Common Diving-petrel - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Indian Yellow-nosed Albatross - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Pygmy Blue Whale - Distribution*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Pygmy Blue Whale - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Pygmy Blue Whale - Foraging annual high use area*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Pygmy Blue Whale - Known Foraging Area	3.54	-	-	0.13	-	-	3.04	-	-	0.13	-	-
	Short-tailed Shearwater - Foraging	2.08	-	-	0.17	-	-	1.88	15.79	-	0.21	-	-
	Shy Albatross - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Southern Right Whale – Aggregation	1.25	-	-	0.13	-	-	1.88	-	-	0.17	-	-
	Southern Right Whale - Known Core Range* ^	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Wandering Albatross - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	Wedge-tailed Shearwater - Foraging*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	White Shark - Distribution*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
	White Shark - Foraging	6.46	-	-	0.08	-	-	6.13	-	-	0.08	-	-
	White-faced Storm-petrel - Foraging	3.58	-	-	0.13	-	-	3.04	-	-	0.13	-	-
IBRA	Otway Plain	7.38	-	-	0.17	-	-	5.92	-	-	0.13	-	-

Receptor		Summer						Winter					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
	Otway Ranges	6.46	-	-	0.04	-	-	4.88	-	-	0.08	-	-
	Warrnambool Plain	15.88	-	-	0.13	-	-	9.71	-	-	0.08	-	-
IMCRA	Central Bass Strait	6.67	-	-	0.13	-	-	3.04	-	-	0.13	-	-
IMCRA	Central Victoria	3.58	-	-	0.13	-	-	3.96	-	-	0.13	-	-
IMCRA	Otway*	0.71	31.92	-	0.29	-	-	0.42	5.79	-	0.33	-	-
KEF	Bonney Coast Upwelling	-	-	-	-	-	-	18.54	-	-	0.04	-	-
KEF	West Tasmania Canyons	13.50	-	-	0.08	-	-	21.96	-	-	0.04	-	-
MNP	Twelve Apostles	7.71	-	-	0.13	-	-	4.96	-	-	0.08	-	-
RSB	Bravenes Rock	24.25	-	-	0.04	-	-	10.25	-	-	0.04	-	-
Nearshore Waters	Colac Otway	6.46	-	-	0.17	-	-	4.88	-	-	0.13	-	-
Nearshore Waters	Corangamite	16.33	-	-	0.13	-	-	9.71	-	-	0.08	-	-
Nearshore Waters	Moyne	21.79	-	-	0.08	-	-	10.25	-	-	0.08	-	-
Nearshore Waters	Warrnambool	-	-	-	-	-	-	10.71	-	-	0.04	-	-
State Waters	Victoria State Waters*	3.08	-	-	0.17	-	-	3.83	-	-	0.21	-	-
Nearshore Waters (Sub-LGA)	Apollo Bay	6.46	-	-	0.04	-	-	4.88	-	-	0.08	-	-
Nearshore Waters (Sub-LGA)	Bay of Islands	21.79	-	-	0.08	-	-	10.25	-	-	0.08	-	-
Nearshore Waters (Sub-LGA)	Cape Otway West	5.04	-	-	0.17	-	-	5.75	-	-	0.13	-	-
Nearshore Waters (Sub-LGA)	Cape Patton	8.58	-	-	0.04	-	-	25.79	-	-	0.04	-	-
Nearshore Waters (Sub-LGA)	Childers Cove	-	-	-	-	-	-	10.96	-	-	0.04	-	-
Nearshore Waters (Sub-LGA)	Moonlight Head	15.88	-	-	0.13	-	-	9.71	-	-	0.08	-	-
Nearshore Waters (Sub-LGA)	Port Campbell	18.42	-	-	0.04	-	-	9.83	-	-	0.04	-	-
Nearshore Waters (Sub-LGA)	Warrnambool	-	-	-	-	-	-	10.71	-	-	0.04	-	-

*The release location resides within the receptor boundaries.

^ RPS have utilised BIA's for the southern right whale that were delineated within the 2011-2021 Southern Right Whale. The NCV Atlas now includes updated BIA's for SRW, though the recently drafted National Recovery Plan for the southern right whale has not been published. The updated BIA's have not been used in this report.

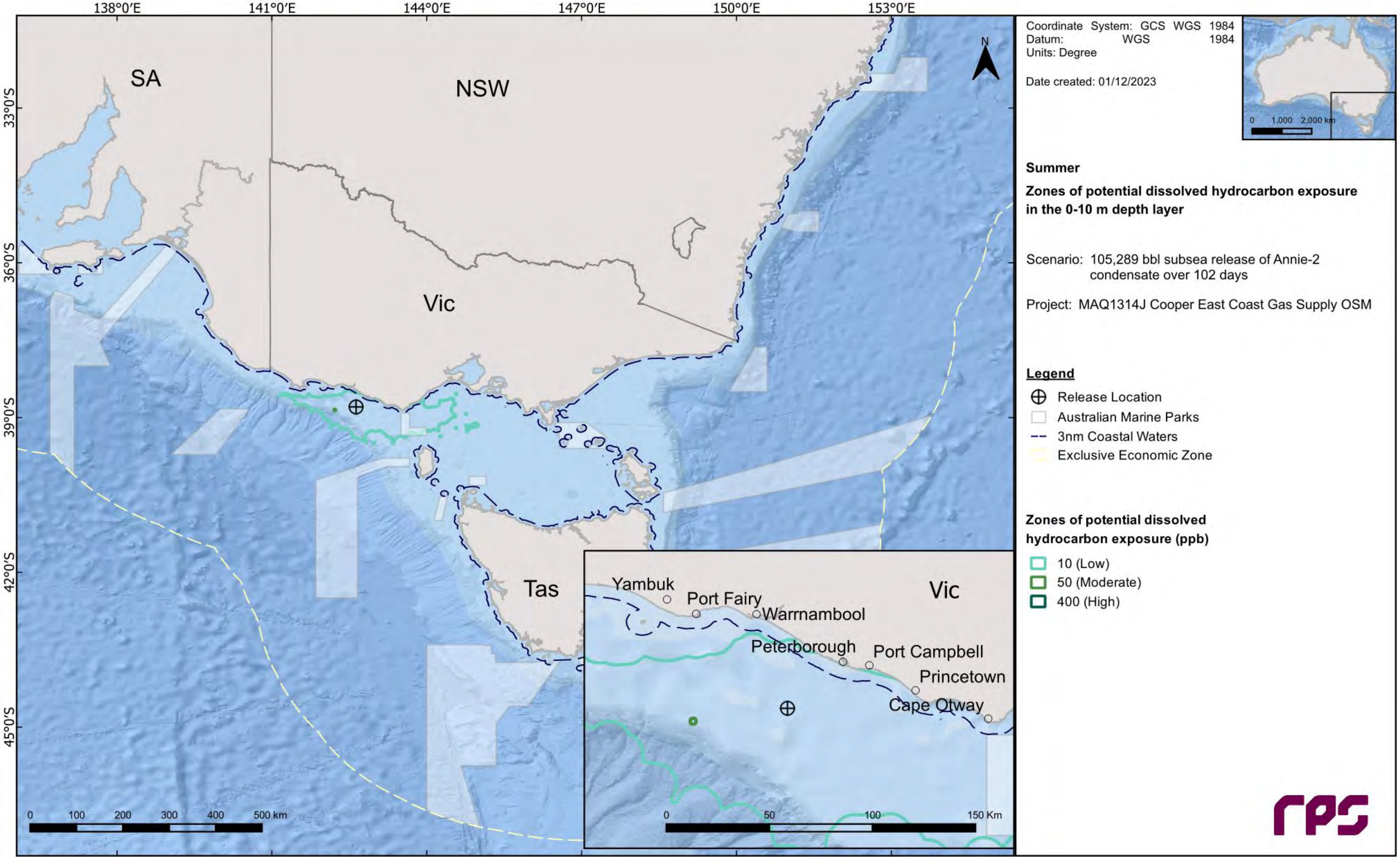


Figure 11.9 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

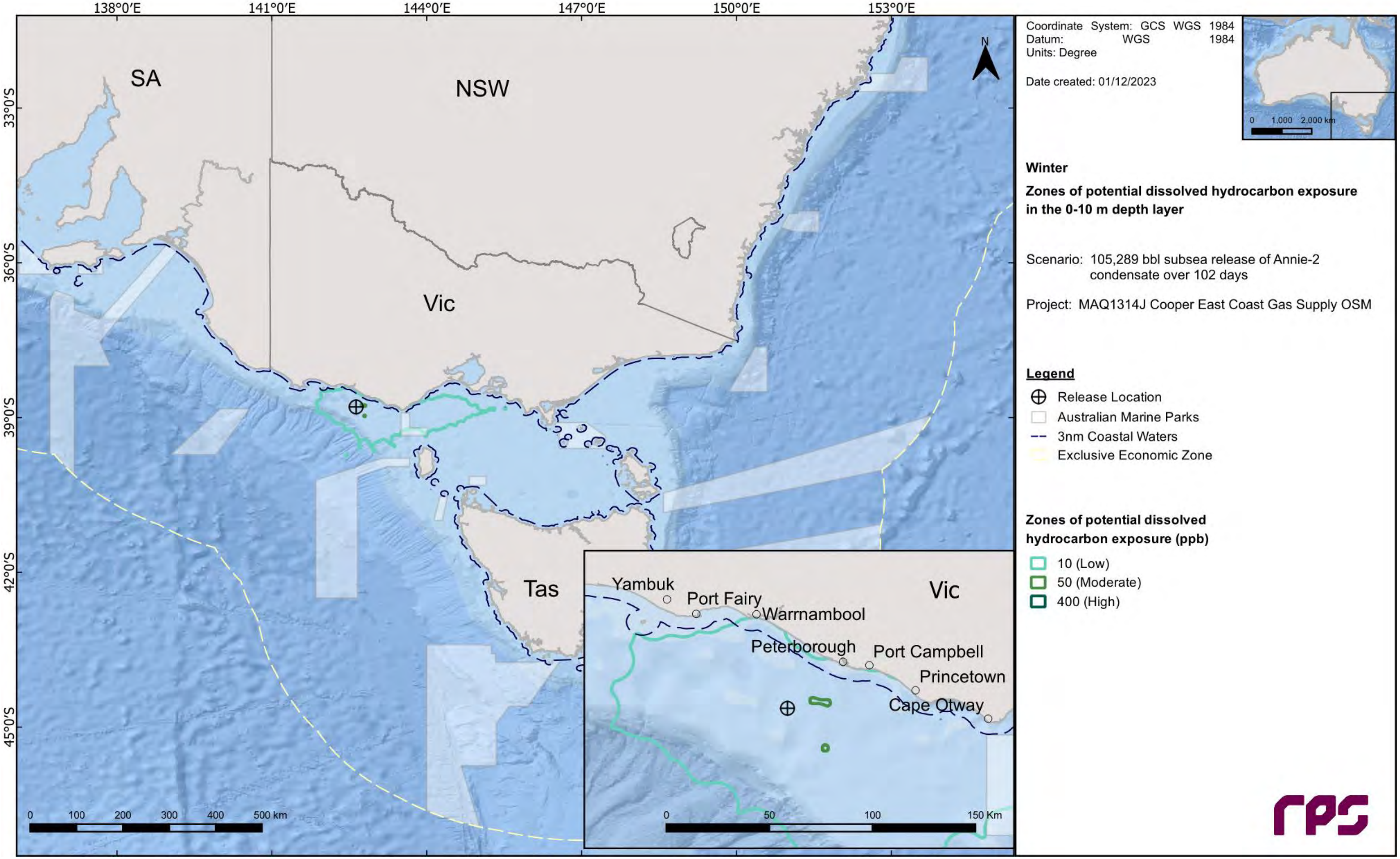


Figure 11.10 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

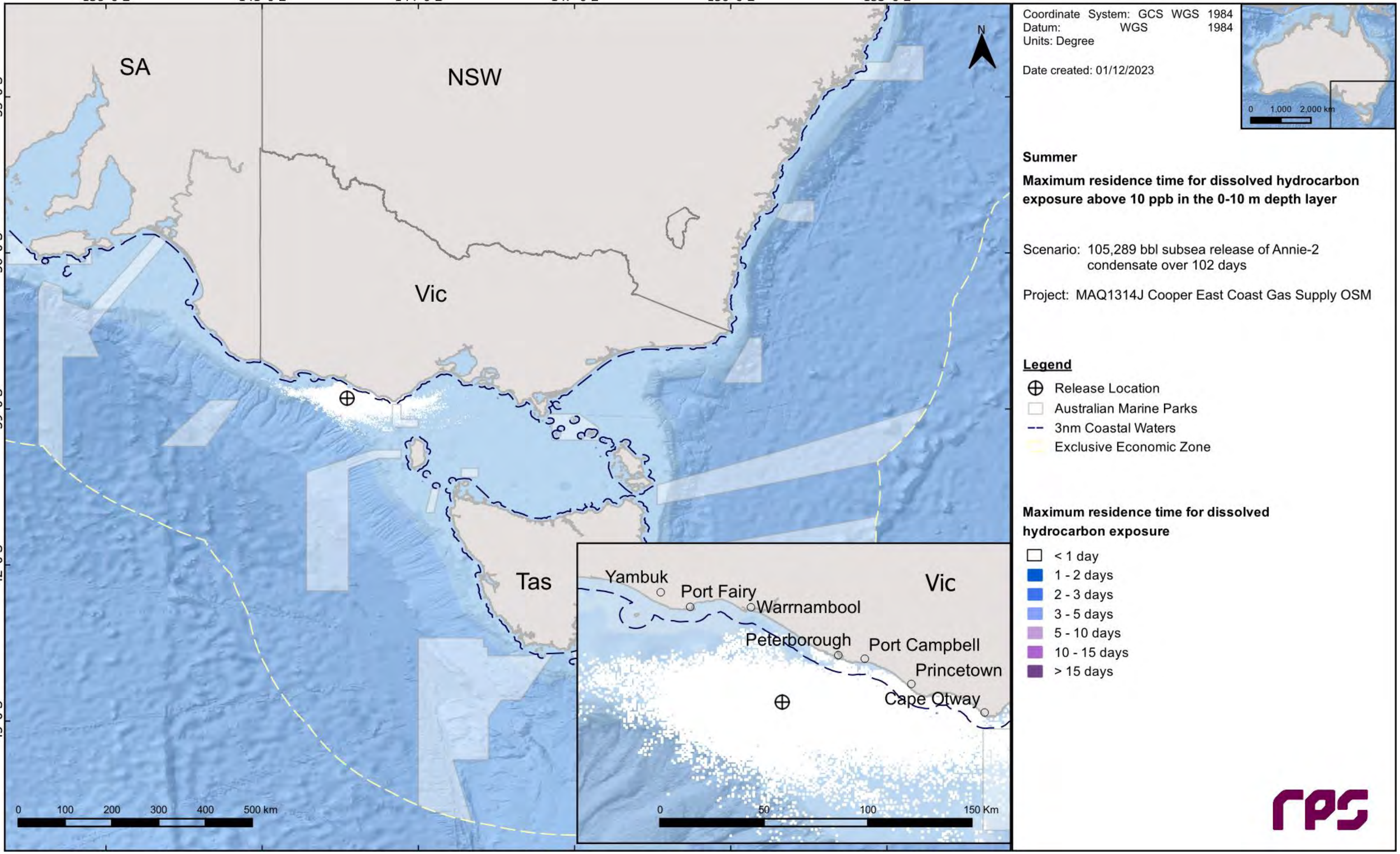


Figure 11.11 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

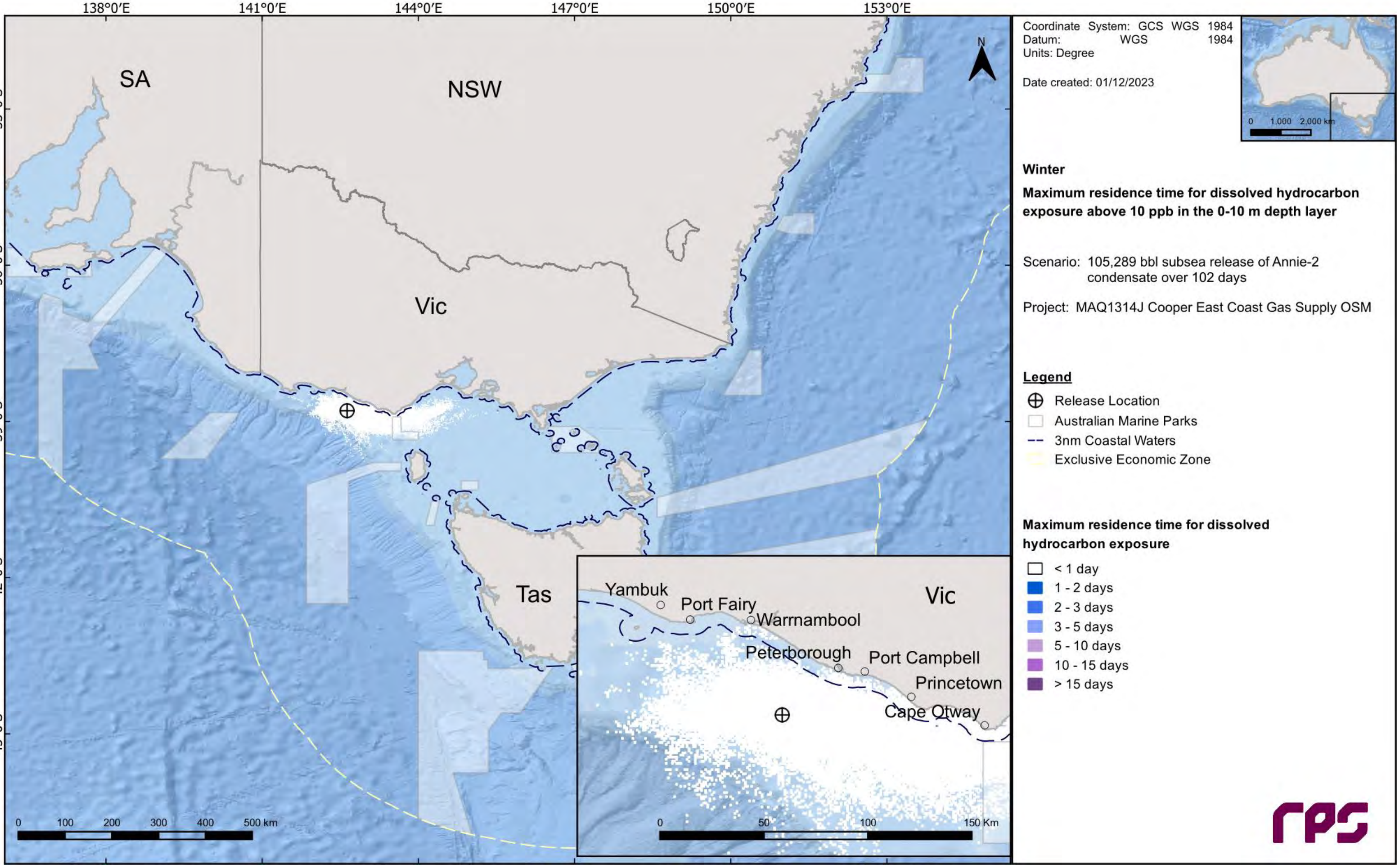


Figure 11.12 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.3.2 Entrained Hydrocarbons

Table 11.9 summarises the potential in-water exposure to individual receptors from entrained hydrocarbons in the 0-10 m depth layer.

Except for the receptors the release location is within, during summer the highest probability of low entrained hydrocarbon exposure was 100% recorded for Southern Right Whale - Aggregation. Additional receptors including LGAs, sub-LGAs, and AMPs were predicted with entrained hydrocarbon exposure (refer to Table 11.9).

During winter, several receptors, including the Apollo AMP, Southern Right Whale – Aggregation and White-faced Storm-petrel - Foraging BIAs revealed a 100% probability of low entrained hydrocarbon exposure.

Table 11.10 presents the predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer, for all thresholds assessed.

Figure 11.13 and Figure 11.14 present the zones of potential entrained hydrocarbon exposure for the 0-10 m depth layer for each season whilst Figure 11.15 and Figure 11.18 present the maximum residence time of entrained hydrocarbon exposure for the NOPSEMA thresholds.

Table 11.9 Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
AMP	Apollo	281.5	98	36	237.4	100	61
	Beagle	38.4	44	-	45.8	63	-
	East Gippsland	16.7	8	-	17.9	5	-
	Franklin	45.4	16	-	44.8	2	-
	Murray	14.8	3	-	7.2	-	-
	Nelson	22.3	11	-	14.4	2	-
	Zeehan	91.2	61	-	91.9	23	-
BIA	Antipodean Albatross - Foraging*	1,334.9	100	100	1,332.9	100	100
	Australasian Gannet - Foraging	132.1	69	4	92.2	90	-
	Australian Sea Lion - Foraging	32	14	-	11.2	1	-
	Black Petrel - Foraging	28.2	7	-	22.8	10	-
	Black-browed Albatross - Foraging*	1,334.9	100	100	1,332.9	100	100
	Black-faced Cormorant - Foraging	45.2	42	-	39.6	31	-
	Bullers Albatross - Foraging*	1,334.9	100	100	1,332.9	100	100
	Campbell Albatross - Foraging*	1,334.9	100	100	1,332.9	100	100
	Common Diving-petrel - Foraging*	1,334.9	100	100	1,332.9	100	100
	Crested Tern - Breeding	19.9	6	-	20.9	10	-
	Crested Tern - Foraging	20.9	7	-	22.8	10	-
	Flesh-footed Shearwater - Foraging	28.2	7	-	22.8	10	-
	Great-winged Petrel - Foraging	28.2	7	-	17.7	10	-
	Grey Nurse Shark - Foraging	27.4	21	-	23.3	32	-
	Grey Nurse Shark - Migration	45.1	27	-	22.8	36	-
	Humpback Whale - Foraging	45.1	27	-	23.8	36	-
	Indian Yellow-nosed Albatross - Foraging*	1,334.9	100	100	1,332.9	100	100
	Indo-Pacific/Spotted Bottlenose Dolphin - Breeding	23.9	13	-	24.5	22	-
	Little Penguin - Breeding	20.7	6	-	22.8	10	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Little Penguin - Foraging	42.1	54	-	61.6	79	-
	Northern Giant Petrel - Foraging	28.2	7	-	17.7	10	-
	Pygmy Blue Whale - Distribution*	1,334.9	100	100	1,332.9	100	100
	Pygmy Blue Whale - Foraging*	1,334.9	100	100	1,332.9	100	100
	Pygmy Blue Whale - Foraging annual high use area*	1,334.9	100	100	1,332.9	100	100
	Pygmy Blue Whale - Known Foraging Area	269.7	98	35	210.4	100	60
	Short-tailed Shearwater - Foraging	439.8	100	85	450.3	100	90
	Shy Albatross - Foraging*	1,334.9	100	100	1,332.9	100	100
	Soft-plumaged Petrel - Foraging	25.6	5	-	13.4	1	-
	Sooty Shearwater - Foraging	38.7	19	-	22.8	33	-
	Southern Giant Petrel - Foraging	28.2	7	-	17.7	10	-
	Southern Right Whale – Aggregation	379	100	87	427.8	100	88
	Southern Right Whale - Connecting Habitat	30.8	31	-	33.6	18	-
	Southern Right Whale - Known Core Range*^	1,334.9	100	100	1,332.9	100	100
	Wandering Albatross - Foraging*	1,334.9	100	100	1,332.9	100	100
	Wedge-tailed Shearwater - Foraging*	1,334.9	100	100	1,332.9	100	100
	White Shark - Breeding	33.6	41	-	34.6	60	-
	White Shark - Distribution*	1,334.9	100	100	1,332.9	100	100
	White Shark - Foraging	176.6	78	26	191.6	81	11
	White-capped Albatross - Foraging	28.2	7	-	17.7	10	-
	White-faced Storm-petrel - Breeding	29.9	12	-	22.8	16	-
	White-faced Storm-petrel - Foraging	269.7	97	28	206.6	100	46
	Wilsons Storm Petrel - Migration	28.2	7	-	17.7	10	-
IBRA	Bateman	15.9	6	-	18	10	-
	Bridgewater	76.1	45	-	65.9	23	-
	East Gippsland Lowlands	23.8	13	-	24	32	-
	Flinders	37.2	25	-	35.8	35	-
	Gippsland Plain	66.6	57	-	83.2	70	-
	Glenelg Plain	77.2	56	-	72.3	28	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	King Island	30.8	31	-	31.6	16	-
	Otway Plain	439.8	99	74	450.3	100	83
	Otway Ranges	355.2	99	48	366.6	100	69
	South East Coastal Ranges	10.1	1	-	9	-	-
	Strzelecki Ranges	37.8	52	-	51.8	70	-
	Tasmanian West	12.6	3	-	12.5	1	-
	Warrnambool Plain	460.3	99	62	350.5	100	60
	Wilsons Promontory	101	62	1	90.6	76	-
IMCRA	Batemans Shelf	22.3	9	-	22.8	13	-
	Central Bass Strait	272.4	96	29	218	100	43
	Central Victoria	265.5	98	35	201.1	100	55
	Coorong	25.9	8	-	12	1	-
	Davey	10.9	1	-	2.3	-	-
	Flinders	106.9	62	2	97.4	77	-
	Franklin	25.6	10	-	14.1	2	-
	Otway*	1,334.9	100	100	1,332.9	100	100
	Twofold Shelf	45.1	33	-	34.2	50	-
	Victorian Embayments	41.5	46	-	63.5	58	-
	Victorian Embayments	12.2	6	-	10.7	3	-
KEF	Big Horseshoe Canyon	16.1	6	-	15.5	11	-
	Bonney Coast Upwelling	107.2	64	1	92	53	-
	Canyons on the Eastern Continental Slope	28.2	6	-	11	3	-
	Shelf rocky reefs	18.8	6	-	19.7	10	-
	Upwelling East of Eden	45.1	27	-	27.6	38	-
	West Tasmania Canyons	108.1	77	2	119	44	1
MNP	Bunurong	32.2	45	-	46.1	64	-
	Cape Howe	25.3	14	-	26.2	24	-
	Churchill Island	21.2	20	-	29.9	31	-
	Discovery Bay	51.1	34	-	24.9	18	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Point Addis	74.6	30	-	55.8	68	-
	Point Hicks	18.1	14	-	21.1	33	-
	Port Phillip Heads	41.5	27	-	61.3	56	-
	Twelve Apostles	376.6	100	65	317.3	100	64
	Wilsons Promontory	106.9	60	2	97.4	75	-
MP	Batemans	19.9	6	-	20.9	10	-
	Lower South East	19.6	19	-	9.5	-	-
MS	Beware Reef	9.5	-	-	10.9	1	-
	Mushroom Reef	31.2	44	-	31.2	50	-
NP	Kent Group	17.3	6	-	13.7	2	-
NPS4	Bunurong Marine Park	32.6	46	-	58.1	59	-
	Corner Inlet Marine and Coastal Park	12.2	6	-	10.7	3	-
	Shallow Inlet Marine and Coastal Park	12.1	3	-	8.5	-	-
	Wilsons Promontory Marine Park	68.7	57	-	63.2	70	-
RAMSAR	Corner Inlet	12.2	6	-	10.7	3	-
	Port Phillip Bay Western Shoreline and Bellarine Peninsula	26.6	14	-	26.7	37	-
	Western Port	24.5	20	-	29.9	31	-
RSB	Bell Reef	11.8	8	-	11.5	4	-
	Beware Reef	9.6	-	-	10.9	1	-
	Bravenes Rock	228.6	99	37	208.5	100	51
	Cody Bank	30.7	63	-	41.3	67	-
	Cutter Rock	29.3	31	-	30.5	45	-
	New Zealand Star Bank	21	22	-	22.5	33	-
Nearshore Waters	Anser Island	101	59	1	90.6	72	-
	Bass Coast	38.7	47	-	66.8	64	-
	Bega Valley	21.4	8	-	24	11	-
	Black Pyramid	28	8	-	29.3	2	-
	Circular Head	8.7	-	-	11.2	1	-

Receptor	Summer: Maximum entrained hydrocarbon exposure (ppb)	Summer: Probability of entrained hydrocarbon exposure (%) Low	Summer: Probability of entrained hydrocarbon exposure (%) High	Winter: Maximum entrained hydrocarbon exposure (ppb)	Winter: Probability of entrained hydrocarbon exposure (%) Low	Winter: Probability of entrained hydrocarbon exposure (%) High
Colac Otway	439.8	99	74	450.3	100	83
Corangamite	365.7	99	62	350.5	100	59
Curtis Island	37.2	21	-	35.8	30	-
East Gippsland	21.4	13	-	23.8	32	-
Eurobodalla	9.3	-	-	13	7	-
French Island	16.9	13	-	19.4	11	-
Gabo Island	23.8	13	-	23.3	25	-
Glenelg	76.7	56	-	72.3	28	-
Glennie Group	96.5	62	-	87.6	76	-
Grant	27.5	16	-	9	-	-
Greater Geelong	61.3	26	-	55.5	53	-
Hogan Island Group	28	25	-	33.7	35	-
Kanowna Island	101	59	1	87.4	71	-
Kent Island Group	20.3	6	-	13.7	2	-
King Island	30.8	32	-	33.9	16	-
Lady Julia Percy Island	72.9	61	-	70.3	36	-
Laurence Rocks	65.3	56	-	64.2	28	-
Moncoeur Islands	34.3	43	-	42.8	58	-
Montague Island	15.9	6	-	18	10	-
Mornington Peninsula	63.3	53	-	83.2	69	-
Moyne	460.3	96	36	310.1	94	40
Mud Island	19.5	10	-	33.8	31	-
Norman Island	83.6	59	-	76.9	75	-
Phillip Island	40.3	49	-	49.6	62	-
Reid Rock	13.3	4	-	13.1	3	-
Rodondo Island	49.9	47	-	50.9	65	-
Seal Islands	17.9	9	-	18.5	30	-
Shellback Island	51	54	-	49.5	72	-
Skull Rock	97.1	59	-	87.4	70	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	South Gippsland	99.9	58	-	88.8	74	-
	Surf Coast	69.7	44	-	56.3	67	-
	Warrnambool	150.6	67	6	171.5	47	11
	West Coast	12.6	3	-	12.5	1	-
State Waters	New South Wales	23.9	13	-	24	22	-
	South Australia State Waters	29	19	-	10.6	2	-
	Tasmania State Waters	44.1	42	-	39.6	42	-
	Victoria State Waters*	460.3	100	77	450.3	100	85
Nearshore Waters (Sub-LGA)	Anglesea	69.7	34	-	44.9	59	-
	Apollo Bay	161.9	95	18	159.4	100	25
	Bay of Islands	460.3	96	36	310.1	94	40
	Bega Valley	21.4	8	-	24	11	-
	Cape Conran	10.8	1	-	12.6	5	-
	Cape Howe / Mallacoota	21.4	8	-	23.8	20	-
	Cape Liptrap - Northwest	37.3	55	-	53.7	70	-
	Cape Nelson	76.7	56	-	72.3	28	-
	Cape Otway West	439.8	99	76	450.3	100	84
	Cape Patton	106.2	84	1	117.4	92	5
	Childers Cove	150.6	77	6	171.5	51	11
	Corner Inlet	12.2	6	-	10.7	3	-
	Corringle	10.5	2	-	8.1	-	-
	Croajingolong - East	12.3	5	-	14.4	12	-
	Croajingolong - West	12.4	9	-	14.1	17	-
	Discovery Bay - East	47.1	30	-	18.5	13	-
	Discovery Bay - West	24.1	25	-	11.2	3	-
	Eurobodalla	9.3	-	-	13	7	-
	French Island - East	10.9	4	-	14.1	2	-
	French Island / Crib Point	17	14	-	19.2	12	-
	French Island / San Remo	22.2	32	-	34.5	42	-

Receptor	Summer			Winter		
	Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
		Low	High		Low	High
Kilcunda	38.1	44	-	66.8	57	-
Lorne	51.4	44	-	55.8	71	-
Marlo	9.7	-	-	10.8	1	-
Moonlight Head	365.7	99	62	350.5	100	60
Mornington Peninsula - South	40.8	52	-	52.1	64	-
Mornington Peninsula - Southwest	63.3	53	-	83.2	68	-
Point Hicks	15.6	13	-	19.7	32	-
Port Campbell	358.7	97	43	301.1	95	39
Port Fairy	95.3	49	-	94.5	40	-
Port Phillip - Mornington	12.3	5	-	16.8	16	-
Port Phillip - Queenscliff	48.5	26	-	52.9	53	-
Port Phillip - Sorrento Shore	40.4	40	-	79.3	69	-
Port Phillip Heads	34.6	20	-	39.9	41	-
Portland Bay - East	40.5	38	-	57.1	22	-
Portland Bay - West	63.7	37	-	61.1	17	-
Sydenham Inlet	14.1	7	-	16.1	15	-
Torquay	66.3	25	-	55.5	57	-
Venus Bay	38.7	47	-	63.7	64	-
Waratah Bay	37.8	52	-	51.8	70	-
Warrnambool	105.4	59	1	110.4	47	1
Westernport	29.4	41	-	33.4	50	-
Wilsons Promontory - East	68.3	52	-	59.2	69	-
Wilsons Promontory - West	99.9	58	-	88.8	74	-

*The release location resides within the receptor boundaries.^ RPS have utilised BIA's for the southern right whale that were delineated within the 2011-2021 Southern Right Whale. The NCV Atlas now includes updated BIA's for SRW, though the recently drafted National Recovery Plan for the southern right whale has not been published. The updated BIA's have not been used in this report.

Table 11.10 Predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 105,289 bbl (16,740 m^3) subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
AMP	Apollo	2.42	3.13	34.25	1.04	1.58	5.33	25.54	1
	Beagle	11.42	-	13.63	-	9.67	-	15.75	-
	East Gippsland	70.88	-	0.46	-	39.67	-	0.5	-
	Franklin	32.21	-	2.13	-	18.5	-	2.17	-
	Murray	37.21	-	0.5	-	-	-	-	-
	Nelson	13.67	-	2.92	-	100.92	-	0.63	-
	Zeehan	8.54	-	9.38	-	7.42	-	7.33	-
BIA	Antipodean Albatross - Foraging*	0.04	0.04	85.58	17.54	0.04	0.04	90.96	17.67
	Australasian Gannet - Foraging	2.92	14.29	72.04	0.25	6.71	-	90.96	-
	Australian Sea Lion - Foraging	14.08	-	4.46	-	24.13	-	0.04	-
	Black Petrel - Foraging	46.92	-	2.83	-	41.21	-	2.96	-
	Black-browed Albatross - Foraging*	0.04	0.04	85.58	17.54	0.04	0.04	90.96	17.67
	Black-faced Cormorant - Foraging	13.79	-	7.33	-	7.63	-	8.96	-
	Bullers Albatross - Foraging*	0.04	0.04	85.58	19.83	0.04	0.04	90.96	17.67
	Campbell Albatross - Foraging*	0.04	0.04	85.58	17.54	0.04	0.04	90.96	17.67
	Common Diving-petrel - Foraging*	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
	Crested Tern - Breeding	88.33	-	2.25	-	41.83	-	2.96	-
	Crested Tern - Foraging	47.88	-	2.83	-	41.33	-	2.96	-
	Flesh-footed Shearwater - Foraging	46.92	-	2.83	-	41.21	-	2.96	-
	Great-winged Petrel - Foraging	46.92	-	2.04	-	42.79	-	1.58	-
	Grey Nurse Shark - Foraging	44.29	-	2.75	-	39.92	-	2.54	-
	Grey Nurse Shark - Migration	44.21	-	2.83	-	39.88	-	3.04	-
	Humpback Whale - Foraging	33.04	-	2.83	-	39.63	-	3.04	-
	Indian Yellow-nosed Albatross - Foraging*	0.04	0.04	85.58	17.54	0.04	0.04	90.96	17.67

Receptor	Summer				Winter			
	Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
	Low	High	Low	High	Low	High	Low	High
Indo-Pacific/Spotted Bottlenose Dolphin - Breeding	44.00	-	2.96	-	40.46	-	2.96	-
Little Penguin - Breeding	88.25	-	2.38	-	41.75	-	2.96	-
Little Penguin - Foraging	14.33	-	18.38	-	7.71	-	39.88	-
Northern Giant Petrel - Foraging	46.92	-	2.04	-	42.79	-	1.58	-
Pygmy Blue Whale - Distribution*	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
Pygmy Blue Whale - Foraging*	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
Pygmy Blue Whale - Foraging annual high use area*	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
Pygmy Blue Whale - Known Foraging Area	2.58	3.38	59.42	1.88	1.67	3.38	65.92	3.17
Short-tailed Shearwater - Foraging	1.46	1.58	83.92	22.08	0.75	1.33	92.75	22.13
Shy Albatross - Foraging*	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
Soft-plumaged Petrel - Foraging	28.71	-	3.79	-	103.92	-	0.29	-
Sooty Shearwater - Foraging	39.54	-	2.83	-	40.08	-	3.04	-
Southern Giant Petrel - Foraging	46.92	-	2.04	-	42.79	-	1.58	-
Southern Right Whale – Aggregation	0.54	1.04	72.04	2.92	0.46	0.58	90.96	3.46
Southern Right Whale - Connecting Habitat	15.67	-	16.88	-	11.21	-	11.38	-
Southern Right Whale - Known Core Range*^	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
Wandering Albatross - Foraging*	0.04	0.04	85.58	17.54	0.04	0.04	90.96	17.67
Wedge-tailed Shearwater - Foraging*	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
White Shark - Breeding	12.04	-	19.5	-	22.13	-	43.42	-
White Shark - Distribution*	0.04	0.04	85.58	17.54	0.04	0.04	90.96	17.67
White Shark - Foraging	2.33	2.46	72.04	1.29	2.67	5.63	90.96	1.08
White-capped Albatross - Foraging	46.92	-	2.04	-	42.79	-	1.58	-
White-faced Storm-petrel - Breeding	46.29	-	2.83	-	40.58	-	2.96	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	White-faced Storm-petrel - Foraging	2.83	3.42	58.33	1.88	1.75	5.71	65.92	3.17
	Wilsons Storm Petrel - Migration	46.92	-	2.04	-	42.79	-	1.58	-
IBRA	Bateman	88.50	-	1.71	-	42.08	-	1.79	-
	Bridgewater	12.33	-	57.71	-	15.88	-	24.83	-
	East Gippsland Lowlands	48.17	-	3.17	-	34.38	-	9.58	-
	Flinders	30.92	-	5.25	-	22.67	-	5.29	-
	Gippsland Plain	12.42	-	40.83	-	7.92	-	53.88	-
	Glenelg Plain	5.46	-	60.63	-	11.21	-	27.08	-
	King Island	15.75	-	16.88	-	11.29	-	11.04	-
	Otway Plain	2.50	2.96	83.33	19.5	1.79	3.21	77.75	22.04
	Otway Ranges	2.38	5.33	76.04	10.67	1.50	4.13	91.29	12
	South East Coastal Ranges	99.63	-	0.04	-	-	-	-	-
	Strzelecki Ranges	12.00	-	13.96	-	12.96	-	17.67	-
	Tasmanian West	85.83	-	0.13	-	103.92	-	0.21	-
	Warrnambool Plain	2.33	6.21	85.21	11.83	1.21	4.21	86.17	17.17
	Wilsons Promontory	11.29	88.71	45.79	0.08	7.58	-	73.17	-
IMCRA	Batemans Shelf	46.38	-	2.83	-	40.58	-	2.96	-
	Central Bass Strait	2.58	6.67	27.17	1.42	1.79	5.83	38.58	3.17
	Central Victoria	2.54	3.42	57.00	1.88	1.67	5.67	65.92	1.79
	Coorong	16.5	-	4.46	-	24.13	-	0.08	-
	Davey	40.17	-	0.08	-	-	-	-	-
	Flinders	10.75	56.67	47.33	0.08	6.83	-	73.17	-
	Franklin	26.96	-	3.79	-	19.04	-	0.33	-
	Otway*	0.04	0.04	85.83	22.08	0.04	0.04	92.75	22.13
	Twofold Shelf	12.33	-	5.33	-	19.42	-	14.54	-
	Victorian Embayments	14.71	-	12.33	-	9.92	-	28.92	-
	Victorian Embayments	50.17	-	0.13	-	58.25	-	0.04	-
KEF	Big Horseshoe Canyon	42.58	-	0.67	-	64.00	-	0.67	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Bonney Coast Upwelling	3.29	9.42	72.04	0.04	7.00	-	90.96	-
	Canyons on the Eastern Continental Slope	46.96	-	2.04	-	51.67	-	0.04	-
	Shelf rocky reefs	88.21	-	2.17	-	42.08	-	2.08	-
	Upwelling East of Eden	15.29	-	5.33	-	27.88	-	14.54	-
	West Tasmania Canyons	3.04	11.79	12.17	0.17	9.13	12.83	8.17	0.21
MNP	Bunurong	36.38	-	10.83	-	13.00	-	11.13	-
	Cape Howe	43.96	-	3.25	-	41.5	-	3.25	-
	Churchill Island	37.00	-	5.92	-	29.63	-	18.21	-
	Discovery Bay	14.29	-	22.38	-	15.88	-	10.04	-
	Point Addis	13.46	-	46.25	-	12.29	-	35.54	-
	Point Hicks	65.92	-	2.67	-	34.04	-	14.54	-
	Port Phillip Heads	18.63	-	6.17	-	20.67	-	26.25	-
	Twelve Apostles	2.13	4.08	85.83	11.83	1.33	4.08	78.54	17.46
	Wilsons Promontory	11.29	56.67	47.33	0.08	7.71	-	73.17	-
MP	Batemans	88.33	-	2.25	-	41.83	-	2.96	-
	Lower South East	26.88	-	4.08	-	-	-	-	-
MS	Beware Reef	-	-	-	-	91.75	-	0.04	-
	Mushroom Reef	14.75	-	11.58	-	10.00	-	7.88	-
NP	Kent Group	32.67	-	0.88	-	41.96	-	0.13	-
NPS4	Bunurong Marine Park	41.08	-	11.25	-	12.13	-	14.00	-
	Corner Inlet Marine and Coastal Park	50.17	-	0.13	-	58.25	-	0.04	-
	Shallow Inlet Marine and Coastal Park	40.04	-	0.17	-	-	-	-	-
	Wilsons Promontory Marine Park	12.54	-	41.79	-	8.33	-	54	-
RAMSAR	Corner Inlet	50.17	-	0.13	-	58.25	-	0.04	-
	Port Phillip Bay Western Shoreline and Bellarine Peninsula	24.21	-	6.83	-	20.83	-	14.79	-
	Western Port	30.58	-	9.08	-	29.63	-	18.21	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
RSB	Bell Reef	33.33	-	0.17	-	19.96	-	0.08	-
	Beware Reef	-	-	-	-	89.00	-	0.04	-
	Bravenes Rock	1.96	5.17	75.96	3.88	1.25	6.38	78.79	3.54
	Cody Bank	11.54	-	9.75	-	6.88	-	6.29	-
	Cutter Rock	31.54	-	5.63	-	19.00	-	4.67	-
	New Zealand Star Bank	39.75	-	3.38	-	36.63	-	4.13	-
Nearshore Waters	Anser Island	11.67	88.71	43.5	0.08	7.88	-	73.17	-
	Bass Coast	33.33	-	11.67	-	11.71	-	17.96	-
	Bega Valley	74.83	-	2.54	-	44.54	-	2.42	-
	Black Pyramid	33.75	-	1.58	-	20	-	1.58	-
	Circular Head	-	-	-	-	108.38	-	0.04	-
	Colac Otway	2.5	2.96	83.33	19.5	1.79	3.21	91.13	22.04
	Corangamite	2.25	6.21	85.21	11.83	1.21	4.21	91.29	17.17
	Curtis Island	30.92	-	2.71	-	22.67	-	3.42	-
	East Gippsland	64.63	-	2.67	-	34.38	-	9.58	-
	Eurobodalla	-	-	-	-	46.79	-	0.25	-
	French Island	38.42	-	0.33	-	55.54	-	6.21	-
	Gabo Island	48.17	-	3.42	-	41.71	-	3.17	-
	Glenelg	5.46	-	60.63	-	11.21	-	72.75	-
	Glennie Group	11.54	-	45.79	-	7.63	-	71.92	-
	Grant	22.38	-	6.38	-	-	-	-	-
	Greater Geelong	17.58	-	19.17	-	14.00	-	44.04	-
	Hogan Island Group	31.83	-	5.25	-	23.42	-	5.29	-
	Kanowna Island	11.38	88.71	43.25	0.04	7.88	-	70.71	-
	Kent Island Group	32.38	-	1.17	-	41.96	-	0.13	-
	King Island	15.75	-	16.88	-	11.29	-	11.04	-
	Lady Julia Percy Island	8.00	-	53.25	-	9.33	-	84.88	-
	Laurence Rocks	8.71	-	60.75	-	10.46	-	27.29	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Moncoeur Islands	11.58	-	13.04	-	9.75	-	7.83	-
	Montague Island	88.5	-	1.71	-	42.08	-	1.79	-
	Mornington Peninsula	14.33	-	20	-	9.50	-	36.54	-
	Moyne	2.38	6.25	50.21	10.79	1.46	6.67	68.63	7.92
	Mud Island	42.17	-	5.71	-	41.17	-	13.25	-
	Norman Island	12.00	-	41.83	-	7.58	-	67.71	-
	Phillip Island	14.67	-	15.13	-	9.88	-	33.58	-
	Reid Rock	30.00	-	0.42	-	24.33	-	0.13	-
	Rodondo Island	11.33	-	19.58	-	9.46	-	28.04	-
	Seal Islands	48.29	-	0.54	-	28.25	-	1.33	-
	Shellback Island	12.29	-	36.42	-	9.79	-	52.04	-
	Skull Rock	11.29	-	43.25	-	7.88	-	70.71	-
	South Gippsland	11.63	-	44.21	-	7.92	-	73.17	-
	Surf Coast	8.92	-	55.38	-	12.13	-	39.83	-
	Warrnambool	8.33	49	56.42	1.13	4.00	6.54	86.17	1.5
	West Coast	85.83	-	0.13	-	103.92	-	0.21	-
State Waters	New South Wales	44.42	-	2.75	-	41.83	-	2.96	-
	South Australia State Waters	20.42	-	6.38	-	19.63	-	0.04	-
	Tasmania State Waters	14.79	-	17.63	-	7.71	-	11.71	-
	Victoria State Waters*	1.50	2.58	85.83	22.08	0.83	3	92.75	22.13
Nearshore Waters (Sub-LGA)	Anglesea	15.00	-	40.5	-	12.46	-	39.83	-
	Apollo Bay	3.42	3.92	59.79	1.25	2.25	20	65.92	0.88
	Bay of Islands	2.38	6.25	39.25	10.79	1.46	6.67	39.29	7.92
	Bega Valley	74.83	-	2.54	-	44.54	-	2.42	-
	Cape Conran	114.29	-	0.04	-	48.63	-	0.13	-
	Cape Howe / Mallacoota	70.29	-	2.67	-	41.75	-	2.75	-
	Cape Liptrap - Northwest	16.29	-	13.38	-	12.75	-	22.33	-
	Cape Nelson	5.46	-	60.63	-	11.13	-	27.13	-

Receptor	Summer: Minimum time before entrained hydrocarbon exposure (days)		Summer: Maximum residence time for entrained hydrocarbon exposure (days)		Winter: Minimum time before entrained hydrocarbon exposure (days)		Winter: Maximum residence time for entrained hydrocarbon exposure (days)	
	Low	High	Low	High	Low	High	Low	High
Cape Otway West	2.46	2.96	83.54	22.04	1.79	3.21	91.13	22.08
Cape Patton	4.83	48.21	46	0.04	5.25	21.79	63.04	0.08
Childers Cove	8.33	48.96	46.96	1.13	4.33	5	46.92	1.5
Corner Inlet	50.17	-	0.13	-	58.25	-	0.04	-
Corringle	64.63	-	0.04	-	-	-	-	-
Croajingolong - East	81.83	-	0.17	-	48.5	-	0.63	-
Croajingolong - West	67.00	-	0.25	-	45.17	-	0.46	-
Discovery Bay - East	16.88	-	24.29	-	18.42	-	6.17	-
Discovery Bay - West	21.79	-	4.38	-	95.96	-	0.04	-
Eurobodalla	-	-	-	-	46.79	-	0.25	-
French Island - East	76.5	-	0.04	-	64.96	-	0.54	-
French Island / Crib Point	38.38	-	0.29	-	55.54	-	2	-
French Island / San Remo	33.38	-	8.54	-	11.79	-	16.38	-
Kilcunda	33.33	-	11.04	-	11.71	-	17.96	-
Lorne	8.38	-	22.92	-	10.42	-	37.25	-
Marlo	-	-	-	-	81.08	-	0.04	-
Moonlight Head	2.33	6.21	76.5	10.29	1.46	4.21	91.29	17.17
Mornington Peninsula - South	14.33	-	18.83	-	9.5	-	23.58	-
Mornington Peninsula - Southwest	14.33	-	20	-	9.5	-	30.42	-
Point Hicks	66.08	-	2.25	-	34.25	-	9.58	-
Port Campbell	2.25	6.38	85.21	11.83	1.21	7.08	76.08	7.67
Port Fairy	7.83	-	49.67	-	14.00	-	68.63	-
Port Phillip - Mornington	55.21	-	0.54	-	47.29	-	3.63	-
Port Phillip - Queenscliff	18.08	-	16	-	19.63	-	26.38	-
Port Phillip - Sorrento Shore	15.96	-	9.29	-	11.17	-	37.13	-
Port Phillip Heads	18.75	-	4.92	-	20.71	-	20.96	-
Portland Bay - East	11.67	-	40.33	-	15.25	-	68.58	-
Portland Bay - West	12.21	-	50.92	-	19.71	-	72.75	-

Receptor	Summer: Minimum time before entrained hydrocarbon exposure (days)		Summer: Maximum residence time for entrained hydrocarbon exposure (days)		Winter: Minimum time before entrained hydrocarbon exposure (days)		Winter: Maximum residence time for entrained hydrocarbon exposure (days)	
	Low	High	Low	High	Low	High	Low	High
Sydenham Inlet	66.46	-	0.42	-	46.83	-	1.75	-
Torquay	15.04	-	55.38	-	13.00	-	36.21	-
Venus Bay	34.38	-	11.67	-	11.88	-	17.42	-
Waratah Bay	12.00	-	25.63	-	12.96	-	17.67	-
Warrnambool	8.42	64.13	56.42	0.04	4.00	10.42	86.17	0.13
Westernport	14.75	-	11.42	-	9.96	-	7.88	-
Wilsons Promontory - East	11.79	-	35.5	-	11.50	-	57.46	-
Wilsons Promontory - West	11.63	-	44.21	-	7.92	-	73.17	-

*The release location resides within the receptor boundaries. ^ RPS have utilised BIA's for the southern right whale that were delineated within the 2011-2021 Southern Right Whale. The NCV Atlas now includes updated BIA's for SRW, though the recently drafted National Recovery Plan for the southern right whale has not been published. The updated BIA's have not been used in this report.

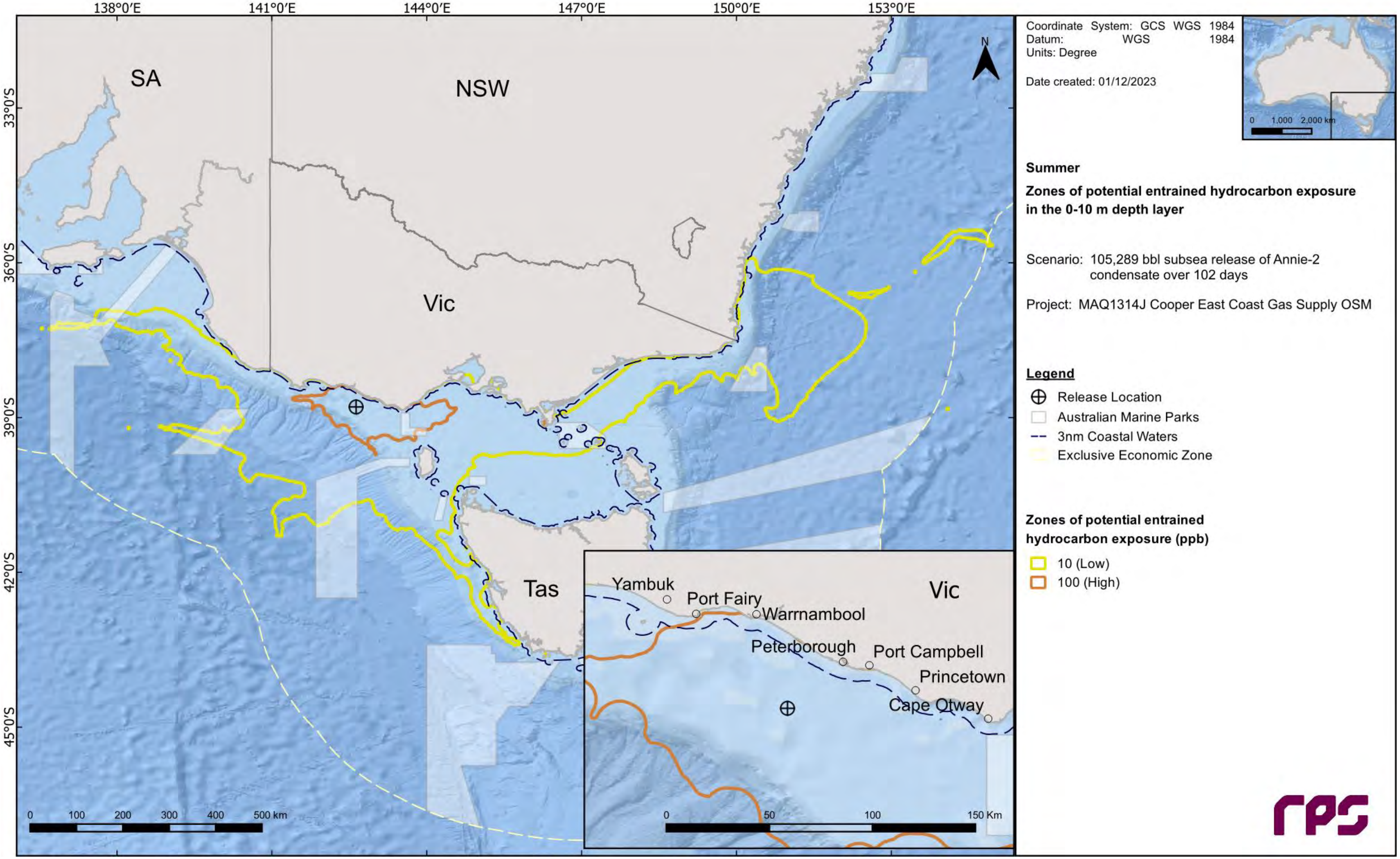


Figure 11.13 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

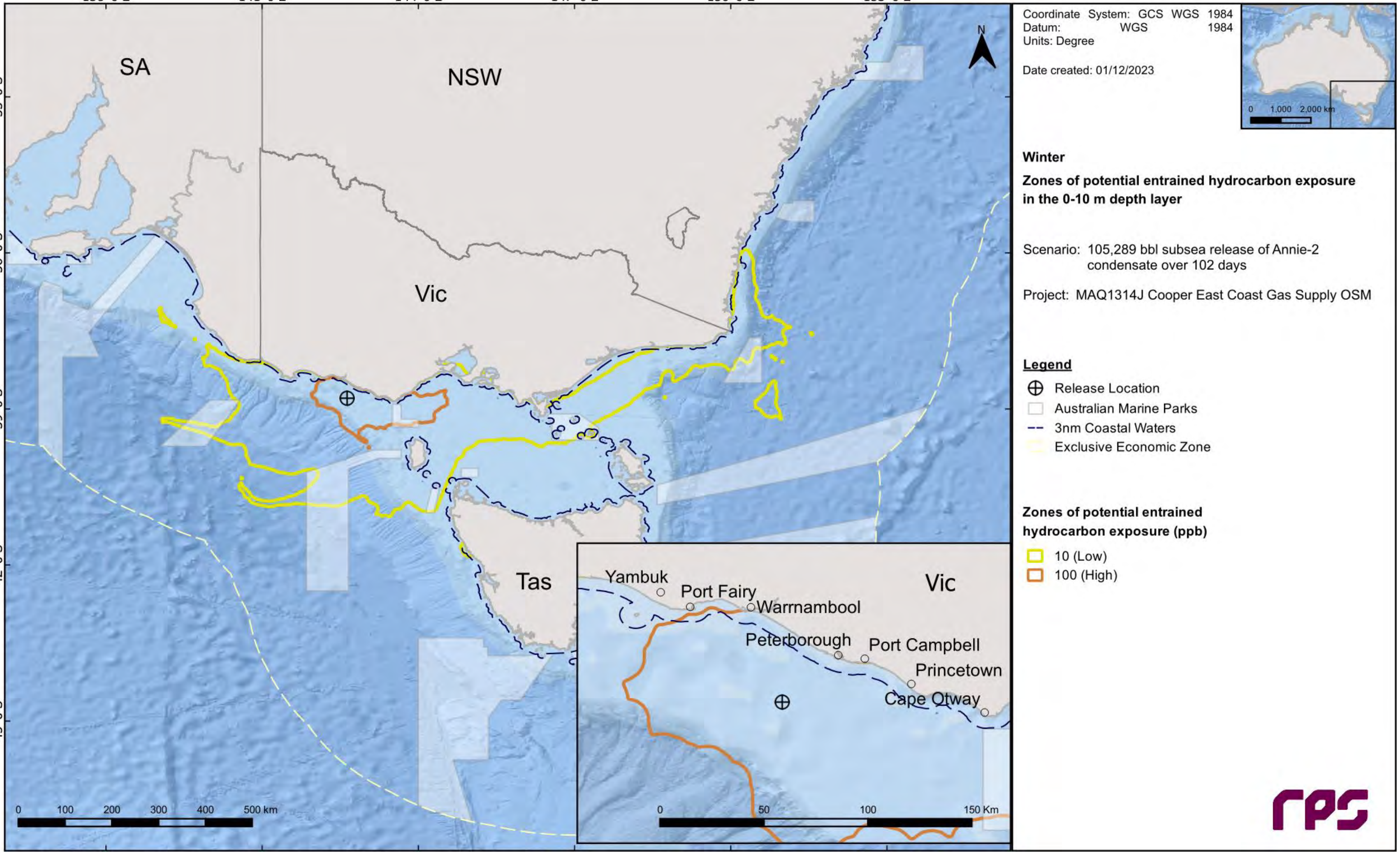


Figure 11.14 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

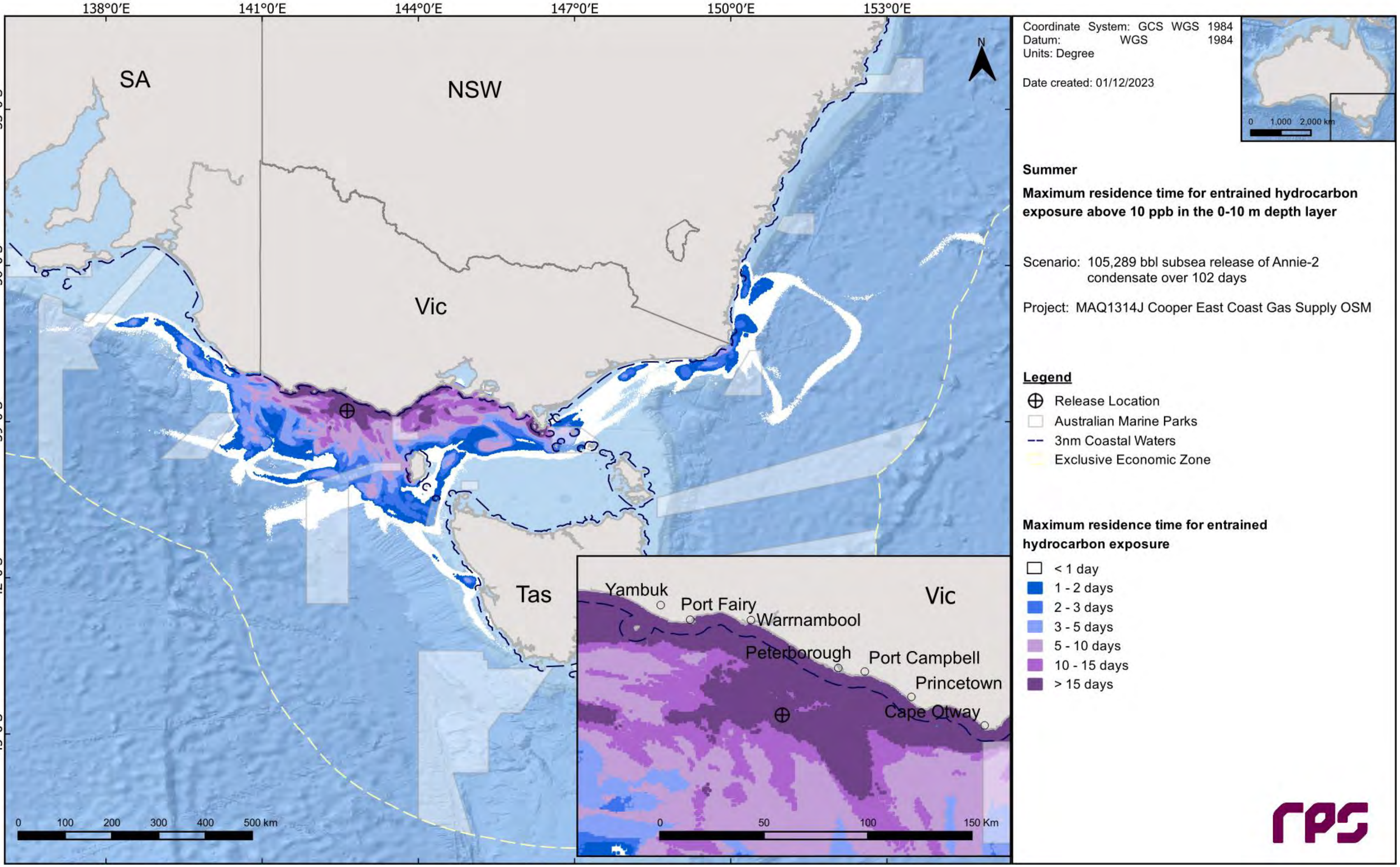


Figure 11.15 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

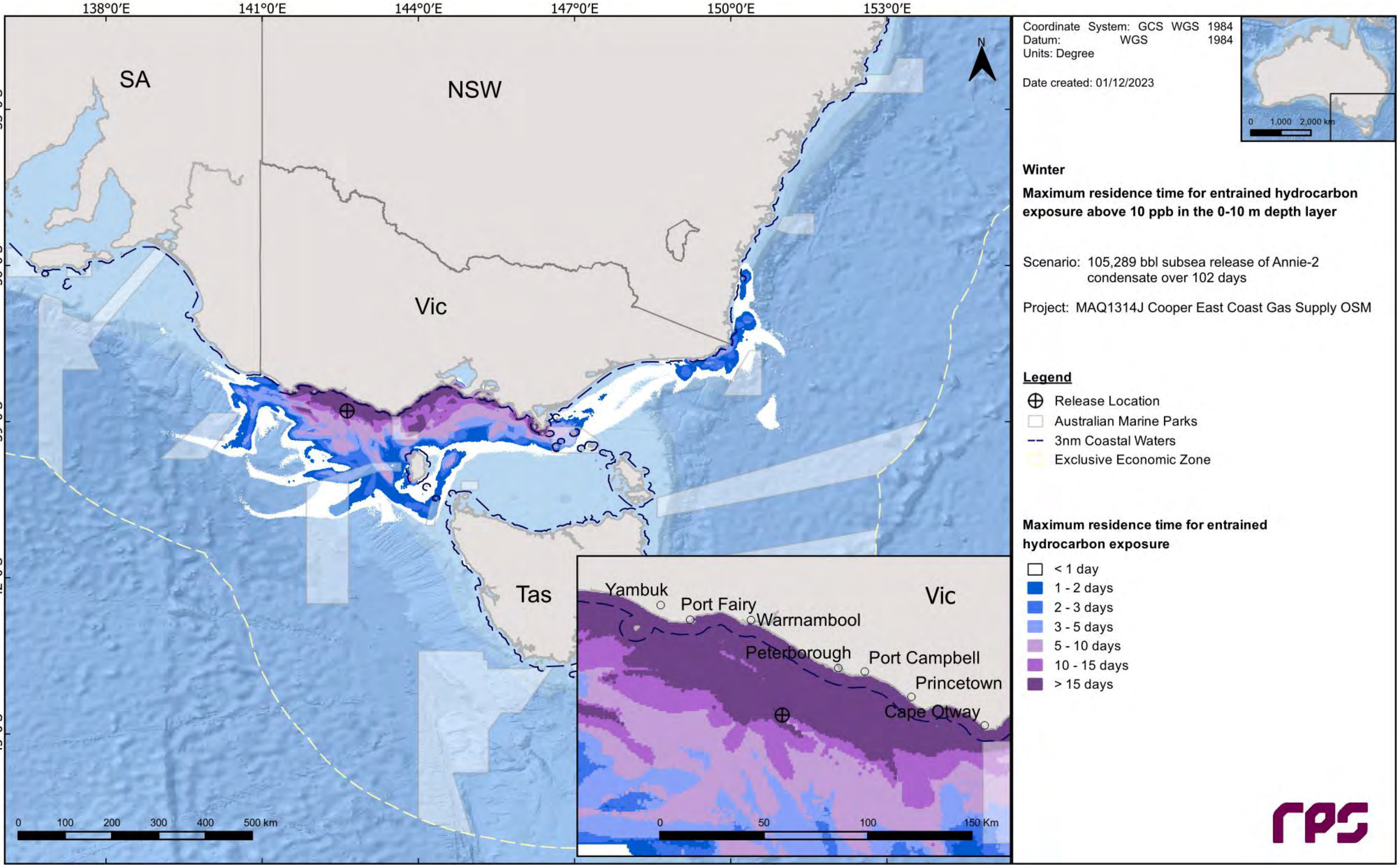


Figure 11.16 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

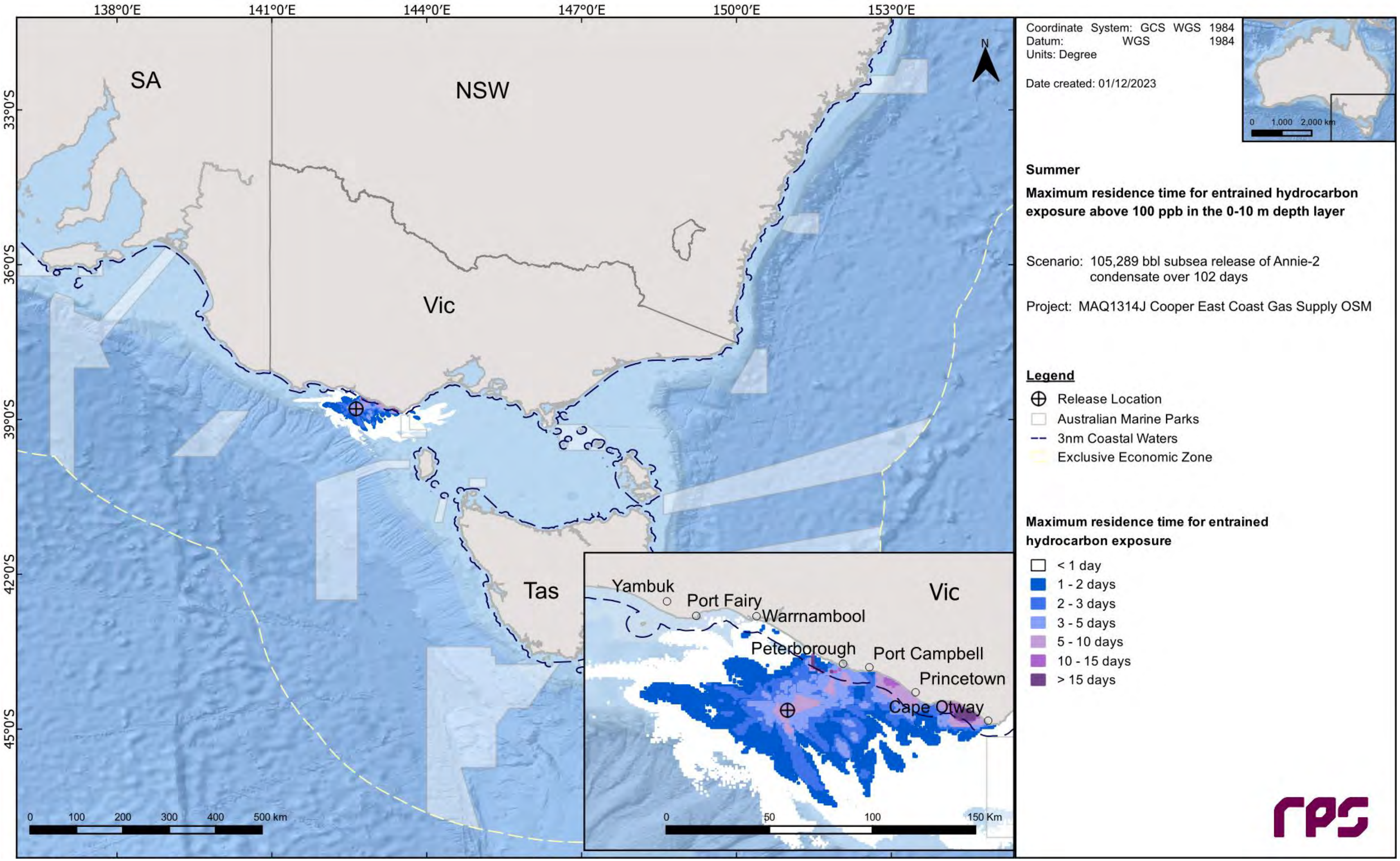


Figure 11.17 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during summer conditions.

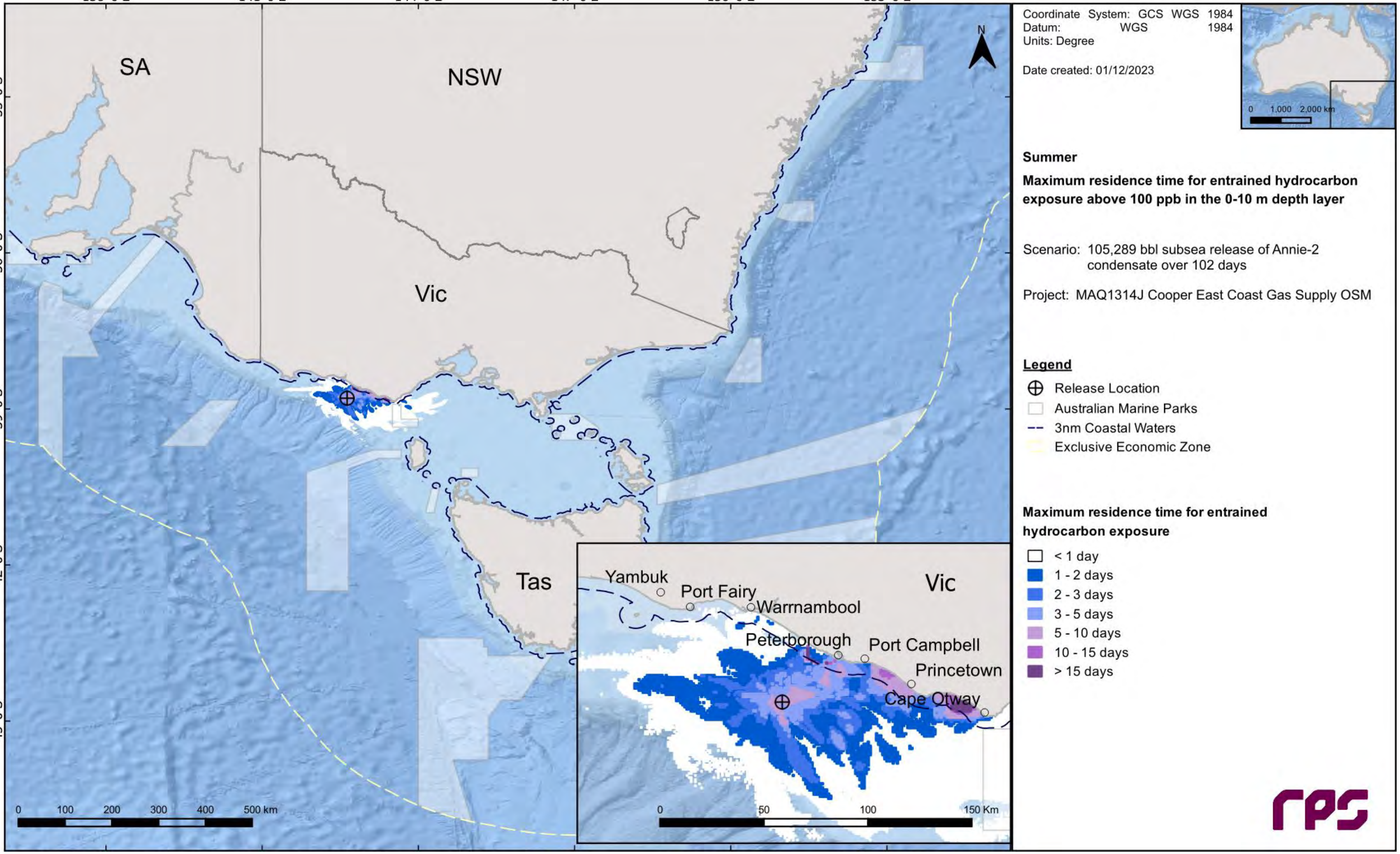


Figure 11.18 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea in the event of a 105,289 bbl subsurface release from a loss of well control at Elanora-1 ST1 (Isabella) over 102 days. The results were calculated from 100 spill simulations during winter conditions.

11.2 Deterministic Analysis

The stochastic modelling results were assessed, and the “worst case” deterministic runs were identified and are presented below for the following criteria:

a. Largest swept area for surface oil above 10 g/m^2;
b. Largest (total) volume of oil ashore;
c. Longest length of shoreline with oil accumulation above 100 $g/m^{2;}$
d. Largest area of entrained hydrocarbon exposure above 100 ppb; and
e. Largest area of dissolved hydrocarbon exposure above 50 ppb.

Table 11.11 presents a summary of sea surface and in-water exposure and shoreline accumulation at the assessed thresholds for the identified deterministic simulations.

Table 11.11 Summary of the worst-case deterministic analysis based on the scenario presented in the stochastic analysis section.

Variable	Threshold	Deterministic Analysis Criteria				
		Largest swept area of floating oil >10 g/m²	Largest volume of oil ashore	Longest length of shoreline with accumulation >100 g/m²	Largest area of entrained hydrocarbon exposure >100 ppb	Largest area of dissolved hydrocarbon exposure >50 ppb
Season		Summer	Winter	Winter	Summer	Summer
Run Number		5	92	17	44	29
Total area of floating Oil exposure (km²)	1 g/m²	360	251	293	276	341
	10 g/m²	**40**	7	5	16	9
	50 g/m²	-	-	-	-	-
Total length of shoreline accumulation (km)	10 g/m²	166	189	268	34	158
	100 g/m²	15	43	**44**	5	12
	1,000 g/m²	-	0	-	-	-
Minimum time before accumulation on any shoreline (hours)	10 g/m²	335	44	269	1035	366
	100 g/m²	994	296	619	1073	436
	1,000 g/m²	-	-	-	-	-
Total volume of oil ashore (m³)		82	**212**	189	22	74
Total area of entrained hydrocarbon exposure (km²)	10 ppb	49,508	24,945	24,641	60,183	48,694
	100 ppb	5,196	5,084	3,596	**6,272**	5,835
Total area of dissolved hydrocarbon exposure (km²)	10 ppb	141	413	400	273	319
	50 ppb	-	-	-	-	**1**
	400 ppb	-	-	-	-	-
Start Date		3rd April 2018 5 am	1st August 2010 1 am	24th September 2013 7 pm	4th January 2018 10 am	12th March 2015 2 pm

NC = No contact at, or above the specified shoreline accumulation threshold.

11.2.1 Deterministic Case: Largest swept area of floating oil above 10 g/m^2

The deterministic trajectory that resulted in the largest swept area of floating oil above 10 g/m^2 was identified as summer run number 5, which started on 3rd April 2018.

Figure 11.19 illustrates the floating oil exposure and shoreline accumulation over the 116-day simulation.

Figure 11.20 displays the time series of the area of sea surface exposure above the low (1 g/m^2), moderate (10 g/m^2) and high (50 g/m^2) thresholds over the 116-day simulation.

Figure 11.21 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.12 summarises the mass balance peaks and at the end of the simulation.

Table 11.12 Summary of the mass balance for the trajectory with the largest swept area of floating oil above 10 g/m^2.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	260.3	26.8	6.4
Entrained (m^3)	2,515.2	96.7	2,002.1
Dissolved (m^3)	8.9	33.8	0.5
Evaporation (m^3)	9,881.7	116.0	9,881.7
Decay (m^3)	4,047.6	116.0	4,047.6
Ashore (m^3)	84.7	101.0	82.0

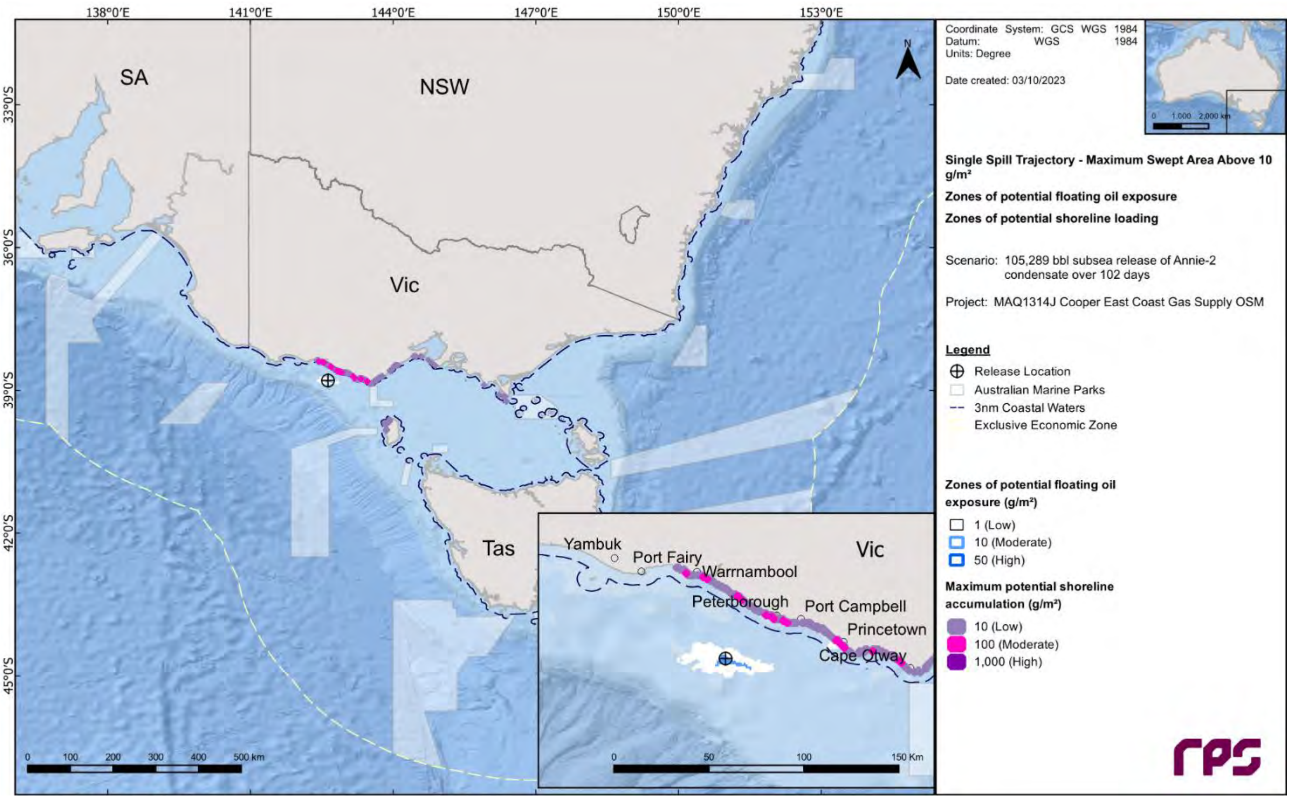


Figure 11.19 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest swept area of floating oil above 10 g/m^2.

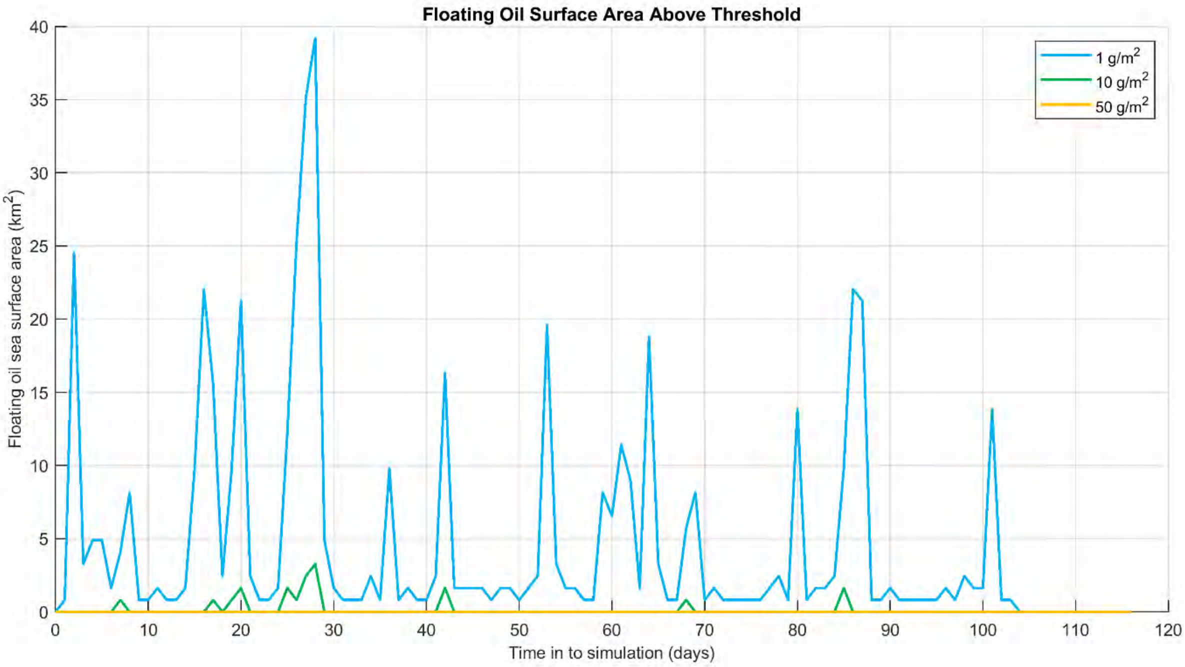


Figure 11.20 Time series of the sea surface exposure above each threshold for the trajectory with the largest swept area of floating oil above 10 g/m².

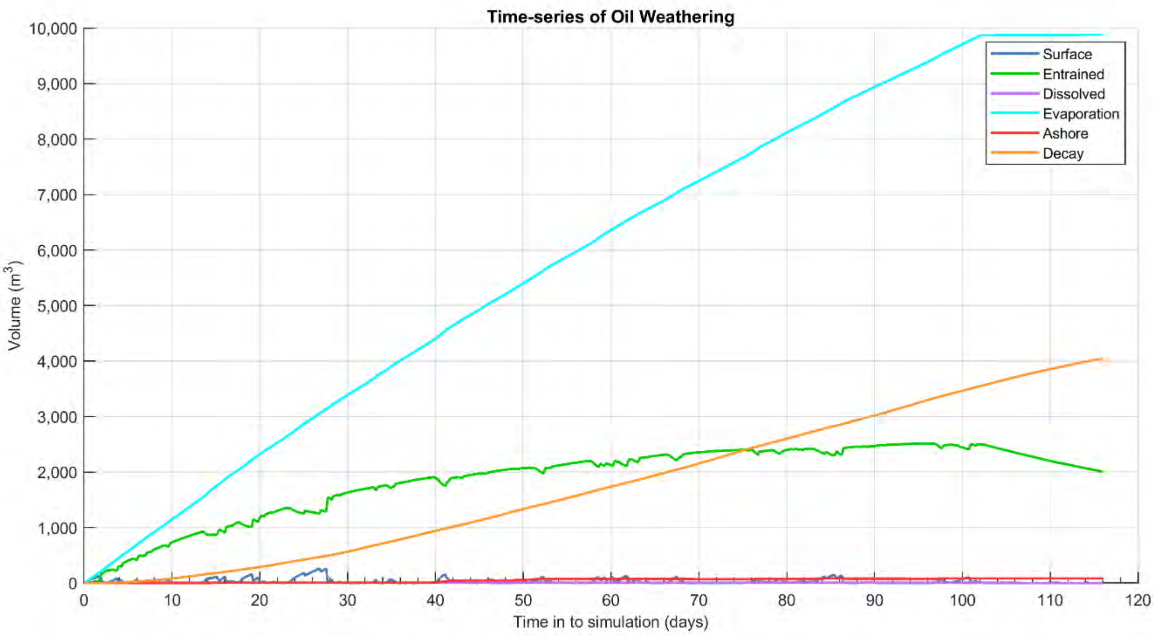


Figure 11.21 Predicted weathering and fates graph for the trajectory with the largest swept area of floating oil above 10 g/m².

11.2.2 Deterministic Case: Largest volume of oil ashore

The deterministic trajectory that resulted in the largest volume of oil ashore was identified as winter run number 92, which started on 1st August 2010.

Figure 11.22 illustrates the floating oil exposure and shoreline accumulation over the 116-day simulation.

Figure 11.23 displays the time series of the shoreline accumulation above the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 116-day simulation.

Figure 11.24 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.13 summarises the mass balance peaks and at the end of the simulation.

Table 11.13 Summary of the mass balance for the trajectory with the largest volume of oil ashore.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	194.2	28.4	0.8
Entrained (m^3)	2,506.9	99.3	1,990.3
Dissolved (m^3)	10.1	24.8	0.7
Evaporation (m^3)	9,748.3	116.0	9,748.3
Decay (m^3)	4,070.4	116.0	4,070.4
Ashore (m^3)	211.7	111.1	209.8

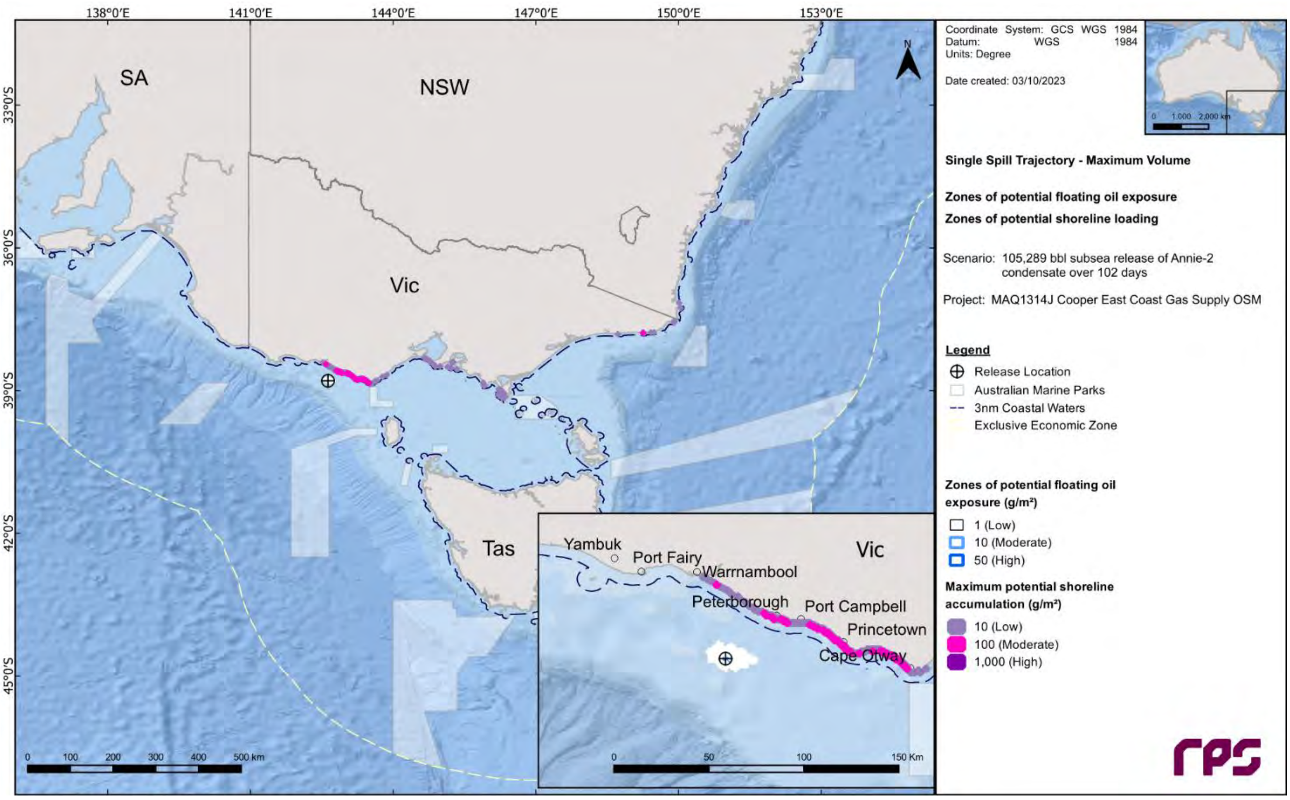


Figure 11.22 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest volume of oil ashore.

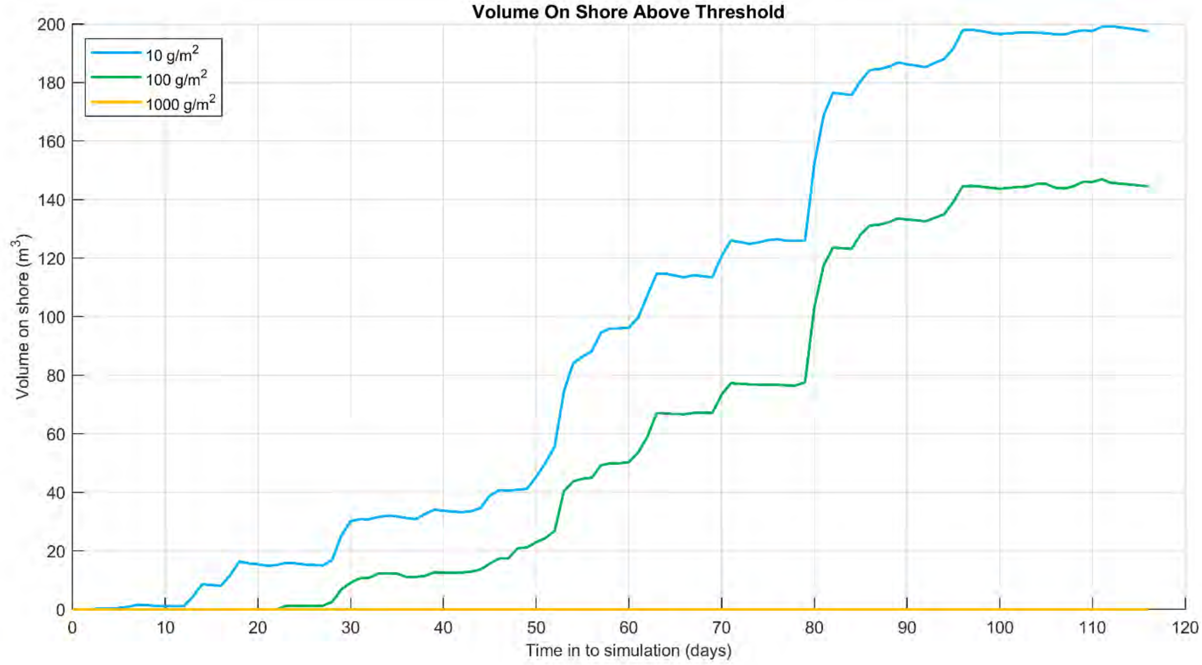


Figure 11.23 Time series of oil accumulation on the shoreline above each threshold for the trajectory with the largest volume of oil ashore.

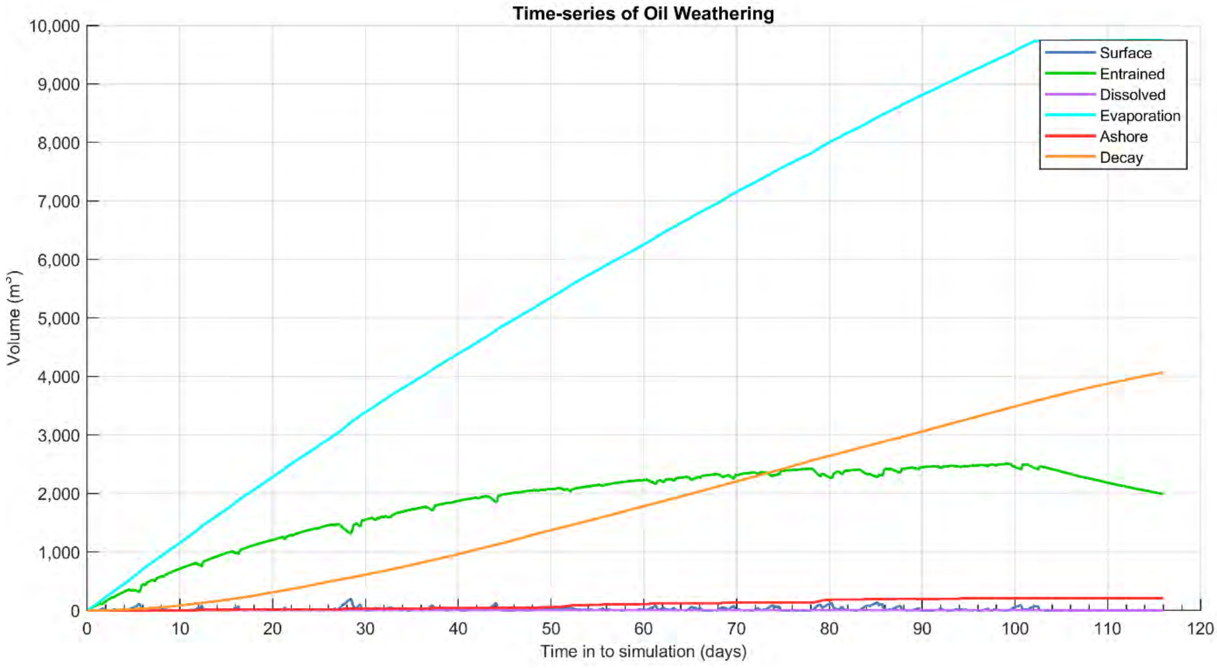


Figure 11.24 Predicted weathering and fates graph for the trajectory with the largest volume of oil ashore.

11.2.3 Deterministic Case: Longest length of shoreline with accumulation above 100 g/m^2

The deterministic trajectory that resulted in the longest length of shoreline with accumulation above 100 g/m^2 was identified as winter run number 17, which started on 24th September 2013.

Figure 11.25 illustrates the floating oil exposure and shoreline accumulation over the 116-day simulation.

Figure 11.26 displays the time series of the length of shoreline with accumulation at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 116-day simulation.

Figure 11.27 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.14 summarises the mass balance peaks and at the end of the simulation.

Table 11.14 Summary of the mass balance for the trajectory with the longest length of shoreline with accumulation above 100 g/m^2.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	192.1	37.9	0.1
Entrained (m^3)	2,556.1	102.0	2,026.8
Dissolved (m^3)	10.2	21.7	0.5
Evaporation (m^3)	9,776.3	116.0	9,776.3
Decay (m^3)	4,027.9	116.0	4,027.9
Ashore (m^3)	190.0	112.7	188.6

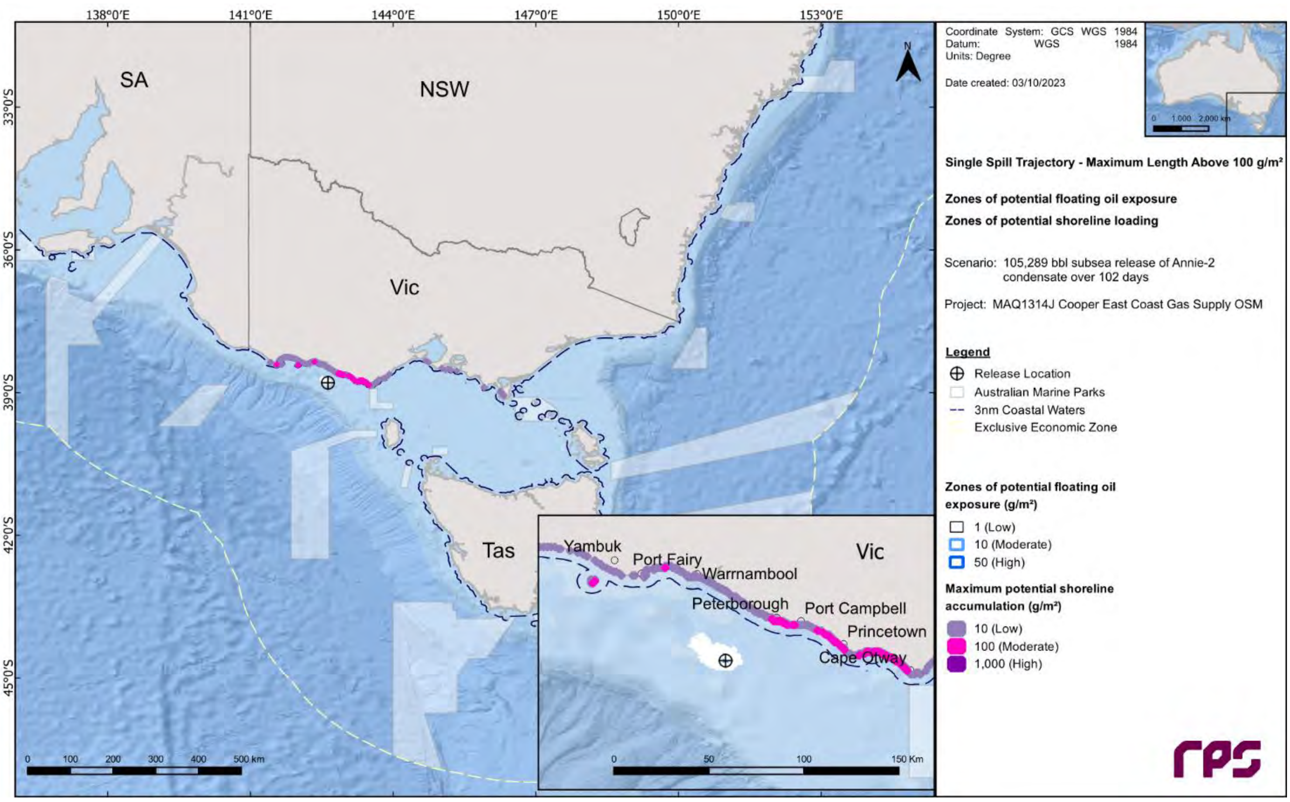


Figure 11.25 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the longest length of shoreline with accumulation above 100 g/m^2.

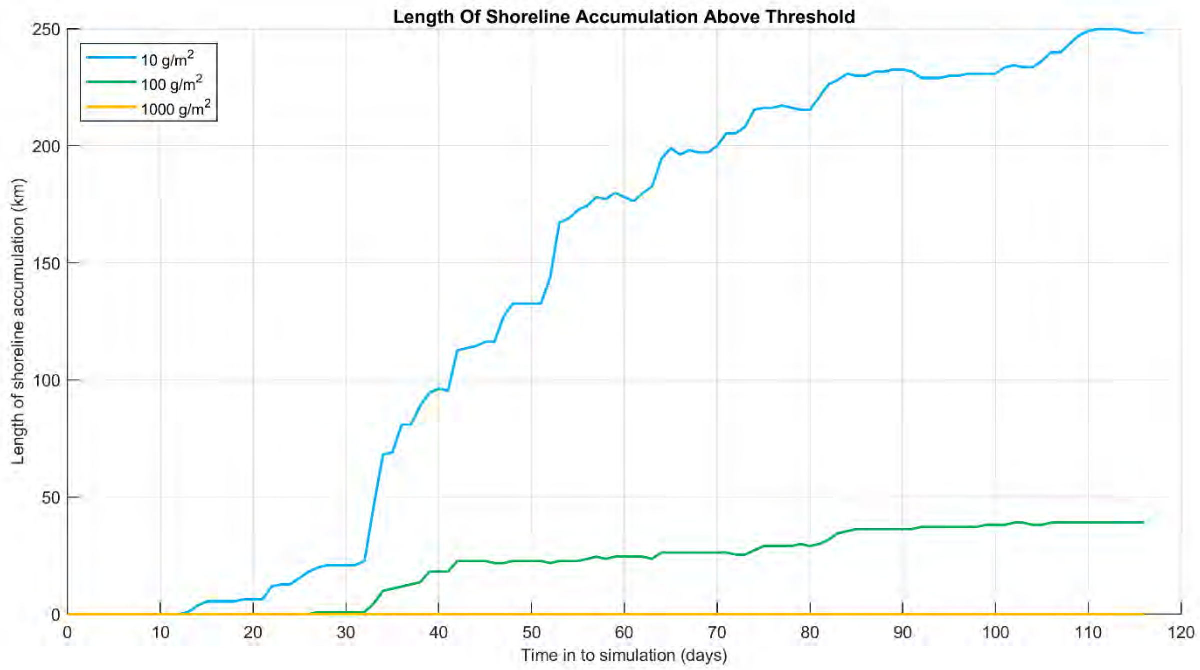


Figure 11.26 Time series of the length of shoreline with accumulation above each threshold for the trajectory with the longest length of shoreline with accumulation above 100 g/m².

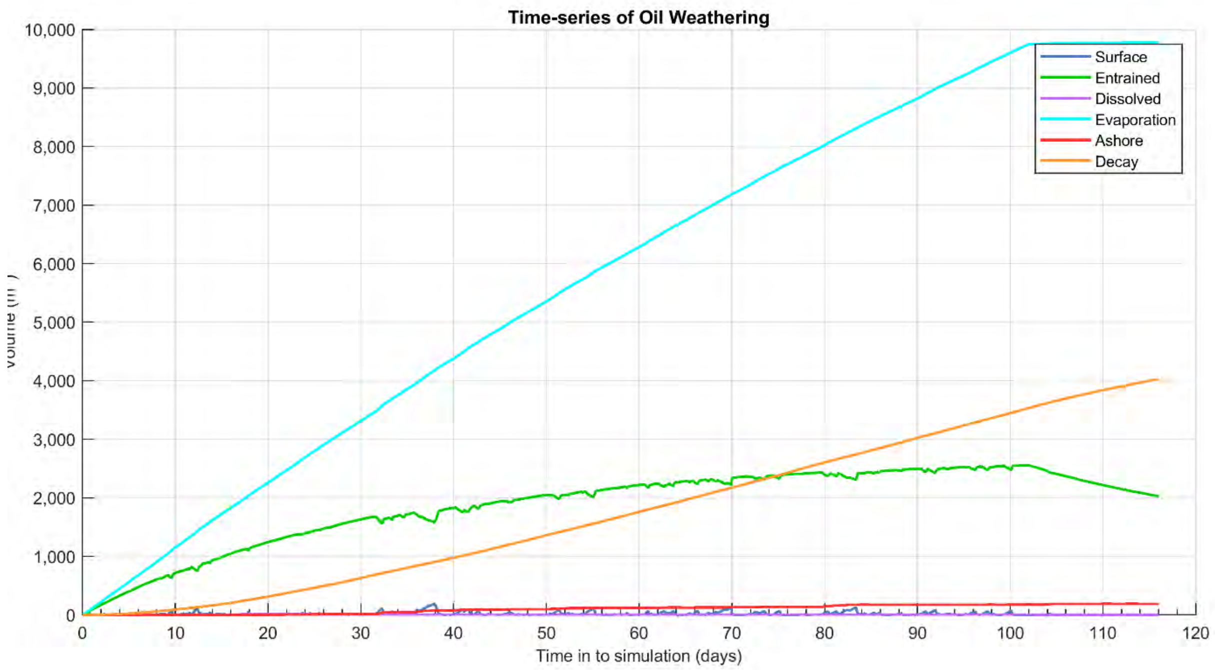


Figure 11.27 Predicted weathering and fates graph for the trajectory with the longest length of shoreline with accumulation above 100 g/m².

11.2.4 Deterministic Case: Largest area of entrained hydrocarbon exposure above 100 ppb

The deterministic trajectory that resulted in the largest area of entrained hydrocarbon exposure above 100 ppb was identified as summer run number 44, which started on 4th January 2018.

Figure 11.28 illustrates the zones of potential entrained hydrocarbon exposure over the 116-day simulation.

Figure 11.29 displays the time series of the area of entrained hydrocarbon exposure at the low (10 ppb) and high (100 ppb) thresholds over the 116-day simulation.

Figure 11.30 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.15 summarises the mass balance peaks and at the end of the simulation.

Table 11.15 Summary of the mass balance for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	183.0	19.8	2.2
Entrained (m^3)	2,654.6	100.1	2,087.2
Dissolved (m^3)	9.7	29.7	0.5
Evaporation (m^3)	9,778.9	116.0	9,778.9
Decay (m^3)	4,130.0	116.0	4,130.0
Ashore (m^3)	21.8	105.5	21.5

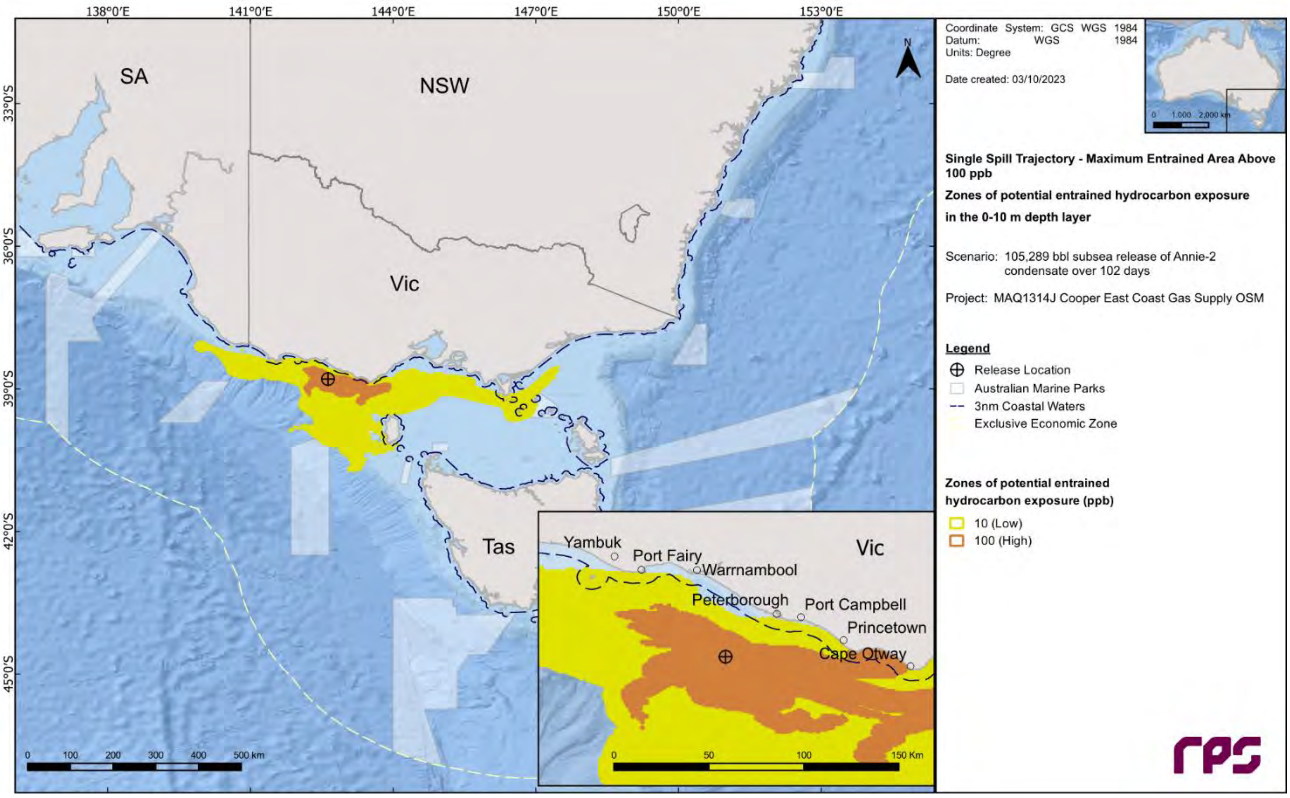


Figure 11.28 Zones of potential entrained hydrocarbon exposure, for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

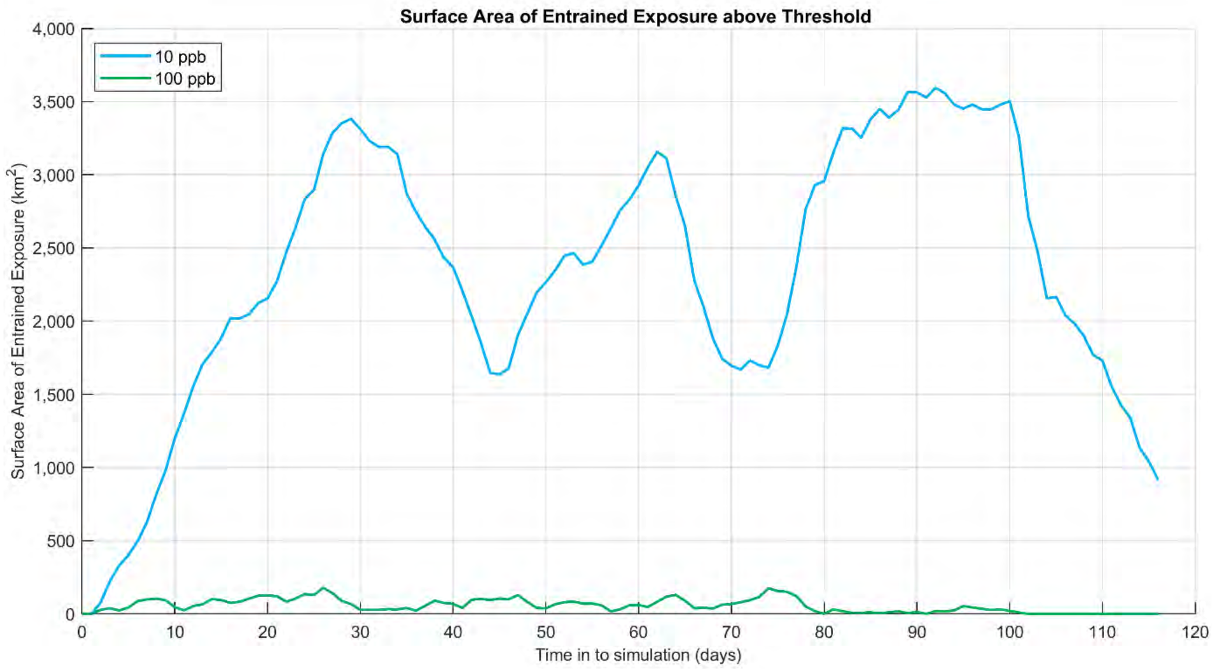


Figure 11.29 Time series of the entrained hydrocarbon exposure area above each threshold for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

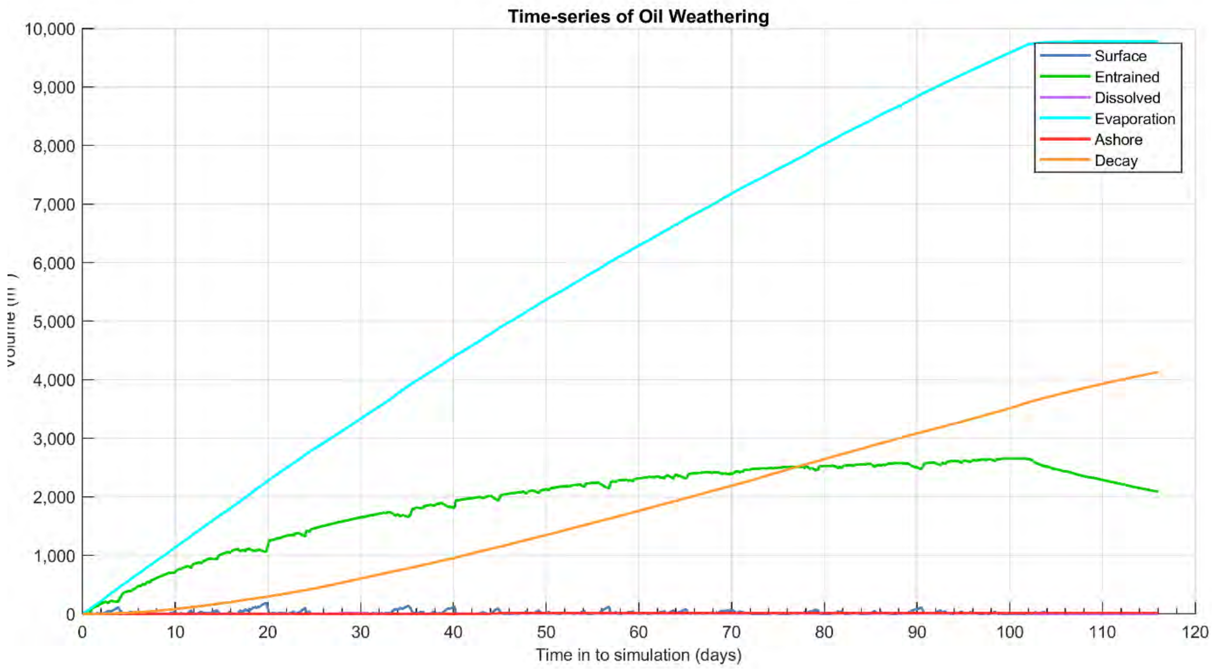


Figure 11.30 Predicted weathering and fates graph for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

11.2.5 Deterministic Case: Largest area of dissolved hydrocarbon exposure above 50 ppb

The deterministic trajectory that resulted in the largest area of dissolved hydrocarbon exposure above 50 ppb was identified as summer run number 29, which started on 12th March 2015.

Figure 11.31 illustrates the zones of potential dissolved hydrocarbon exposure over the 116-day simulation.

Figure 11.32 displays the time series of the area of dissolved hydrocarbon exposure at the low (10 ppb), moderate (50 ppb) and high (400 ppb) thresholds over the 116-day simulation.

Figure 11.33 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.16 summarises the mass balance peaks and at the end of the simulation.

Table 11.16 Summary of the mass balance for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	155.8	65.1	0.4
Entrained (m^3)	2,557.9	102.0	2,041.7
Dissolved (m^3)	9.0	22.1	0.6
Evaporation (m^3)	9,827.6	116.0	9,827.6
Decay (m^3)	4,076.3	116.0	4,076.3
Ashore (m^3)	76.6	93.8	73.8

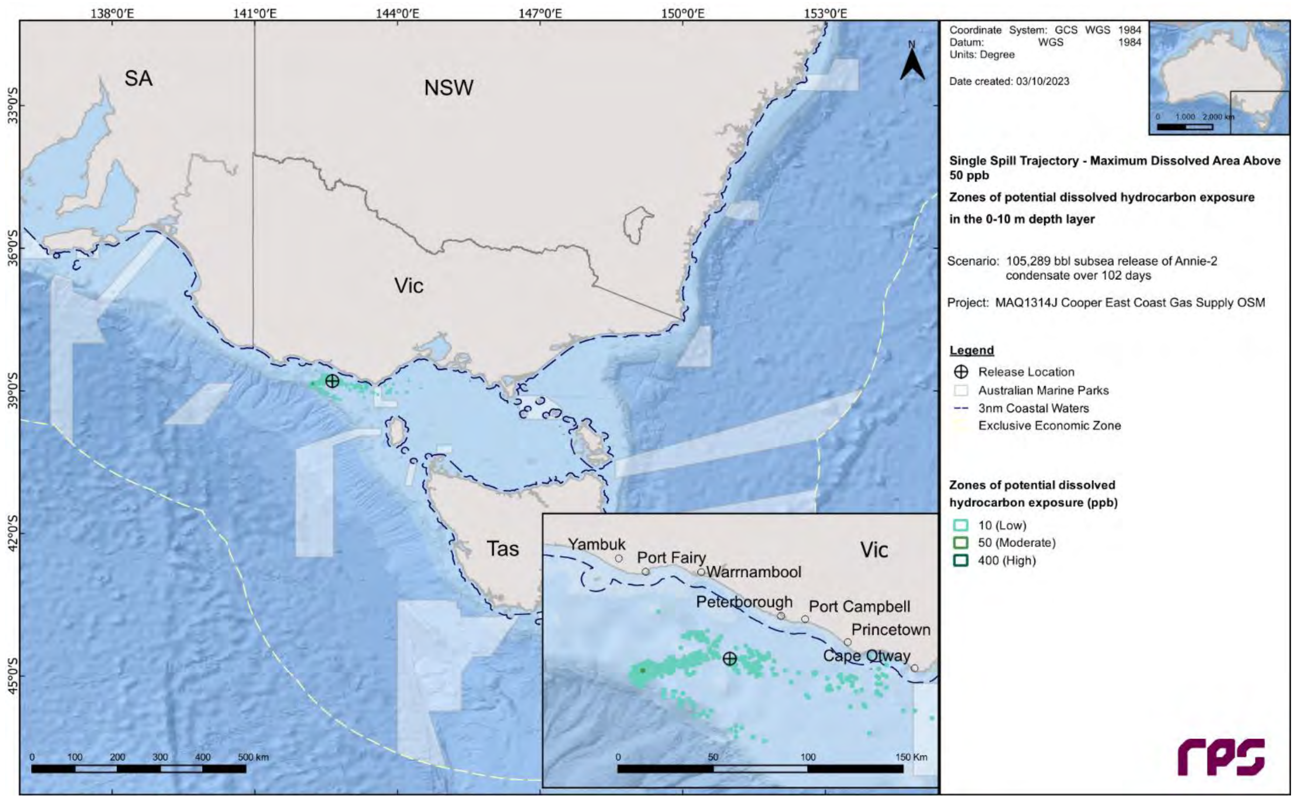


Figure 11.31 Zones of potential dissolved hydrocarbon exposure, for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

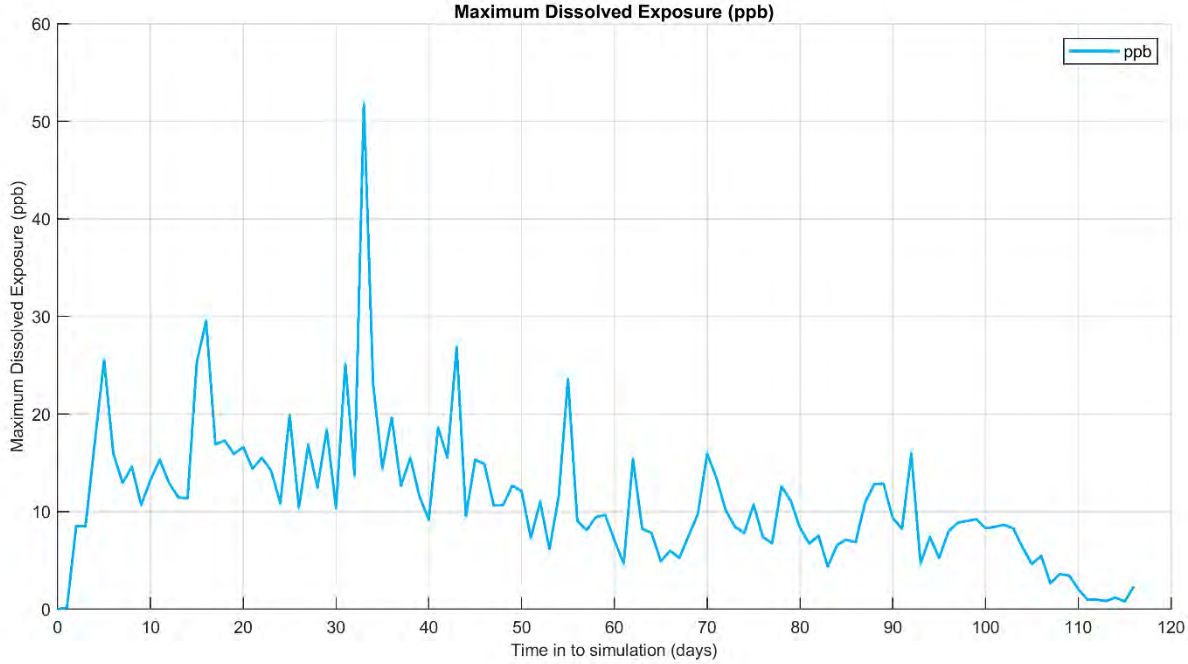


Figure 11.32 Time series of the dissolved hydrocarbon exposure area above each threshold for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

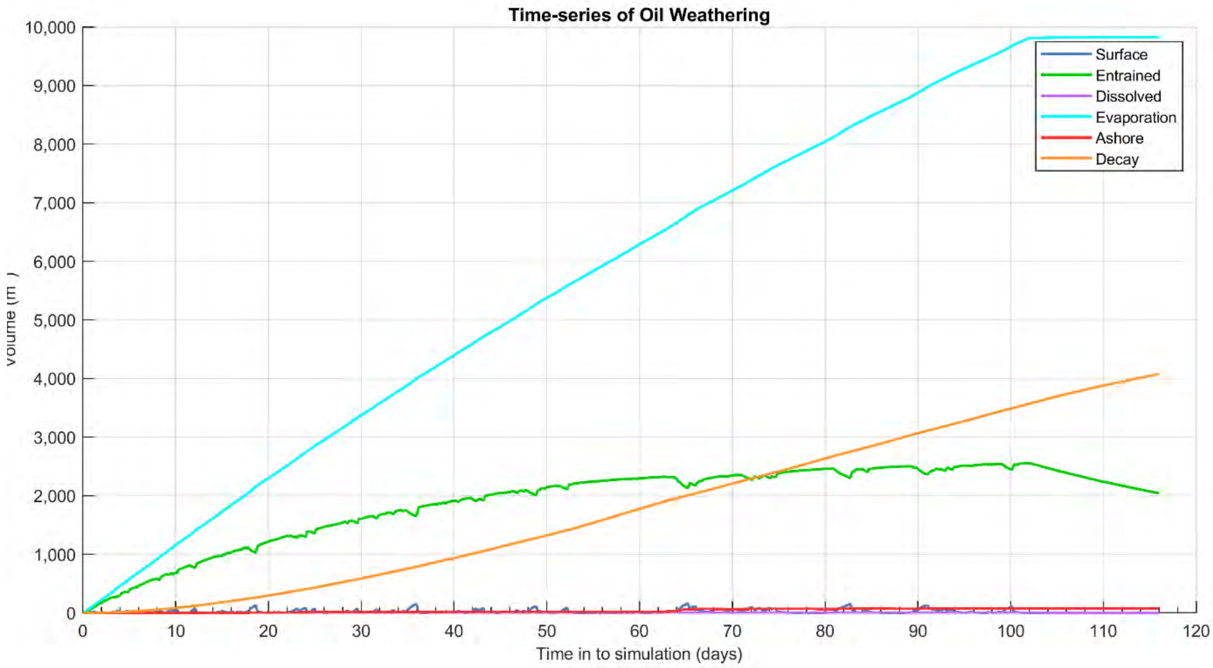


Figure 11.33 Predicted weathering and fates graph for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

12 RESULTS – SCENARIO 2 – 83,273 BBL (13,239 M^3) SUBSURFACE RELEASE FROM A LOSS OF WELL CONTROL AT PECTEN EAST-2

This scenario examined an 83,273 bbl (13,239 m^3) subsurface release of condensate over 102 days to represent a LOWC scenario at Pecten East-2 well. A total of 100 spill simulations were run per season (summer and winter) and each simulation was tracked for 116 days. The results are presented on a seasonal basis.

Sections 12.1 and 12.1.1 present the seasonal stochastic analysis and deterministic analysis results, respectively.

12.1 Stochastic Analysis

12.1.1 Floating Oil Exposure

Table 12.1 summarises the maximum distance travelled by floating oil on the sea surface at each threshold. The maximum distance and corresponding direction from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) exposure zones was 74.4 km (east-southeast, winter) and 15.2 km (east-southeast, winter), respectively. No high (>50 g/m^2) exposure zones were predicted during either summer or winter conditions.

Table 12.2 summarises the potential floating oil exposure to individual receptors.

In summer conditions, a total of 18 BIAs were predicted to be exposed to floating oil at, or above, the low threshold. Excluding the BIAs that the release location resides within (see Section 10.3), the highest probability (8%) of low exposure was predicted at the Short-tailed Shearwater – Foraging BIA. The minimum time before low exposure to the Short-tailed Shearwater – Foraging BIA was 11.63 days.

Additionally, during winter, a total of 18 BIAs were predicted to be exposed to floating oil at, or above, the low threshold. Again, the highest probability (20%) of low exposure for any BIA was predicted at the Short-tailed Shearwater – Foraging BIA. The minimum time before low exposure to the Short-tailed Shearwater – Foraging BIA was 8.46 days.

Table 12.3 presents the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor.

Figure 12.1 and Figure 12.2 present the zones of potential floating oil exposure for each season whilst Figure 12.3 to Figure 12.6 present the maximum residence time of floating oil exposure for the NOPSEMA thresholds.

Table 12.1 Maximum distance and direction from the release location to the edge of floating oil exposure. Results are based on an 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Distance and direction travelled	Zones of potential floating oil exposure					
	Summer			Winter		
	Low	Moderate	High	Low	Moderate	High
Maximum distance (km) from release location	67.4	12.7	-	74.4	15.2	-
Maximum distance (km) from release location (99th percentile)	45.5	12.4	-	49.7	14.9	-
Direction	ESE	ESE	-	ESE	ESE	-

Table 12.2 Summary of the potential floating oil exposure to individual receptors. Results are based on an 83,273 bbl (13,239 m³) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer						Winter					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)		
		Low	Mod.	High	Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
BIA	Antipodean Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Australasian Gannet - Foraging	-	-	-	-	-	-	2	-	-	10.29	-	-
	Black-browed Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Bullers Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Campbell Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Common Diving-petrel - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Indian Yellow-nosed Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Pygmy Blue Whale - Distribution*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Pygmy Blue Whale - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Pygmy Blue Whale - Foraging annual high use area*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Short-tailed Shearwater - Foraging	8	-	-	11.63	-	-	20	-	-	8.46	-	-
	Shy Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Southern Right Whale - Aggregation	100	78	-	0.04	0.75	-	100	62	-	0.13	0.58	-
	Southern Right Whale - Known Core Range*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Wandering Albatross - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	Wedge-tailed Shearwater - Foraging*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	White Shark - Distribution*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
	White Shark - Foraging	-	-	-	-	-	-	2	-	-	10.29	-	-
IBRA	Otway Plain	8	-	-	11.63	-	-	11	-	-	8.96	-	-
	Otway Ranges	-	-	-	-	-	-	8	-	-	8.46	-	-
	Warrnambool Plain	87	-	-	1.71	-	-	90	-	-	2.04	-	-
IMCRA	Otway*	100	100	-	0.04	0.08	-	100	100	-	0.04	0.08	-
KEF	Bonney Coast Upwelling	-	-	-	-	-	-	2	-	-	10.29	-	-

Receptor		Summer						Winter					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)		
		Low	Mod.	High	Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
MNP	Twelve Apostles	51	-	-	4.38	-	-	65	-	-	2.54	-	-
Nearshore Waters	Colac Otway	8	-	-	11.63	-	-	16	-	-	8.46	-	-
	Corangamite	67	-	-	2.75	-	-	81	-	-	2.54	-	-
	Lady Julia Percy Island	-	-	-	-	-	-	2	-	-	10.29	-	-
	Moyne	64	-	-	1.71	-	-	59	-	-	2.04	-	-
	Warrnambool	2	-	-	69	-	-	6	-	-	6.63	-	-
State Waters	Victoria State Waters	100	-	-	0.67	-	-	100	-	-	0.83	-	-
Nearshore Waters (Sub-LGA)	Bay of Islands	56	-	-	1.71	-	-	56	-	-	2.04	-	-
	Cape Otway West	8	-	-	11.63	-	-	16	-	-	8.46	-	-
	Childers Cove	23	-	-	3.83	-	-	9	-	-	6.63	-	-
	Moonlight Head	56	-	-	4.38	-	-	73	-	-	5.54	-	-
	Port Campbell	44	-	-	2.75	-	-	59	-	-	2.54	-	-
	Warrnambool	-	-	-	-	-	-	2	-	-	6.83	-	-

*The release location resides within the receptor boundaries.

Table 12.3 Summary of the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor. Results are based on an 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer Maximum residence time of floating oil exposure (hours)			Winter Maximum residence time of floating oil exposure (hours)		
		Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross - Foraging*	21.92	1.08	-	21	1.42	-
	Australasian Gannet - Foraging	-	-	-	0.13	-	-
	Black-browed Albatross - Foraging*	21.92	1.08	-	21	1.42	-
	Bullers Albatross - Foraging*	21.92	1.08	-	21	1.42	-
	Campbell Albatross - Foraging*	21.92	1.08	-	21	1.42	-
	Common Diving-petrel - Foraging*	21.92	1.08	-	21	1.42	-
	Indian Yellow-nosed Albatross - Foraging*	21.92	1.08	-	21	1.42	-
	Pygmy Blue Whale - Distribution*	21.92	1.08	-	21	1.42	-
	Pygmy Blue Whale - Foraging*	21.92	1.08	-	21	1.42	-
	Pygmy Blue Whale - Foraging annual high use area*	21.92	1.08	-	21	1.42	-
	Short-tailed Shearwater - Foraging	0.33	-	-	0.25	-	-
	Shy Albatross - Foraging*	21.92	1.08	-	21	1.42	-
	Southern Right Whale - Aggregation	2.5	0.21	-	2.58	0.42	-
	Southern Right Whale - Known Core Range*	21.92	1.08	-	21	1.42	-
	Wandering Albatross - Foraging*	21.92	1.08	-	21	1.42	-
	Wedge-tailed Shearwater - Foraging*	21.92	1.08	-	21	1.42	-
	White Shark - Distribution*	21.92	1.08	-	21	1.42	-
	White Shark - Foraging	-	-	-	0.13	-	-
IBRA	Otway Plain	0.33	-	-	0.25	-	-
	Otway Ranges	-	-	-	0.17	-	-
	Warrnambool Plain	1.17	-	-	1.08	-	-
IMCRA	Otway*	21.92	1.08	-	21	1.42	-
KEF	Bonney Coast Upwelling	-	-	-	0.13	-	-
MNP	Twelve Apostles	0.71	-	-	0.71	-	-

Receptor		Summer Maximum residence time of floating oil exposure (hours)			Winter Maximum residence time of floating oil exposure (hours)		
		Low	Moderate	High	Low	Moderate	High
Nearshore Waters	Colac Otway	0.33	-	-	0.25	-	-
	Corangamite	0.71	-	-	1.08	-	-
	Lady Julia Percy Island	-	-	-	0.13	-	-
	Moyne	1.08	-	-	0.79	-	-
	Warrnambool	0.17	-	-	0.67	-	-
State Waters	Victoria State Waters	1.58	-	-	1.08	-	-
Nearshore Waters (Sub-LGA)	Bay of Islands	0.96	-	-	0.79	-	-
	Cape Otway West	0.33	-	-	0.25	-	-
	Childers Cove	1.08	-	-	0.67	-	-
	Moonlight Head	0.71	-	-	0.83	-	-
	Port Campbell	0.71	-	-	1.08	-	-
	Warrnambool	-	-	-	0.04	-	-

*The release location resides within the receptor boundaries.

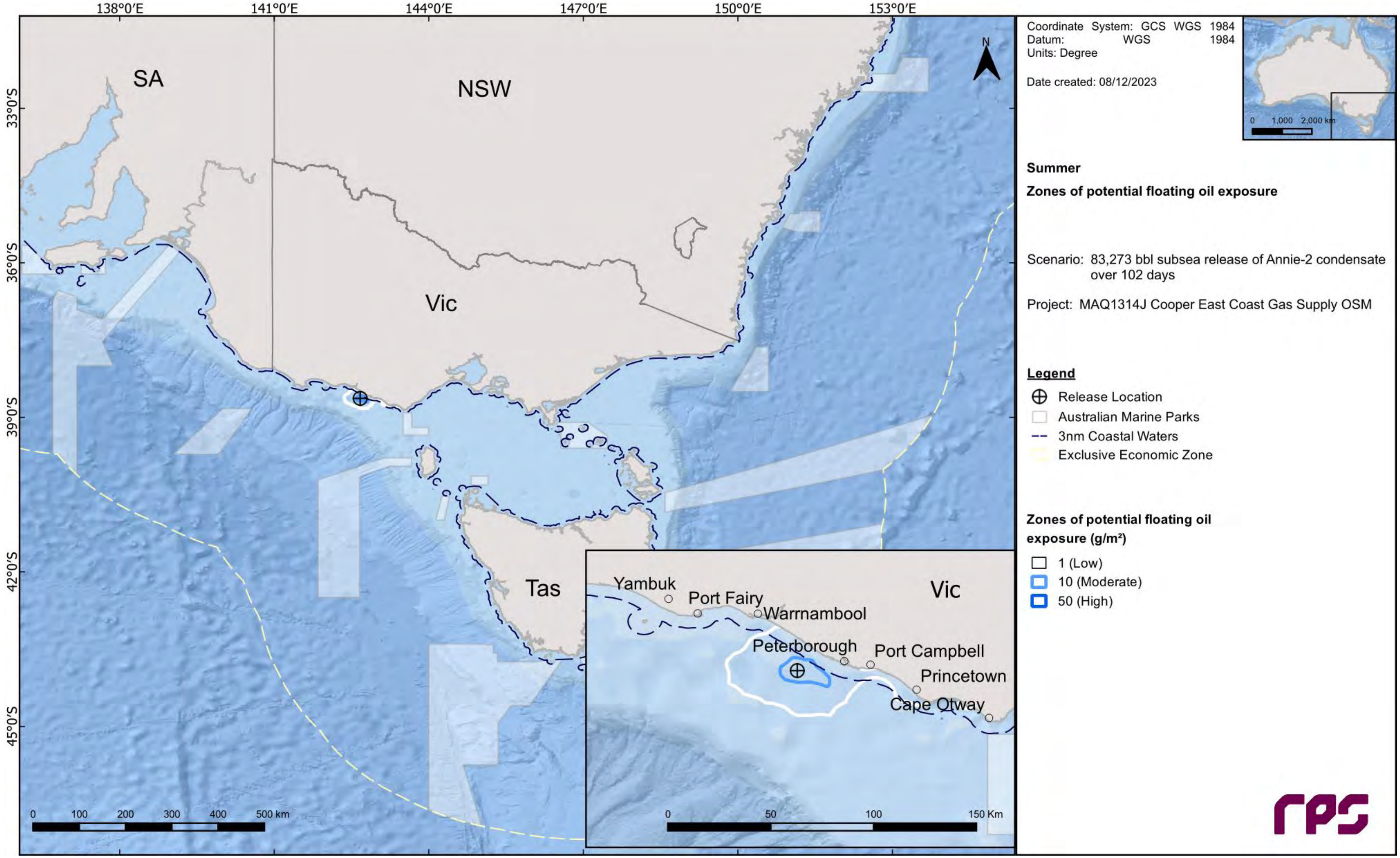


Figure 12.1 Zones of potential floating oil exposure in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

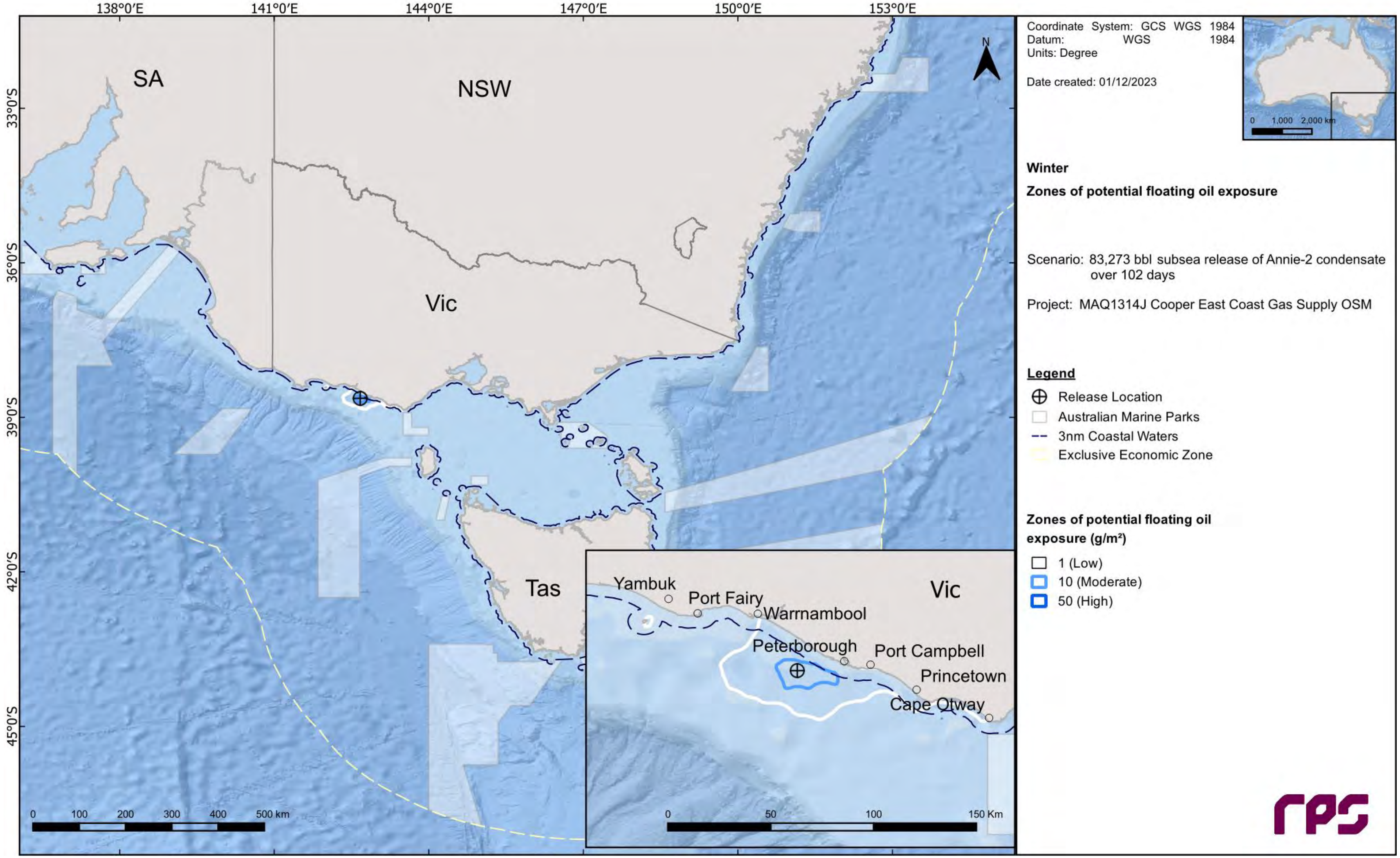


Figure 12.2 Zones of potential floating oil exposure in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

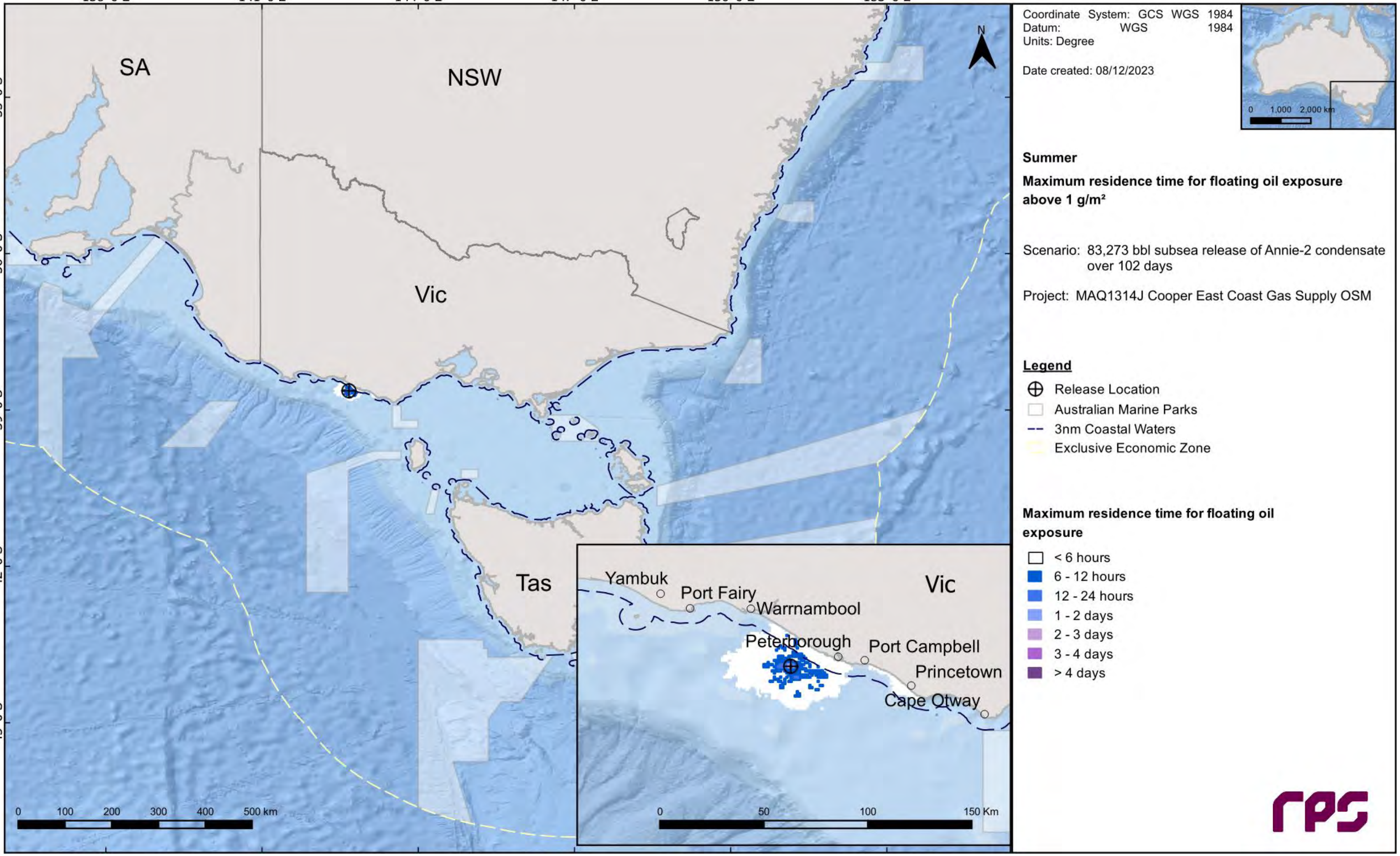


Figure 12.3 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

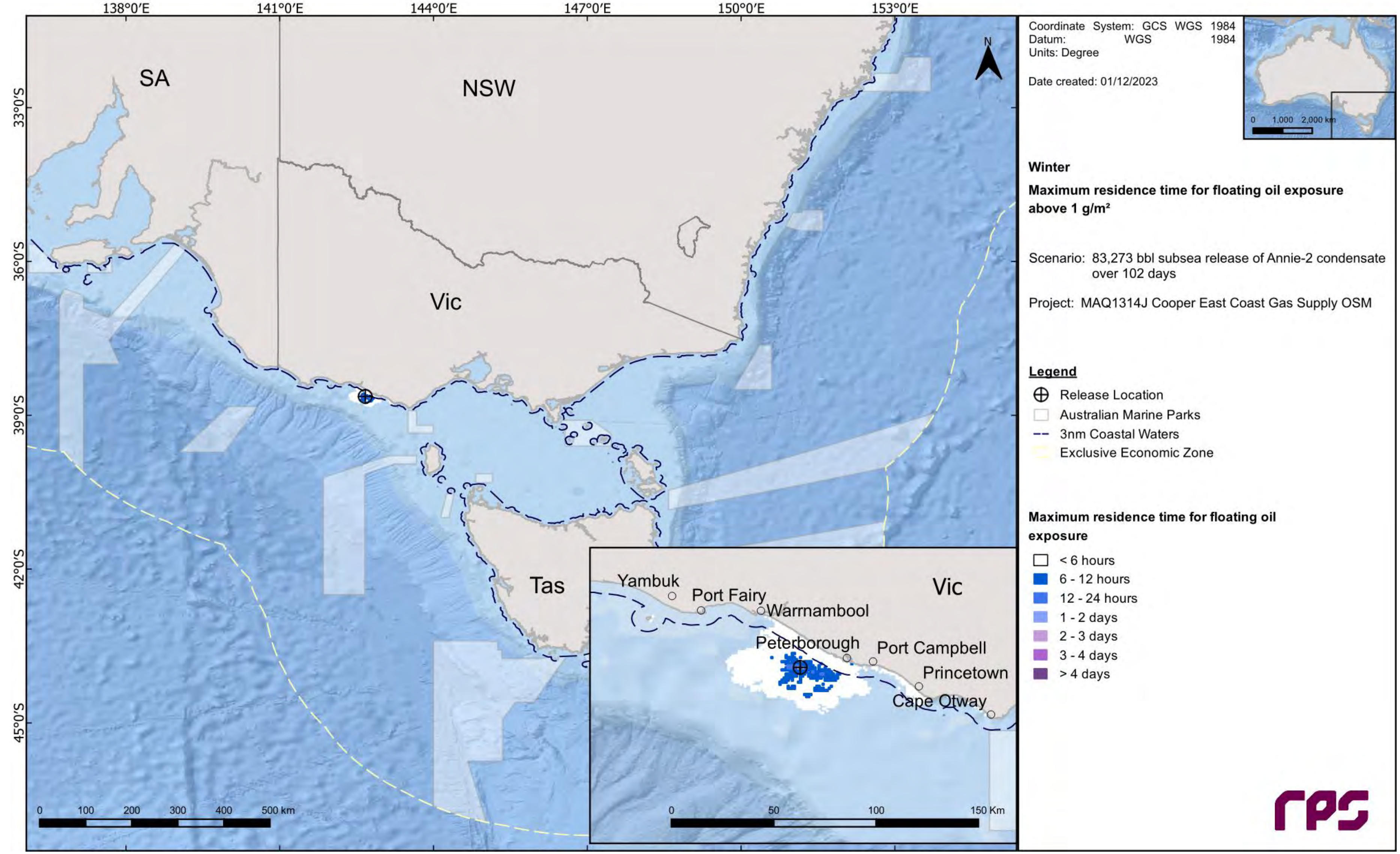


Figure 12.4 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

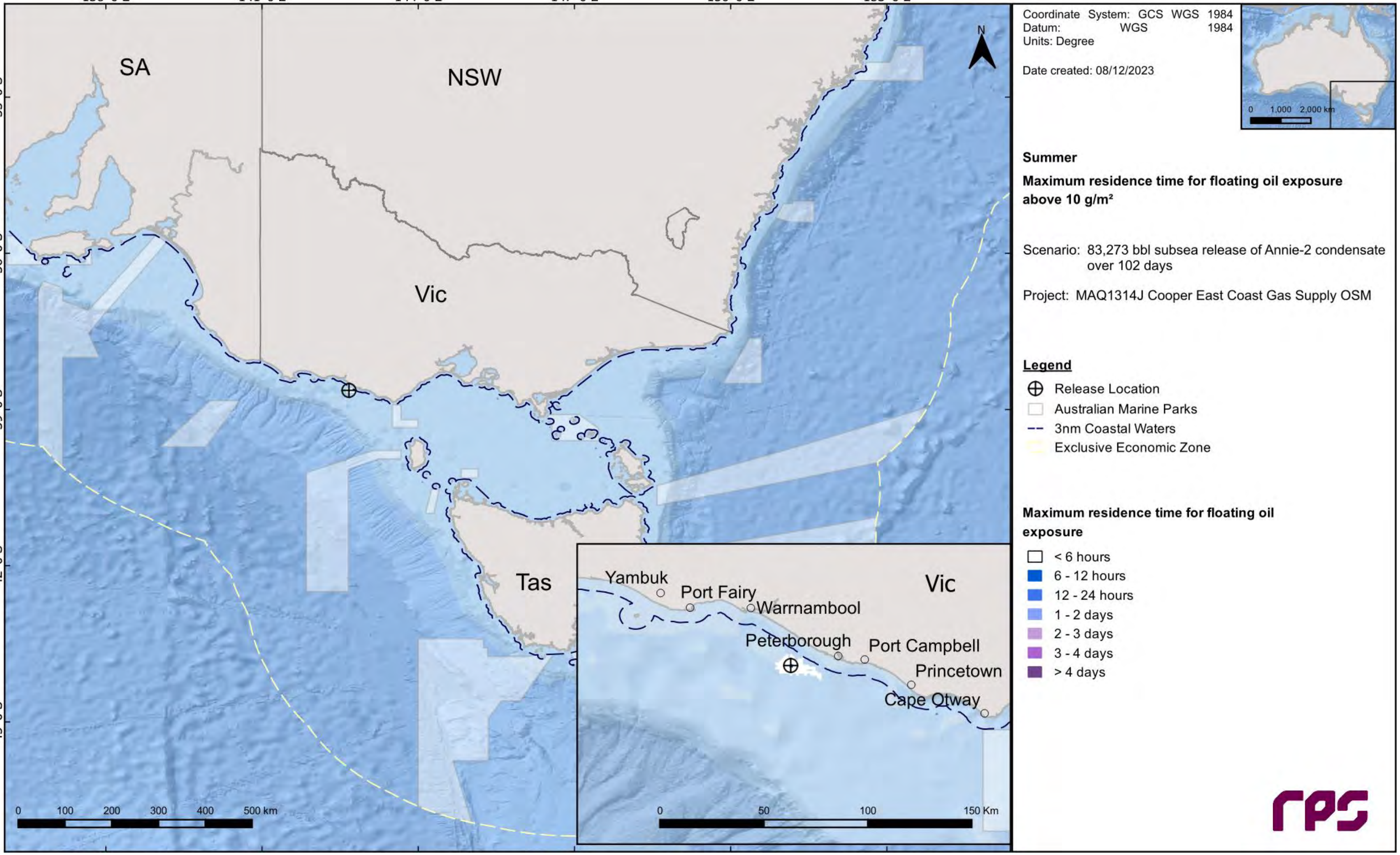


Figure 12.5 Maximum residence time of floating oil exposure above 10 g/m^2, in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

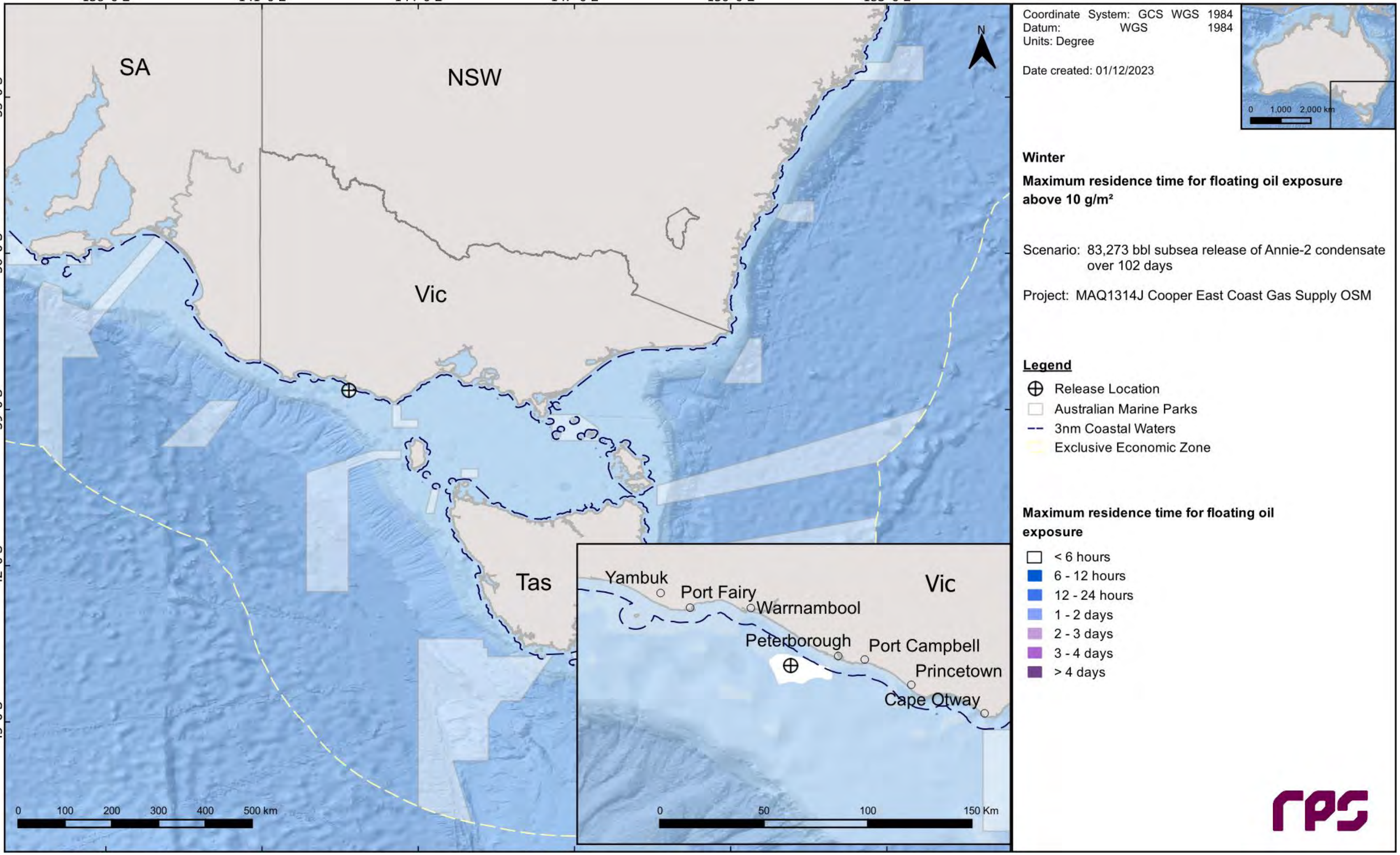


Figure 12.6 Maximum residence time of floating oil exposure above 10 g/m^2, in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

12.1.2 Shoreline Accumulation

Table 12.4 presents a summary of the potential shoreline accumulation. The probability of accumulation to any shoreline at, or above, the low (10 g/m^2) threshold was 100% throughout the year. The minimum time before oil accumulation at, or above, the low threshold was 1.17 days. The maximum total volume ashore for a single spill trajectory was 406.6 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 269.0 km (summer), 75.0 km (summer) and 6.0 km (winter), respectively.

Table 12.5 and Table 12.6 summarises the shoreline accumulation on individual receptors during summer and winter, respectively.

During summer conditions, the shoreline segment of Bay of Islands and Moyne had the highest probabilities of accumulation above all three thresholds with probabilities of 100%, 99% and 14% for the low, moderate and high thresholds. It is acknowledged that Corangamite and Moyne LGA and Port Campbell sub-LGA demonstrated 100% for low threshold shoreline accumulation. The minimum time for low threshold shoreline accumulation at these receptors was 1.21 days (Bay of Islands and Moyne LGAs).

Alternatively, in winter the shoreline segment with the highest probability of accumulation above all three thresholds was Corangamite with probabilities of 100%, 100% and 23% for the low, moderate and high thresholds. The minimum time for low threshold shoreline accumulation at Bay of Islands and Moyne LGA was 1.17 days.

The maximum potential shoreline loadings above each shoreline thresholds are presented in Figure 12.7 and Figure 12.8 for summer and winter respectively.

Table 12.4 Summary of oil accumulation across all shorelines. Results are based on an 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Shoreline Statistics	Summer	Winter
Probability of accumulation on any shoreline (%)	100	100
Absolute minimum time for visible oil to shore (days)	1.21	1.17
Maximum total volume of hydrocarbons ashore (m^3)	347.3	406.6
Average total volume of hydrocarbons ashore (m^3)	169.8	204.1
Maximum length of the shoreline at **10 g/m^2** (km)	269.0	251.0
Average shoreline length (km) at **10 g/m^2** (km)	150.8	154.0
Maximum length of the shoreline at **100 g/m^2** (km)	78.0	76.0
Average shoreline length (km) at **100 g/m^2** (km)	37.9	42.5
Maximum length of the shoreline at **1,000 g/m^2** (km)	4.0	6.0
Average shoreline length (km) at **1,000 g/m^2** (km)	2.4	2.0

Table 12.5 Summary of oil accumulation on individual shoreline receptors. Results are based on an 83,273 bbl (13,239 m³) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

Shoreline Receptor		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA Shoreline	Anglesea	7	-	-	54.54	-	-	3	27	0.5	2.8	5.1	-	-	9.1	-	-
	Apollo Bay	62	-	-	10.92	-	-	6	73	1.9	5.5	6	-	-	13.6	-	-
	Bass Coast	6	-	-	20.38	-	-	2	22	0.3	1.3	1.4	-	-	3.6	-	-
	Bay of Islands	100	99	14	1.21	1.50	26.46	134	2,545	52	142.8	24.3	11.4	2	29.1	21.8	3.6
	Bega Valley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Colac Otway	92	60	-	4.46	12.17	-	21	471	21.1	59.3	26.6	7.3	-	54.5	17.3	-
	Corangamite	100	99	-	1.75	3.21	-	81	936	61.6	118.8	43.6	14.3	-	56.3	26.4	-
	East Gippsland	10	-	-	80.50	-	-	2	25	0.6	1.8	1.9	-	-	3.6	-	-
	French Island	2	-	-	53.83	-	-	2	21	< 0.1	0.5	0.9	-	-	0.9	-	-
	Gabo Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Glenelg	53	12	-	6.92	10.58	-	9	250	9.4	23.2	16.3	2.7	-	47.2	6.4	-
	Glennie Group	19	-	-	24.92	-	-	4	39	0.5	1.9	2.1	-	-	5.5	-	-
	Grant	4	-	-	22.33	-	-	2	25	0.6	5.2	4.3	-	-	9.1	-	-
	Greater Geelong	14	5	-	32.04	57.71	-	6	137	1.8	9.6	6.4	1.6	-	14.5	1.8	-
	Hogan Island Group	1	-	-	110.67	-	-	1	11	0.1	0.4	0.9	-	-	0.9	-	-
	Kanowna Island	9	-	-	92.04	-	-	3	16	0.2	0.7	1.2	-	-	1.8	-	-
	King Island	2	-	-	84.63	-	-	1	14	0.4	1.4	1.4	-	-	1.8	-	-
	Lady Julia Percy Island	60	23	-	4.21	16.67	-	30	195	2.8	5.8	4.3	1.6	-	6.4	2.7	-
	Laurence Rocks	45	-	-	8.67	-	-	19	78	0.7	1.9	2.1	-	-	2.7	-	-
	Moncoeur Islands	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Montague Island	1	-	-	87.79	-	-	2	15	< 0.1	0.4	0.9	-	-	0.9	-	-
	Mornington Peninsula	18	-	-	38.29	-	-	2	32	1	5.2	4.8	-	-	14.5	-	-
	Moyne	100	99	14	1.21	1.50	26.33	71	2,545	69.4	168.1	40.1	14.6	2.2	81.8	31.8	3.6
	Norman Island	8	-	-	21.96	-	-	4	29	0.2	0.8	1.4	-	-	2.7	-	-
	Phillip Island	10	-	-	45.67	-	-	2	33	0.4	3.1	2.3	-	-	7.3	-	-
	Rodondo Island	12	-	-	71.58	-	-	4	36	0.2	0.8	1.1	-	-	1.8	-	-
	Shellback Island	1	-	-	31.13	-	-	3	11	< 0.1	0.2	0.9	-	-	0.9	-	-
	Skull Rock	3	-	-	92.04	-	-	3	16	< 0.1	0.3	0.9	-	-	0.9	-	-
	South Gippsland	28	-	-	20.17	-	-	3	77	2.3	13.4	9.7	-	-	29.1	-	-
	Surf Coast	13	2	-	24.96	58.96	-	3	116	1.5	11.3	10.4	0.9	-	24.5	0.9	-
	Warrnambool	81	23	-	3.50	12.17	-	20	738	6.1	28.2	11.6	3.2	-	22.7	6.4	-
Sub-LGA Shoreline	Bega Valley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Conran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Howe / Mallacoota	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Liptrap (NW)	16	-	-	20.17	-	-	3	77	0.7	4.2	4.4	-	-	10	-	-
	Cape Nelson	53	12	-	6.92	10.58	-	12	250	8.2	22.3	14.5	2.7	-	30.9	6.4	-
	Cape Otway West	92	60	-	4.46	12.17	-	38	471	18.4	53.9	20.4	7.3	-	34.5	17.3	-
	Cape Patton	33	-	-	16.46	-	-	4	71	1.2	8	5.6	-	-	17.3	-	-
	Childers Cove	96	65	2	1.42	3.88	26.33	50	1,577	17.9	87	15.6	5.3	1.4	24.5	12.7	1.8
	Croajingolong (West)	5	-	-	86.63	-	-	2	24	0.2	0.8	0.9	-	-	0.9	-	-
	Discovery Bay (East)	4	-	-	27.75	-	-	2	17	0.3	1.6	2	-	-	4.5	-	-
	Discovery Bay (West)	2	-	-	29.83	-	-	2	20	0.3	1.9	4.1	-	-	5.5	-	-
	French Island / Crib Point	1	-	-	96.63	-	-	2	14	< 0.1	0.2	0.9	-	-	0.9	-	-

Shoreline Receptor	Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
Kilcunda	5	-	-	21.13	-	-	2	22	0.2	0.6	0.9	-	-	0.9	-	-
Lorne	13	-	-	24.96	-	-	3	17	0.5	1.9	2	-	-	5.5	-	-
Marlo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moonlight Head	98	94	-	2.50	4.58	-	84	781	34	83.6	20.4	8.5	-	30	14.5	-
Mornington Peninsula (S)	11	-	-	39.96	-	-	3	32	0.4	2.7	4	-	-	7.3	-	-
Mornington Peninsula (SW)	16	-	-	38.29	-	-	2	28	0.5	2.7	2.5	-	-	9.1	-	-
New South Wales	1	-	-	87.79	-	-	2	15	0.3	0.9	0.9	-	-	0.9	-	-
Point Hicks	9	-	-	80.50	-	-	3	25	0.3	0.8	1.6	-	-	2.7	-	-
Port Campbell	100	91	-	1.75	3.21	-	79	936	27.8	62.2	23.3	6.7	-	26.4	15.4	-
Port Fairy	64	8	-	7.75	13.38	-	11	249	4	15	7.8	2.3	-	26.4	4.5	-
Port Phillip (Queenscliff)	14	-	-	32.04	-	-	3	30	0.5	1.2	1.8	-	-	2.7	-	-
Port Phillip (Sorrento Shore)	1	-	-	50.13	-	-	2	11	0.2	0.5	0.9	-	-	0.9	-	-
Portland Bay (East)	13	-	-	20.29	-	-	3	26	0.5	2.1	2	-	-	4.5	-	-
Portland Bay (West)	22	-	-	24.5	-	-	3	31	0.7	2.2	2.8	-	-	6.4	-	-
South Australia State Waters	4	-	-	22.33	-	-	2	25	0.7	6	4.3	-	-	9.1	-	-
Tasmania State Waters	3	-	-	84.63	-	-	1	14	0.4	1.6	1.2	-	-	1.8	-	-
Torquay	8	5	-	32.96	57.71	-	6	137	2.2	16.2	18.9	2	-	26.4	2.7	-
Venus Bay	2	-	-	20.38	-	-	2	14	0.2	0.8	1.8	-	-	2.7	-	-
Victoria State Waters	100	100	14	1.21	1.5	26.33	39	2,545	169.2	347.3	136.8	34.4	2.2	244.4	70.9	3.6
Waratah Bay	4	-	-	97.17	-	-	2	30	0.2	0.7	0.9	-	-	0.9	-	-
Warrnambool	67	9	-	3.83	12.17	-	10	179	2.8	14.9	7.4	2	-	20.9	5.5	-
Westernport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wilsons Promontory (East)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wilsons Promontory (West)	28	-	-	21.54	-	-	5	74	1.7	9.1	7	-	-	19.1	-	-

Table 12.6 Summary of oil accumulation on individual shoreline receptors. Results are based on an 83,273 bbl (13,239 m³) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

Shoreline Receptor		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA Shoreline	Anglesea	6	-	-	14.71	-	-	2	43	0.3	3.9	4.1	-	-	9.1	-	-
	Apollo Bay	89	-	-	7.17	-	-	8	92	2.5	7.2	6.4	-	-	14.5	-	-
	Bass Coast	9	-	-	31.33	-	-	2	22	0.4	1.6	1.5	-	-	3.6	-	-
	Bay of Islands	100	97	11	1.17	2.42	36.13	119	1,431	45.6	136.7	21.4	10	1.4	29.1	20.9	3.6
	Bega Valley	17	-	-	35.21	-	-	2	32	0.5	1.6	1.9	-	-	3.6	-	-
	Colac Otway	98	87	-	4.08	8.54	-	27	394	29.3	67.8	34.1	7.7	-	63.6	15.4	-
	Corangamite	100	100	23	2.04	3.96	41.5	132	1,603	102.4	237.4	48.9	19.5	1.5	57.2	35.4	5.5
	East Gippsland	46	-	-	40.92	-	-	3	66	1.4	4.6	3.2	-	-	6.4	-	-
	French Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Gabo Island	15	-	-	41.83	-	-	4	33	0.2	0.9	1.8	-	-	2.7	-	-
	Glenelg	19	1	-	25.96	108.21	-	4	109	3.9	16.3	12.6	0.9	-	37.3	0.9	-
	Glennie Group	48	-	-	24.75	-	-	5	41	0.7	2.3	2.5	-	-	7.3	-	-
	Grant	4	-	-	58.38	-	-	2	25	0.8	3.9	2.7	-	-	5.5	-	-
	Greater Geelong	5	3	-	15.58	17.21	-	3	187	0.7	12.3	8.7	3	-	14.5	3.6	-
	Hogan Island Group	1	-	-	82.46	-	-	2	12	0.2	0.7	2.7	-	-	2.7	-	-
	Kanowna Island	29	-	-	27.63	-	-	5	41	0.4	1	2	-	-	2.7	-	-
	King Island	10	-	-	33.79	-	-	2	26	0.8	2.7	2.2	-	-	4.5	-	-
	Lady Julia Percy Island	34	11	-	10	10.5	-	22	234	2.1	7	3.9	1.6	-	6.4	2.7	-
	Laurence Rocks	13	-	-	21.54	-	-	9	37	0.3	1	1.8	-	-	2.7	-	-
	Moncoeur Islands	2	-	-	92.5	-	-	2	12	0.1	0.4	0.9	-	-	0.9	-	-
	Montague Island	6	-	-	65.96	-	-	4	25	0.2	0.8	1.5	-	-	2.7	-	-
	Mornington Peninsula	33	-	-	14.08	-	-	3	44	1.2	5.9	3.5	-	-	13.6	-	-
	Moyne	100	99	13	1.17	2.42	12.08	77	1,431	55.3	184.3	32.4	11.4	1.3	98.1	36.3	3.6
	Norman Island	17	-	-	25.75	-	-	4	30	0.2	0.9	1.7	-	-	2.7	-	-
	Phillip Island	39	-	-	15.38	-	-	3	47	0.9	3.2	2.5	-	-	7.3	-	-
	Rodondo Island	34	-	-	16.58	-	-	6	48	0.3	1.3	1.5	-	-	2.7	-	-
	Shellback Island	2	-	-	49.17	-	-	3	12	< 0.1	0.2	0.9	-	-	0.9	-	-
	Skull Rock	27	-	-	27.63	-	-	5	23	0.2	0.5	1.1	-	-	1.8	-	-
	South Gippsland	65	1	-	20.88	72.54	-	5	106	3.5	12.2	9.1	0.9	-	23.6	0.9	-
	Surf Coast	9	2	-	14.71	18.29	-	2	124	0.9	13	8.8	0.9	-	24.5	0.9	-
	Warrnambool	56	23	1	5.13	6.92	12.13	25	1,185	7.5	43.2	11	3.6	0.9	25.4	11.8	0.9
Sub-LGA Shoreline	Bega Valley	17	-	-	35.21	-	-	2	32	0.5	1.6	1.9	-	-	3.6	-	-
	Cape Conran	1	-	-	70.46	-	-	1	11	< 0.1	0.4	0.9	-	-	0.9	-	-
	Cape Howe / Mallacoota	14	-	-	40.92	-	-	3	16	0.2	0.8	1	-	-	1.8	-	-
	Cape Liptrap (NW)	51	-	-	20.88	-	-	5	50	0.8	2.4	2.4	-	-	7.3	-	-
	Cape Nelson	18	1	-	25.96	108.21	-	5	109	2.9	11.8	9.8	0.9	-	24.5	0.9	-
	Cape Otway West	98	87	-	4.08	8.54	-	51	394	25.2	49.6	25	7.7	-	32.7	15.4	-
	Cape Patton	60	1	-	13.75	44.13	-	5	102	1.7	13.1	5.3	0.9	-	19.1	0.9	-
	Childers Cove	80	30	2	2.54	4.92	12.08	30	1,185	10.1	99	11.4	5.6	1.4	24.5	17.3	1.8
	Croajingolong (West)	22	-	-	47	-	-	3	37	0.3	1	1	-	-	1.8	-	-
	Discovery Bay (East)	1	-	-	70.25	-	-	2	16	0.4	1.7	2.7	-	-	2.7	-	-
	Discovery Bay (West)	1	-	-	65.79	-	-	2	12	0.4	1.7	3.6	-	-	3.6	-	-
	French Island / Crib Point	3	-	-	28	-	-	2	19	< 0.1	0.3	0.9	-	-	0.9	-	-

Shoreline Receptor	Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
Kilcunda	4	-	-	46.42	-	-	2	16	0.2	0.7	1.1	-	-	1.8	-	-
Lorne	8	-	-	20	-	-	2	28	0.3	1.5	2.2	-	-	3.6	-	-
Marlo	12	-	-	69.75	-	-	2	23	0.2	0.6	0.9	-	-	0.9	-	-
Moonlight Head	100	100	21	2.71	5.96	44.92	154	1,603	63.9	167.5	25.5	11.4	1.2	30.9	15.4	4.5
Mornington Peninsula (S)	29	-	-	14.08	-	-	4	44	0.6	3.8	2.7	-	-	10.9	-	-
Mornington Peninsula (SW)	19	-	-	17.42	-	-	3	28	0.5	1.4	1.5	-	-	2.7	-	-
New South Wales	20	-	-	35.21	-	-	2	32	0.6	2	2	-	-	4.5	-	-
Point Hicks	41	-	-	41.04	-	-	6	66	0.7	2.2	2.3	-	-	3.6	-	-
Port Campbell	100	91	10	2.04	3.96	41.5	109	1,348	38.4	108.6	23	8.9	1	26.4	21.8	1.8
Port Fairy	40	17	-	10.21	13.29	-	15	379	5.6	23.9	10	2.1	-	30	4.5	-
Port Phillip (Queenscliff)	5	-	-	20.08	-	-	2	35	0.1	1.1	1.6	-	-	2.7	-	-
Port Phillip (Sorrento Shore)	2	-	-	35.42	-	-	2	12	0.1	0.4	0.9	-	-	0.9	-	-
Portland Bay (East)	10	-	-	12.79	-	-	3	38	0.8	3.7	5.3	-	-	13.6	-	-
Portland Bay (West)	8	-	-	27.71	-	-	4	55	1.1	5.7	6.6	-	-	19.1	-	-
South Australia State Waters	4	-	-	58.38	-	-	2	25	0.9	4.3	2.7	-	-	5.5	-	-
Tasmania State Waters	11	-	-	33.79	-	-	2	26	0.7	3	2.2	-	-	4.5	-	-
Torquay	5	3	-	14.79	17.21	-	4	187	1.1	20.4	16.7	3.6	-	29.1	4.5	-
Venus Bay	7	-	-	31.33	-	-	2	22	0.2	1.2	1.3	-	-	1.8	-	-
Victoria State Waters	100	100	29	1.17	2.42	12.08	42	1,603	203.2	406.3	139.2	38.6	1.8	228.1	69.1	5.5
Waratah Bay	4	-	-	48.04	-	-	2	27	0.1	0.8	0.9	-	-	0.9	-	-
Warrnambool	46	15	-	7	13.38	-	14	470	4.2	34.7	7.7	2.6	-	28.2	9.1	-
Westernport	2	-	-	49.67	-	-	2	11	0.2	0.7	1.4	-	-	1.8	-	-
Wilsons Promontory (East)	1	-	-	107.75	-	-	1	18	0.1	0.9	1.8	-	-	1.8	-	-
Wilsons Promontory (West)	62	1	-	24	72.54	-	7	106	2.7	8.8	7.4	0.9	-	18.2	0.9	-

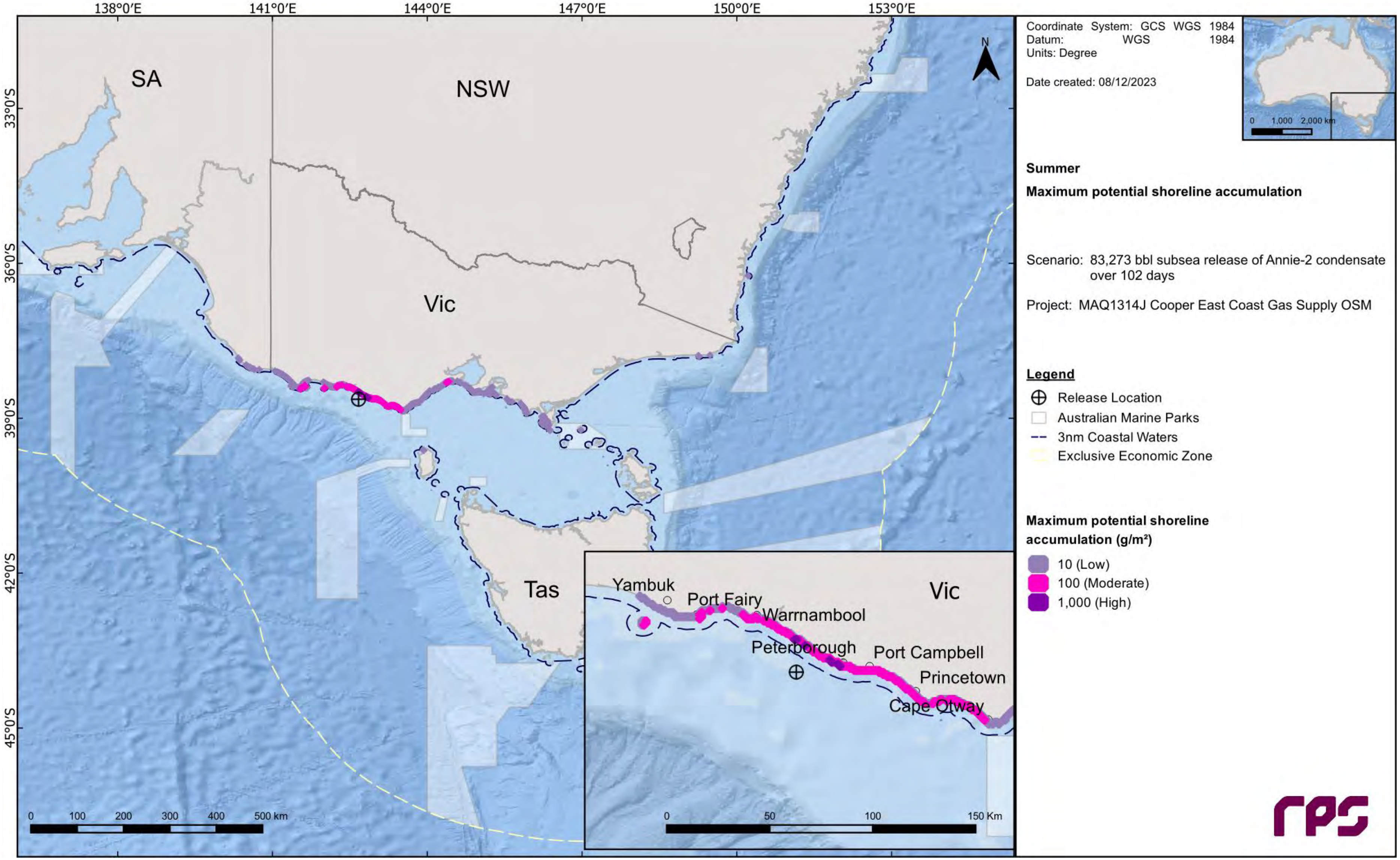


Figure 12.7 Maximum potential shoreline accumulation in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

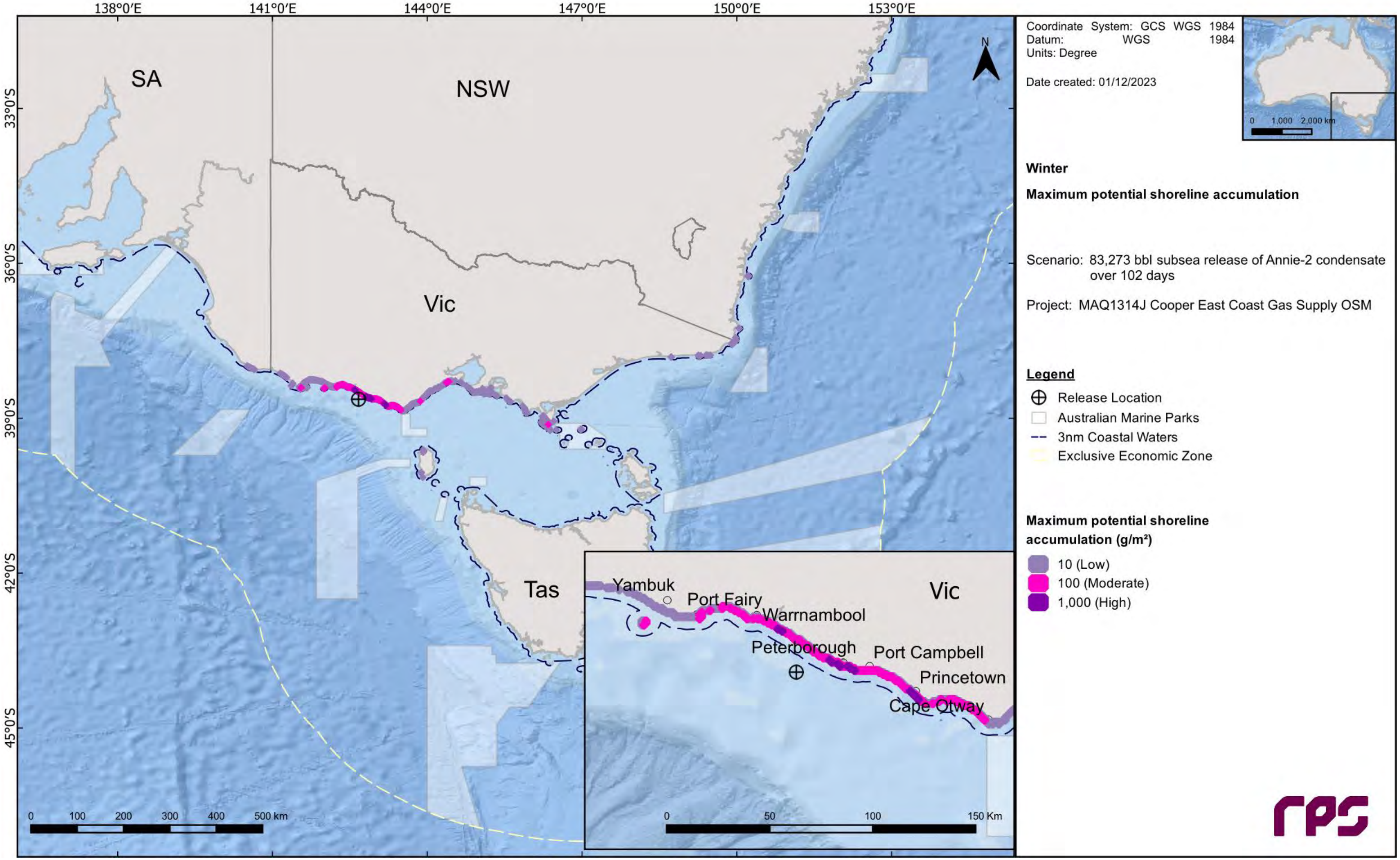


Figure 12.8 Maximum potential shoreline accumulation in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

12.1.3 In-water exposure

12.1.3.1 Dissolved Hydrocarbons

Table 12.7 summarises the potential in-water exposure to individual receptors from dissolved hydrocarbons in the 0-10 m layer.

A total of 20 BIAs were predicted to be exposed to dissolved hydrocarbon at, or above, the low threshold during both winter and summer. Excluding the BIAs that the release location resides within (see Section 10.3), the highest probability of low exposure was 21% during summer (Short-tailed Shearwater - Foraging,) and 59% during winter (Short-tailed Shearwater - Foraging).

The maximum dissolved hydrocarbon concentration at any given receptor(s) was predicted to be 50.1 ppb and 51.7 ppb during summer and winter respectively.

Table 12.8 presents the predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors, in the 0-10 m depth layer, for all thresholds assessed.

Figure 12.9 and Figure 12.10 present the zones of potential dissolved hydrocarbon exposure for the 0-10 m depth layer for each season whilst Figure 12.11to Figure 12.12 present the maximum residence time of dissolved hydrocarbon exposure for the NOPSEMA thresholds.

Table 12.7 Probability of dissolved hydrocarbons exposure to marine based receptors in the 0–10 m depth. Results are based on an 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer				Winter			
		Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure(%)			Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	13.3	2	-	-	22.8	4	-	-
BIA	Antipodean Albatross - Foraging*	40.4	28	-	-	39.5	35	-	-
	Australasian Gannet - Foraging	18.9	2	-	-	20.9	2	-	-
	Black-browed Albatross - Foraging*	40.4	28	-	-	43.1	35	-	-
	Bullers Albatross - Foraging*	40.4	28	-	-	43.1	35	-	-
	Campbell Albatross - Foraging*	40.4	28	-	-	43.1	35	-	-
	Common Diving-petrel - Foraging*	50.1	36	1	-	51.7	73	1	-
	Indian Yellow-nosed Albatross - Foraging*	40.4	28	-	-	43.1	35	-	-
	Pygmy Blue Whale - Distribution*	50.1	36	1	-	51.7	73	1	-
	Pygmy Blue Whale - Foraging*	50.1	36	1	-	51.7	73	1	-
	Pygmy Blue Whale - Foraging annual high use area*	50.1	36	1	-	51.7	73	1	-
	Pygmy Blue Whale - Known Foraging Area	18.8	2	-	-	43.1	4	-	-
	Short-tailed Shearwater - Foraging	27.7	21	-	-	43.1	59	-	-
	Shy Albatross - Foraging*	50.1	36	1	-	51.7	73	1	-
	Southern Right Whale - Aggregation	40.4	10	-	-	36.1	11	-	-
	Southern Right Whale - Known Core Range*	50.1	36	1	-	51.7	73	1	-
	Wandering Albatross - Foraging*	40.4	28	-	-	43.1	35	-	-
	Wedge-tailed Shearwater - Foraging*	50.1	36	1	-	51.7	73	1	-
	White Shark - Distribution*	40.4	28	-	-	43.1	35	-	-
	White Shark - Foraging	21.2	3	-	-	20.9	2	-	-
	White-faced Storm-petrel - Foraging	16.8	1	-	-	43.1	3	-	-
IBRA	Otway Plain	21.1	6	-	-	25.2	16	-	-
	Otway Ranges	20.4	6	-	-	31.8	30	-	-
	Warrnambool Plain	50.1	35	1	-	44.4	72	-	-

Receptor		Summer				Winter			
		Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure(%)			Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)		
			Low	Moderate	High		Low	Moderate	High
IMCRA	Central Bass Strait	16.8	1	-	-	24.8	3	-	-
	Central Victoria	16.1	1	-	-	43.1	4	-	-
	Otway*	50.1	36	1	-	51.7	73	1	-
KEF	Bonney Coast Upwelling	18.9	1	-	-	20.9	2	-	-
MNP	Twelve Apostles	44.1	35	-	-	51.7	69	1	-
RSB	Bravenes Rock	10.7	1	-	-	8.9	-	-	-
Nearshore Waters	Colac Otway	21.1	6	-	-	25.2	16	-	-
	Corangamite	50.1	35	1	-	44.4	72	-	-
	Lady Julia Percy Island	8.2	-	-	-	15.1	2	-	-
	Moyne	25.2	23	-	-	26.6	27	-	-
	Warrnambool	6.7	-	-	-	19.4	2	-	-
State Waters	Victoria State Waters	50.1	36	1	-	51.7	73	1	-
Nearshore Waters (Sub-LGA)	Apollo Bay	17.8	2	-	-	16.5	1	-	-
	Bay of Islands	25.2	23	-	-	26.6	27	-	-
	Cape Otway West	21.1	6	-	-	25.2	16	-	-
	Childers Cove	12.1	1	-	-	19.4	4	-	-
	Moonlight Head	50.1	35	1	-	44.4	72	-	-
	Port Campbell	38.2	29	-	-	30.9	41	-	-
	Warrnambool	6.7	-	-	-	10	1	-	-

*The release location resides within the receptor boundaries.

Table 12.8 Predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on an 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer						Winter					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
AMP	Apollo	7.13	-	-	0.04	-	-	3.33	-	-	0.08	-	-
BIA	Antipodean Albatross - Foraging*	1.00	-	-	0.25	-	-	0.88	-	-	0.25	-	-
	Australasian Gannet - Foraging	6.21	-	-	0.08	-	-	9.17	-	-	0.08	-	-
	Black-browed Albatross - Foraging*	1.00	-	-	0.25	-	-	0.88	-	-	0.25	-	-
	Bullers Albatross - Foraging*	1.00	-	-	0.25	-	-	0.88	-	-	0.25	-	-
	Campbell Albatross - Foraging*	1.00	-	-	0.25	-	-	0.88	-	-	0.25	-	-
	Common Diving-petrel - Foraging*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
	Indian Yellow-nosed Albatross - Foraging*	1.00	-	-	0.25	-	-	0.88	-	-	0.25	-	-
	Pygmy Blue Whale - Distribution*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
	Pygmy Blue Whale - Foraging*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
	Pygmy Blue Whale - Foraging annual high use area*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
	Pygmy Blue Whale - Known Foraging Area	7.13	-	-	0.08	-	-	3.42	-	-	0.13	-	-
	Short-tailed Shearwater - Foraging	2.58	-	-	0.13	-	-	2.08	-	-	0.25	-	-
	Shy Albatross - Foraging*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
	Southern Right Whale - Aggregation*	1.33	-	-	0.17	-	-	1.13	-	-	0.21	-	-
	Southern Right Whale - Known Core Range*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
	Wandering Albatross - Foraging*	1.00	-	-	0.25	-	-	0.88	-	-	0.25	-	-
	Wedge-tailed Shearwater - Foraging*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
	White Shark - Distribution*	1.00	-	-	0.25	-	-	0.88	-	-	0.25	-	-
	White Shark - Foraging	2.54	-	-	0.08	-	-	6.96	-	-	0.08	-	-
	White-faced Storm-petrel - Foraging	7.29	-	-	0.08	-	-	3.58	-	-	0.08	-	-
IBRA	Otway Plain	3.96	-	-	0.08	-	-	7.00	-	-	0.13	-	-
	Otway Ranges	2.58	-	-	0.13	-	-	4.67	-	-	0.17	-	-
	Warrnambool Plain	2.08	13.92	-	0.25	-	-	2.29	15.58	-	0.29	-	-

Receptor		Summer						Winter					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
IMCRA	Central Bass Strait	8.88	-	-	0.08	-	-	3.88	-	-	0.08	-	-
	Central Victoria	7.13	-	-	0.08	-	-	3.42	-	-	0.13	-	-
	Otway*	1.00	8.38	-	0.25	-	-	0.88	8.54	-	0.29	-	-
KEF	Bonney Coast Upwelling	6.21	-	-	0.08	-	-	11.67	-	-	0.08	-	-
MNP	Twelve Apostles	2.42	22.33	-	0.21	-	-	2.13	8.54	-	0.21	-	-
RSB	Bravenes Rock	28.33	-	-	0.04	-	-	18.38	-	-	0.04	-	-
Nearshore Waters	Colac Otway	3.96	-	-	0.08	-	-	6.54	-	-	0.13	-	-
	Corangamite	2.58	13.92	-	0.25	-	-	2.50	-	-	0.29	-	-
	Lady Julia Percy Island	-	-	-	-	-	-	13.58	-	-	0.04	-	-
	Moyne	2.08	-	-	0.13	-	-	2.29	-	-	0.17	-	-
	Warrnambool	-	-	-	-	-	-	5.96	-	-	0.04	-	-
State Waters	Victoria State Waters	1.50	8.38	-	0.25	-	-	1.17	8.54	-	0.29	-	-
Nearshore Waters (Sub-LGA)	Apollo Bay	13.5	-	-	0.04	-	-	12.63	-	-	0.04	-	-
	Bay of Islands	2.08	-	-	0.13	-	-	2.29	-	-	0.17	-	-
	Cape Otway West	3.96	-	-	0.08	-	-	6.54	-	-	0.13	-	-
	Childers Cove	18.08	-	-	0.04	-	-	3.29	-	-	0.08	-	-
	Moonlight Head	2.58	13.92	-	0.25	-	-	2.13	15.58	-	0.29	-	-
	Port Campbell	3.50	-	-	0.13	-	-	2.50	-	-	0.17	-	-
	Warrnambool	-	-	-	-	-	-	18.67	-	-	0.04	-	-

*The release location resides within the receptor boundaries.

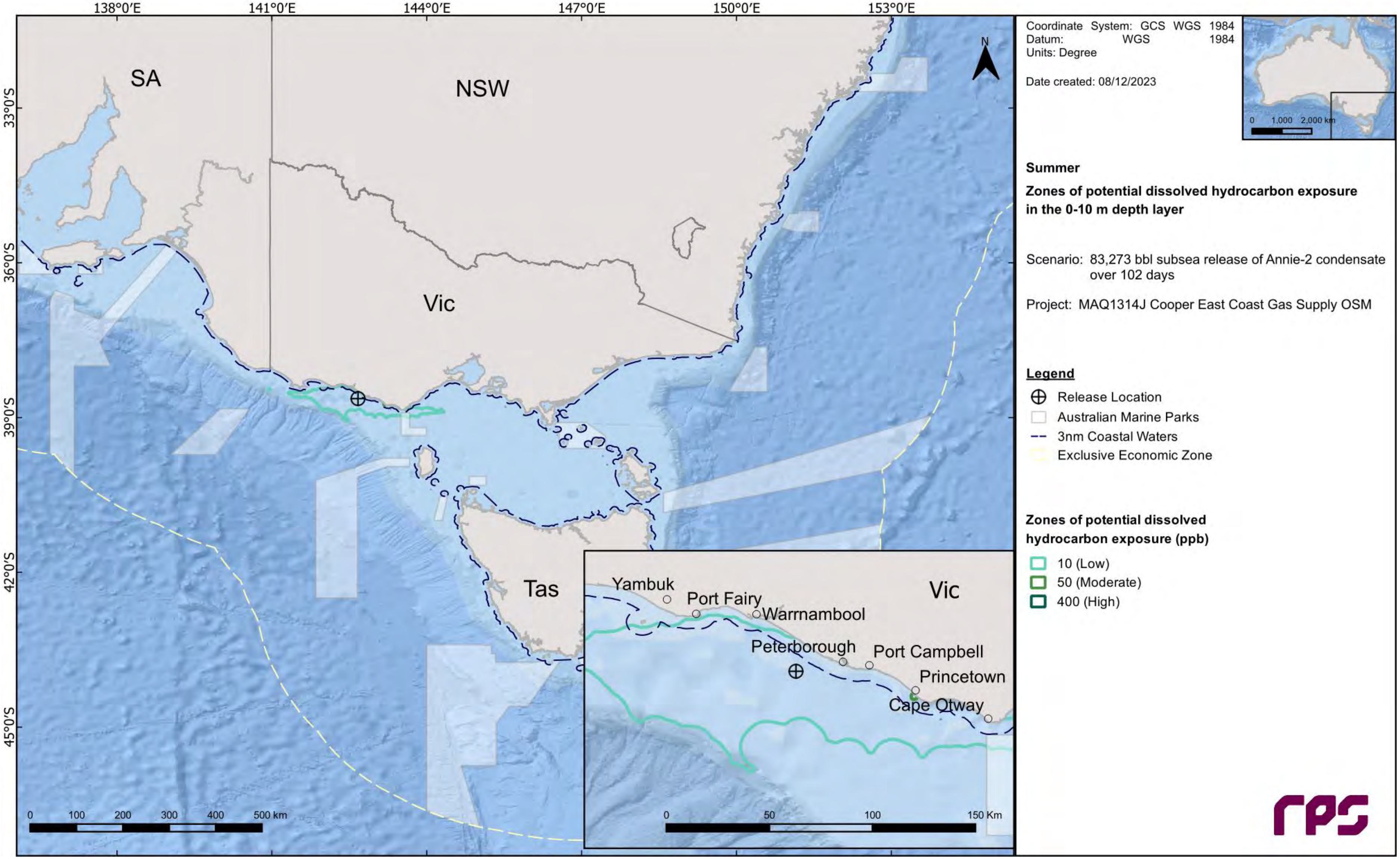


Figure 12.9 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

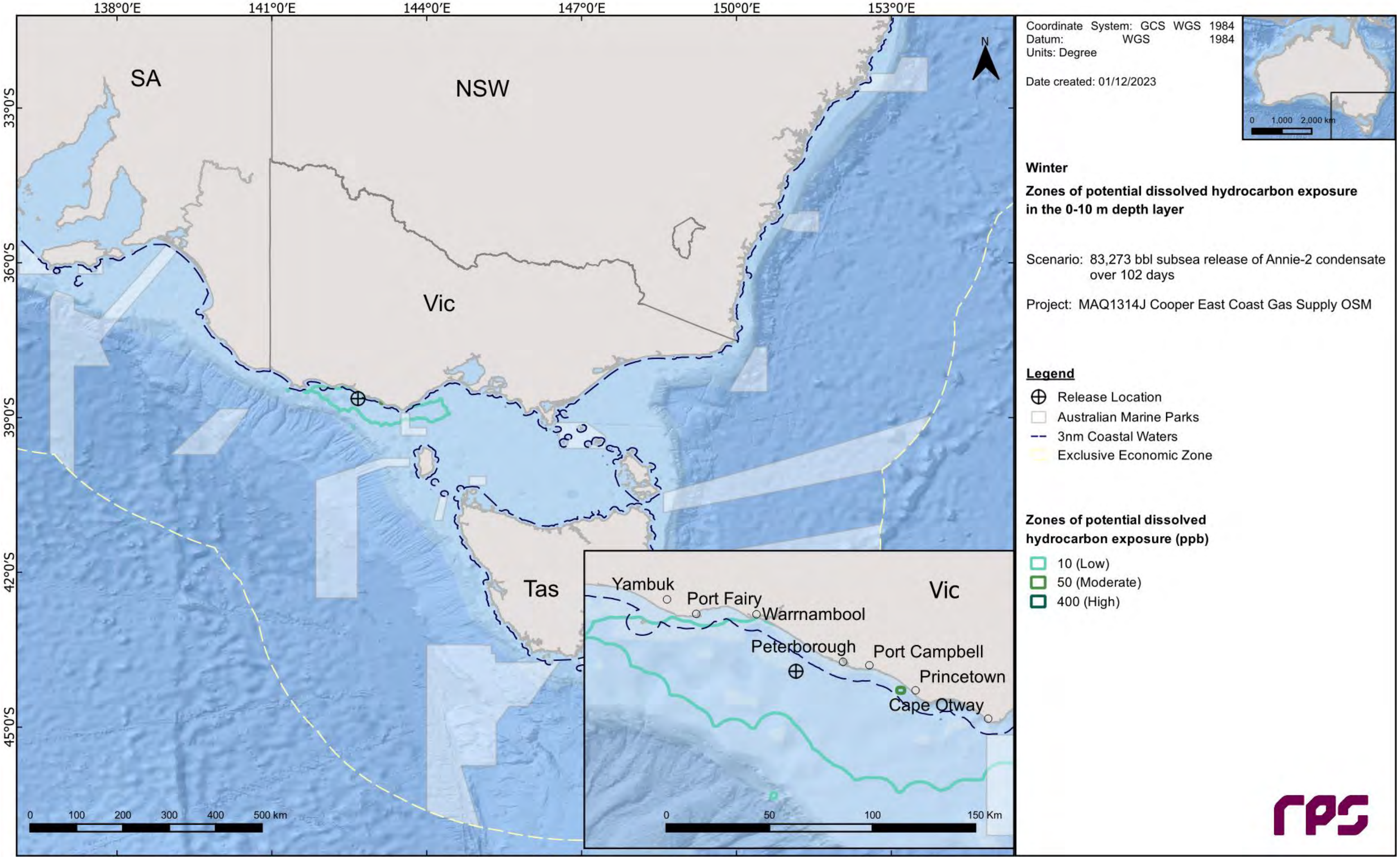


Figure 12.10 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

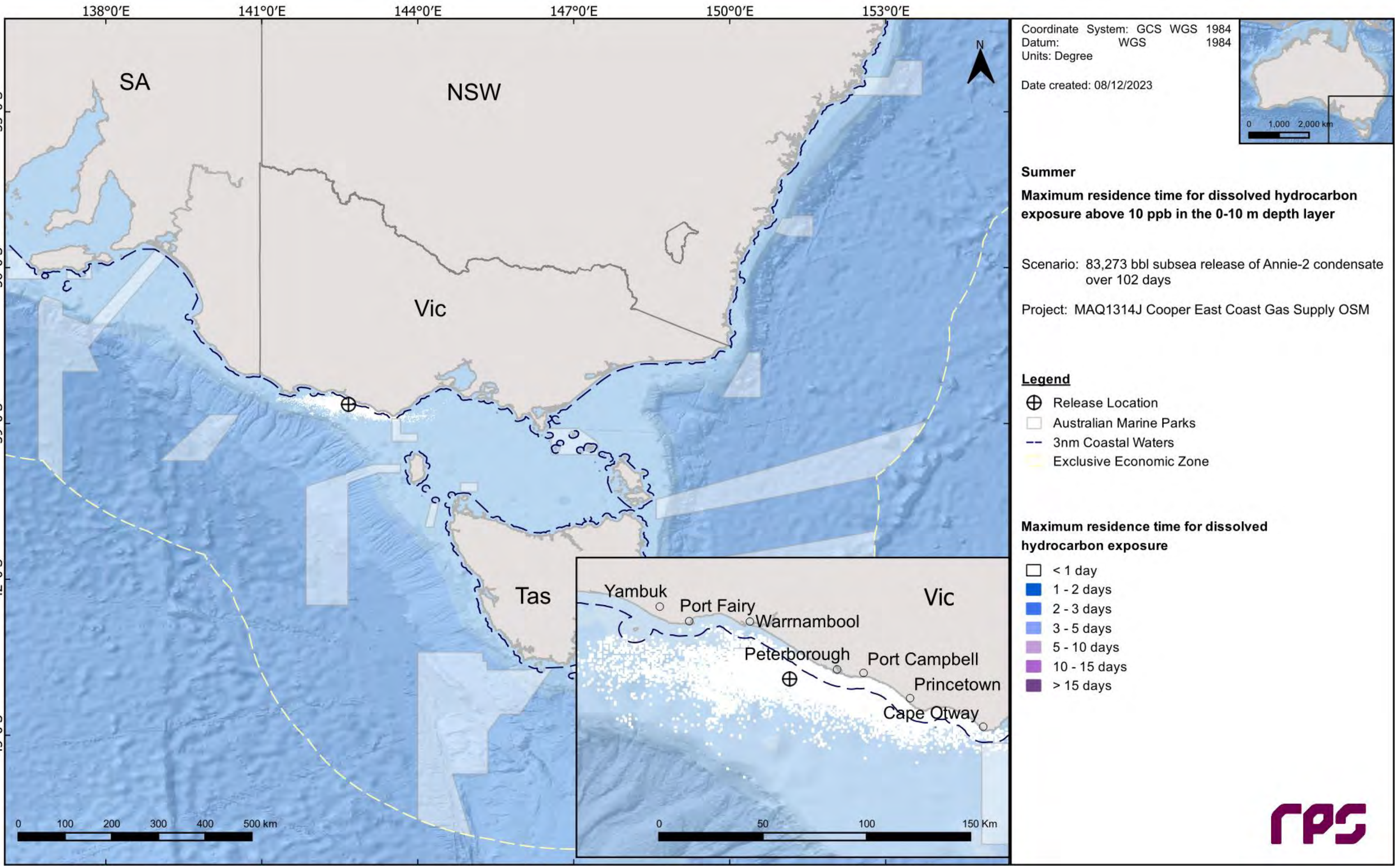


Figure 12.11 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

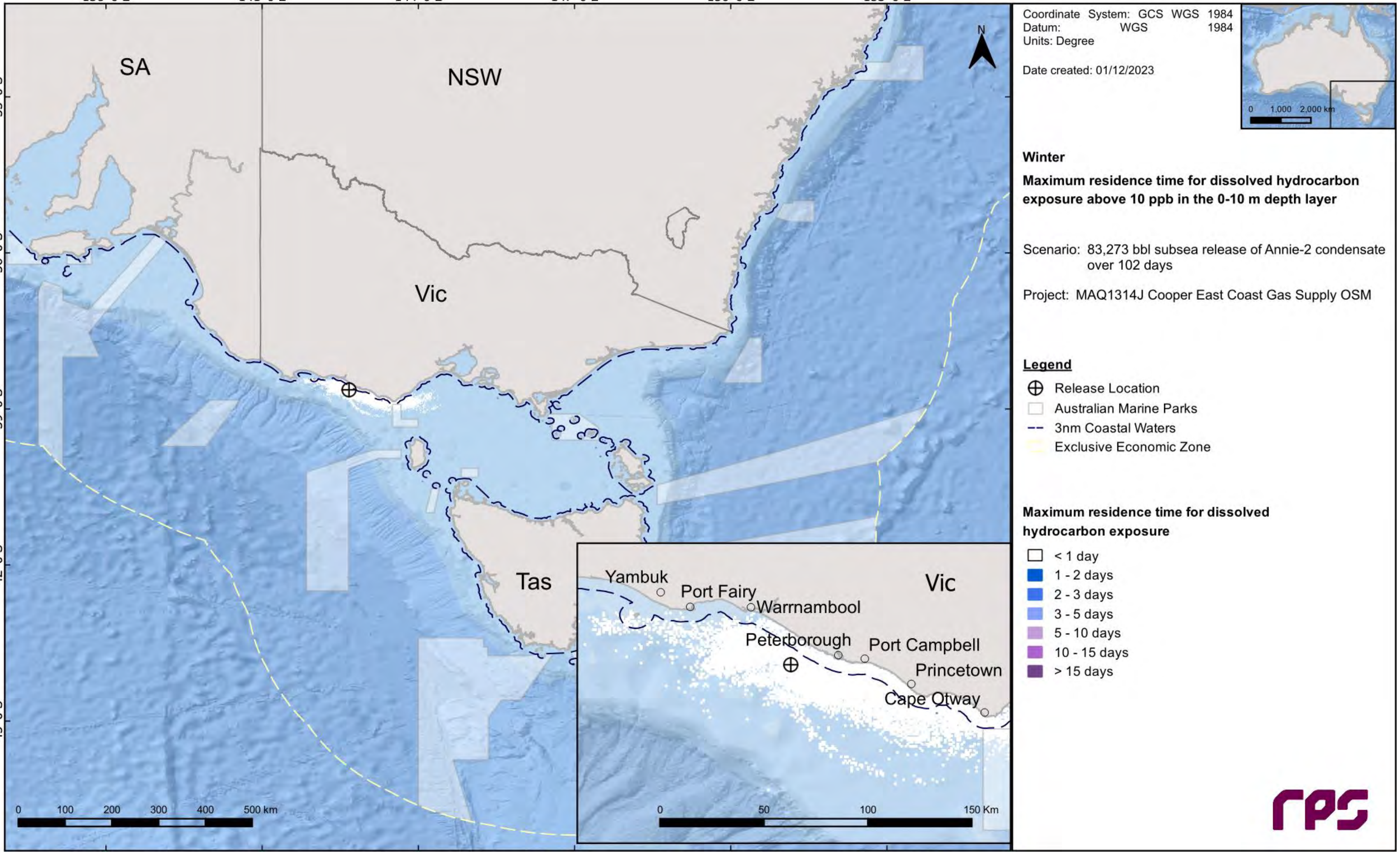


Figure 12.12 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

12.1.3.2 Entrained Hydrocarbons

Table 12.9 summarises the potential in-water exposure to individual receptors from entrained hydrocarbons in the 0-10 m depth layer.

Many receptors were exposed above the low and high thresholds, however most of these receptors (predominantly BIAs) coincided with the release location.

In summer conditions, the highest probability of low entrained hydrocarbon exposure was recorded at 100% for receptors that the release location doesn't reside within, including Southern Right Whale – Aggregation BIA and Warrnambool Plain IBRA. Additional receptors including sub-LGAs, and AMPs were predicted with entrained hydrocarbon exposure (refer to Table 11.9). Similarly, during winter several receptors that the release location doesn't reside within revealed probabilities of 100% for low entrained hydrocarbon exposure.

Table 12.10 presents the predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer, for all thresholds assessed.

Figure 12.13 and Figure 12.14 present the zones of potential entrained hydrocarbon exposure for the 0-10 m depth layer for each season whilst Figure 12.15 to Figure 12.18 present the maximum residence time of entrained hydrocarbon exposure for the NOPSEMA thresholds.

Table 12.9 Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer. Results are based on an 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
AMP	Apollo	165.5	82	16	216.7	93	31
	Beagle	36.8	39	-	37.1	59	-
	East Gippsland	11.0	3	-	10.3	1	-
	Franklin	11.7	3	-	9.2	-	-
	Nelson	18.9	6	-	16.1	3	-
	Zeehan	33.8	15	-	19.1	7	-
BIA	Antipodean Albatross - Foraging*	940.7	100	100	1,534.8	100	100
	Australasian Gannet - Foraging	148.6	72	19	243	77	5
	Australian Sea Lion - Foraging	17.0	20	-	11.9	1	-
	Black Petrel - Foraging	25.1	4	-	15.3	6	-
	Black-browed Albatross - Foraging*	940.7	100	100	1,534.8	100	100
	Black-faced Cormorant - Foraging	19.1	10	-	18.7	7	-
	Bullers Albatross - Foraging*	940.7	100	100	1,534.8	100	100
	Campbell Albatross - Foraging*	940.7	100	100	1,534.8	100	100
	Common Diving-petrel - Foraging*	940.7	100	100	1,534.8	100	100
	Crested Tern - Breeding	14.3	4	-	13.4	6	-
	Crested Tern - Foraging	16.0	4	-	15.3	6	-
	Flesh-footed Shearwater - Foraging	25.1	4	-	15.3	6	-
	Great-winged Petrel - Foraging	25.1	3	-	12.4	6	-
	Grey Nurse Shark - Foraging	24.6	12	-	14.7	12	-
	Grey Nurse Shark - Migration	41.4	14	-	16.3	14	-
	Humpback Whale - Foraging	42.6	14	-	18.4	14	-
	Indian Yellow-nosed Albatross - Foraging*	940.7	100	100	1,534.8	100	100
	Indo-Pacific/Spotted Bottlenose Dolphin - Breeding	16.8	11	-	13.4	6	-
	Little Penguin - Breeding	14.5	4	-	14.5	6	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Little Penguin - Foraging	33.0	47	-	45.1	73	-
	Northern Giant Petrel - Foraging	25.1	3	-	12.4	6	-
	Pygmy Blue Whale - Distribution*	940.7	100	100	1,534.8	100	100
	Pygmy Blue Whale - Foraging*	940.7	100	100	1,534.8	100	100
	Pygmy Blue Whale - Foraging annual high use area*	940.7	100	100	1,534.8	100	100
	Pygmy Blue Whale - Known Foraging Area	180.1	81	16	208.6	93	31
	Short-tailed Shearwater - Foraging	300.8	98	90	379.4	100	100
	Shy Albatross - Foraging*	940.7	100	100	1,534.8	100	100
	Soft-plumaged Petrel - Foraging	10.1	1	-	7.4	-	-
	Sooty Shearwater - Foraging	36.1	13	-	16.3	14	-
	Southern Giant Petrel - Foraging	25.1	3	-	12.4	6	-
	Southern Right Whale - Aggregation	833.2	100	100	1,262.8	100	100
	Southern Right Whale - Connecting Habitat	11.7	2	-	14.8	7	-
	Southern Right Whale - Known Core Range*	940.7	100	100	1,534.8	100	100
	Wandering Albatross - Foraging*	940.7	100	100	1,534.8	100	100
	Wedge-tailed Shearwater - Foraging*	940.7	100	100	1,534.8	100	100
	White Shark - Breeding	23.3	37	-	28.4	56	-
	White Shark - Distribution*	940.7	100	100	1,534.8	100	100
	White Shark - Foraging	218.7	87	34	243	79	24
	White-capped Albatross - Foraging	25.1	3	-	12.4	6	-
	White-faced Storm-petrel - Breeding	25.1	8	-	15.3	7	-
	White-faced Storm-petrel - Foraging	153.7	81	11	208.6	93	23
	Wilsons Storm Petrel - Migration	25.1	3	-	12.4	6	-
IBRA	Bateman	11.4	3	-	11.6	4	-
	Bridgewater	113.5	52	8	104.1	20	2
	East Gippsland Lowlands	17.4	7	-	12.3	9	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Flinders	23.7	20	-	31.4	21	-
	Gippsland Plain	65.3	41	-	77.0	66	-
	Glenelg Plain	148.6	53	11	108.5	22	2
	King Island	11.7	1	-	14.8	7	-
	Otway Plain	260	94	58	252	98	82
	Otway Ranges	209.7	97	65	259.5	100	92
	Strzelecki Ranges	30.4	40	-	35.5	65	-
	Tasmanian West	10.0	1	-	7.1	-	-
	Warrnambool Plain	513.7	100	98	626.6	100	100
	Wilsons Promontory	72.4	43	-	81.4	69	-
IMCRA	Batemans Shelf	20	7	-	15.3	7	-
	Central Bass Strait	135.9	76	11	204.1	91	17
	Central Victoria	149.6	80	13	208.6	93	25
	Coorong	10.9	1	-	9.0	-	-
	Flinders	73.3	43	-	82.9	69	-
	Franklin	10.6	1	-	8.0	-	-
	Otway*	940.7	100	100	1,534.8	100	100
	Twofold Shelf	42.6	21	-	29.2	28	-
	Victorian Embayments	31.8	27	-	30.6	50	-
KEF	Big Horseshoe Canyon	11.7	2	-	9.9	-	-
	Bonney Coast Upwelling	148.6	73	19	243	53	7
	Canyons on the Eastern Continental Slope	25.1	2	-	9.1	-	-
	Shelf rocky reefs	13.9	4	-	13.4	6	-
	Upwelling East of Eden	42.6	18	-	20.6	21	-
	West Tasmania Canyons	44.6	23	-	38.3	14	-
MNP	Bunurong	33.8	29	-	32.1	52	-
	Cape Howe	18.9	12	-	13.3	8	-
	Churchill Island	23.8	10	-	20.0	12	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Discovery Bay	51.1	47	-	41.9	13	-
	Point Addis	57.4	28	-	58.6	39	-
	Point Hicks	11.3	3	-	11.1	4	-
	Port Phillip Heads	33.0	25	-	37.0	29	-
	Twelve Apostles	455.9	99	98	572.8	100	100
	Wilsons Promontory	73.3	43	-	82.9	69	-
MP	Batemans	14.3	4	-	13.4	6	-
	Lower South East	26.5	15	-	27.3	4	-
	Upper South East	12.8	2	-	4.4	-	-
MS	Mushroom Reef	19.2	22	-	24.2	48	-
NPS4	Bunurong Marine Park	40.2	31	-	48.1	49	-
	Wilsons Promontory Marine Park	64.3	41	-	75.2	61	-
RAMSAR	Port Phillip Bay Western Shoreline and Bellarine Peninsula	23.6	17	-	23.3	10	-
	Western Port	23.8	10	-	22.3	25	-
RSB	Bell Reef	11.0	1	-	7.2	-	-
	Bravenes Rock	181.0	91	41	177.2	98	55
	Cody Bank	21.3	40	-	29.6	61	-
	Cutter Rock	26.8	24	-	33.6	18	-
	New Zealand Star Bank	20.0	11	-	14.4	13	-
Nearshore Waters	Anser Island	62.4	43	-	67.1	67	-
	Bass Coast	40.2	31	-	52.2	53	-
	Bega Valley	16.8	6	-	11.6	5	-
	Colac Otway	260.0	96	58	259.5	100	82
	Corangamite	522.4	100	97	572.8	100	100
	Curtis Island	23.7	11	-	31.4	10	-
	East Gippsland	17.4	6	-	12.2	7	-
	French Island	8.3	-	-	13.3	5	-
	Gabo Island	17.1	7	-	12.3	9	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Glenelg	146.4	53	11	108.5	22	2
	Glennie Group	66.3	43	-	73.3	69	-
	Grant	36.7	23	-	35.9	5	-
	Greater Geelong	57.8	24	-	58.3	16	-
	Hogan Island Group	22.4	20	-	28.9	21	-
	Kanowna Island	58.5	43	-	63.1	66	-
	King Island	11.7	1	-	14.8	7	-
	Lady Julia Percy Island	134.8	64	19	243.0	44	5
	Laurence Rocks	108.3	53	4	90.1	22	-
	Moncoeur Islands	35.0	39	-	27.6	52	-
	Montague Island	11.4	3	-	11.6	4	-
	Mornington Peninsula	42.6	31	-	37.5	53	-
	Moyne	508.9	100	98	626.6	100	95
	Mud Island	14.8	10	-	16.2	4	-
	Norman Island	72.4	42	-	80.8	69	-
	Phillip Island	28.9	31	-	33.6	58	-
	Robe	10.9	1	-	3.2	-	-
	Rodondo Island	45.9	41	-	44.8	60	-
	Seal Islands	8.7	-	-	13.9	15	-
	Shellback Island	52.9	41	-	66.4	60	-
	Skull Rock	54.0	42	-	60.8	66	-
	South Gippsland	69.1	43	-	79.2	68	-
	Surf Coast	56.7	31	-	56.3	55	-
	Warrnambool	257.7	95	29	310.5	62	23
	Wattle Range	14.4	4	-	14.4	3	-
	West Coast	10.0	1	-	7.1	-	-
State Waters	New South Wales	16.8	11	-	13.4	6	-
	South Australia State Waters	40.1	26	-	38.7	5	-
	Tasmania State Waters	29.2	21	-	35.0	26	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Victoria State Waters	640.5	100	100	626.6	100	100
Nearshore Waters (Sub-LGA)	Anglesea	42.6	20	-	43.0	25	-
	Apollo Bay	153.7	84	10	108.8	93	3
	Bay of Islands	508.9	100	98	626.6	100	95
	Bega Valley	16.8	6	-	11.6	5	-
	Cape Howe / Mallacoota	17.4	6	-	12.2	7	-
	Cape Liptrap – Northwest	36.9	40	-	45.9	66	-
	Cape Nelson	146.4	53	11	108.5	22	2
	Cape Otway West	260	96	59	259.5	100	84
	Cape Patton	84.3	70	-	79.2	89	-
	Childers Cove	320.9	100	60	313.1	87	31
	Croajingolong - East	10.6	1	-	10.5	1	-
	Croajingolong - West	10.2	1	-	10.0	1	-
	Discovery Bay - East	46.3	36	-	39.3	11	-
	Discovery Bay - West	28.5	28	-	28.6	5	-
	French Island - East	5.4	-	-	13.2	2	-
	French Island / Crib Point	8.1	-	-	13.6	8	-
	French Island / San Remo	23.5	21	-	25.2	35	-
	Kilcunda	39.6	29	-	52.1	53	-
	Lorne	42.0	38	-	41.6	62	-
	Moonlight Head	455.9	99	97	572.8	100	100
	Mornington Peninsula - South	30.0	31	-	27.1	50	-
	Mornington Peninsula - Southwest	42.6	30	-	37.5	52	-
	Point Hicks	10.1	1	-	10.7	4	-
	Port Campbell	522.4	100	97	482.4	100	96
	Port Fairy	187.1	67	8	200.1	41	5
	Port Phillip - Queenscliff	42.7	24	-	42.5	16	-
	Port Phillip - Sorrento Shore	36.2	26	-	37.0	41	-
	Port Phillip Heads	30.5	21	-	27.4	13	-

Receptor	Summer: Maximum entrained hydrocarbon exposure (ppb)	Summer: Probability of entrained hydrocarbon exposure (%)		Winter: Maximum entrained hydrocarbon exposure (ppb)	Winter: Probability of entrained hydrocarbon exposure (%)	
		Low	High		Low	High
Portland Bay - East	79.3	59	-	94.7	32	-
Portland Bay - West	91.1	47	-	84.7	18	-
Torquay	57.8	22	-	58.3	18	-
Venus Bay	40.2	31	-	52.2	53	-
Waratah Bay	30.4	40	-	35.5	65	-
Warrnambool	213.4	82	12	197.1	57	16
Westernport	18.0	16	-	22.3	47	-
Wilsons Promontory - East	42.3	42	-	46.1	64	-
Wilsons Promontory - West	69.1	43	-	79.2	68	-

*The release location resides within the receptor boundaries.

Table 12.10 Predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on an 83,273 bbl (13,239 m^3) subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
AMP	Apollo	2.88	10.67	39.33	0.42	2.63	3.5	24.21	0.58
	Beagle	16.71	-	7.58	-	16.96	-	8	-
	East Gippsland	90.33	-	0.13	-	64.08	-	0.04	-
	Franklin	64.92	-	0.08	-	-	-	-	-
	Nelson	16.63	-	1.96	-	80.13	-	1.25	-
	Zeehan	14.21	-	7.13	-	16.08	-	3.08	-
BIA	Antipodean Albatross – Foraging*	0.04	0.08	101.71	24.83	0.04	0.04	109.29	21.88
	Australasian Gannet – Foraging	2.33	7.04	89.83	6.63	5.42	9.25	99.83	3.08
	Australian Sea Lion – Foraging	10.13	-	0.63	-	75.33	-	0.08	-
	Black Petrel – Foraging	60.13	-	1.63	-	63.67	-	0.75	-
	Black-browed Albatross – Foraging*	0.04	0.08	101.88	24.83	0.04	0.04	109.29	26.29
	Black-faced Cormorant – Foraging	23.33	-	2.08	-	17.79	-	0.54	-
	Bullers Albatross – Foraging*	0.04	0.08	101.88	24.83	0.04	0.04	109.29	26.29
	Campbell Albatross – Foraging*	0.04	0.08	101.88	24.83	0.04	0.04	109.29	26.29
	Common Diving-petrel – Foraging*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
	Crested Tern – Breeding	85.25	-	0.58	-	64.13	-	0.33	-
	Crested Tern – Foraging	60.63	-	1	-	63.67	-	0.75	-
	Flesh-footed Shearwater – Foraging	60.13	-	1.63	-	63.67	-	0.75	-
	Great-winged Petrel – Foraging	60.13	-	1.63	-	65.21	-	0.08	-
	Grey Nurse Shark – Foraging	57.46	-	1.42	-	33.54	-	0.33	-
	Grey Nurse Shark – Migration	29.83	-	1.79	-	33.50	-	0.75	-
	Humpback Whale – Foraging	29.50	-	1.79	-	32.75	-	0.75	-
	Indian Yellow-nosed Albatross – Foraging*	0.04	0.08	101.88	24.83	0.04	0.04	109.29	26.29

Receptor	Summer				Winter			
	Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
	Low	High	Low	High	Low	High	Low	High
Indo-Pacific/Spotted Bottlenose Dolphin – Breeding	57.08	-	1.92	-	33.71	-	0.33	-
Little Penguin – Breeding	85.13	-	1	-	64.08	-	0.75	-
Little Penguin – Foraging	15.42	-	12	-	10.96	-	25.63	-
Northern Giant Petrel – Foraging	60.13	-	1.63	-	65.21	-	0.08	-
Pygmy Blue Whale – Distribution*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
Pygmy Blue Whale – Foraging*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
Pygmy Blue Whale – Foraging annual high use area*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
Pygmy Blue Whale – Known Foraging Area	2.42	6.71	54.83	1.21	2.29	3.63	46.42	1.13
Short-tailed Shearwater – Foraging	1.58	4.13	99.71	24.25	1.13	2.38	110.54	13.79
Shy Albatross – Foraging*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
Soft-plumaged Petrel – Foraging	82.17	-	0.04	-	-	-	-	-
Sooty Shearwater – Foraging	30.17	-	1.79	-	44.38	-	0.75	-
Southern Giant Petrel – Foraging	60.13	-	1.63	-	65.21	-	0.08	-
Southern Right Whale - Aggregation*	0.04	0.08	89.83	35.46	0.04	0.08	102.58	22.88
Southern Right Whale – Connecting Habitat	48.04	-	0.08	-	19.88	-	1.08	-
Southern Right Whale – Known Core Range*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
Wandering Albatross – Foraging*	0.04	0.08	101.88	24.83	0.04	0.04	109.29	26.29
Wedge-tailed Shearwater – Foraging*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
White Shark – Breeding	49.42	-	9.38	-	19.38	-	30.75	-
White Shark – Distribution*	0.04	0.08	101.88	24.83	0.04	0.04	109.29	26.29
White Shark – Foraging	1.25	3	89.83	1.92	2.13	6.83	99.83	22.88
White-capped Albatross – Foraging	60.13	-	1.63	-	65.21	-	0.08	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	White-faced Storm-petrel – Breeding	59.50	-	1.63	-	45.38	-	0.75	-
	White-faced Storm-petrel – Foraging	2.50	10.79	54.46	0.42	2.79	4	46.42	1.13
	Wilsons Storm Petrel – Migration	60.13	-	1.63	-	65.21	-	0.08	-
IBRA	Bateman	85.42	-	0.08	-	64.38	-	0.04	-
	Bridgewater	5.38	26.46	61.63	1.38	19.75	99.46	44.58	0.04
	East Gippsland Lowlands	53.63	-	2.42	-	40.38	-	0.17	-
	Flinders	20.63	-	4.5	-	18.54	-	3.08	-
	Gippsland Plain	15.63	-	28.92	-	11.42	-	50.67	-
	Glenelg Plain	4.63	8.71	78.42	5.88	19.38	99.04	48.58	0.13
	King Island	35.42	-	0.08	-	19.88	-	1.08	-
	Otway Plain	2.21	7.29	85.25	23.38	2.25	2.88	83.08	13.71
	Otway Ranges	1.88	6.42	99.71	12.54	1.92	5.42	101.92	9.13
	Strzelecki Ranges	15.71	-	16.38	-	19.08	-	18.42	-
	Tasmanian West	89.42	-	0.04	-	-	-	-	-
	Warrnambool Plain	0.83	1.33	99.63	35.21	0.63	1.29	111.08	41.79
	Wilsons Promontory	13.83	-	53.54	-	10.88	-	69.54	-
IMCRA	Batemans Shelf	59.58	-	1	-	45.58	-	0.75	-
	Central Bass Strait	3.38	11.79	21.54	0.38	2.92	3.71	21.75	1.13
	Central Victoria	2.88	10.79	46.54	0.42	2.79	3.63	46.42	0.54
	Coorong	23.75	-	0.04	-	-	-	-	-
	Flinders	13.08	-	53.83	-	10.29	-	69.54	-
	Franklin	82.17	-	0.04	-	-	-	-	-
	Otway*	0.04	0.08	109.38	35.46	0.04	0.04	112.54	42.17
	Twofold Shelf	17.63	-	5.17	-	17.58	-	3.67	-
	Victorian Embayments	31.58	-	10.83	-	15.04	-	16.92	-
KEF	Big Horseshoe Canyon	55.88	-	0.04	-	-	-	-	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Bonney Coast Upwelling	2.13	7.04	89.83	6.63	6.63	8.92	99.83	4.25
	Canyons on the Eastern Continental Slope	60.17	-	1.38	-	-	-	-	-
	Shelf rocky reefs	85.00	-	0.42	-	64.00	-	0.33	-
	Upwelling East of Eden	29.42	-	3	-	32.58	-	2.96	-
	West Tasmania Canyons	12.13	-	11.42	-	12.25	-	2.75	-
MNP	Bunurong	16	-	8.5	-	17.04	-	13.13	-
	Cape Howe	53.54	-	2.38	-	40.50	-	0.21	-
	Churchill Island	50.08	-	5.58	-	32.29	-	9.71	-
	Discovery Bay	5.58	-	8.88	-	28.00	-	7	-
	Point Addis	29.13	-	41.67	-	12.75	-	41.83	-
	Point Hicks	77.96	-	0.04	-	54.29	-	0.08	-
	Port Phillip Heads	31.58	-	10.79	-	20.88	-	14	-
	Twelve Apostles	1.25	1.79	109.38	31.04	0.92	1.38	112.54	42.17
	Wilsons Promontory	14	-	53.83	-	10.67	-	69.46	-
MP	Batemans	85.25	-	0.58	-	64.13	-	0.33	-
	Lower South East	15.67	-	4.29	-	56.96	-	11.54	-
	Upper South East	27.21	-	0.08	-	-	-	-	-
MS	Mushroom Reef	36.08	-	8.38	-	15.79	-	3.79	-
NPS4	Bunurong Marine Park	16.92	-	9.63	-	16.75	-	12.42	-
	Wilsons Promontory Marine Park	16.29	-	28.92	-	19.38	-	51.33	-
RAMSAR	Port Phillip Bay Western Shoreline and Bellarine Peninsula	32.67	-	8.17	-	21.42	-	9.21	-
	Western Port	50.08	-	5.58	-	17.5	-	10.63	-
RSB	Bell Reef	92.21	-	0.04	-	-	-	-	-
	Bravenes Rock	1.83	6.21	89.63	1.13	1.71	6.13	84.67	1.54
	Cody Bank	14.79	-	2.54	-	17.5	-	4.17	-
	Cutter Rock	44.08	-	1.75	-	16.96	-	2.21	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	New Zealand Star Bank	52.92	-	2.13	-	39.08	-	1.17	-
Nearshore Waters	Anser Island	16.88	-	52.83	-	16.92	-	65.25	-
	Bass Coast	16.92	-	12	-	16.13	-	21.25	-
	Bega Valley	78.88	-	1.79	-	41.42	-	0.08	-
	Colac Otway	2.17	7.29	85.25	23.38	2.13	2.88	94.04	13.71
	Corangamite	0.79	1.50	99.71	30.88	0.63	1.63	111.08	41.79
	Curtis Island	44.17	-	1	-	18.83	-	1.13	-
	East Gippsland	78.79	-	2	-	40.54	-	0.17	-
	French Island	-	-	-	-	43.21	-	0.17	-
	Gabo Island	53.63	-	2.33	-	40.42	-	0.17	-
	Glenelg	4.63	8.71	78.42	5.88	19.38	99.04	87.17	0.13
	Glennie Group	16.13	-	53.54	-	11.00	-	65.83	-
	Grant	18.42	-	5.58	-	56.33	-	12.17	-
	Greater Geelong	29.83	-	19.63	-	14.17	-	21.38	-
	Hogan Island Group	20.63	-	4.5	-	18.54	-	3.08	-
	Kanowna Island	14.04	-	52.13	-	14.83	-	62.54	-
	King Island	35.42	-	0.08	-	19.88	-	1.08	-
	Lady Julia Percy Island	3.00	15.71	65.63	1.88	8.96	9.29	97.08	3.08
	Laurence Rocks	4.33	32.63	79.58	0.38	15.29	-	27.29	-
	Moncoeur Islands	17.04	-	8.21	-	17.42	-	6.13	-
	Montague Island	85.42	-	0.08	-	64.38	-	0.04	-
	Mornington Peninsula	31.71	-	10.63	-	11.42	-	11.25	-
	Moyne	0.83	1.33	92.88	29	0.71	1.29	98.92	20.63
	Mud Island	43.04	-	0.96	-	56.50	-	1.25	-
	Norman Island	16.00	-	32.88	-	10.88	-	51.88	-
	Phillip Island	16.08	-	11.38	-	14.83	-	22.75	-
	Robe	30.17	-	0.04	-	-	-	-	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Rodondo Island	13.83	-	15.38	-	15.00	-	13	-
	Seal Islands	-	-	-	-	35.79	-	0.42	-
	Shellback Island	15.96	-	23.17	-	19.29	-	33.5	-
	Skull Rock	14.04	-	52.13	-	14.83	-	55.96	-
	South Gippsland	15.63	-	53.17	-	18.42	-	69.46	-
	Surf Coast	29.71	-	45.92	-	13.17	-	46.29	-
	Warrnambool	2.46	3.29	59.08	9.79	1.83	5.25	101.42	6.38
	Wattle Range	25.46	-	0.29	-	66.25	-	1	-
	West Coast	89.42	-	0.04	-	-	-	-	-
State Waters	New South Wales	57.13	-	1.79	-	33.71	-	0.33	-
	South Australia State Waters	15.08	-	9.38	-	55.29	-	12.58	-
	Tasmania State Waters	18.08	-	5.17	-	17.21	-	4.33	-
	Victoria State Waters	0.29	0.38	109.38	35.46	0.29	0.42	112.54	42.17
Nearshore Waters (Sub-LGA)	Anglesea	29.71	-	39.42	-	13.21	-	41.29	-
	Apollo Bay	2.46	28.25	59.04	4.33	2.33	9.63	31.88	0.17
	Bay of Islands	0.83	1.33	92.88	29	0.71	1.29	84.54	20.63
	Bega Valley	78.88	-	1.79	-	41.42	-	0.08	-
	Cape Howe / Mallacoota	78.83	-	2	-	40.38	-	0.17	-
	Cape Liptrap – Northwest	15.63	-	16.42	-	19.33	-	20.13	-
	Cape Nelson	4.58	8.71	78.42	5.88	19.38	99.04	48.58	0.13
	Cape Otway West	2.17	7.17	85.29	23.67	2.13	2.88	94.04	10.29
	Cape Patton	9.33	-	23.13	-	5.25	-	20.63	-
	Childers Cove	0.92	2.75	55.67	35.21	1.75	2.17	51.21	9.38
	Croajingolong – East	78.83	-	0.04	-	76.04	-	0.04	-
	Croajingolong – West	81.46	-	0.04	-	77.42	-	0.04	-
	Discovery Bay – East	9.42	-	14.25	-	32.46	-	18	-
	Discovery Bay – West	15.92	-	14.29	-	57	-	14.54	-

Receptor	Summer				Winter			
	Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
	Low	High	Low	High	Low	High	Low	High
French Island – East	-	-	-	-	74.5	-	1.33	-
French Island / Crib Point	-	-	-	-	42.21	-	0.13	-
French Island / San Remo	35.58	-	6.83	-	16.13	-	16.92	-
Kilcunda	16.96	-	9.17	-	16.42	-	21.25	-
Lorne	26.79	-	20	-	13.67	-	14.29	-
Moonlight Head	1.79	2.33	109.38	27.67	1.21	1.71	111.08	41.79
Mornington Peninsula – South	34.00	-	10.58	-	14.83	-	6.58	-
Mornington Peninsula – Southwest	33.79	-	10.63	-	11.42	-	10	-
Point Hicks	114.54	-	0.04	-	55.04	-	0.04	-
Port Campbell	0.79	1.5	90.63	30.88	0.63	1.63	87.58	24.58
Port Fairy	2.75	12.71	80.04	1.58	8.63	12.25	98.92	13.13
Port Phillip – Queenscliff	29.88	-	19.63	-	15.08	-	20.42	-
Port Phillip – Sorrento Shore	31.71	-	8.96	-	20.96	-	13.79	-
Port Phillip Heads	32.54	-	4.08	-	21	-	10.83	-
Portland Bay – East	6.29	-	68.54	-	9.67	-	96.79	-
Portland Bay – West	11.33	-	66.96	-	20.29	-	87.17	-
Torquay	29.79	-	45.92	-	13.38	-	46.29	-
Venus Bay	16.92	-	12	-	16.75	-	13.17	-
Waratah Bay	15.71	-	16.38	-	19.08	-	18.42	-
Warrnambool	2.50	10.67	85.21	4.13	5.08	5.25	101.42	20.17
Westernport	45.08	-	9.46	-	16.38	-	3.5	-
Wilsons Promontory – East	25.08	-	26.21	-	18.75	-	50.58	-
Wilsons Promontory – West	16.21	-	53.17	-	18.42	-	69.46	-

*The release location resides within the receptor boundaries.

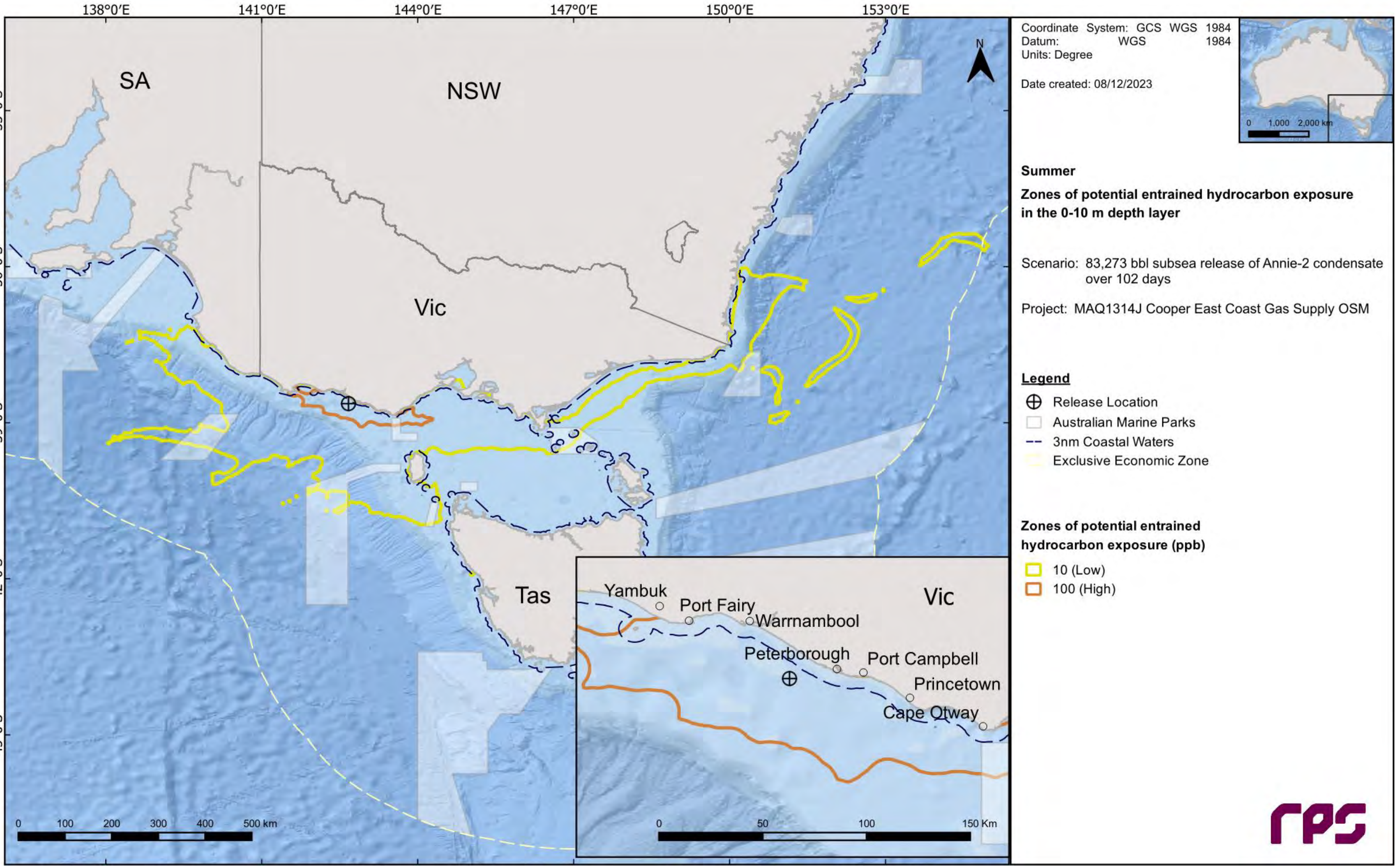


Figure 12.13 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

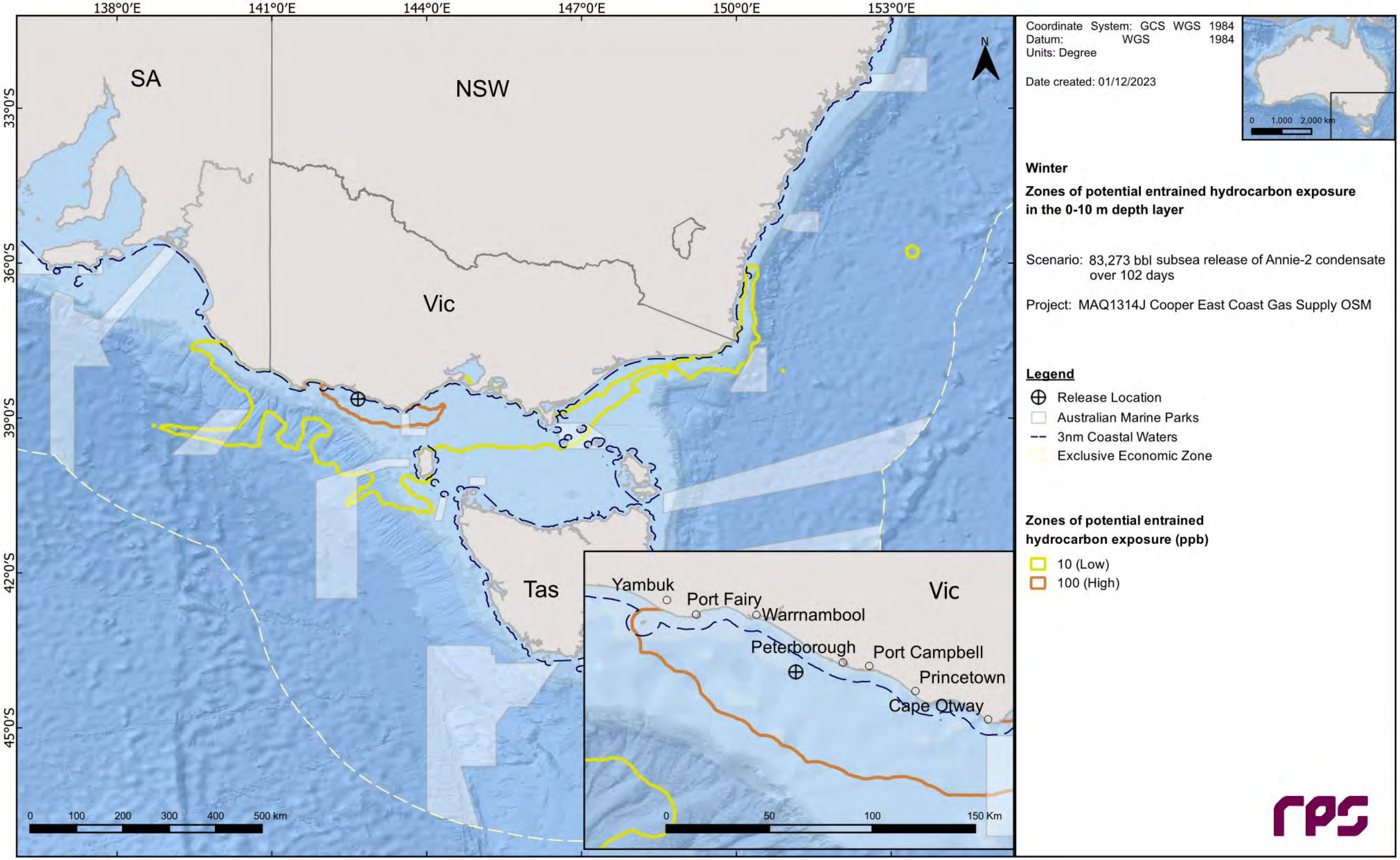


Figure 12.14 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

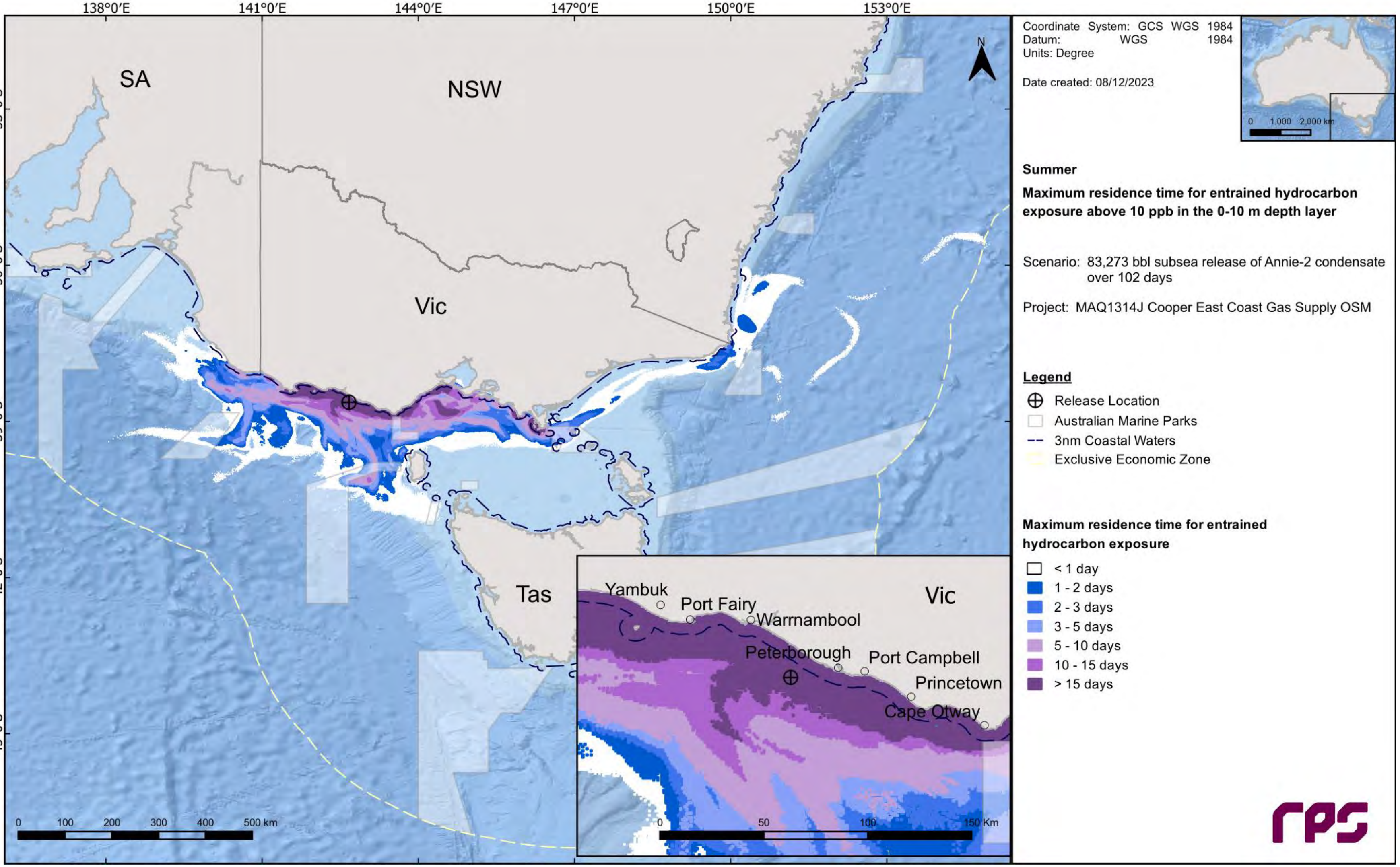


Figure 12.15 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

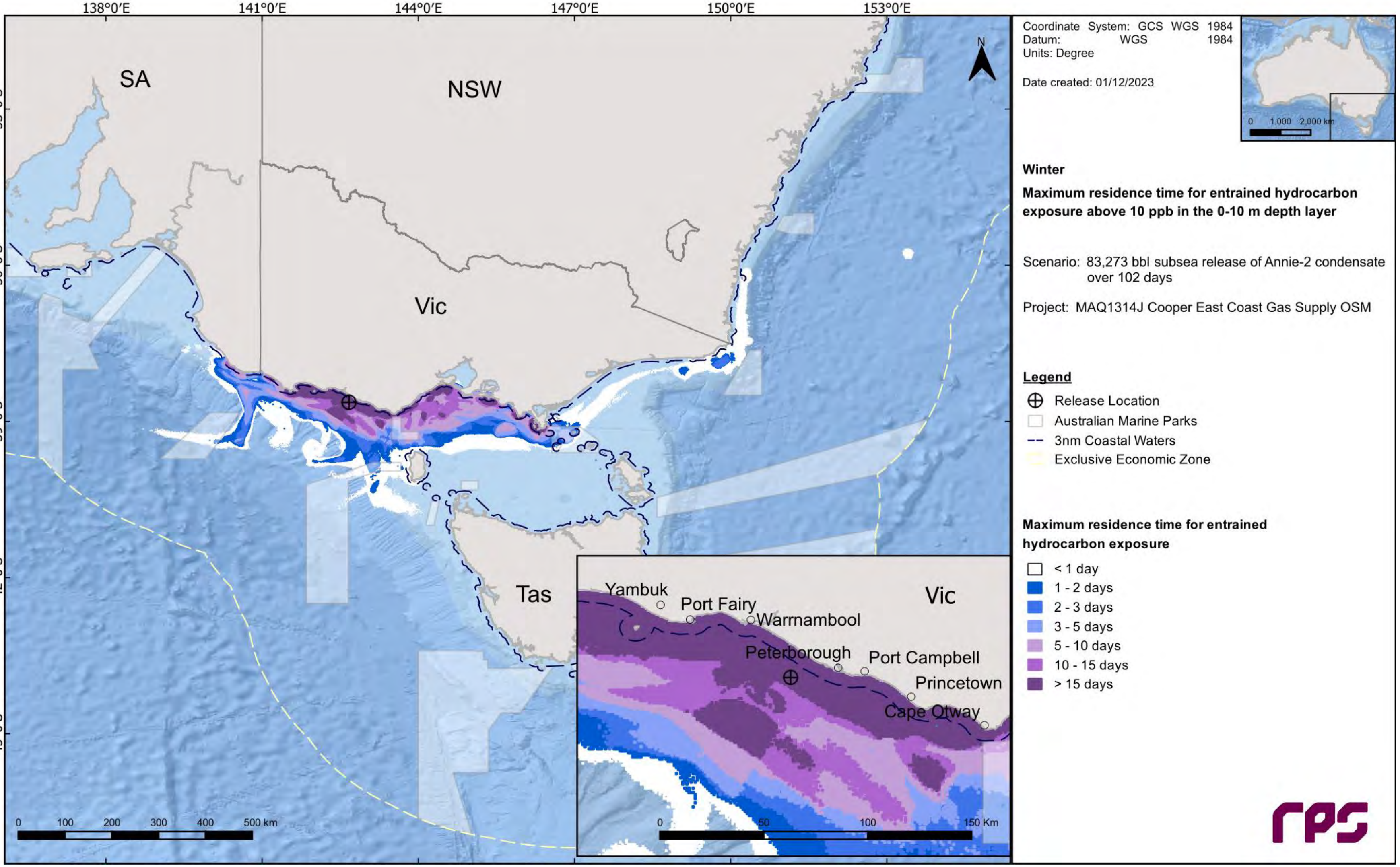


Figure 12.16 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

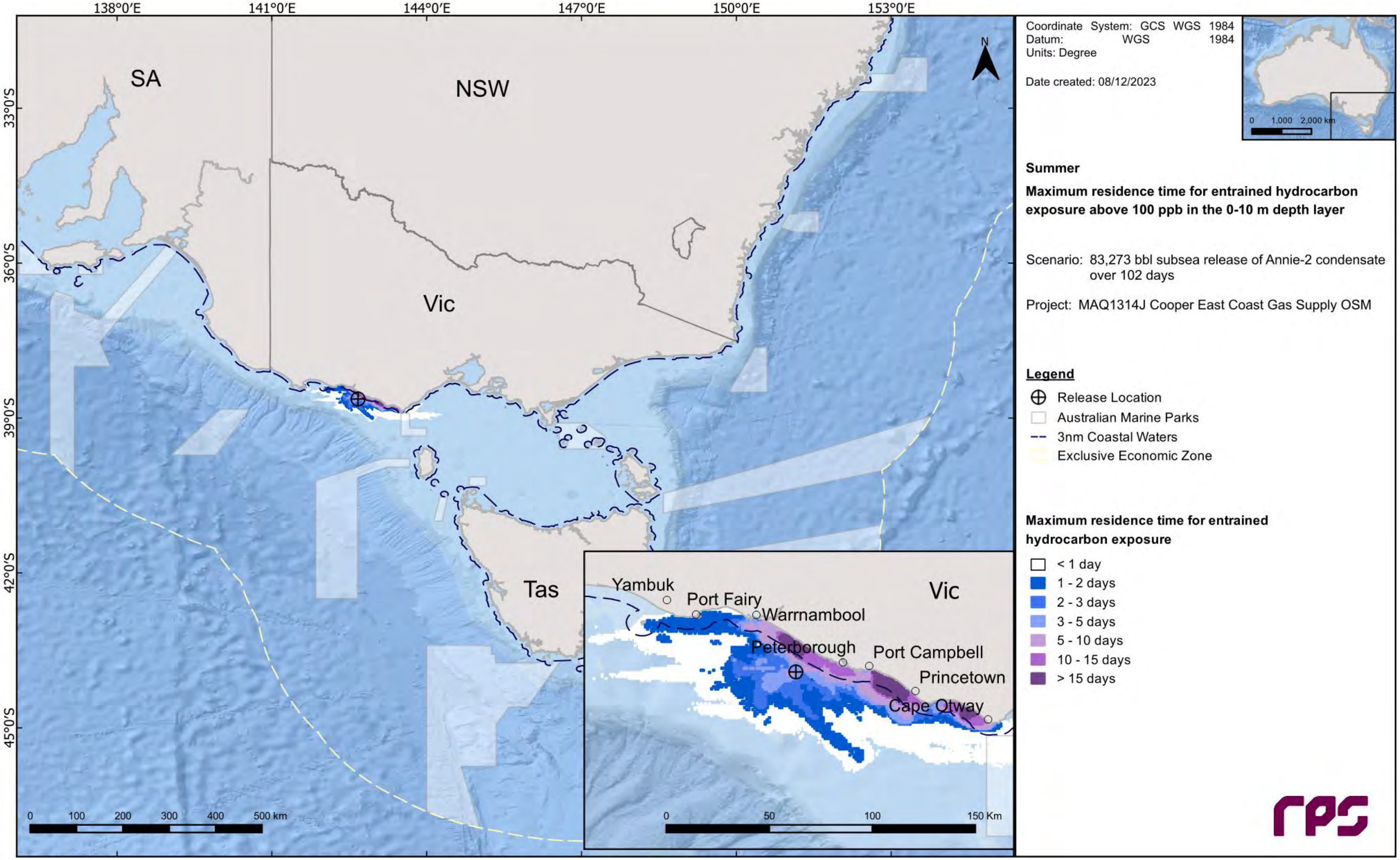


Figure 12.17 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during summer conditions.

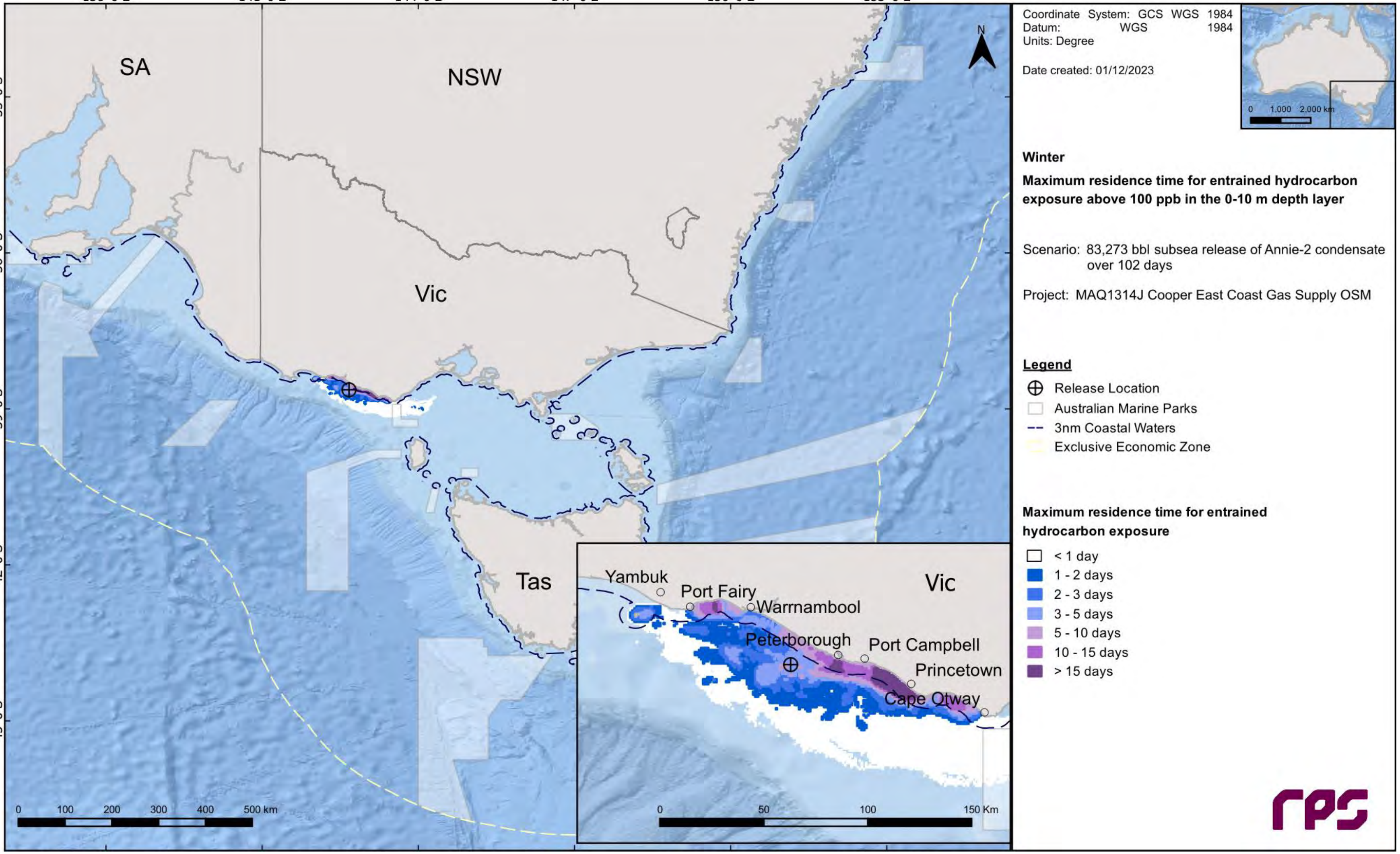


Figure 12.18 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea in the event of an 83,273 bbl subsurface release from a loss of well control at Pecten East-2 over 102 days. The results were calculated from 100 spill simulations during winter conditions.

12.2 Deterministic Analysis

The stochastic modelling results were assessed, and the “worst case” deterministic runs were identified and are presented below for the following criteria:

a. Largest swept area for surface oil above 10 g/m^2;
b. Largest (total) volume of oil ashore;
c. Longest length of shoreline with oil accumulation above 100 g/m^2;
d. Largest area of entrained hydrocarbon exposure above 100 ppb; and
e. Largest area of dissolved hydrocarbon exposure above 50 ppb.

Table 12.11 presents a summary of in-water exposure and shoreline accumulation at the assessed thresholds for the identified deterministic simulations.

Table 12.11 Summary of the worst-case deterministic analysis based on the scenario presented in the stochastic analysis section.

Variable	Threshold	Deterministic Analysis Criteria				
		Largest swept area of floating oil >10 g/m^2	Largest volume of oil ashore	Longest length of shoreline with accumulation >100 g/m^2	Largest area of entrained hydrocarbon exposure >100 ppb	Largest area of dissolved hydrocarbon exposure >50 ppb
Season		Summer	Winter	Summer	Winter	Summer
Run Number		61	13	57	58	68
Total area of floating Oil exposure (km^2)	1 g/m^2	740	270	575	511	329
	10 g/m^2	**45**	8	10	25	8
	50 g/m^2	-	-	-	-	-
Total length of shoreline accumulation (km)	10 g/m^2	134	164	187	133	65
	100 g/m^2	47	69	**71**	45	14
	1,000 g/m^2	-	3	4	-	-
Minimum time before accumulation on any shoreline (hours)	10 g/m^2	60	77	113	207	327
	100 g/m^2	375	103	125	240	390
	1,000 g/m^2	-	1,665	1,147	-	-
Total volume of oil ashore (m^3)		196	**343**	287	184	63
Total area of entrained hydrocarbon exposure (km^2)	10 ppb	25,660	15,963	26,125	22,543	35,799
	100 ppb	3,143	2,678	3,050	**5,589**	2,606
Total area of dissolved hydrocarbon exposure (km^2)	10 ppb	68	216	61	125	131
	50 ppb	-	-	-	-	**1**
	400 ppb	-	-	-	-	-
Start Date		27th April 2010 3 pm	23rd July 2010 4 am	19th March 2012 11 am	3rd August 2014 2 am	29th April 2016 11 am

NC = No contact at, or above the specified shoreline accumulation threshold.

12.2.1 Deterministic Case: Largest swept area of floating oil above 10 g/m²

The deterministic trajectory that resulted in the largest swept area of floating oil above 10 g/m² was identified as summer run number 61, which started on 27th April 2010.

Figure 11.19 illustrates the floating oil exposure and shoreline accumulation over the 116-day simulation.

Figure 11.20 displays the time series of the area of sea surface exposure above the low (1 g/m²), moderate (10 g/m²) and high (50 g/m²) thresholds over the 116-day simulation.

Figure 11.21 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.12 summarises the mass balance peaks and at the end of the simulation.

Table 12.12 Summary of the mass balance for the trajectory with the largest swept area of floating oil above 10 g/m².

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m³)	382.3	20.3	0.1
Entrained (m³)	1,925.8	78.0	1,476.6
Dissolved (m³)	8.1	14.1	0.5
Evaporation (m³)	7,868.8	116.0	7,868.8
Decay (m³)	3,154.7	116.0	3,154.7
Ashore (m³)	199.6	107.8	195.9

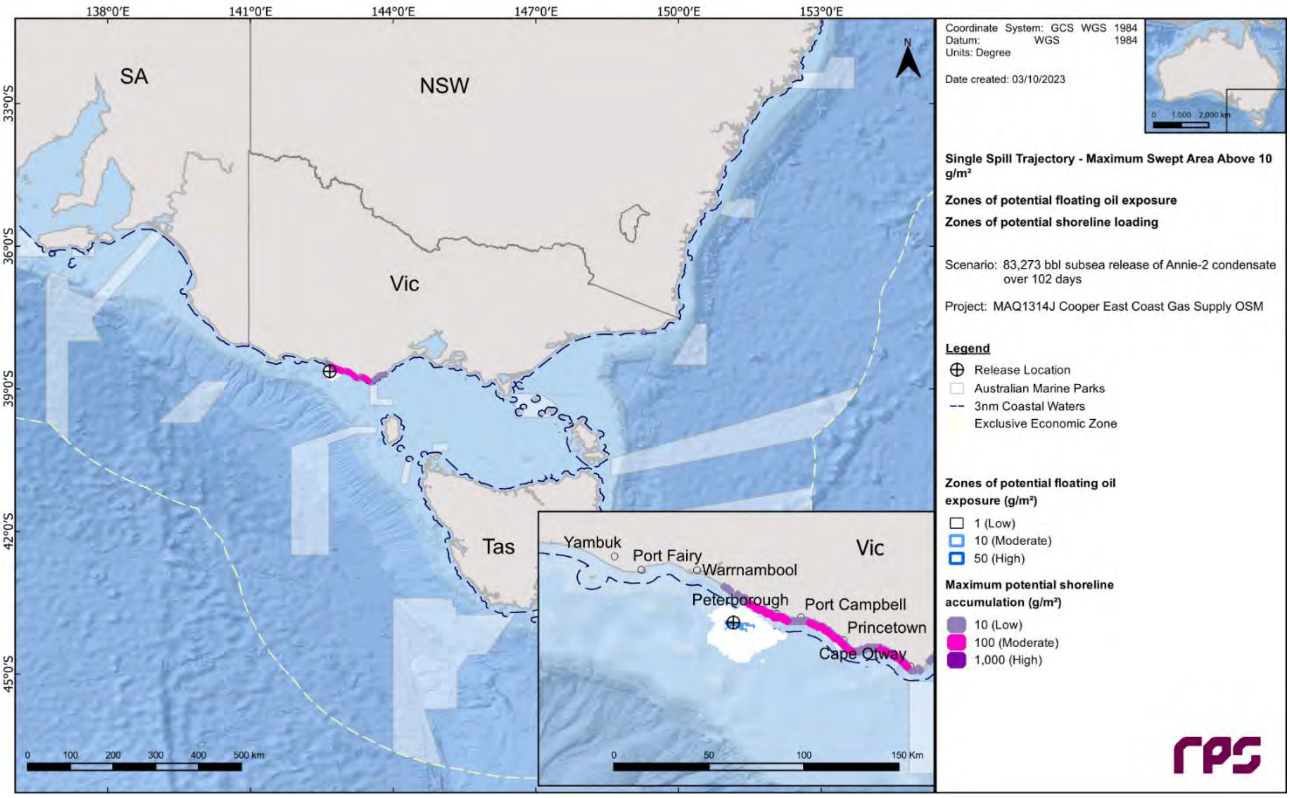


Figure 12.19 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest swept area of floating oil above 10 g/m².

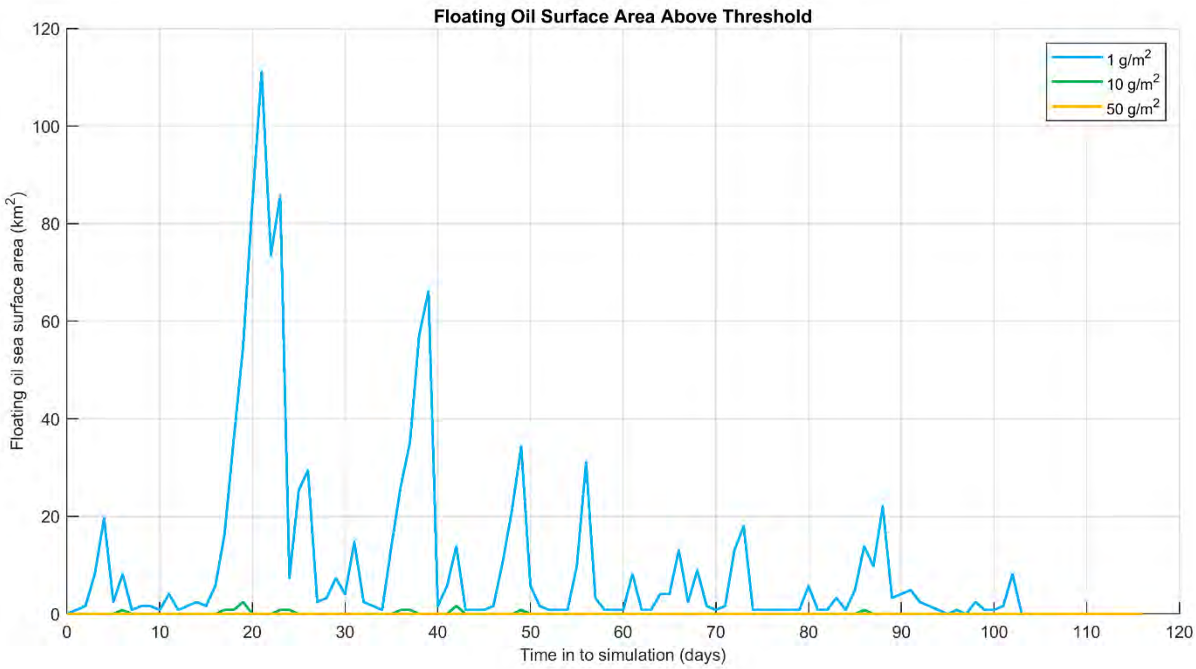


Figure 12.20 Time series of the sea surface exposure above each threshold for the trajectory with the largest swept area of floating oil above 10 g/m².

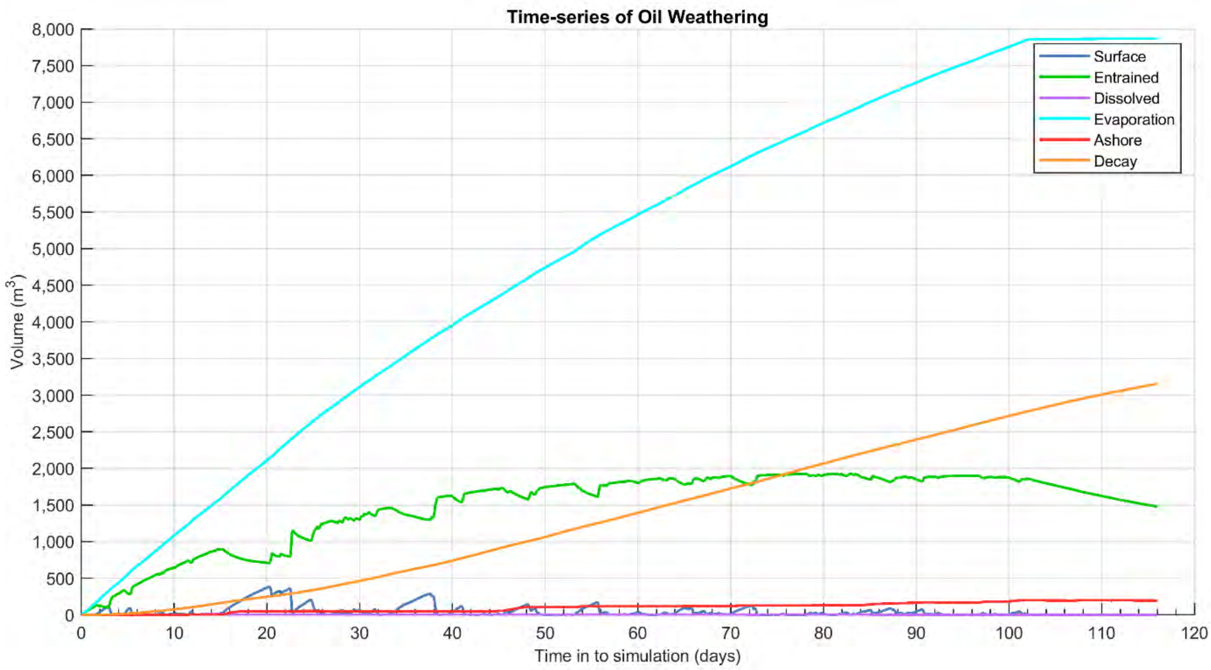


Figure 12.21 Predicted weathering and fates graph for the trajectory with the largest swept area of floating oil above 10 g/m².

12.2.2 Deterministic Case: Largest volume of oil ashore

The deterministic trajectory that resulted in the largest volume of oil ashore was identified as winter run number 13, which started on 23rd July 2010.

Figure 12.22 illustrates the floating oil exposure and shoreline accumulation over the 116-day simulation.

Figure 12.23 displays the time series of the volume of oil accumulating on shorelines at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 116-day simulation.

Figure 12.24 presents the fates and weathering graph for the corresponding single spill trajectory and Table 12.13 summarises the mass balance peaks and at the end of the simulation.

Table 12.13 Summary of the mass balance for the trajectory with the largest volume ashore.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	156.7	37.3	0.2
Entrained (m^3)	1,857.0	87.0	1,433.1
Dissolved (m^3)	7.9	18.5	0.5
Evaporation (m^3)	7,697.1	116.0	7,697.1
Decay (m^3)	3,222.8	116.0	3,222.8
Ashore (m^3)	348.4	104.1	342.9

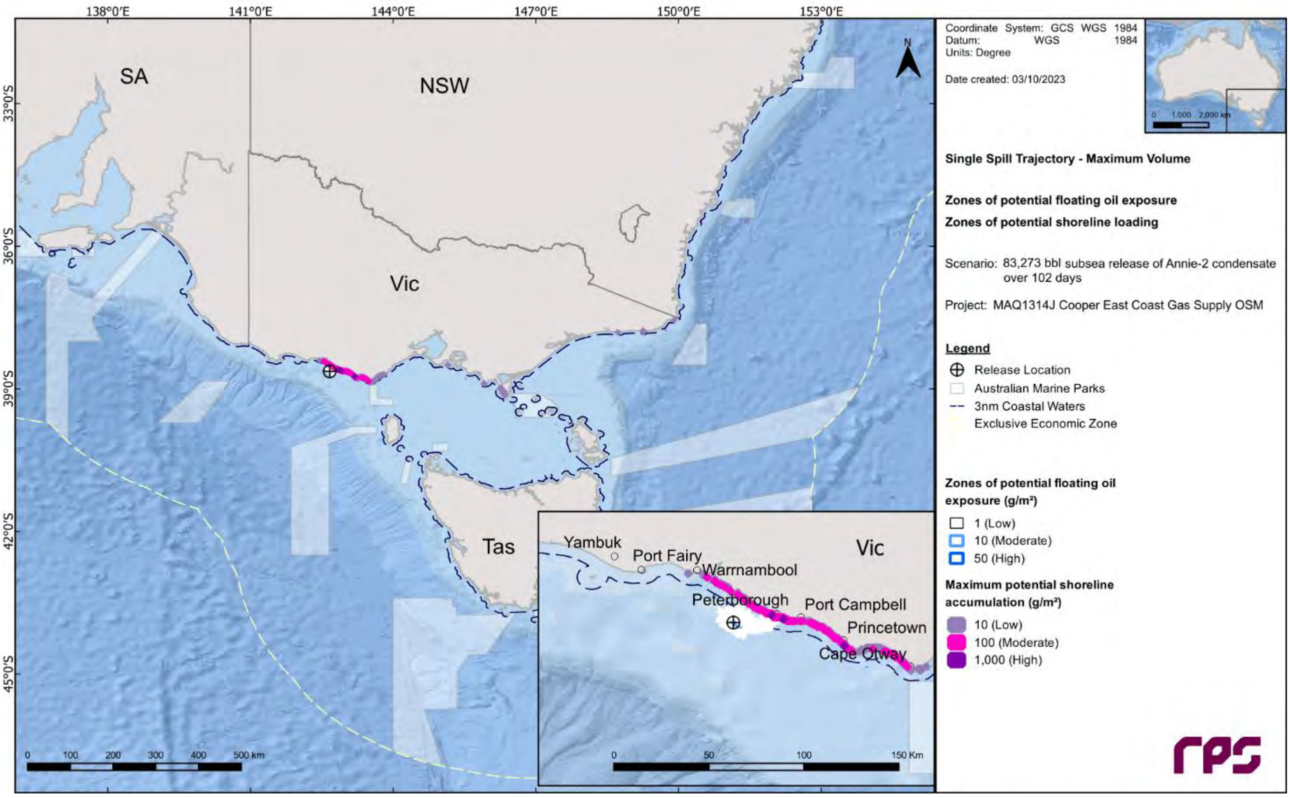


Figure 12.22 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest volume ashore.

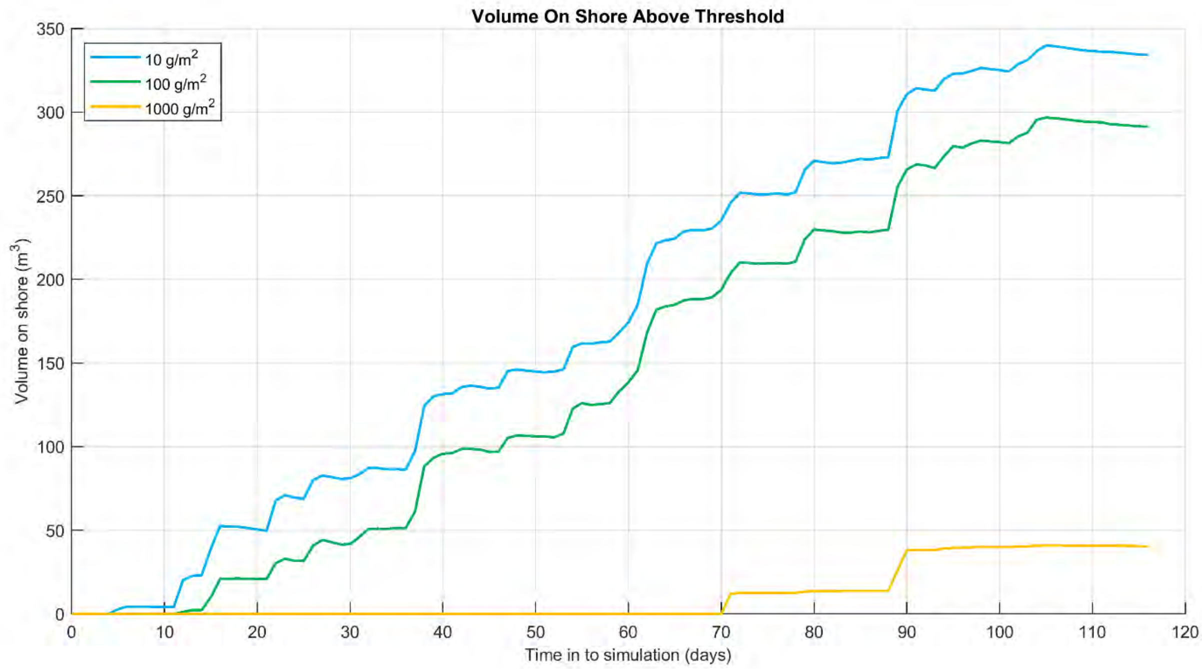


Figure 12.23 Time series of oil accumulation on the shoreline above each threshold for the trajectory with the largest volume ashore.

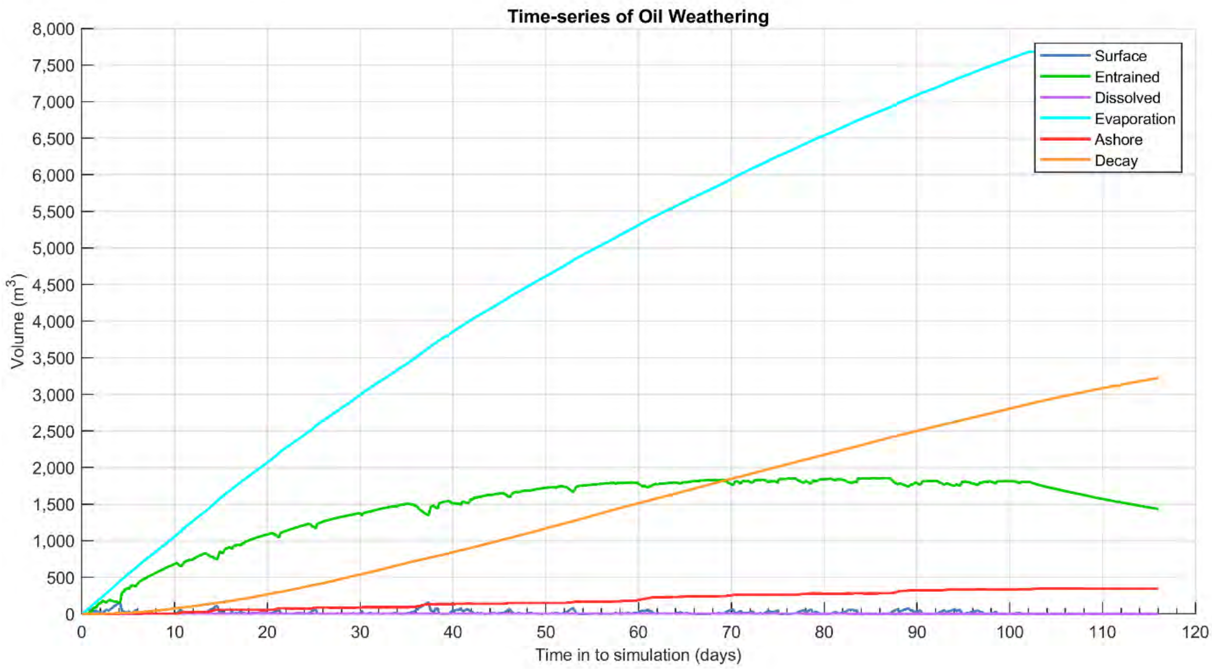


Figure 12.24 Predicted weathering and fates graph for the trajectory with the largest volume ashore.

12.2.3 Deterministic Case: Longest length of shoreline with accumulation above 100 g/m²

The deterministic trajectory that resulted in the longest length of shoreline with accumulation above 100 g/m² was identified as summer run number 57, which started on 19th March 2012.

Figure 12.25 illustrates the floating oil exposure and shoreline accumulation over the 116-day simulation.

Figure 12.26 displays the time series of the length of shoreline with accumulation at the low (10 g/m²), moderate (100 g/m²) and high (1,000 g/m²) thresholds over the 116-day simulation.

Figure 12.27 presents the fates and weathering graph for the corresponding single spill trajectory and Table 12.14 summarises the mass balance peaks and at the end of the simulation.

Table 12.14 Summary of the mass balance for the trajectory with the longest length of shoreline with accumulation above 100 g/m².

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	353.5	5.3	0.7
Entrained (m^3)	1,884.2	89.0	1,458.1
Dissolved (m^3)	8.1	20.9	0.4
Evaporation (m^3)	7,765.0	116.0	7,765.0
Decay (m^3)	3,222.7	116.0	3,222.7
Ashore (m^3)	250.0	115.5	249.9

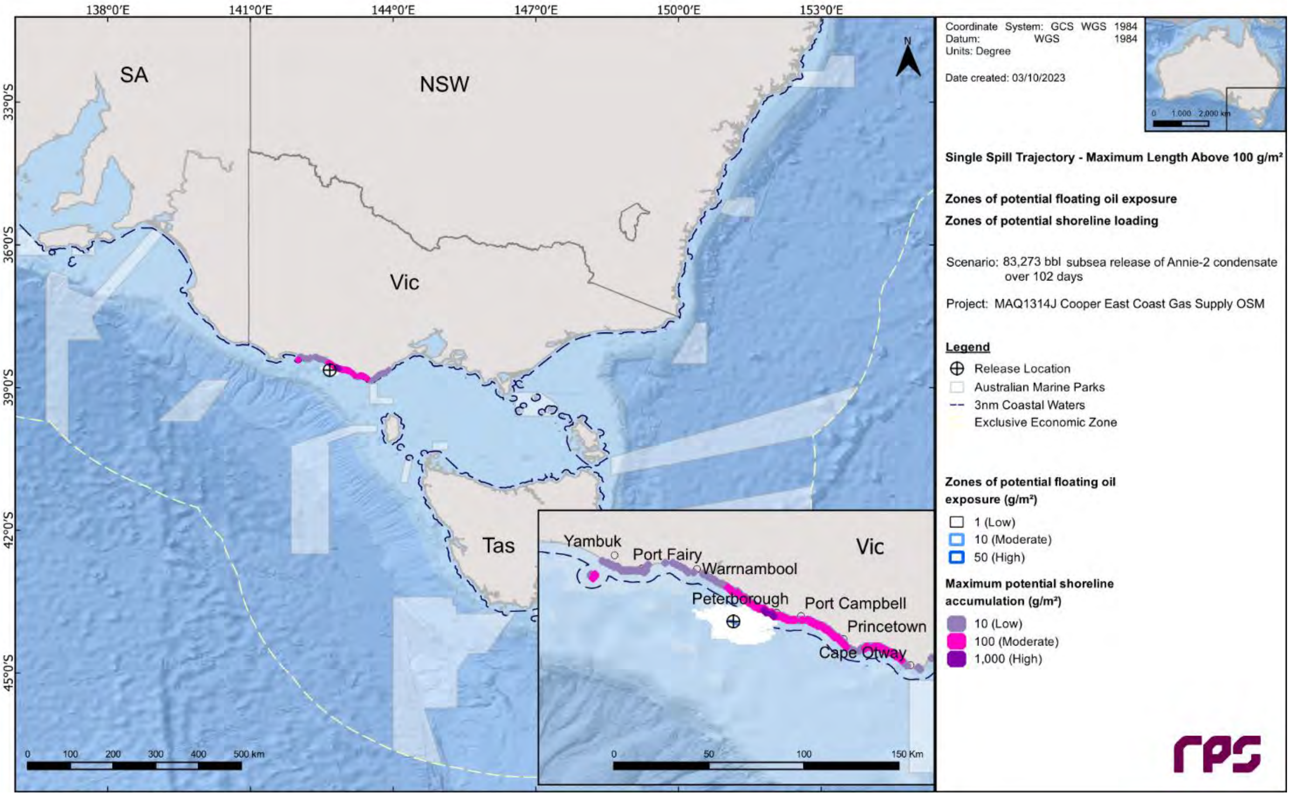


Figure 12.25 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the longest length of shoreline with accumulation above 100 g/m².

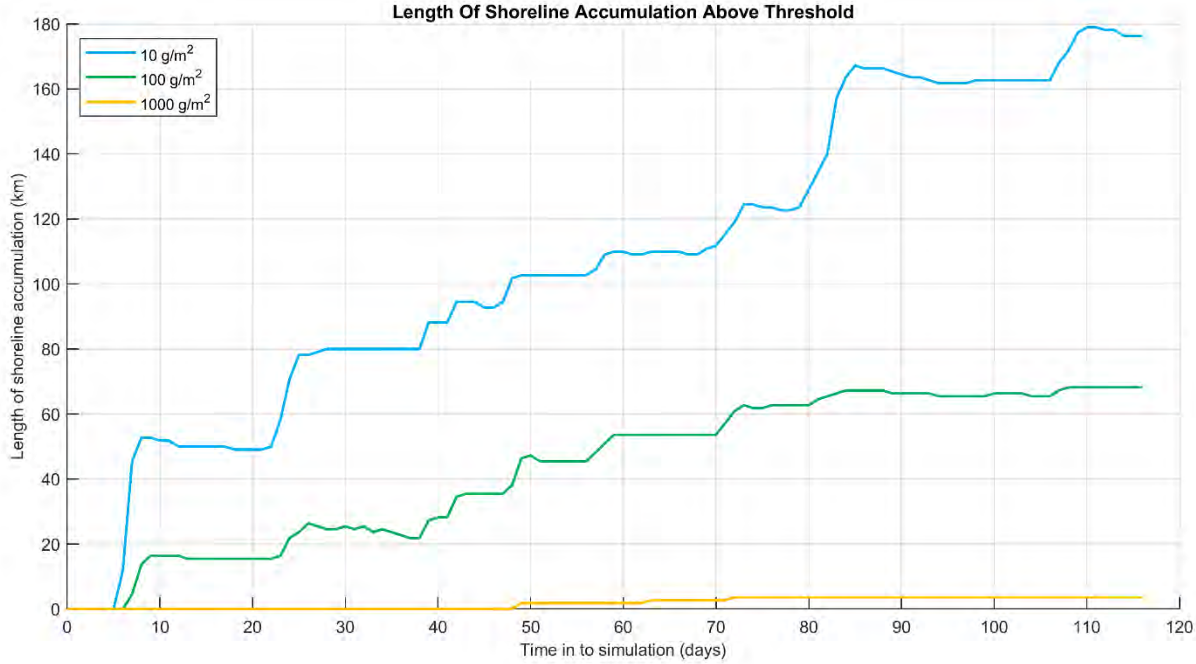


Figure 12.26 Time series of the length of shoreline with accumulation above each threshold for the trajectory with the longest length of shoreline with accumulation above 100 g/m².

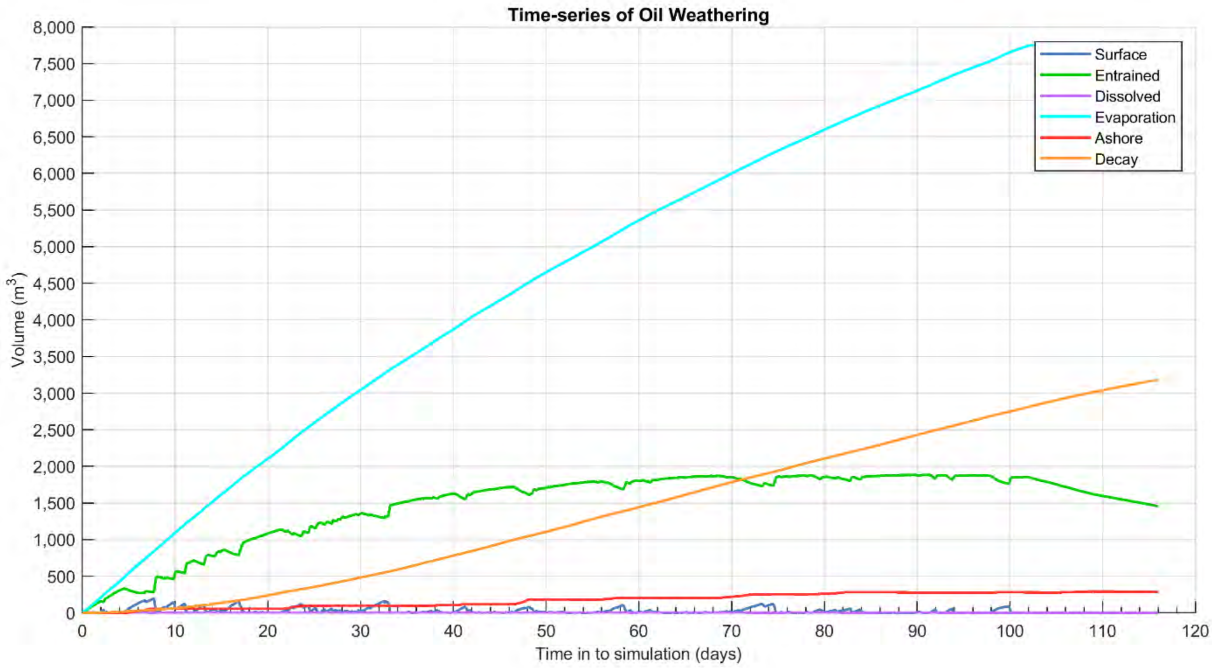


Figure 12.27 Predicted weathering and fates graph for the trajectory with the longest length of shoreline with accumulation above 100 g/m².

12.2.4 Deterministic Case: Largest area of entrained hydrocarbon exposure above 100 ppb

The deterministic trajectory that resulted in the largest area of entrained hydrocarbon exposure above 100 ppb was identified as winter run number 58, which started on 3rd August 2014.

Figure 12.28 illustrates the zones of potential entrained hydrocarbon exposure over the 116-day simulation.

Figure 12.29 displays the time series of the area of entrained hydrocarbon exposure at the low (10 ppb) and high (100 ppb) thresholds over the 116-day simulation.

Figure 12.30 presents the fates and weathering graph for the corresponding single spill trajectory and Table 12.15 summarises the mass balance peaks and at the end of the simulation.

Table 12.15 Summary of the mass balance for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	266.1	13.8	0.1
Entrained (m^3)	1,935.0	85.5	1,506.6
Dissolved (m^3)	8.1	22.0	0.5
Evaporation (m^3)	7,751.3	116.0	7,751.3
Decay (m^3)	3,254.5	116.0	3,254.5
Ashore (m^3)	184.5	113.0	183.8

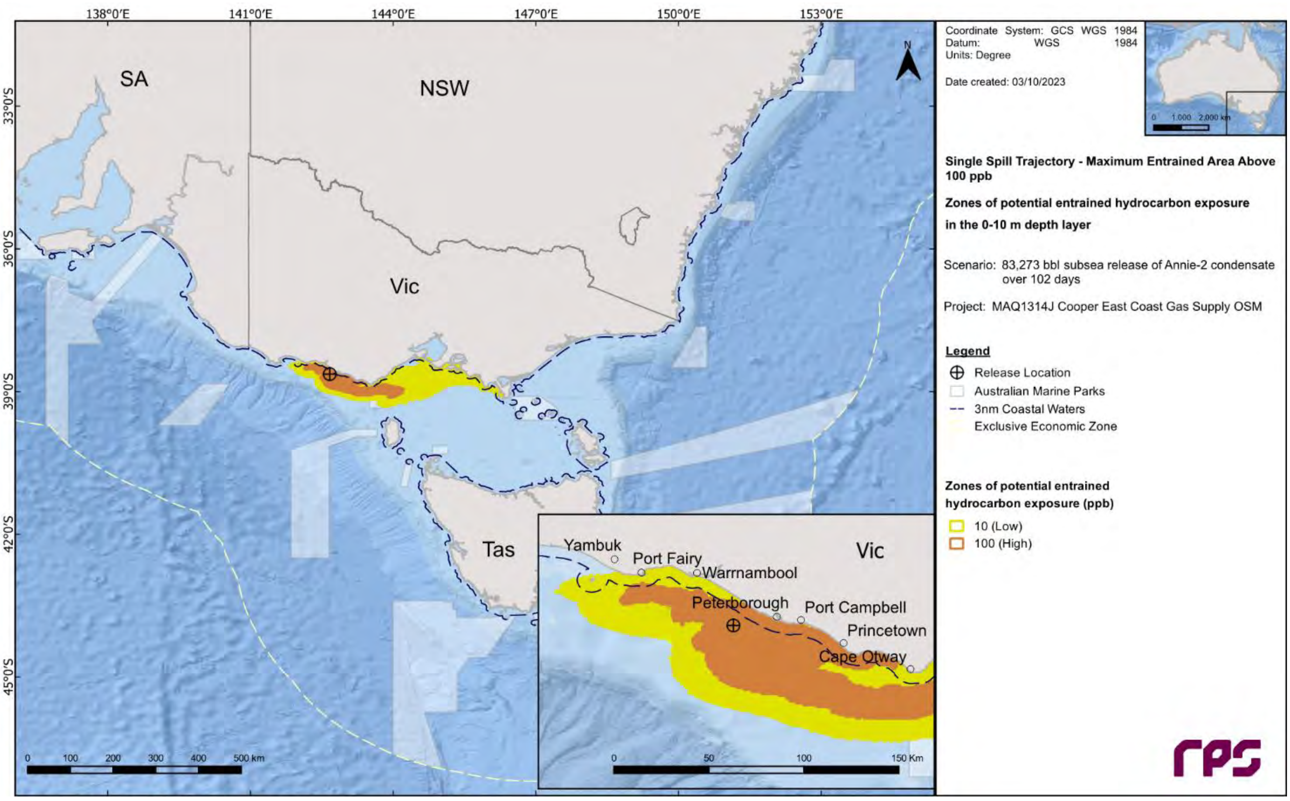


Figure 12.28 Zones of potential entrained hydrocarbon exposure, for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

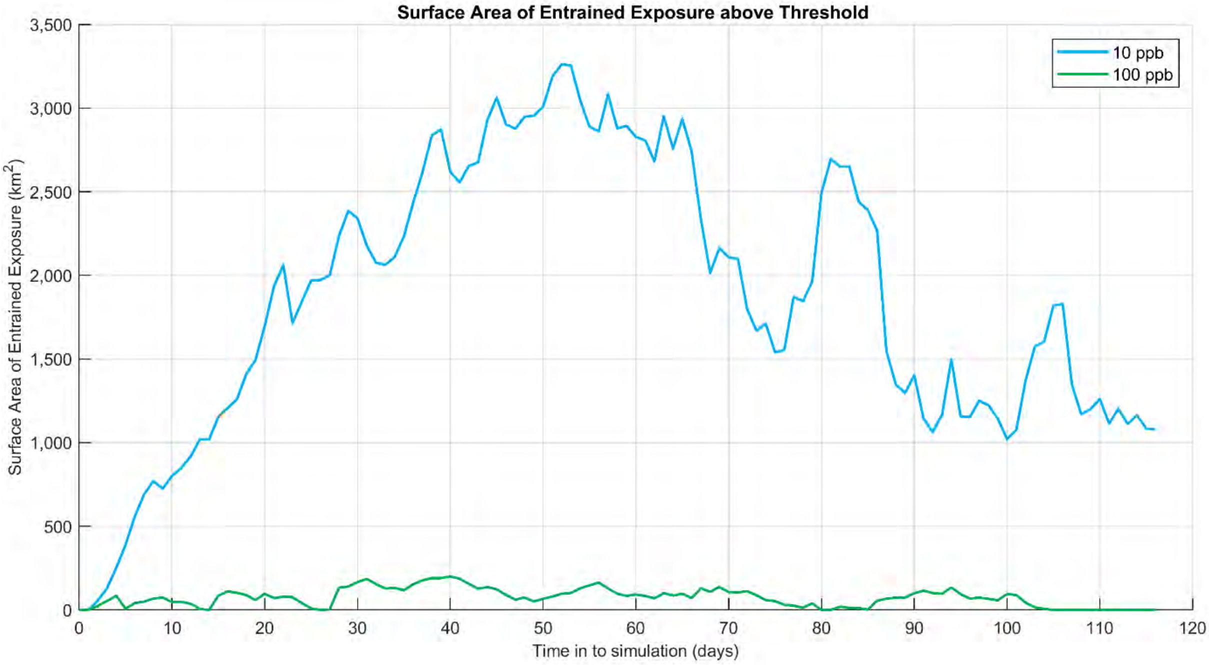


Figure 12.29 Time series of the entrained hydrocarbon exposure area above each threshold for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

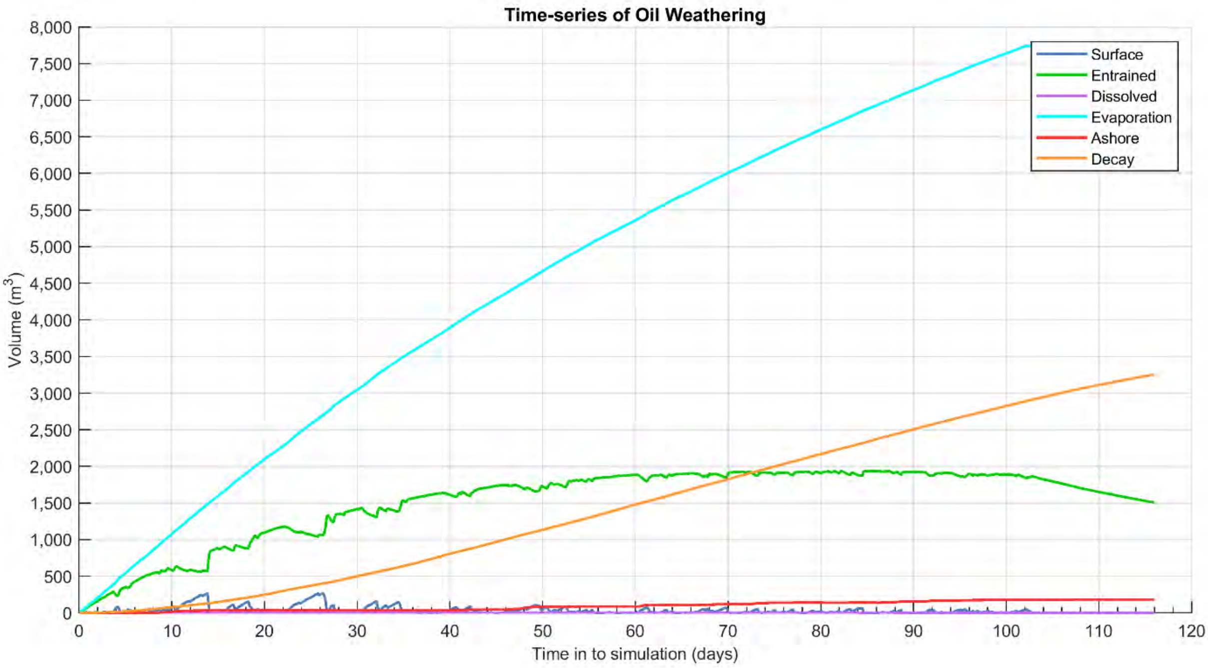


Figure 12.30 Predicted weathering and fates graph for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

12.2.5 Deterministic Case: Largest area of dissolved hydrocarbon exposure above 50 ppb

The deterministic trajectory that resulted in the largest area of dissolved hydrocarbon exposure above 50 ppb was identified as summer run number 68, which started on 29th April 2016.

Figure 12.31 illustrates the zones of potential dissolved hydrocarbon exposure over the 116-day simulation.

Figure 12.32 displays the time series of the area of dissolved hydrocarbon exposure at the low (10 ppb), moderate (50 ppb) and high (400 ppb) thresholds over the 116-day simulation.

Figure 12.33 presents the fates and weathering graph for the corresponding single spill trajectory and Table 12.16 summarises the mass balance peaks and at the end of the simulation.

Table 12.16 Summary of the mass balance for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 116
Surface (m^3)	160.9	7.8	0.7
Entrained (m^3)	1,982.5	74.3	1,550.5
Dissolved (m^3)	7.7	17.8	0.3
Evaporation (m^3)	7,670.3	116.0	7,670.3
Decay (m^3)	3,411.7	116.0	3,411.7
Ashore (m^3)	66.6	99.3	63.1

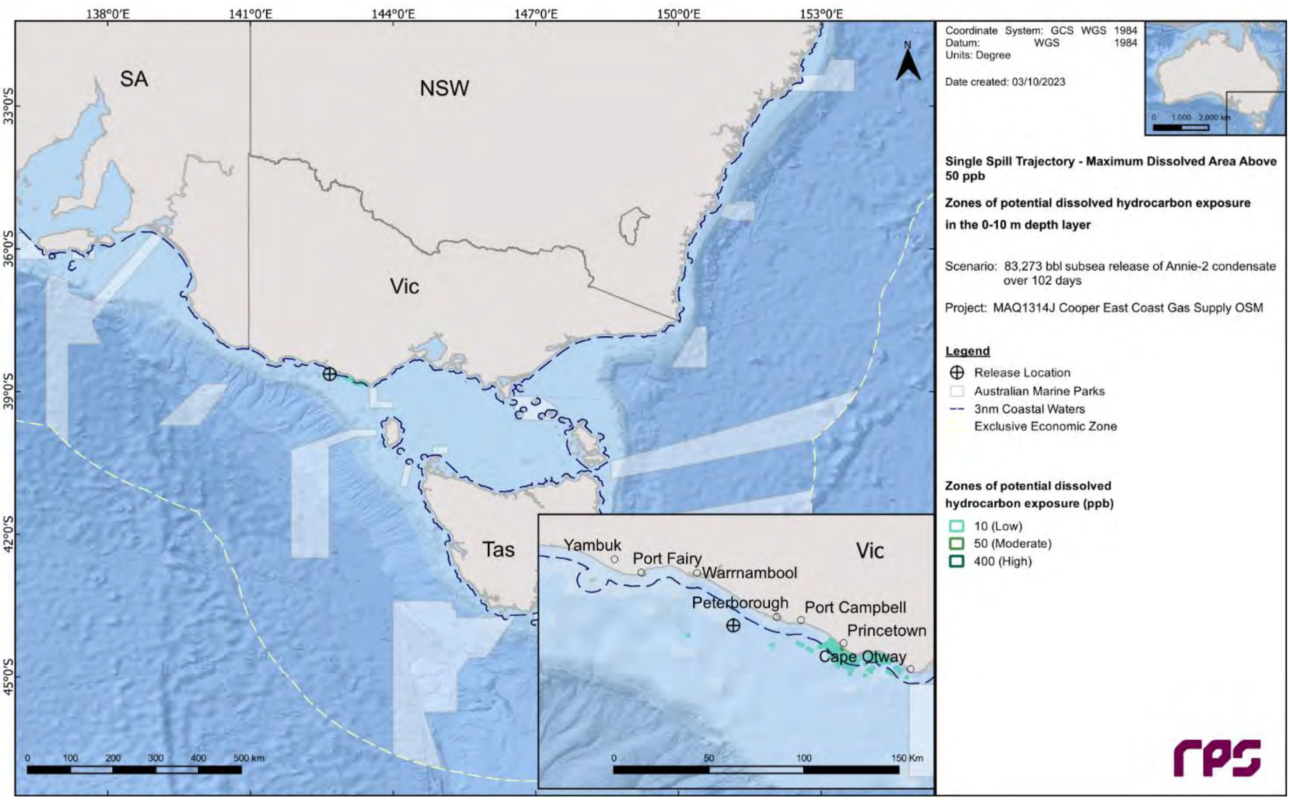


Figure 12.31 Zones of potential dissolved hydrocarbon exposure, for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

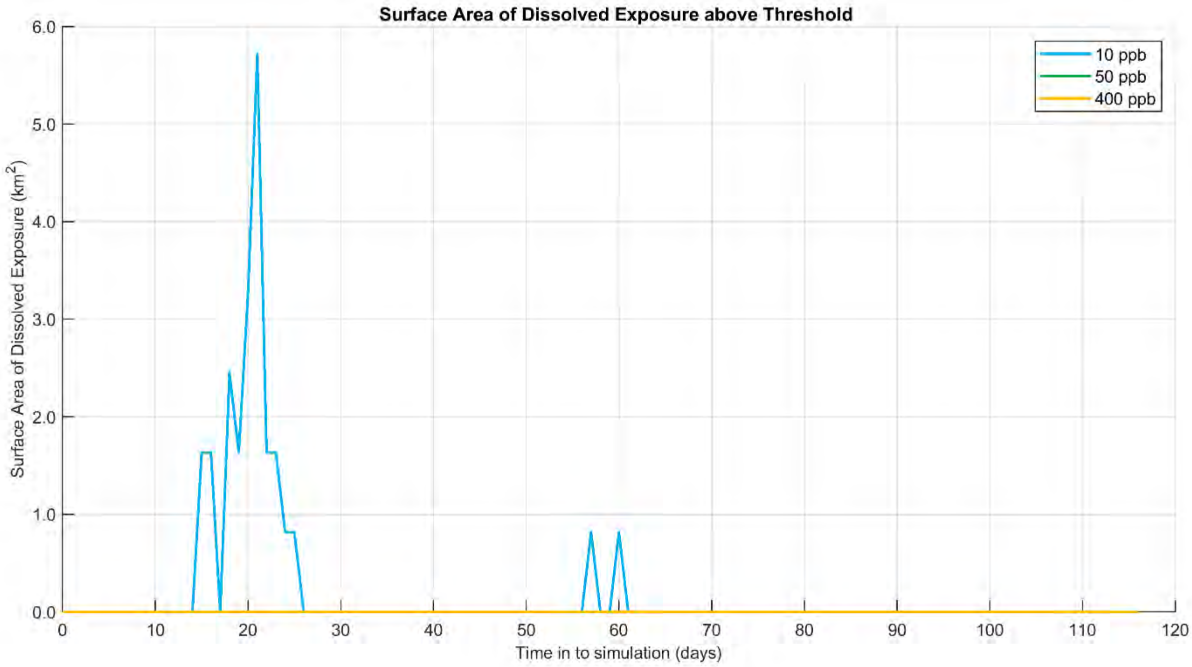


Figure 12.32 Time series of the dissolved hydrocarbon exposure area above each threshold for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

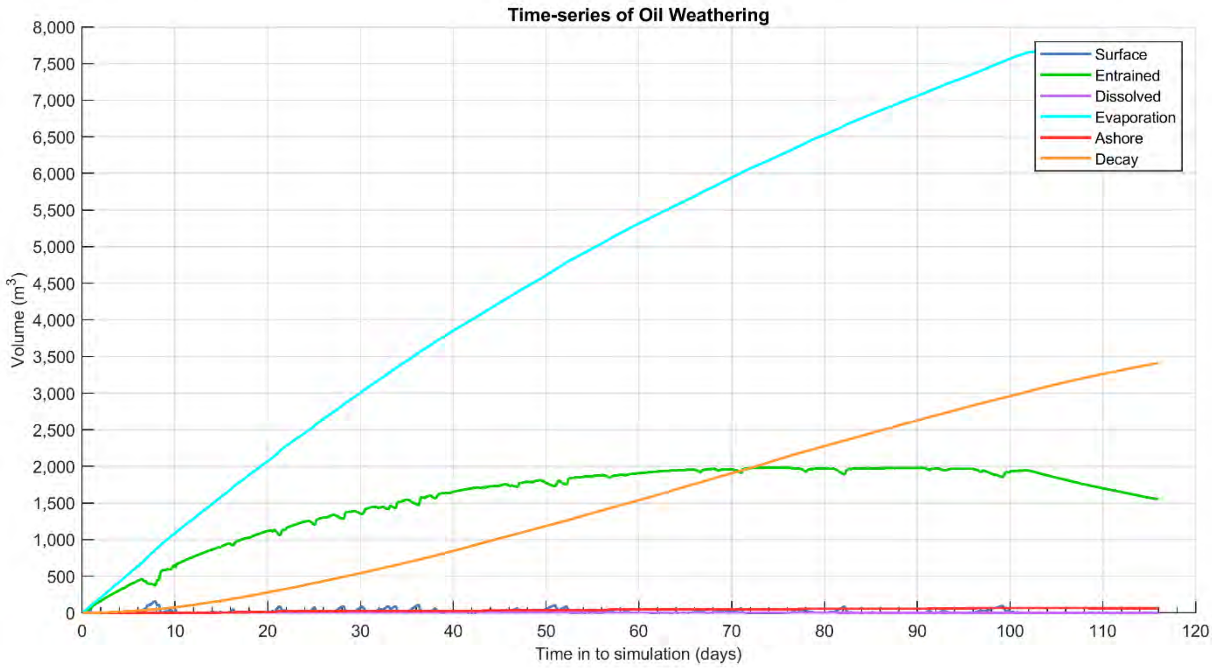


Figure 12.33 Predicted weathering and fates graph for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb.

13 RESULTS – SCENARIO 3 – 66,430 BBL (10,562 M^3) SUBSURFACE RELEASE FROM A LOSS OF WELL CONTROL AT ANNIE-2

This scenario examined a 66,430 bbl (10,562 m^3) subsurface release of condensate over 104 days to represent a LOWC scenario at Annie-2 well. A total of 100 spill simulations were run per season (summer and winter) and each simulation was tracked for 118 days. The results are presented on a seasonal basis.

Sections 13.1 and 13.2 present the seasonal stochastic analysis and deterministic analysis results, respectively.

13.1 Stochastic Analysis

13.1.1 Floating Oil Exposure

Table 13.1 summarises the maximum distance travelled by floating oil on the sea surface at each threshold. The maximum distance and corresponding direction from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) exposure zones was 55.7.0 km (east, winter) and 3.2 km (east, winter), respectively. No high (>50 g/m^2) exposure zones were predicted during either summer or winter conditions.

Table 13.2 summarises the potential floating oil exposure to individual receptors.

During summer, a total of 16 BIAs were predicted to be exposed to floating oil at, or above, the low threshold. Excluding the BIAs that the release location resides within (see Section 10.3), the highest probability (38%) of low exposure was predicted at the Southern Right Whale – Aggregation BIA. The minimum time before low exposure to the Southern Right Whale – Aggregation was 0.83 days.

Similarly, during winter, a total of 16 BIAs were predicted to be exposed to floating oil at, or above, the low threshold. Again, the highest probability (8%) of low exposure was predicted at the Southern Right Whale – Aggregation BIA. The minimum time before low exposure to the Southern Right Whale – Aggregation was 2.17 days.

Table 13.3 presents the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor.

Figure 13.1 and Figure 13.2 present the zones of potential floating oil exposure for each season whilst Figure 13.3 to Figure 13.6 present the maximum residence time of floating oil exposure for the NOPSEMA thresholds.

Table 13.1 Maximum distance and direction from the release location to the edge of floating oil exposure. Results are based on a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Distance and direction travelled	Zones of potential floating oil exposure					
	Summer			Winter		
	Low	Moderate	High	Low	Moderate	High
Maximum distance (km) from release location	53.0	1.6	-	55.7	3.2	-
Maximum distance (km) from release location (99th percentile)	30.0	1.6	-	33.1	3.2	-
Direction	E	W	-	E	E	-

Table 13.2 Summary of the potential floating oil exposure to individual receptors. Results are based on a 66,430 bbl (10,562 m³) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer						Winter					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)		
		Low	Mod.	High	Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
BIA	Antipodean Albatross - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Black-browed Albatross - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Bullers Albatross - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Campbell Albatross - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Common Diving-petrel - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Indian Yellow-nosed Albatross - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Pygmy Blue Whale - Distribution*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Pygmy Blue Whale - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Pygmy Blue Whale - Foraging annual high use area*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Short-tailed Shearwater - Foraging	2	-	-	12.29	-	-	2	-	-	13.63	-	-
	Shy Albatross - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Southern Right Whale - Aggregation	38	-	-	0.83	-	-	8	-	-	2.17	-	-
	Southern Right Whale - Known Core Range*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Wandering Albatross - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	Wedge-tailed Shearwater - Foraging*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
	White Shark - Distribution*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
IBRA	Otway Plain	2	-	-	12.29	-	-	2	-	-	13.63	-	-
	Warrnambool Plain	65	-	-	1.63	-	-	78	-	-	1.33	-	-
IMCRA	Otway*	100	57	-	0.04	0.50	-	100	44	-	0.04	0.58	-
MNP	Twelve Apostles	36	-	-	7.42	-	-	58	-	-	4.21	-	-
Nearshore Waters	Colac Otway	2	-	-	12.29	-	-	2	-	-	13.63	-	-
	Corangamite	50	-	-	4.92	-	-	78	-	-	1.17	-	-
	Moyne	22	-	-	1.63	-	-	11	-	-	5.96	-	-

Receptor		Summer						Winter					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)		
		Low	Mod.	High	Low	Mod.	High	Low	Mod.	High	Low	Mod.	High
State Waters	Victoria State Waters	99	-	-	0.50	-	-	99	-	-	0.54	-	-
Nearshore Waters (Sub-LGA)	Bay of Islands	22	-	-	1.63	-	-	10	-	-	5.96	-	-
	Cape Otway West	2	-	-	12.29	-	-	2	-	-	13.63	-	-
	Moonlight Head	42	-	-	7.21	-	-	66	-	-	4.54	-	-
	Port Campbell	15	-	-	4.92	-	-	35	-	-	1.17	-	-

*The release location resides within the receptor boundaries.

Table 13.3 Summary of the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor. Results are based on a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer – Maximum residence time of floating oil exposure (days)			Winter – Maximum residence time of floating oil exposure (days)		
		Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross - Foraging*	12.83	0.46	-	8.42	0.58	-
	Black-browed Albatross - Foraging*	12.83	0.46	-	8.42	0.58	-
	Bullers Albatross - Foraging*	12.83	0.46	-	8.42	0.58	-
	Campbell Albatross - Foraging*	12.83	0.46	-	8.42	0.58	-
	Common Diving-petrel - Foraging*	12.83	0.46	-	8.42	0.58	-
	Indian Yellow-nosed Albatross - Foraging*	12.83	0.46	-	8.42	0.58	-
	Pygmy Blue Whale - Distribution*	12.83	0.46	-	8.42	0.58	-
	Pygmy Blue Whale - Foraging*	12.83	0.46	-	8.42	0.58	-
	Pygmy Blue Whale - Foraging annual high use area*	12.83	0.46	-	8.42	0.58	-
	Short-tailed Shearwater - Foraging	0.04	-	-	0.17	-	-
	Shy Albatross - Foraging*	12.83	0.46	-	8.42	0.58	-
	Southern Right Whale - Aggregation	0.17	-	-	0.25	-	-
	Southern Right Whale - Known Core Range*	12.83	0.46	-	8.42	0.58	-
	Wandering Albatross - Foraging*	12.83	0.46	-	8.42	0.58	-
	Wedge-tailed Shearwater - Foraging*	12.83	0.46	-	8.42	0.58	-
	White Shark - Distribution*	12.83	0.46	-	8.42	0.58	-
IBRA	Otway Plain	0.04	-	-	0.17	-	-
	Warrnambool Plain	0.71	-	-	0.75	-	-
IMCRA	Otway*	12.83	0.46	-	8.42	0.58	-
MNP	Twelve Apostles	0.54	-	-	0.63	-	-
Nearshore Waters	Colac Otway	0.04	-	-	0.17	-	-
	Corangamite	0.71	-	-	0.75	-	-
	Moyne	0.38	-	-	0.33	-	-
State Waters	Victoria State Waters	1.5	-	-	1.21	-	-

Receptor		Summer Maximum residence time of floating oil exposure (days)			Winter Maximum residence time of floating oil exposure (days)		
		Low	Moderate	High	Low	Moderate	High
Nearshore Waters (Sub-LGA)	Bay of Islands	0.38	-	-	0.33	-	-
	Cape Otway West	0.04	-	-	0.17	-	-
	Moonlight Head	0.54	-	-	0.63	-	-
	Port Campbell	0.71	-	-	0.75	-	-

*The release location resides within the receptor boundaries.

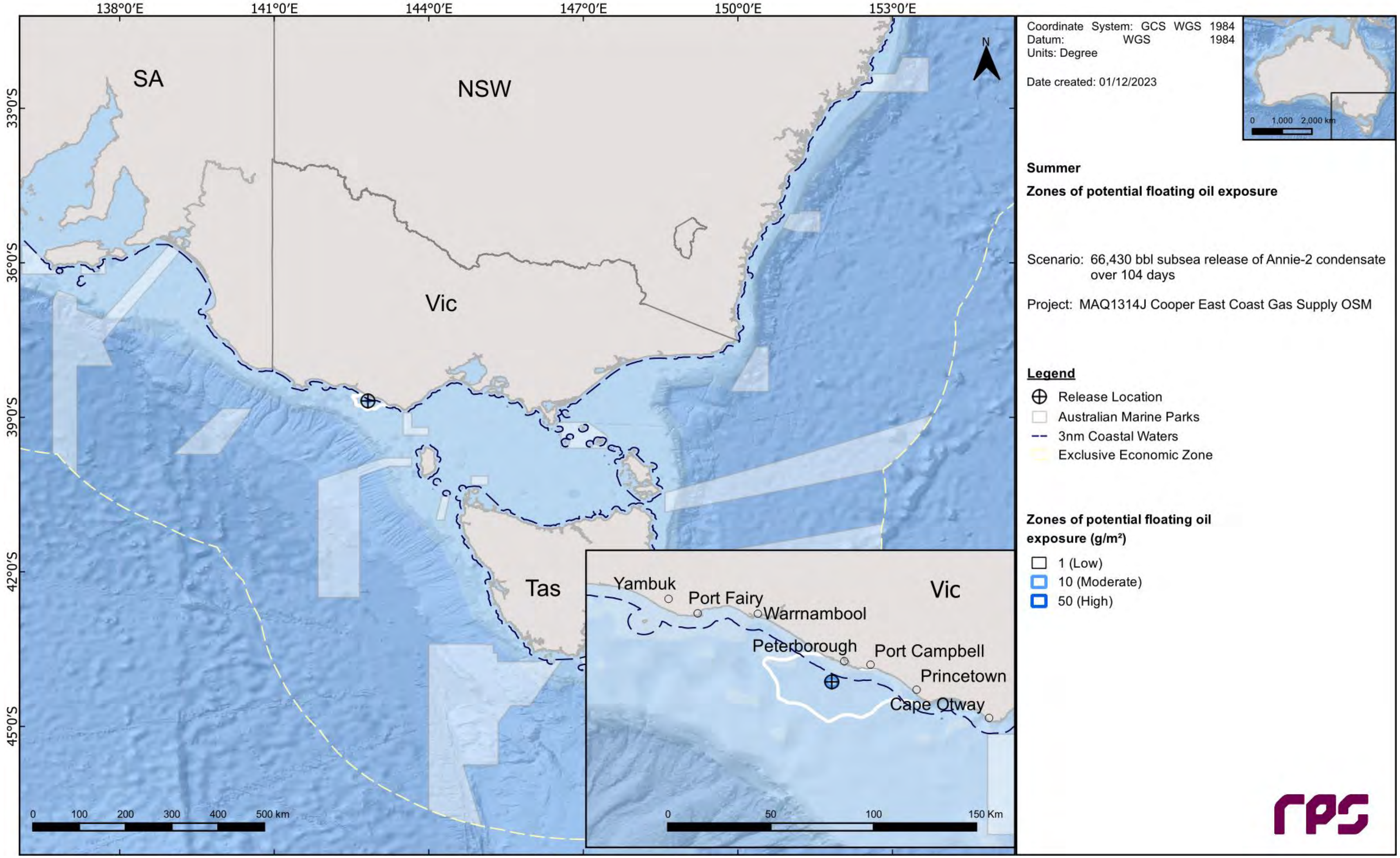


Figure 13.1 Zones of potential floating oil exposure in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

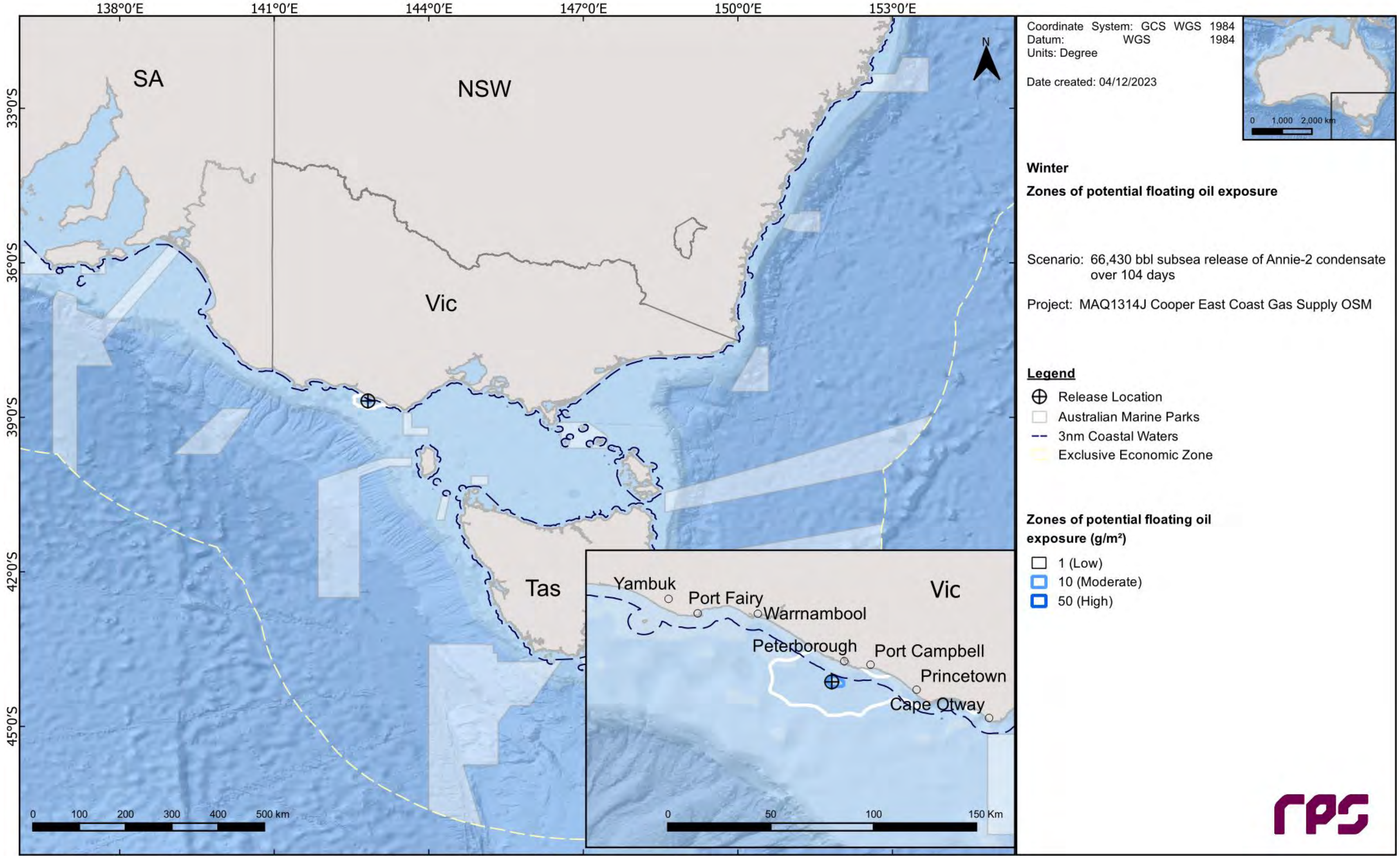


Figure 13.2 Zones of potential floating oil exposure in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

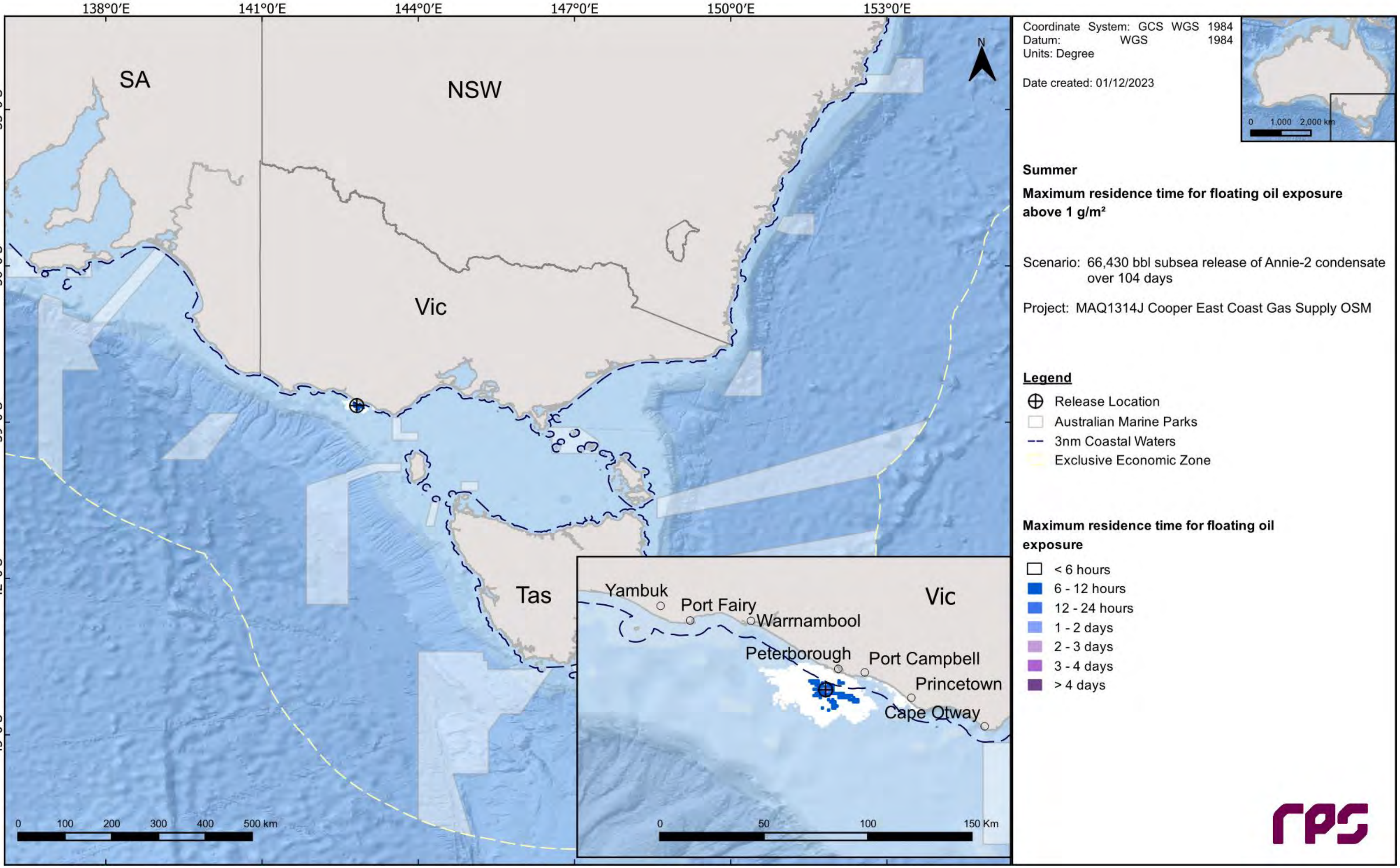


Figure 13.3 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

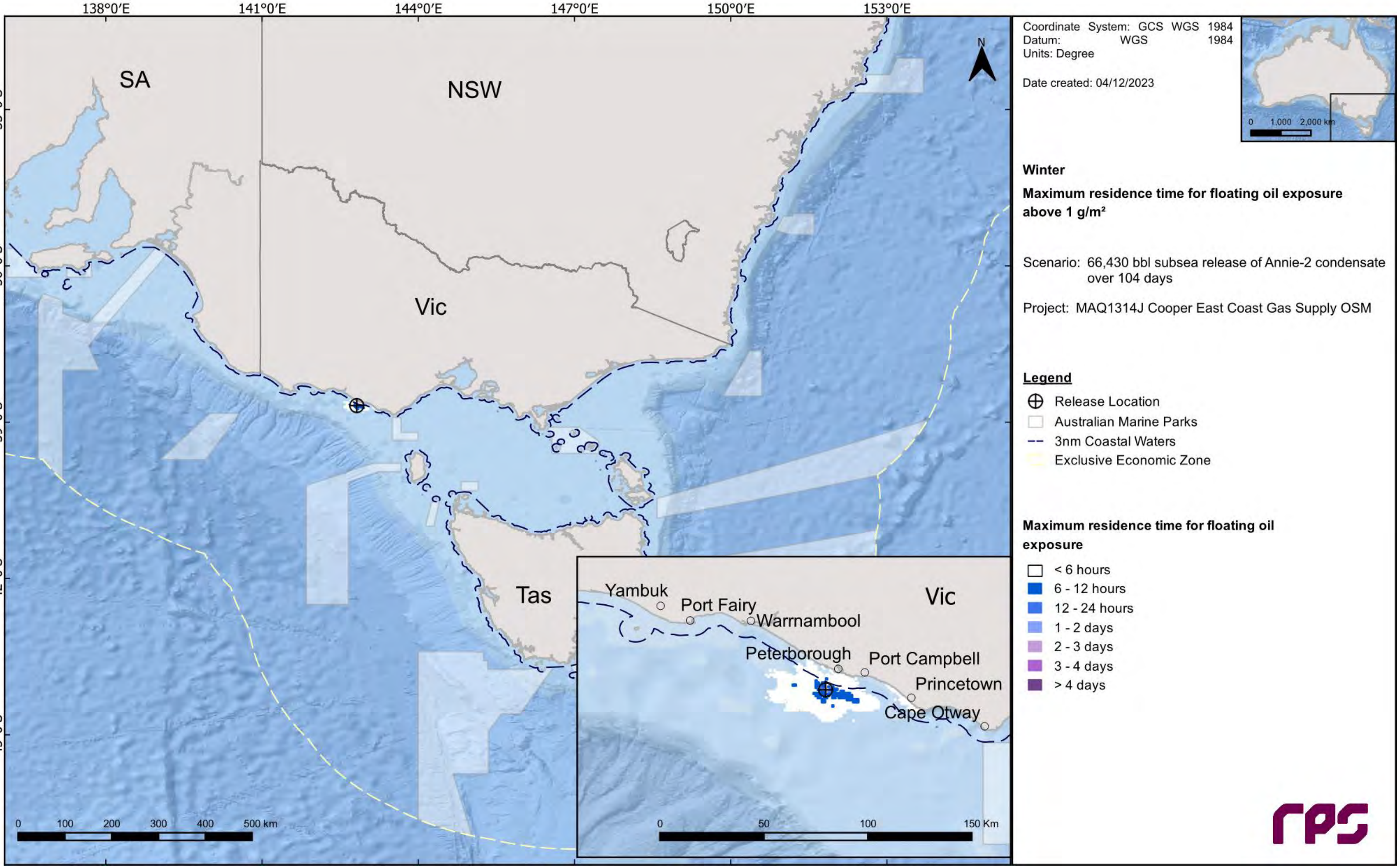


Figure 13.4 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

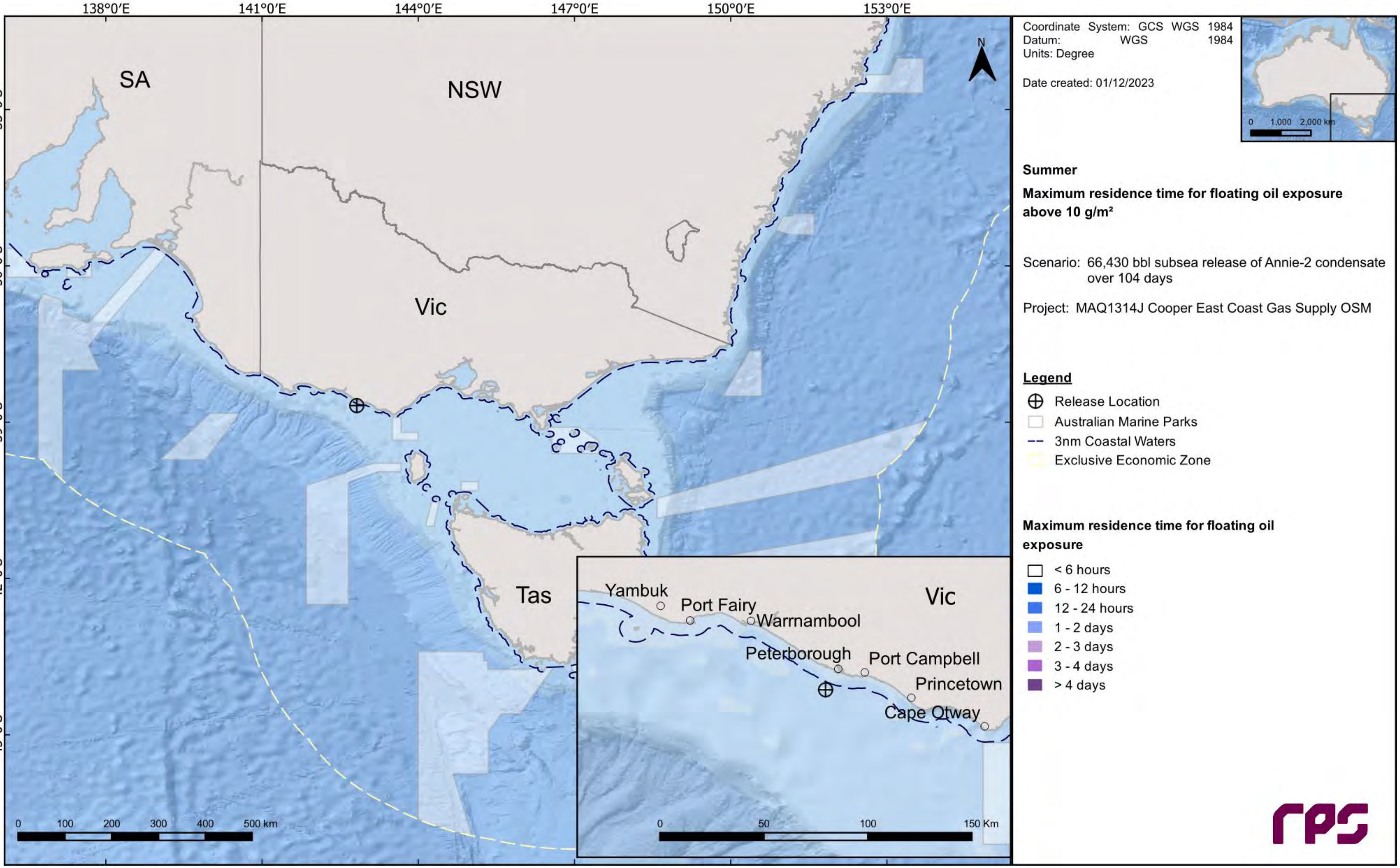


Figure 13.5 Maximum residence time of floating oil exposure above 10 g/m², in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

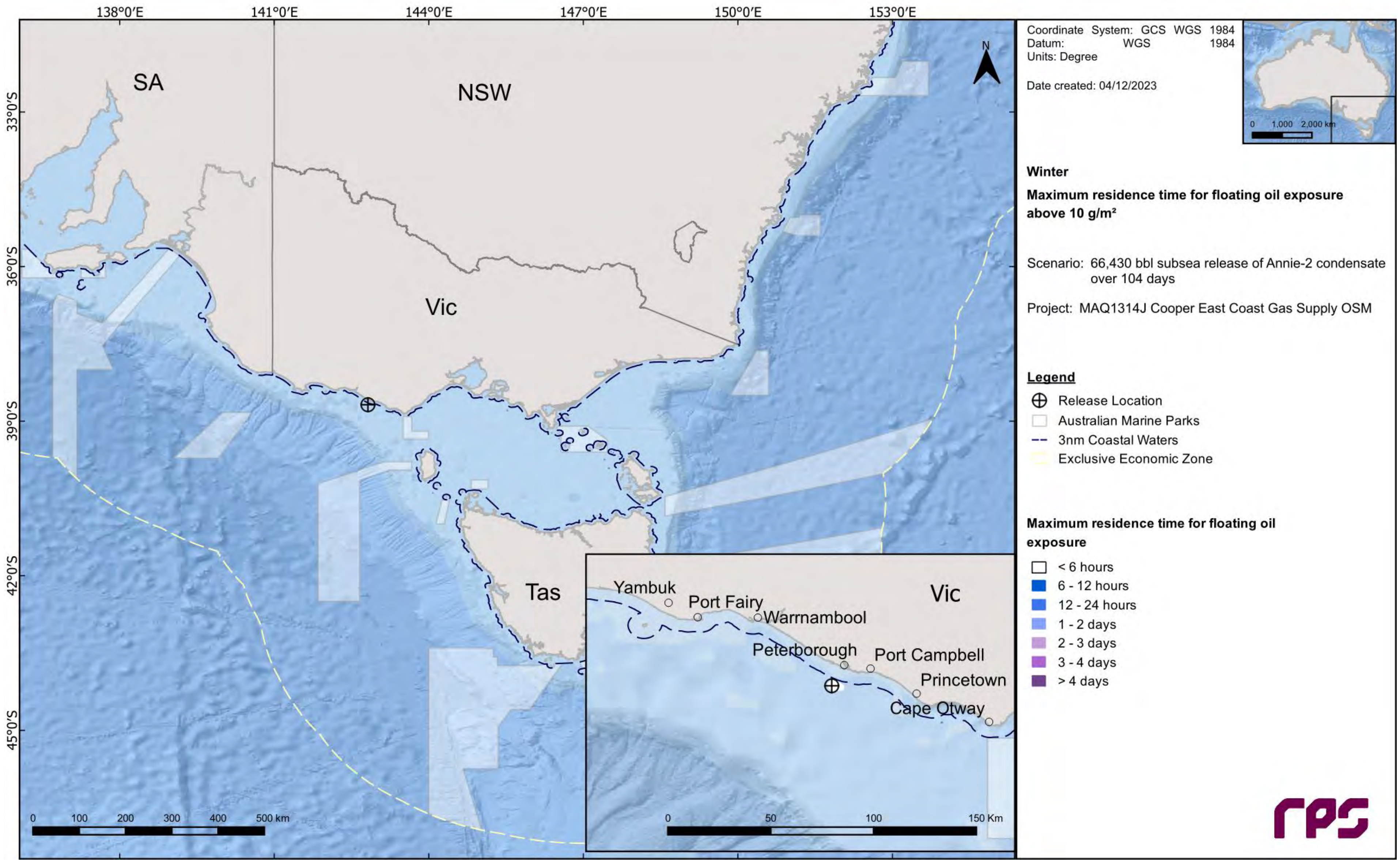


Figure 13.6 Maximum residence time of floating oil exposure above 10 g/m², in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

13.1.2 Shoreline Accumulation

Table 13.4 presents a summary of the potential shoreline accumulation. The probability of accumulation to any shoreline at, or above, the low (10 g/m^2) threshold was 100% throughout the year. The minimum time before oil accumulation at, or above, the low threshold was 0.96 day. The maximum total volume ashore for a single spill trajectory was 312.1 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 224.0 km (winter), 62.0 km (winter) and 6.0 km (winter), respectively.

Table 13.5 and Table 13.6 summarises the shoreline accumulation on individual receptors during summer and winter, respectively.

During summer conditions, the shoreline segment of Corangamite LGA had the highest probability of accumulation above the low and moderate thresholds (100% and 99% respectively), whilst Moyne LGA and Bay of Islands sub-LGA shoreline had the highest probability of accumulation above the high threshold (5%). The minimum time for low threshold shoreline accumulation at Moyne was 0.96 days.

Alternatively, in winter the shoreline segment with the highest probability of accumulation above all three thresholds was Corangamite LGA (100%, 100% and 27% for low, moderate and high, respectively). The minimum time for low threshold shoreline accumulation at the Corangamite LGA receptor was 1 day.

The maximum potential shoreline loadings above each shoreline thresholds are presented in Figure 13.7 and Figure 13.8 for summer and winter respectively.

Table 13.4 Summary of oil accumulation across all shorelines. Results are based on a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Shoreline Statistics	Summer	Winter
Probability of accumulation on any shoreline (%)	100	100
Absolute minimum time for visible oil to shore (days)	0.96	1.00
Maximum total volume of hydrocarbons ashore (m^3)	206.3	312.1
Average total volume of hydrocarbons ashore (m^3)	124.1	161.7
Maximum length of the shoreline at **10 g/m^2** (km)	220.0	224.0
Average shoreline length (km) at **10 g/m^2** (km)	124.9	131.7
Maximum length of the shoreline at **100 g/m^2** (km)	58.0	62.0
Average shoreline length (km) at **100 g/m^2** (km)	28.6	33.3
Maximum length of the shoreline at **1,000 g/m^2** (km)	2.0	6.0
Average shoreline length (km) at **1,000 g/m^2** (km)	1.2	1.6

Table 13.5 Summary of oil accumulation on individual shoreline receptors. Results are based on a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

Shoreline Receptor		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA Shoreline	Anser Island	10	-	-	61.46	-	-	3	26	0.2	0.7	1.3	-	-	2.7	-	-
	Bass Coast	4	-	-	50.79	-	-	1	15	0.2	0.7	1.1	-	-	1.8	-	-
	Bega Valley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Colac Otway	98	66	-	2.29	6.83	-	23	400	22.5	56.3	26.6	7.6	-	54.5	14.5	-
	Corangamite	100	99	-	1.54	2.79	-	82	811	63.5	126.8	44.8	15.3	-	55.4	31.8	-
	East Gippsland	1	-	-	103.25	-	-	1	18	0.3	1.1	0.9	-	-	0.9	-	-
	Gabo Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Glenelg	47	1	-	7.58	55.38	-	5	103	4.2	10	9.4	0.9	-	20	0.9	-
	Glennie Group	9	-	-	45.38	-	-	2	20	0.3	1.3	1.5	-	-	2.7	-	-
	Greater Geelong	12	-	-	42.75	-	-	3	94	0.9	7.4	5.2	-	-	14.5	-	-
	Hogan Island Group	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Kanowna Island	6	-	-	66.21	-	-	2	12	0.2	0.7	1.2	-	-	1.8	-	-
	Kent Island Group	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	King Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Lady Julia Percy Island	54	-	-	8.29	-	-	13	90	1.2	2.8	2.8	-	-	5.5	-	-
	Laurence Rocks	36	-	-	16.67	-	-	10	41	0.4	1	1.7	-	-	2.7	-	-
	Montague Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mornington Peninsula	10	-	-	49.33	-	-	2	21	0.6	3.1	2.7	-	-	5.5	-	-
	Moyne	99	92	5	0.96	1.33	25.38	35	1,354	29.3	78.9	28	6.3	1.1	49.1	15.4	1.8
	Norman Island	9	-	-	47.75	-	-	3	23	0.2	0.6	1.1	-	-	1.8	-	-
	Phillip Island	8	-	-	48.13	-	-	2	22	0.5	2.8	2.6	-	-	6.4	-	-
	Rodondo Island	8	-	-	82.42	-	-	3	24	0.2	0.6	1.4	-	-	1.8	-	-
	Shellback Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Skull Rock	4	-	-	66.21	-	-	2	11	< 0.1	0.3	0.9	-	-	0.9	-	-
	South Gippsland	23	-	-	42.92	-	-	2	55	1.5	8.2	7.5	-	-	20	-	-
	Surf Coast	9	-	-	45.54	-	-	2	81	0.8	7.9	8.5	-	-	20.9	-	-
	Warrnambool	62	11	-	5.25	7.63	-	9	160	2.6	12.9	7.2	1.4	-	20	2.7	-
	Wellington	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sub-LGA Shoreline	Anglesea	5	-	-	45.54	-	-	2	25	0.3	1.9	3.1	-	-	6.4	-	-
	Apollo Bay	64	-	-	5.17	-	-	5	80	1.6	4.9	5.4	-	-	12.7	-	-
	Bay of Islands	99	87	5	0.96	1.33	25.38	64	1,354	24.4	72.7	19.3	6.2	1.1	29.1	13.6	1.8
	Bega Valley	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Howe / Mallacoota	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Liptrap - Northwest	15	-	-	43.17	-	-	2	35	0.4	1.9	2.4	-	-	3.6	-	-
	Cape Nelson	47	1	-	7.58	55.38	-	7	103	3.8	9.4	9	0.9	-	18.2	0.9	-
	Cape Otway West	98	66	-	2.29	6.83	-	42	400	20.3	49.9	22.1	7.6	-	34.5	14.5	-
	Cape Patton	17	-	-	19.88	-	-	3	43	0.7	4.4	5.3	-	-	15.4	-	-
	Childers Cove	88	9	-	3.33	7.63	-	14	179	4.8	18.8	9.8	4	-	19.1	5.5	-
	Croajingolong - West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Discovery Bay - East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Discovery Bay - West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	French Island / Crib Point	4	-	-	80.54	-	-	2	13	< 0.1	0.3	0.9	-	-	0.9	-	-
	Kilcunda	4	-	-	50.79	-	-	2	15	0.2	0.5	1.1	-	-	1.8	-	-

Shoreline Receptor	Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
Lorne	6	-	-	64.79	-	-	2	16	0.2	1.3	2	-	-	4.5	-	-
Marlo	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Moonlight Head	100	96	-	2.00	2.79	-	93	811	38.5	77.6	21.9	9.3	-	29.1	13.6	-
Mornington Peninsula - South	7	-	-	70.38	-	-	2	15	0.2	1	1.7	-	-	2.7	-	-
Mornington Peninsula - Southwest	6	-	-	49.33	-	-	2	21	0.3	1.8	2	-	-	4.5	-	-
Point Hicks	1	-	-	103.25	-	-	2	18	0.1	0.5	0.9	-	-	0.9	-	-
Port Campbell	100	89	-	1.54	3.08	-	70	677	24.8	61.7	22.6	7	-	26.4	20.9	-
Port Fairy	59	10	-	9.67	31.29	-	6	156	1.9	9.3	3.8	1.5	-	17.3	2.7	-
Port Phillip - Queenscliff	12	-	-	42.75	-	-	2	25	0.3	1.1	2	-	-	3.6	-	-
Portland Bay - East	2	-	-	43.00	-	-	1	12	0.2	0.7	0.9	-	-	0.9	-	-
Portland Bay - West	7	-	-	32.21	-	-	2	15	0.2	0.7	1.3	-	-	1.8	-	-
Snake Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Torquay	4	-	-	45.54	-	-	3	94	1.1	11.8	23.2	-	-	25.4	-	-
Venus Bay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Waratah Bay	2	-	-	87.88	-	-	1	14	< 0.1	0.3	0.9	-	-	0.9	-	-
Warrnambool	46	2	-	5.79	12.5	-	5	150	1.5	7.3	4.8	0.9	-	15.4	0.9	-
Wilsons Promontory - East	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wilsons Promontory - West	23	-	-	42.92	-	-	3	55	1.1	6.2	5.8	-	-	16.4	-	-

Table 13.6 Summary of oil accumulation on individual shoreline receptors. Results are based on a 66,430 bbl (10,562 m³) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

Shoreline Receptor		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA Shoreline	Anser Island	36	-	-	21.08	-	-	5	33	0.3	0.9	1.5	-	-	2.7	-	-
	Bass Coast	5	-	-	30.42	-	-	2	15	0.4	1.6	1.3	-	-	1.8	-	-
	Bega Valley	4	-	-	54.13	-	-	2	17	0.3	1	1.4	-	-	1.8	-	-
	Colac Otway	100	93	-	2.88	7	-	28	406	31.8	61.2	36.4	8.2	-	61.8	17.3	-
	Corangamite	100	100	27	1.00	1.25	49.21	128	1,845	99.2	225	48.9	18.6	1.4	58.2	34.5	5.5
	East Gippsland	36	-	-	27.92	-	-	2	65	1.2	3.8	2.8	-	-	6.4	-	-
	Gabo Island	4	-	-	90.25	-	-	2	21	0.1	0.6	1.8	-	-	1.8	-	-
	Glenelg	8	-	-	37.67	-	-	2	40	1.4	7.1	5.6	-	-	16.4	-	-
	Glennie Group	39	-	-	21.67	-	-	4	48	0.6	3	2.8	-	-	8.2	-	-
	Greater Geelong	4	-	-	12.04	-	-	2	75	0.3	6.5	5.9	-	-	13.6	-	-
	Hogan Island Group	1	-	-	44.63	-	-	1	11	0.1	0.4	0.9	-	-	0.9	-	-
	Kanowna Island	19	-	-	34.38	-	-	3	22	0.3	0.8	1.7	-	-	2.7	-	-
	Kent Island Group	1	-	-	32.29	-	-	1	16	< 0.1	0.4	0.9	-	-	0.9	-	-
	King Island	11	-	-	39.92	-	-	1	25	0.5	1.7	1.2	-	-	1.8	-	-
	Lady Julia Percy Island	13	-	-	23.29	-	-	4	68	0.3	2.2	2	-	-	3.6	-	-
	Laurence Rocks	4	-	-	66.96	-	-	5	17	0.2	0.4	1.1	-	-	1.8	-	-
	Montague Island	2	-	-	102.21	-	-	2	11	< 0.1	0.4	0.9	-	-	0.9	-	-
	Mornington Peninsula	21	-	-	13.83	-	-	2	28	0.8	3.8	2.8	-	-	10	-	-
	Moyne	100	78	-	1.21	1.71	-	34	718	20	90.6	19.8	5.3	-	75.4	20.9	-
	Norman Island	8	-	-	31.38	-	-	3	22	0.2	0.7	1.4	-	-	1.8	-	-
	Phillip Island	29	-	-	18.79	-	-	2	47	0.8	3.3	2.8	-	-	7.3	-	-
	Rodondo Island	18	-	-	29.67	-	-	4	40	0.2	1	1.7	-	-	2.7	-	-
	Shellback Island	1	-	-	45.38	-	-	3	11	< 0.1	0.2	0.9	-	-	0.9	-	-
	Skull Rock	14	-	-	42.63	-	-	4	20	0.1	0.5	1.2	-	-	1.8	-	-
	South Gippsland	59	-	-	20.75	-	-	4	83	2.7	8.3	7.1	-	-	19.1	-	-
	Surf Coast	12	-	-	10.75	-	-	2	86	0.8	9.5	4.2	-	-	20	-	-
	Warrnambool	50	15	-	5.00	13.54	-	12	260	3.1	19	8.4	1.4	-	20.9	3.6	-
	Wellington	1	-	-	78.33	-	-	1	10	0.3	2.2	0.9	-	-	0.9	-	-
Sub-LGA Shoreline	Anglesea	4	-	-	14.08	-	-	2	23	0.3	2	2.5	-	-	5.5	-	-
	Apollo Bay	91	-	-	2.96	-	-	8	96	2.6	7.2	6.8	-	-	19.1	-	-
	Bay of Islands	100	74	-	1.21	1.71	-	48	718	16.9	62.6	14.5	5.2	-	25.4	16.4	-
	Bega Valley	4	-	-	54.13	-	-	2	17	0.3	1	1.4	-	-	1.8	-	-
	Cape Howe / Mallacoota	2	-	-	93.75	-	-	2	11	0.1	0.6	0.9	-	-	0.9	-	-
	Cape Liptrap - Northwest	31	-	-	20.75	-	-	3	45	0.6	2.1	2.4	-	-	5.5	-	-
	Cape Nelson	6	-	-	66.54	-	-	2	40	1	4.4	5.8	-	-	12.7	-	-
	Cape Otway West	100	93	-	2.88	7	-	56	406	27.7	51.1	26.7	8.2	-	33.6	17.3	-
	Cape Patton	61	-	-	5.25	-	-	5	45	1.5	4.8	5.6	-	-	16.4	-	-
	Childers Cove	59	15	-	2.50	22.67	-	12	187	3.9	22	9.6	2	-	18.2	6.4	-
	Croajingolong - West	16	-	-	44.79	-	-	2	21	0.2	0.8	0.9	-	-	0.9	-	-
	Discovery Bay - East	1	-	-	104.79	-	-	1	10	0.3	1	0.9	-	-	0.9	-	-
	Discovery Bay - West	1	-	-	104.25	-	-	1	12	0.2	1.1	0.9	-	-	0.9	-	-
	French Island / Crib Point	6	-	-	30.25	-	-	2	20	< 0.1	0.4	0.9	-	-	0.9	-	-
	Kilcunda	2	-	-	67.79	-	-	2	12	0.2	0.5	0.9	-	-	0.9	-	-

Shoreline Receptor	Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
Lorne	12	-	-	10.42	-	-	2	20	0.4	1.5	2.1	-	-	4.5	-	-
Marlo	4	-	-	89.00	-	-	1	19	0.1	0.5	0.9	-	-	0.9	-	-
Moonlight Head	100	100	24	1.96	4.33	49.21	166	1,845	68.8	161	26.3	11.4	1.3	30.9	16.4	5.5
Mornington Peninsula - South	10	-	-	13.83	-	-	2	24	0.3	1.4	2.4	-	-	5.5	-	-
Mornington Peninsula - Southwest	15	-	-	17.63	-	-	2	28	0.3	2.2	2	-	-	6.4	-	-
Point Hicks	36	-	-	27.92	-	-	4	65	0.6	2.3	2.2	-	-	3.6	-	-
Port Campbell	99	89	5	1.00	1.25	66.96	86	1,202	30.3	87.5	22.3	8.1	1.3	26.4	20	1.8
Port Fairy	36	6	-	11.96	13.38	-	5	185	1.7	13.2	4.3	2	-	26.4	2.7	-
Port Phillip - Queenscliff	2	-	-	17.54	-	-	1	16	0.1	1	2.7	-	-	3.6	-	-
Portland Bay - East	2	-	-	25.42	-	-	2	16	0.3	1.5	1.8	-	-	2.7	-	-
Portland Bay - West	3	-	-	37.67	-	-	2	21	0.6	2.7	2.7	-	-	5.5	-	-
Snake Island	1	-	-	78.33	-	-	1	10	< 0.1	0.4	0.9	-	-	0.9	-	-
Torquay	3	-	-	12.04	-	-	2	86	0.5	12.6	16.1	-	-	24.5	-	-
Venus Bay	4	-	-	30.42	-	-	2	15	0.2	1.3	1.1	-	-	1.8	-	-
Waratah Bay	5	-	-	39.17	-	-	1	23	0.1	0.7	0.9	-	-	0.9	-	-
Warrnambool	38	4	-	6.08	13.54	-	7	260	1.9	16.6	6	1.6	-	23.6	1.8	-
Wilsons Promontory - East	1	-	-	38.79	-	-	1	14	0.1	0.7	0.9	-	-	0.9	-	-
Wilsons Promontory - West	58	-	-	29.88	-	-	5	83	1.9	6.1	5.9	-	-	14.5	-	-

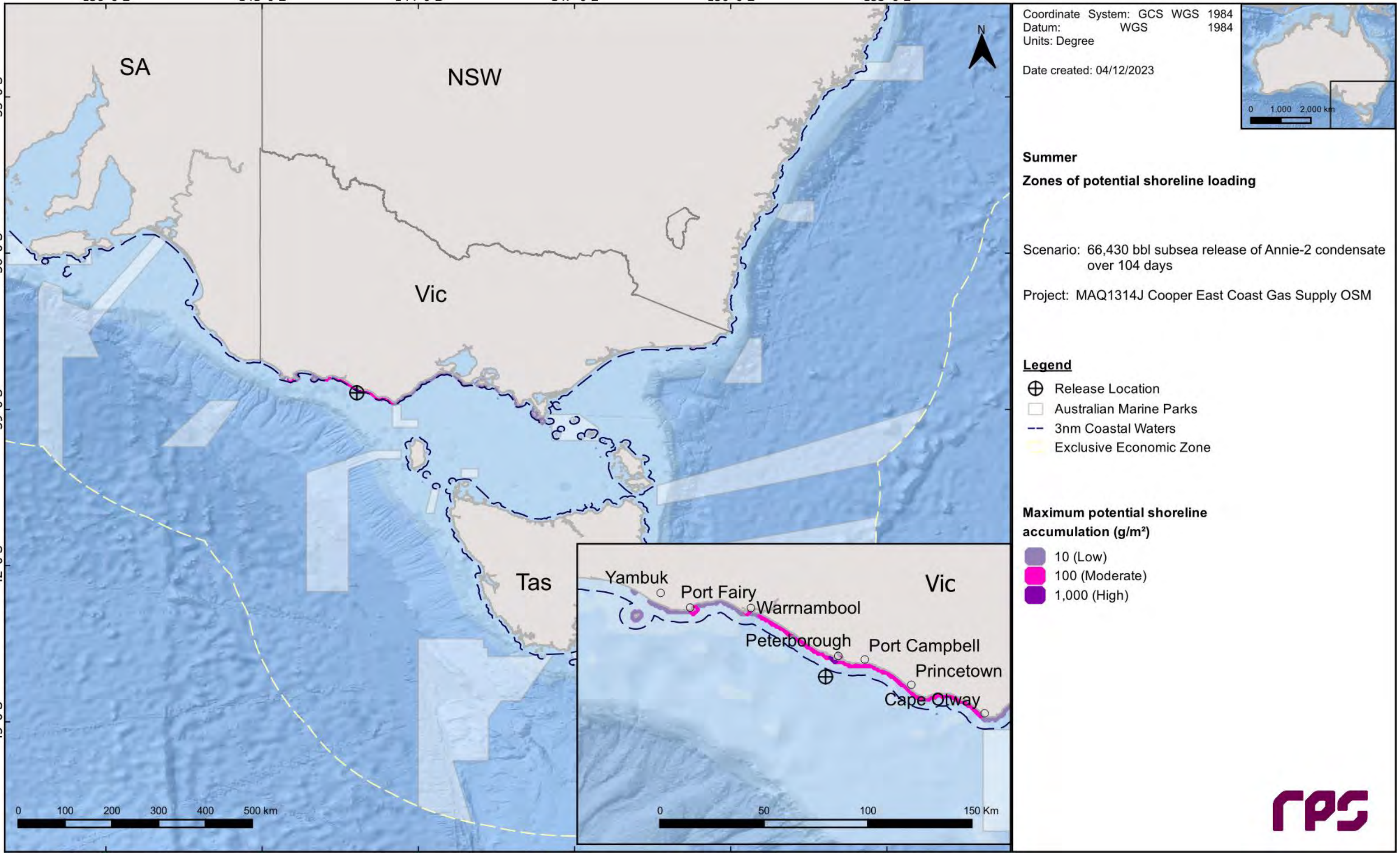


Figure 13.7 Maximum potential shoreline accumulation in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

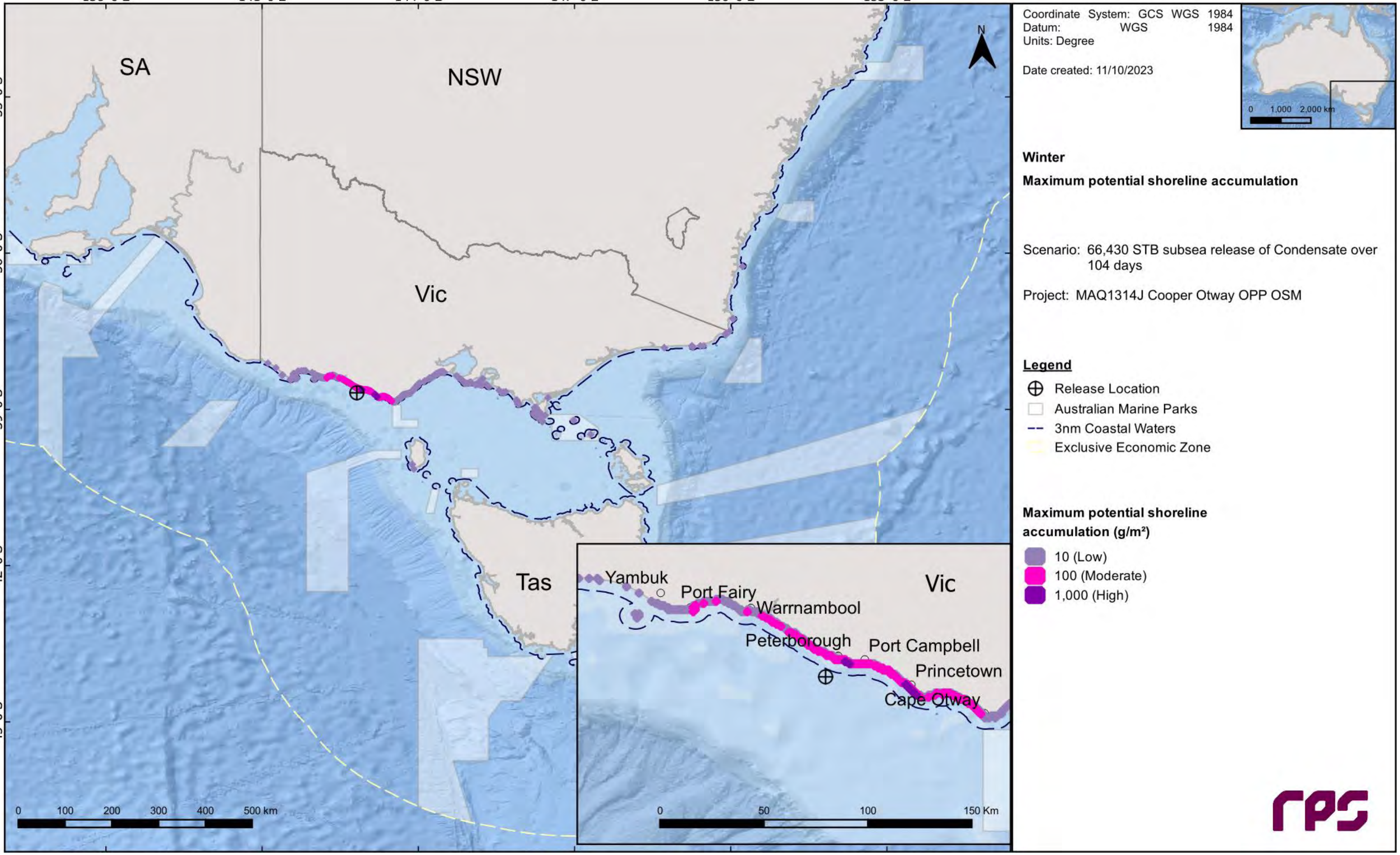


Figure 13.8 **Maximum potential shoreline accumulation in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.**

13.1.3 In-water exposure

13.1.3.1 Dissolved Hydrocarbons

Table 13.7 summarises the potential in-water exposure to individual receptors from dissolved hydrocarbons in the 0-10 m layer.

A total of 20 BIAs were predicted to be exposed to dissolved hydrocarbon at, or above, the low threshold. Excluding the BIAs that the release location resides within (see Section 10.3), the highest probability of low exposure was 10% during summer and 33% during winter at the Short-tailed Shearwater - Foraging BIA receptor.

The maximum dissolved hydrocarbon concentration at any given receptor(s) was shown to be 35.3 ppb and 41.0 ppb during summer and winter respectively.

Table 13.8 presents the predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors, in the 0-10 m depth layer, for all thresholds assessed.

Figure 13.9 and Figure 13.10 present the zones of potential dissolved hydrocarbon exposure for the 0-10 m depth layer for each season whilst Figure 13.11 and Figure 13.12 present the maximum residence time of dissolved hydrocarbon exposure for the NOPSEMA thresholds.

Table 13.7 Probability of dissolved hydrocarbons exposure to marine based receptors in the 0–10 m depth. Results are based on a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer				Winter			
		Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)			Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	14.5	1	-	-	14.8	1	-	-
BIA	Antipodean Albatross - Foraging*	30.4	13	-	-	23.8	11	-	-
	Australasian Gannet - Foraging	14.5	1	-	-	6.9	-	-	-
	Black-browed Albatross - Foraging*	30.4	13	-	-	23.8	11	-	-
	Bullers Albatross - Foraging*	30.4	13	-	-	23.8	11	-	-
	Campbell Albatross - Foraging*	30.4	13	-	-	23.8	11	-	-
	Common Diving-petrel - Foraging*	35.3	24	-	-	41	50	-	-
	Indian Yellow-nosed Albatross - Foraging*	30.4	13	-	-	23.8	11	-	-
	Pygmy Blue Whale - Distribution*	35.3	24	-	-	41.0	50	-	-
	Pygmy Blue Whale - Foraging*	35.3	24	-	-	41.0	50	-	-
	Pygmy Blue Whale - Foraging annual high use area*	35.3	24	-	-	41.0	50	-	-
	Pygmy Blue Whale - Known Foraging Area	16.6	1	-	-	21.6	3	-	-
	Short-tailed Shearwater - Foraging	21.9	10	-	-	41.0	33	-	-
	Shy Albatross - Foraging*	35.3	24	-	-	41.0	50	-	-
	Southern Right Whale - Aggregation	20.1	2	-	-	19.4	2	-	-
	Southern Right Whale - Known Core Range*	35.3	24	-	-	41.0	50	-	-
	Wandering Albatross - Foraging*	30.4	13	-	-	23.8	11	-	-
	Wedge-tailed Shearwater - Foraging*	35.3	24	-	-	41.0	50	-	-
	White Shark - Distribution*	30.4	13	-	-	23.8	11	-	-
	White Shark - Foraging	17.7	1	-	-	8.9	-	-	-
	White-faced Storm-petrel - Foraging	16.6	1	-	-	21.6	3	-	-
IBRA	Otway Plain	17.3	3	-	-	17.1	9	-	-
	Otway Ranges	15.5	4	-	-	23.2	9	-	-

Receptor		Summer				Winter			
		Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)			Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure (%)		
			Low	Moderate	High		Low	Moderate	High
	Warrnambool Plain	29.6	23	-	-	35.1	50	-	-
IMCRA	Central Bass Strait	16.6	1	-	-	21.6	3	-	-
IMCRA	Central Victoria	16.1	1	-	-	17.2	2	-	-
IMCRA	Otway*	35.3	24	-	-	41.0	50	-	-
KEF	Bonney Coast Upwelling	11.1	1	-	-	5.9	-	-	-
MNP	Twelve Apostles	27.7	20	-	-	33.8	40	-	-
RSB	Bravenes Rock	11.2	2	-	-	10.8	1	-	-
Nearshore Waters	Colac Otway	17.3	3	-	-	18.2	9	-	-
Nearshore Waters	Corangamite	29.6	23	-	-	35.1	48	-	-
Nearshore Waters	Moyne	11.5	1	-	-	13.2	1	-	-
State Waters	Victoria State Waters	35.3	24	-	-	41.0	50	-	-
Nearshore Waters (Sub-LGA)	Apollo Bay	9.6	-	-	-	13.0	2	-	-
Nearshore Waters (Sub-LGA)	Bay of Islands	11.5	1	-	-	13.2	1	-	-
Nearshore Waters (Sub-LGA)	Cape Otway West	17.3	3	-	-	18.2	9	-	-
Nearshore Waters (Sub-LGA)	Moonlight Head	29.6	23	-	-	35.1	50	-	-
Nearshore Waters (Sub-LGA)	Port Campbell	20.6	6	-	-	15.3	2	-	-

*The release location resides within the receptor boundaries.

Table 13.8 Predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer						Winter					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
AMP	Apollo	9.71	-	-	0.04	-	-	6.29	-	-	0.04	-	-
BIA	Antipodean Albatross - Foraging*	2.46	-	-	0.13	-	-	1.63	-	-	0.21	-	-
	Australasian Gannet - Foraging	5.38	-	-	0.04	-	-	-	-	-	-	-	-
	Black-browed Albatross - Foraging*	2.46	-	-	0.13	-	-	1.63	-	-	0.21	-	-
	Bullers Albatross - Foraging*	2.46	-	-	0.13	-	-	1.63	-	-	0.21	-	-
	Campbell Albatross - Foraging*	2.46	-	-	0.13	-	-	1.63	-	-	0.21	-	-
	Common Diving-petrel - Foraging*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
	Indian Yellow-nosed Albatross - Foraging*	2.46	-	-	0.13	-	-	1.63	-	-	0.21	-	-
	Pygmy Blue Whale - Distribution*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
	Pygmy Blue Whale - Foraging*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
	Pygmy Blue Whale - Foraging annual high use area*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
	Pygmy Blue Whale - Known Foraging Area	9.96	-	-	0.04	-	-	6.38	-	-	0.08	-	-
	Short-tailed Shearwater - Foraging	4.63	-	-	0.08	-	-	3.42	-	-	0.13	-	-
	Shy Albatross - Foraging*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
	Southern Right Whale - Aggregation	3.33	-	-	0.08	-	-	3.79	-	-	0.13	-	-
	Southern Right Whale - Known Core Range*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
	Wandering Albatross - Foraging*	2.46	-	-	0.13	-	-	1.63	-	-	0.21	-	-
	Wedge-tailed Shearwater - Foraging*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
	White Shark - Distribution*	2.46	-	-	0.13	-	-	1.63	-	-	0.21	-	-
	White Shark - Foraging	5.38	-	-	0.04	-	-	78.46	-	-	0.04	-	-
	White-faced Storm-petrel - Foraging	9.96	-	-	0.04	-	-	6.42	-	-	0.08	-	-
IBRA	Otway Plain	11.42	-	-	0.08	-	-	4.75	-	-	0.08	-	-

Receptor		Summer						Winter					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
	Otway Ranges	11.46	-	-	0.08	-	-	4.29	-	-	0.08	-	-
	Warrnambool Plain	4.63	-	-	0.17	-	-	2.96	-	-	0.21	-	-
IMCRA	Central Bass Strait	10.29	-	-	0.04	-	-	7.33	-	-	0.08	-	-
	Central Victoria	9.96	-	-	0.04	-	-	7	-	-	0.08	-	-
	Otway*	2.46	-	-	0.25	-	-	1.63	-	-	0.21	-	-
KEF	Bonney Coast Upwelling	11.67	-	-	0.04	-	-	-	-	-	-	-	-
MNP	Twelve Apostles	3.54	-	-	0.17	-	-	2.96	-	-	0.21	-	-
RSB	Bravenes Rock	30.88	-	-	0.04	-	-	23.79	-	-	0.04	-	-
Nearshore Waters	Colac Otway	11.42	-	-	0.08	-	-	4.29	-	-	0.08	-	-
	Corangamite	4.63	-	-	0.17	-	-	2.96	-	-	0.21	-	-
	Moyne	11.33	-	-	0.04	-	-	4.5	-	-	0.13	-	-
State Waters	Victoria State Waters	3.54	-	-	0.25	-	-	2.96	-	-	0.21	-	-
Nearshore Waters (Sub-LGA)	Apollo Bay	-	-	-	-	-	-	10.21	-	-	0.08	-	-
	Bay of Islands	11.33	-	-	0.04	-	-	4.5	-	-	0.13	-	-
	Cape Otway West	11.42	-	-	0.08	-	-	4.29	-	-	0.08	-	-
	Moonlight Head	4.54	-	-	0.17	-	-	2.96	-	-	0.21	-	-
	Port Campbell	5.17	-	-	0.08	-	-	3.88	-	-	0.08	-	-

*The release location resides within the receptor boundaries.

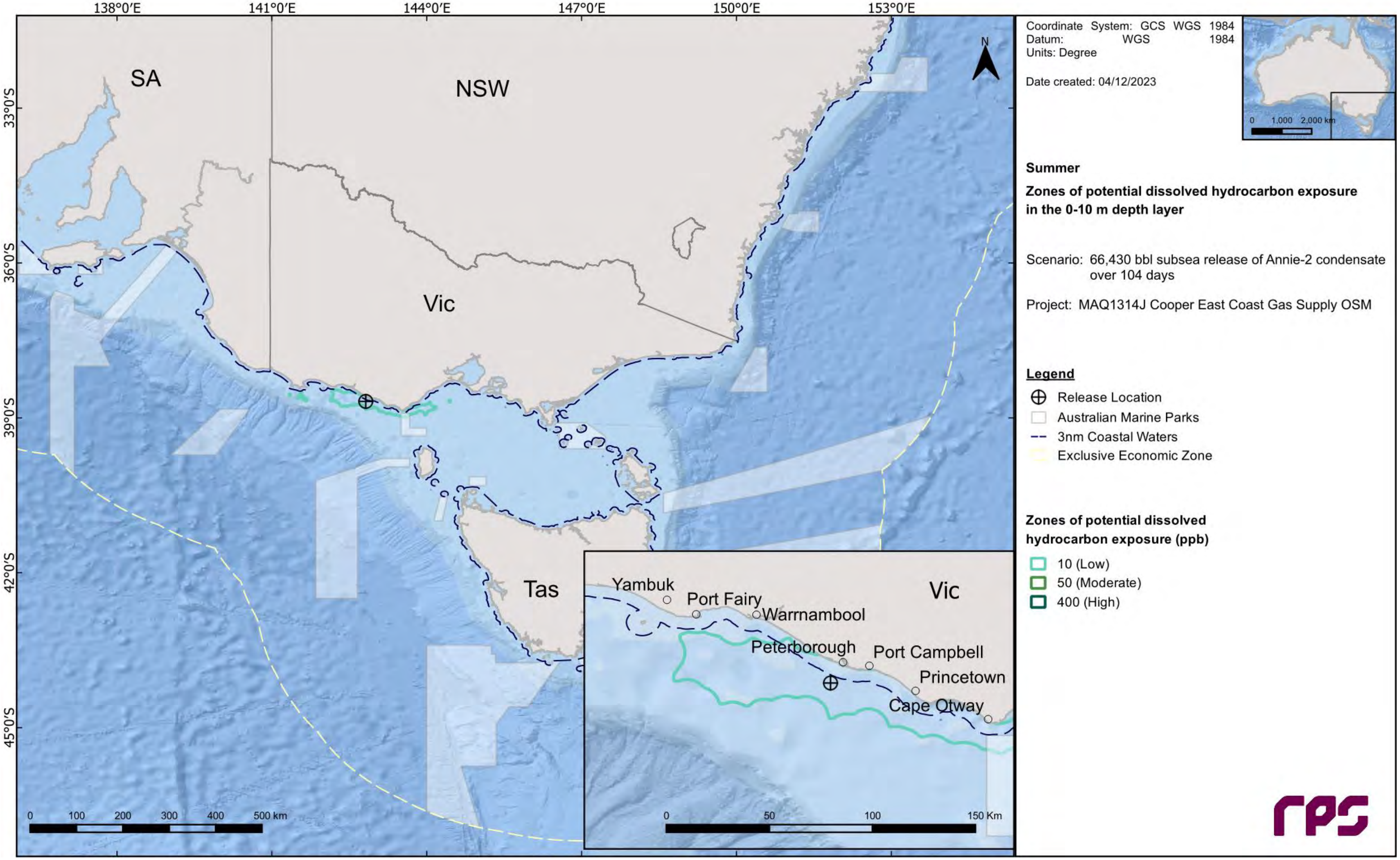


Figure 13.9 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

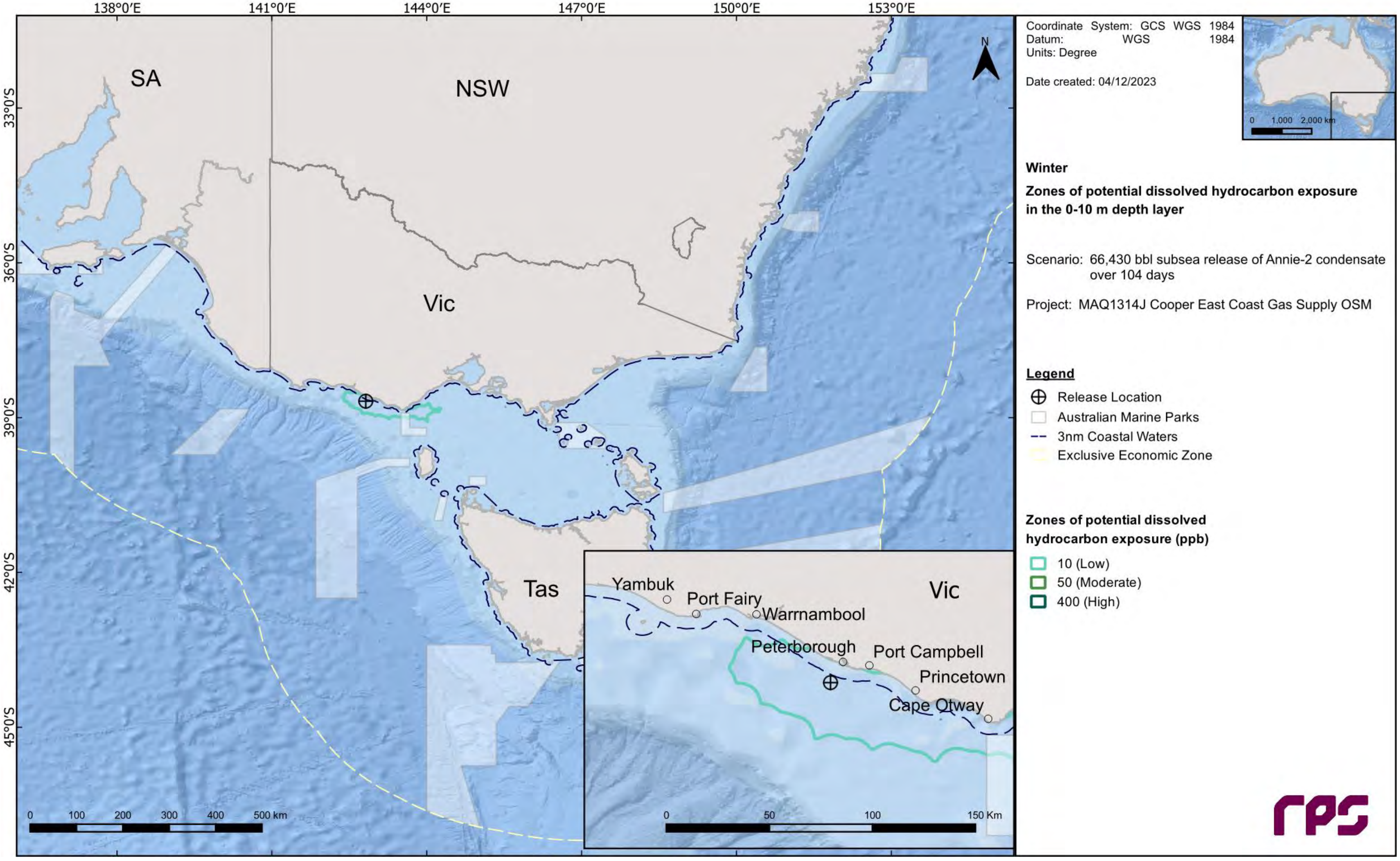


Figure 13.10 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

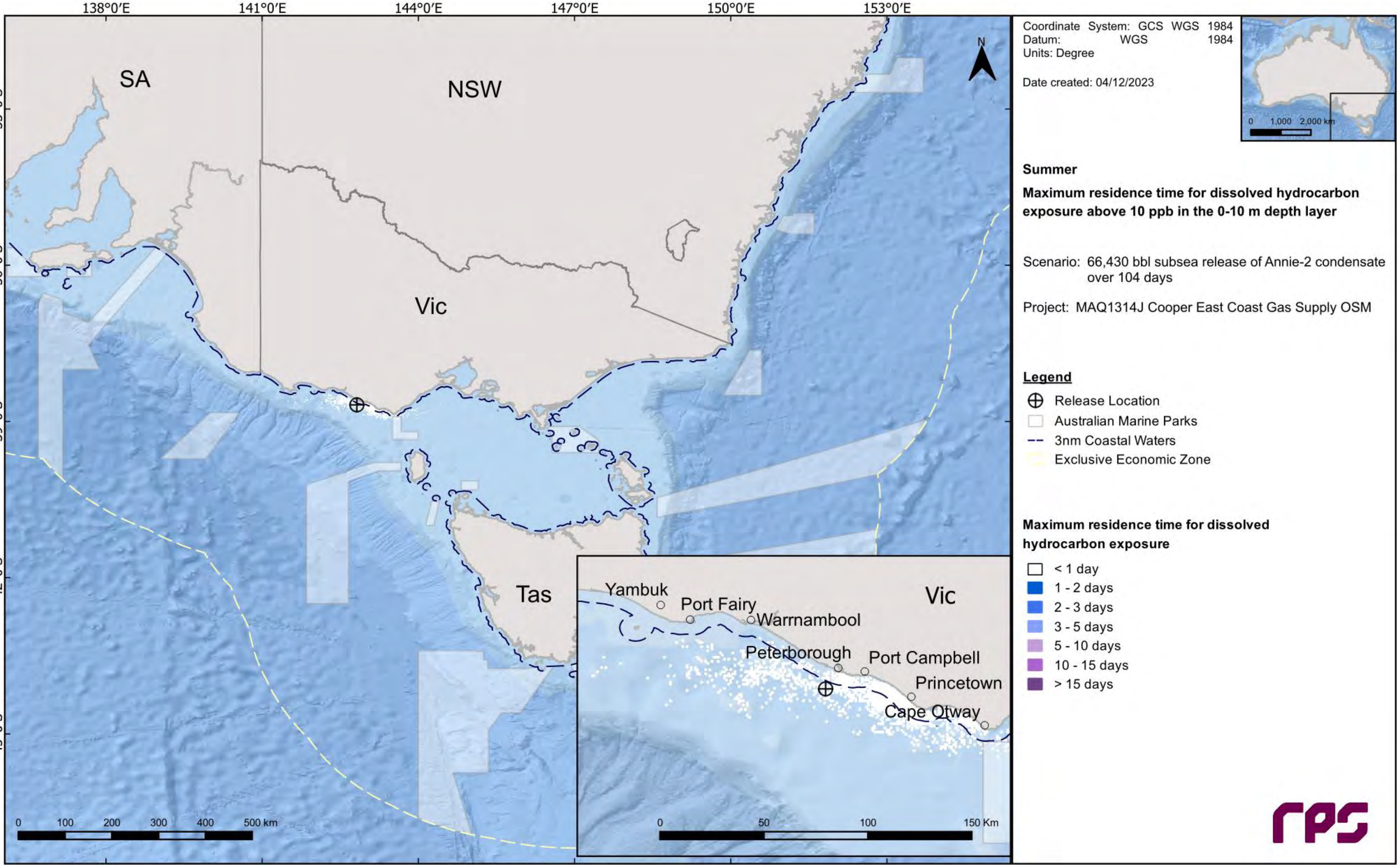


Figure 13.11 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

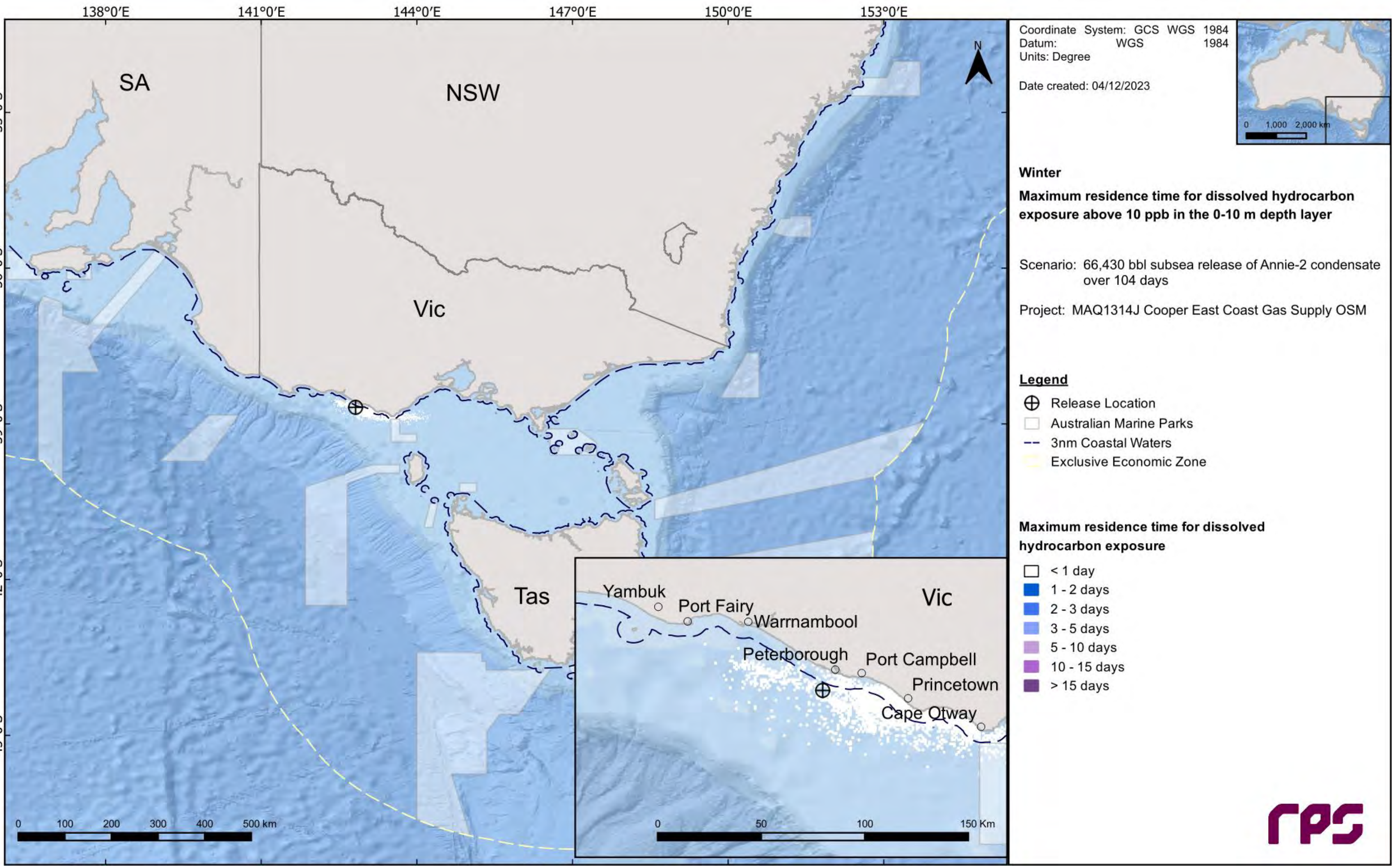


Figure 13.12 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

13.1.3.2 Entrained Hydrocarbons

Table 13.9 summarises the potential in-water exposure to individual receptors from entrained hydrocarbons in the 0-10 m depth layer.

Many receptors were exposed above the low and high thresholds, however most of these receptors (predominantly BIAs) coincided with the release location.

In summer conditions, the highest probability of low entrained hydrocarbon exposure was recorded at 100% for receptors that the release location doesn't reside within, including Short-tailed Shearwater – Foraging, Southern Right Whale – Aggregation BIAs and Warrnambool Plain IBRA. Additional receptors including near-shore sub-LGA waters, and AMPs were predicted with entrained hydrocarbon exposure (refer to Table 13.9). Similarly, during winter several receptors that the release location doesn't reside within revealed probabilities of 100% for low entrained hydrocarbon exposure.

Table 13.10 presents the predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer, for all thresholds assessed.

Figure 13.13 and Figure 13.14 present the zones of potential entrained hydrocarbon exposure for the 0-10 m depth layer for each season whilst Figure 13.15 to Figure 13.18 present the maximum residence time of entrained hydrocarbon exposure for the NOPSEMA thresholds.

Table 13.9 Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer. Results are based on a 66,430 bbl (10,562 m³) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
AMP	Apollo	119.1	86	6	124.6	97	5
	Beagle	25.0	36	-	26.9	34	-
	Nelson	15.5	7	-	14.3	1	-
	Zeehan	17.0	9	-	15.6	8	-
BIA	Antipodean Albatross - Foraging*	647.2	100	100	663.8	100	100
	Australasian Gannet - Foraging	87.5	71	-	74.5	66	-
	Australian Sea Lion - Foraging	13.0	7	-	6.9	-	-
	Black Petrel - Foraging	15.4	6	-	11.7	2	-
	Black-browed Albatross - Foraging*	647.2	100	100	663.8	100	100
	Black-faced Cormorant - Foraging	16.0	3	-	14	8	-
	Bullers Albatross - Foraging*	647.2	100	100	663.8	100	100
	Campbell Albatross - Foraging*	647.2	100	100	663.8	100	100
	Common Diving-petrel - Foraging*	647.2	100	100	663.8	100	100
	Crested Tern - Breeding	8.1	-	-	10.5	1	-
	Crested Tern - Foraging	9.3	-	-	11.7	2	-
	Flesh-footed Shearwater - Foraging	15.4	6	-	11.7	2	-
	Great-winged Petrel - Foraging	15.4	6	-	9.2	-	-
	Grey Nurse Shark - Foraging	16	6	-	13.3	4	-
	Grey Nurse Shark - Migration	26.5	7	-	12.9	4	-
	Humpback Whale - Foraging	26.8	7	-	13.3	5	-
	Indian Yellow-nosed Albatross - Foraging*	647.2	100	100	663.8	100	100
	Indo-Pacific/Spotted Bottlenose Dolphin - Breeding	10.6	1	-	12.5	2	-
	Little Penguin - Breeding	8.4	-	-	11.7	2	-
	Little Penguin - Foraging	24.9	43	-	28.8	61	-
	Northern Giant Petrel - Foraging	15.4	6	-	9.2	-	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Pygmy Blue Whale - Distribution*	647.2	100	100	663.8	100	100
	Pygmy Blue Whale - Foraging*	647.2	100	100	663.8	100	100
	Pygmy Blue Whale - Foraging annual high use area*	647.2	100	100	663.8	100	100
	Pygmy Blue Whale - Known Foraging Area	125.8	86	4	113.1	97	6
	Short-tailed Shearwater - Foraging	254.5	100	95	256.5	100	99
	Shy Albatross - Foraging*	647.2	100	100	663.8	100	100
	Sooty Shearwater - Foraging	24.3	7	-	13.3	4	-
	Southern Giant Petrel - Foraging	15.4	6	-	9.2	-	-
	Southern Right Whale - Aggregation	347.5	100	83	287.9	98	76
	Southern Right Whale - Connecting Habitat	10.3	1	-	9.8	-	-
	Southern Right Whale - Known Core Range*	647.2	100	100	663.8	100	100
	Wandering Albatross - Foraging*	647.2	100	100	663.8	100	100
	Wedge-tailed Shearwater - Foraging*	647.2	100	100	663.8	100	100
	White Shark - Breeding	17.9	18	-	18.0	27	-
	White Shark - Distribution*	647.2	100	100	663.8	100	100
	White Shark - Foraging	99.1	84	-	111.7	73	2
	White-capped Albatross - Foraging	15.4	6	-	9.2	-	-
	White-faced Storm-petrel - Breeding	16.0	6	-	11.7	2	-
	White-faced Storm-petrel - Foraging	110.8	86	4	103.4	97	2
	Wilsons Storm Petrel - Migration	15.4	6	-	9.2	-	-
IBRA	Bridgewater	80.0	42	-	71.0	9	-
	East Gippsland Lowlands	8.0	-	-	13.0	2	-
	Flinders	19.1	11	-	23.0	13	-
	Gippsland Plain	48.7	31	-	54.4	52	-
	Glenelg Plain	87.5	52	-	74.0	10	-
	Otway Plain	243.6	99	59	183.1	100	67

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Otway Ranges	202.1	99	67	206.6	100	76
	Strzelecki Ranges	19.6	26	-	26.8	50	-
	Warrnambool Plain	475.1	100	99	441.0	100	100
	Wilsons Promontory	59.4	42	-	60.4	60	-
IMCRA	Batemans Shelf	13.0	5	-	11.7	2	-
	Central Bass Strait	110.8	85	3	103.4	95	2
	Central Victoria	112.7	86	4	107.6	97	2
	Flinders	60.8	43	-	61.0	61	-
	Otway*	647.2	100	100	663.8	100	100
	Twofold Shelf	26.8	12	-	21.1	16	-
	Victorian Embayments	27.4	24	-	20.5	40	-
KEF	Bonney Coast Upwelling	87.5	71	-	85.5	50	-
	Canyons on the Eastern Continental Slope	15.4	6	-	5.8	-	-
	Shelf rocky reefs	8.5	-	-	10.8	1	-
	Upwelling East of Eden	26.8	10	-	15.1	8	-
	West Tasmania Canyons	29.6	27	-	38.2	22	-
MNP	Bunurong	22.9	15	-	21.4	28	-
	Cape Howe	10.1	1	-	13.8	2	-
	Churchill Island	15.2	12	-	18.9	12	-
	Discovery Bay	36.6	30	-	29	2	-
	Point Addis	43.0	23	-	41.7	21	-
	Port Phillip Heads	27.4	25	-	21.5	16	-
	Twelve Apostles	483.8	100	99	445.8	100	100
	Wilsons Promontory	58.8	43	-	60.3	60	-
MP	Batemans	8.1	-	-	10.5	1	-
	Lower South East	16.1	3	-	11.4	1	-
MS	Mushroom Reef	16.1	18	-	18.0	25	-
NPS4	Bunurong Marine Park	26.6	21	-	30	36	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Wilsons Promontory Marine Park	47.3	32	-	50.9	52	-
RAMSAR	Port Phillip Bay Western Shoreline and Bellarine Peninsula	19.7	6	-	15.5	4	-
	Western Port	15.2	12	-	18.9	12	-
RSB	Bravenes Rock	205.4	95	24	123.0	99	12
	Cody Bank	16.0	20	-	19.0	40	-
	Cutter Rock	22.3	17	-	25.5	15	-
	New Zealand Star Bank	13.7	5	-	12.0	2	-
Nearshore Waters	Anser Island	53.1	41	-	52.3	59	-
	Bass Coast	29.5	23	-	33.1	44	-
	Bega Valley	8.1	-	-	12.1	2	-
	Colac Otway	243.6	99	59	183.1	100	67
	Corangamite	475.1	100	99	441.0	100	100
	Curtis Island	19.1	11	-	23.0	7	-
	East Gippsland	8.0	-	-	13.0	2	-
	French Island	9.7	-	-	11.8	2	-
	Gabo Island	8.3	-	-	12.6	2	-
	Glenelg	87.5	52	-	74.0	10	-
	Glennie Group	57.9	43	-	57.6	60	-
	Grant	12.4	4	-	9.0	-	-
	Greater Geelong	48.6	25	-	40.0	12	-
	Hogan Island Group	16.1	11	-	20.2	13	-
	Kanowna Island	49.7	41	-	47.5	59	-
	Lady Julia Percy Island	76.5	62	-	71.1	25	-
	Laurence Rocks	69.7	47	-	62.4	9	-
	Moncoeur Islands	22.4	33	-	26.7	36	-
	Mornington Peninsula	28.9	30	-	31.5	42	-
	Moyne	308.3	100	79	377.8	100	75
	Mud Island	12.5	4	-	11.2	3	-

Receptor		Summer			Winter		
		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High		Low	High
	Norman Island	59.4	39	-	60.4	57	-
	Phillip Island	21.6	28	-	22.3	44	-
	Rodondo Island	33.9	39	-	33.8	49	-
	Seal Islands	7.4	-	-	10.8	1	-
	Shellback Island	38.0	29	-	41.8	44	-
	Skull Rock	46.9	41	-	44.6	59	-
	South Gippsland	58.3	41	-	58.0	60	-
	Surf Coast	44.3	23	-	40.3	40	-
	Warrnambool	199.1	84	4	159.7	56	12
State Waters	New South Wales	9.7	-	-	12.5	2	-
	South Australia State Waters	17.4	10	-	12.1	2	-
	Tasmania State Waters	23.4	15	-	25.5	15	-
	Victoria State Waters	499.5	100	100	462.8	100	100
Nearshore Waters (Sub-LGA)	Anglesea	34.6	18	-	30.9	11	-
	Apollo Bay	133.7	86	7	101.4	97	1
	Bay of Islands	308.3	100	79	377.8	100	75
	Bega Valley	8.1	-	-	12.1	2	-
	Cape Howe / Mallacoota	7.7	-	-	13.0	2	-
	Cape Liptrap - Northwest	25.5	28	-	29.0	52	-
	Cape Nelson	87.5	52	-	74.0	10	-
	Cape Otway West	249.8	99	59	183.1	100	67
	Cape Patton	49.9	76	-	60.2	94	-
	Childers Cove	210.6	93	12	176.2	75	14
	Discovery Bay - East	33.3	18	-	27.2	1	-
	Discovery Bay - West	19.2	15	-	19.6	1	-
	French Island / Crib Point	8.0	-	-	11.5	2	-
	French Island / San Remo	14.1	20	-	19.2	18	-
	Kilcunda	29.5	23	-	33.1	44	-

Receptor	Summer			Winter		
	Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
		Low	High		Low	High
Lorne	30.8	23	-	26.6	46	-
Moonlight Head	483.8	100	99	445.8	100	100
Mornington Peninsula - South	21.1	23	-	21.2	40	-
Mornington Peninsula - Southwest	28.9	30	-	31.7	42	-
Port Campbell	426.8	100	86	346.1	100	88
Port Fairy	68.3	62	-	104.6	31	1
Port Phillip - Queenscliff	34.4	25	-	29.3	12	-
Port Phillip - Sorrento Shore	26.4	25	-	24.4	27	-
Port Phillip Heads	25.1	15	-	20.5	9	-
Portland Bay - East	38.3	46	-	38.8	10	-
Portland Bay - West	63.6	31	-	57.4	7	-
Torquay	48.6	16	-	40.3	10	-
Venus Bay	27.6	23	-	32.2	40	-
Waratah Bay	19.6	26	-	26.8	50	-
Warrnambool	103.3	66	2	121	45	3
Westernport	15.2	16	-	15.6	18	-
Wilsons Promontory - East	37.0	38	-	34.1	53	-
Wilsons Promontory - West	58.3	41	-	58.0	60	-

*The release location resides within the receptor boundaries.

Table 13.10 Predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
AMP	Apollo	3.13	24.42	30.29	0.21	2.00	8.25	11.54	0.21
	Beagle	26.46	-	6.63	-	25.63	-	4	-
	Nelson	20.04	-	1.38	-	84.88	-	1	-
	Zeehan	26.17	-	2.21	-	18.58	-	0.71	-
BIA	Antipodean Albatross - Foraging*	0.04	0.08	93.08	14.96	0.04	0.08	104.75	15.08
	Australasian Gannet - Foraging	2.29	-	84.17	-	6.25	-	55.04	-
	Australian Sea Lion - Foraging	11.38	-	0.67	-	-	-	-	-
	Black Petrel - Foraging	42.83	-	0.54	-	54.83	-	0.08	-
	Black-browed Albatross - Foraging*	0.04	0.08	93.08	15.46	0.04	0.08	104.75	15.08
	Black-faced Cormorant - Foraging	29.71	-	0.29	-	17.92	-	0.38	-
	Bullers Albatross - Foraging*	0.04	0.08	93.08	15.46	0.04	0.08	104.75	15.08
	Campbell Albatross - Foraging*	0.04	0.08	93.08	15.46	0.04	0.08	104.75	15.08
	Common Diving-petrel - Foraging*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	Crested Tern - Breeding	-	-	-	-	55.08	-	0.04	-
	Crested Tern - Foraging	-	-	-	-	54.83	-	0.08	-
	Flesh-footed Shearwater - Foraging	42.83	-	0.54	-	54.83	-	0.08	-
	Great-winged Petrel - Foraging	42.83	-	0.54	-	-	-	-	-
	Grey Nurse Shark - Foraging	40.33	-	0.92	-	49.33	-	0.13	-
	Grey Nurse Shark - Migration	40.04	-	1.67	-	49.08	-	0.17	-
	Humpback Whale - Foraging	39.71	-	1.67	-	36.88	-	0.25	-
	Indian Yellow-nosed Albatross - Foraging*	0.04	0.08	93.08	15.46	0.04	0.08	104.75	15.08
	Indo-Pacific/Spotted Bottlenose Dolphin - Breeding	73.33	-	0.04	-	48.63	-	0.25	-
	Little Penguin –– Breeding	-	-	-	-	54.83	-	0.08	-
	Little Penguin - Foraging	26.42	-	14.88	-	10.08	-	20.42	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Northern Giant Petrel - Foraging	42.83	-	0.54	-	-	-	-	-
	Pygmy Blue Whale - Distribution*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	Pygmy Blue Whale - Foraging*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	Pygmy Blue Whale - Foraging annual high use area*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	Pygmy Blue Whale - Known Foraging Area	3.17	24.54	31.42	0.25	2.00	8.33	30.5	0.08
	Short-tailed Shearwater - Foraging	0.79	2.00	93.08	20.29	0.92	3.21	104.92	11.04
	Shy Albatross - Foraging*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	Sooty Shearwater - Foraging	40.33	-	1.67	-	49.08	-	0.17	-
	Southern Giant Petrel - Foraging	42.83	-	0.54	-	-	-	-	-
	Southern Right Whale - Aggregation	0.5	0.96	84.17	2.96	0.46	1.00	96.63	2.25
	Southern Right Whale - Connecting Habitat	32.21	-	0.04	-	-	-	-	-
	Southern Right Whale - Known Core Range*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	Wandering Albatross - Foraging*	0.04	0.08	93.08	15.46	0.04	0.08	104.75	15.08
	Wedge-tailed Shearwater - Foraging*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	White Shark - Breeding	67.63	-	5.17	-	30.25	-	8.58	-
	White Shark - Distribution*	0.04	0.08	93.08	15.46	0.04	0.08	104.75	15.08
	White Shark - Foraging	1.54	-	84.17	-	3.88	21.5	96.63	0.21
	White-capped Albatross - Foraging	42.83	-	0.54	-	-	-	-	-
	White-faced Storm-petrel - Breeding	42.54	-	0.54	-	54.83	-	0.08	-
	White-faced Storm-petrel - Foraging	3.71	24.67	28.46	0.17	2.13	18.33	30.5	0.04
	Wilsons Storm Petrel - Migration	42.83	-	0.54	-	-	-	-	-
IBRA	Bridgewater	7.63	-	52.5	-	24.04	-	43.75	-
	East Gippsland Lowlands	-	-	-	-	48.71	-	0.33	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Flinders	26.58	-	1.17	-	27.96	-	1.54	-
	Gippsland Plain	32.08	-	17.25	-	13.29	-	28.79	-
	Glenelg Plain	6.21	-	60.29	-	22.83	-	43.75	-
	Otway Plain	1.38	5.13	92.04	18.79	1.88	4.13	94.5	7.42
	Otway Ranges	0.83	4.67	68.67	6.63	1.92	4.58	102.29	7.42
	Strzelecki Ranges	39.21	-	10.92	-	24.71	-	12.54	-
	Warrnambool Plain	0.71	1.50	90.67	21	0.71	1.25	108.17	32.42
	Wilsons Promontory	26.75	-	32.54	-	15.04	-	40.13	-
IMCRA	Batemans Shelf	48.54	-	0.17	-	54.83	-	0.08	-
	Central Bass Strait	4.46	24.79	17.33	0.13	2.33	15.75	16.67	0.04
	Central Victoria	3.67	24.58	24.88	0.21	2.13	18.25	30.5	0.04
	Flinders	26.00	-	35.79	-	14.96	-	40.13	-
	Otway*	0.04	0.08	93.08	22.25	0.04	0.08	109.71	32.5
	Twofold Shelf	27.08	-	1.67	-	27.88	-	2.54	-
	Victorian Embayments	35.00	-	10.13	-	15.33	-	12.33	-
KEF	Bonney Coast Upwelling	2.92	-	84.17	-	7.79	-	55.04	-
	Canyons on the Eastern Continental Slope	42.83	-	0.46	-	-	-	-	-
	Shelf rocky reefs	-	-	-	-	54.88	-	0.04	-
	Upwelling East of Eden	36.50	-	1.67	-	36.79	-	1	-
	West Tasmania Canyons	18.58	-	4.88	-	11.04	-	2.67	-
MNP	Bunurong	38.42	-	4.96	-	20.71	-	7.08	-
	Cape Howe	73.25	-	0.04	-	48.67	-	0.71	-
	Churchill Island	51.38	-	2.58	-	24.92	-	12.33	-
	Discovery Bay	7.83	-	6.46	-	63.29	-	5.88	-
	Point Addis	24.29	-	10.75	-	12.17	-	23.17	-
	Port Phillip Heads	33.13	-	3.63	-	14.50	-	8.58	-
	Twelve Apostles	0.58	1.83	91.33	22.25	0.46	1.29	108.33	32.5

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Wilsons Promontory	26.88	-	35.79	-	15.04	-	40.13	-
MP	Batemans	-	-	-	-	55.08	-	0.04	-
	Lower South East	37.67	-	2.38	-	96.54	-	0.08	-
MS	Mushroom Reef	39.08	-	4.5	-	20.25	-	5.38	-
NPS4	Bunurong Marine Park	39.71	-	8	-	21.79	-	9.92	-
	Wilsons Promontory Marine Park	38.79	-	18.04	-	20.79	-	33.58	-
RAMSAR	Port Phillip Bay Western Shoreline and Bellarine Peninsula	47.42	-	3.63	-	35.54	-	1.92	-
	Western Port	51.38	-	2.58	-	24.92	-	12.33	-
RSB	Bravenes Rock	2.21	11.33	56.96	0.96	1.13	13.96	89	0.63
	Cody Bank	35.17	-	4.5	-	15.42	-	2	-
	Cutter Rock	26.5	-	2.04	-	26.63	-	1.21	-
	New Zealand Star Bank	42.25	-	0.33	-	47.88	-	0.13	-
Nearshore Waters	Anser Island	36.29	-	16.63	-	15.08	-	37.42	-
	Bass Coast	39.58	-	8.5	-	21.25	-	10.04	-
	Bega Valley	-	-	-	-	49.17	-	0.33	-
	Colac Otway	1.21	5.13	92.04	18.79	1.88	4.13	94.5	7.46
	Corangamite	0.71	1.50	90.79	21	0.79	1.58	108.17	32.42
	Curtis Island	26.58	-	0.67	-	42.75	-	0.92	-
	East Gippsland	-	-	-	-	49.13	-	0.25	-
	French Island	-	-	-	-	100.25	-	0.25	-
	Gabo Island	-	-	-	-	48.83	-	0.25	-
	Glenelg	6.21	-	60.29	-	22.83	-	43.75	-
	Glennie Group	35.58	-	31.92	-	17.83	-	36.67	-
	Grant	26.38	-	0.33	-	-	-	-	-
	Greater Geelong	33.13	-	10.08	-	13.75	-	12.38	-
	Hogan Island Group	27.25	-	1.17	-	27.96	-	1.54	-
	Kanowna Island	28.92	-	16.63	-	15.04	-	37.04	-

Receptor		Summer				Winter			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Lady Julia Percy Island	5.17	-	38.88	-	15.54	-	38.25	-
	Laurence Rocks	6.92	-	60.58	-	21.46	-	33.67	-
	Moncoeur Islands	27	-	6.96	-	25.5	-	2.67	-
	Mornington Peninsula	32.08	-	7.25	-	13.29	-	9.38	-
	Moyne	0.75	1.88	57.5	8.04	0.79	1.25	95.04	5
	Mud Island	56.38	-	0.42	-	66.33	-	0.25	-
	Norman Island	38.42	-	27.25	-	20.75	-	36.25	-
	Phillip Island	34.67	-	14.88	-	19.25	-	20.42	-
	Rodondo Island	26.75	-	12.04	-	24.46	-	8.08	-
	Seal Islands	-	-	-	-	62.04	-	0.04	-
	Shellback Island	38.67	-	14.75	-	20.38	-	14.63	-
	Skull Rock	28.92	-	16.46	-	15.04	-	36.71	-
	South Gippsland	36.38	-	32.54	-	19.04	-	40.13	-
	Surf Coast	24.33	-	10.79	-	9.38	-	17.17	-
	Warrnambool	3.13	6.00	37.46	1.67	4.33	20.83	85.5	1.33
State Waters	New South Wales	-	-	-	-	48.79	-	0.25	-
	South Australia State Waters	25.38	-	2.46	-	96.42	-	0.17	-
	Tasmania State Waters	26.50	-	2.79	-	27.46	-	2.67	-
	Victoria State Waters	0.21	0.42	93.04	22.25	0.21	0.42	109.71	32.5
Nearshore Waters (Sub-LGA)	Anglesea	28.67	-	10.29	-	12.67	-	15.13	-
	Apollo Bay	3.25	31.71	33.71	0.71	2.00	34.04	22.71	0.04
	Bay of Islands	0.75	1.88	57.5	8.04	0.79	1.29	59.58	5
	Bega Valley	-	-	-	-	49.17	-	0.33	-
	Cape Howe / Mallacoota	-	-	-	-	49.13	-	0.25	-
	Cape Liptrap - Northwest	39.04	-	10.42	-	24.75	-	13.46	-
	Cape Nelson	6.21	-	60.29	-	22.83	-	43.75	-
	Cape Otway West	1.21	5.17	92.04	20.29	1.88	5.25	94.5	7.42
	Cape Patton	16.42	-	22.13	-	4.54	-	19.08	-

Receptor	Summer				Winter			
	Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
	Low	High	Low	High	Low	High	Low	High
Childers Cove	3.00	5.67	38.21	2.75	0.83	3.83	38.63	1.79
Discovery Bay - East	10.58	-	7.21	-	64.21	-	4.71	-
Discovery Bay - West	21.75	-	2.88	-	69.42	-	5.54	-
French Island / Crib Point	-	-	-	-	104.96	-	0.13	-
French Island / San Remo	44.25	-	1.25	-	24.21	-	10.04	-
Kilcunda	40.13	-	8.5	-	21.71	-	9.96	-
Lorne	24.17	-	19.58	-	9.38	-	10.67	-
Moonlight Head	0.79	2.92	82	21.67	0.88	1.58	108.17	32.42
Mornington Peninsula - South	32.33	-	6.58	-	13.50	-	7.96	-
Mornington Peninsula - Southwest	32.04	-	7.25	-	13.29	-	9.29	-
Port Campbell	0.75	1.50	90.79	14.54	0.79	1.83	87	13.17
Port Fairy	7.46	-	50.38	-	11.29	36.92	56.13	0.08
Port Phillip - Queenscliff	33.13	-	10.08	-	14.58	-	12.38	-
Port Phillip - Sorrento Shore	32.63	-	7.21	-	14.33	-	8.63	-
Port Phillip Heads	41.04	-	3.29	-	15.33	-	3.71	-
Portland Bay - East	8.50	-	38.58	-	22.96	-	51.75	-
Portland Bay - West	16.46	-	53.33	-	30.79	-	40.5	-
Torquay	29.50	-	9.88	-	12.79	-	17.17	-
Venus Bay	39.58	-	8.5	-	21.25	-	9.92	-
Waratah Bay	39.21	-	10.92	-	24.71	-	12.54	-
Warrnambool	3.71	13.88	30.75	0.04	8.58	33.96	95.04	1.13
Westernport	40.13	-	5.38	-	27.38	-	5.33	-
Wilsons Promontory - East	47.04	-	15	-	25.50	-	31.71	-
Wilsons Promontory - West	36.38	-	32.54	-	19.04	-	40.13	-

*The release location resides within the receptor boundaries.

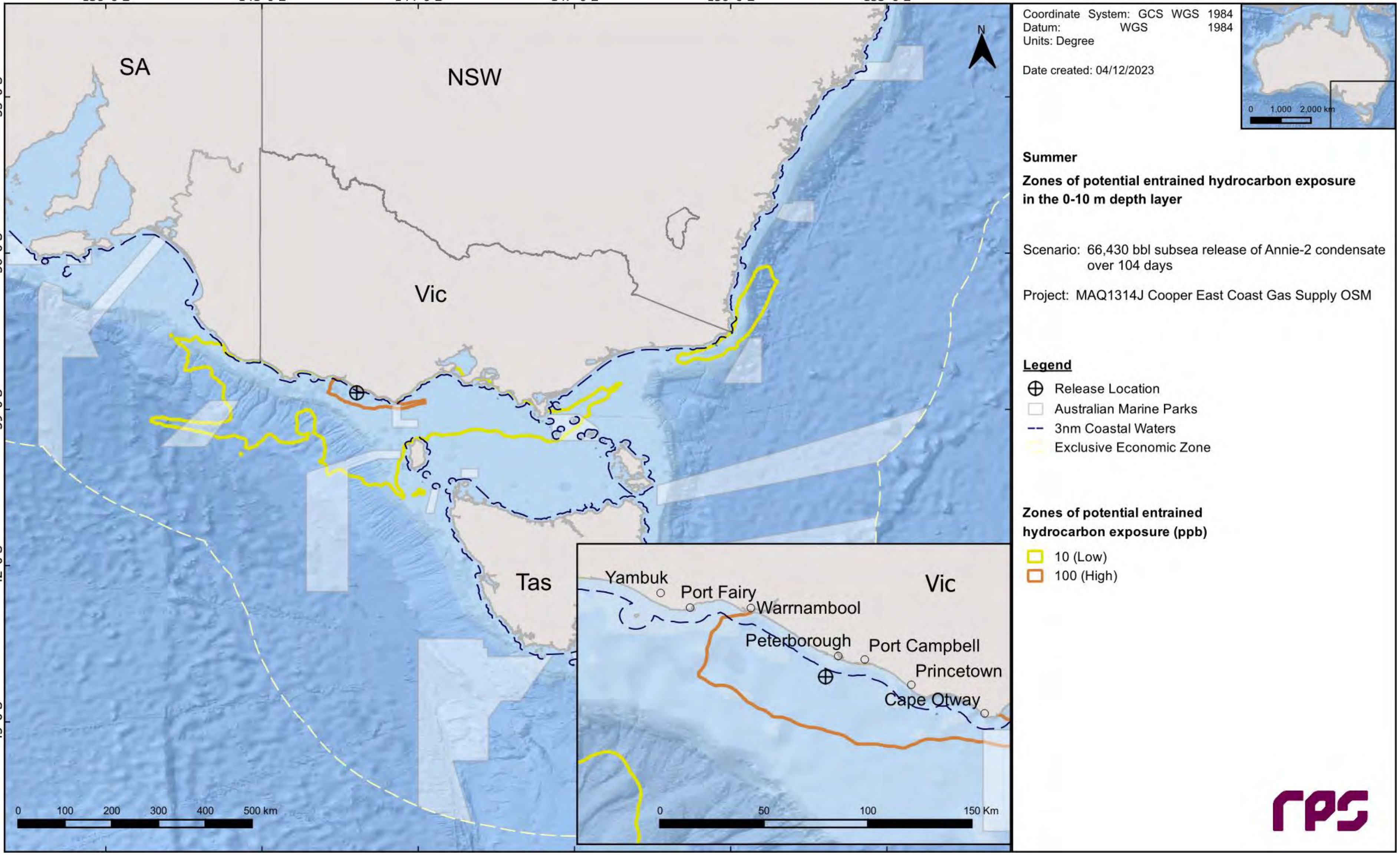


Figure 13.13 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

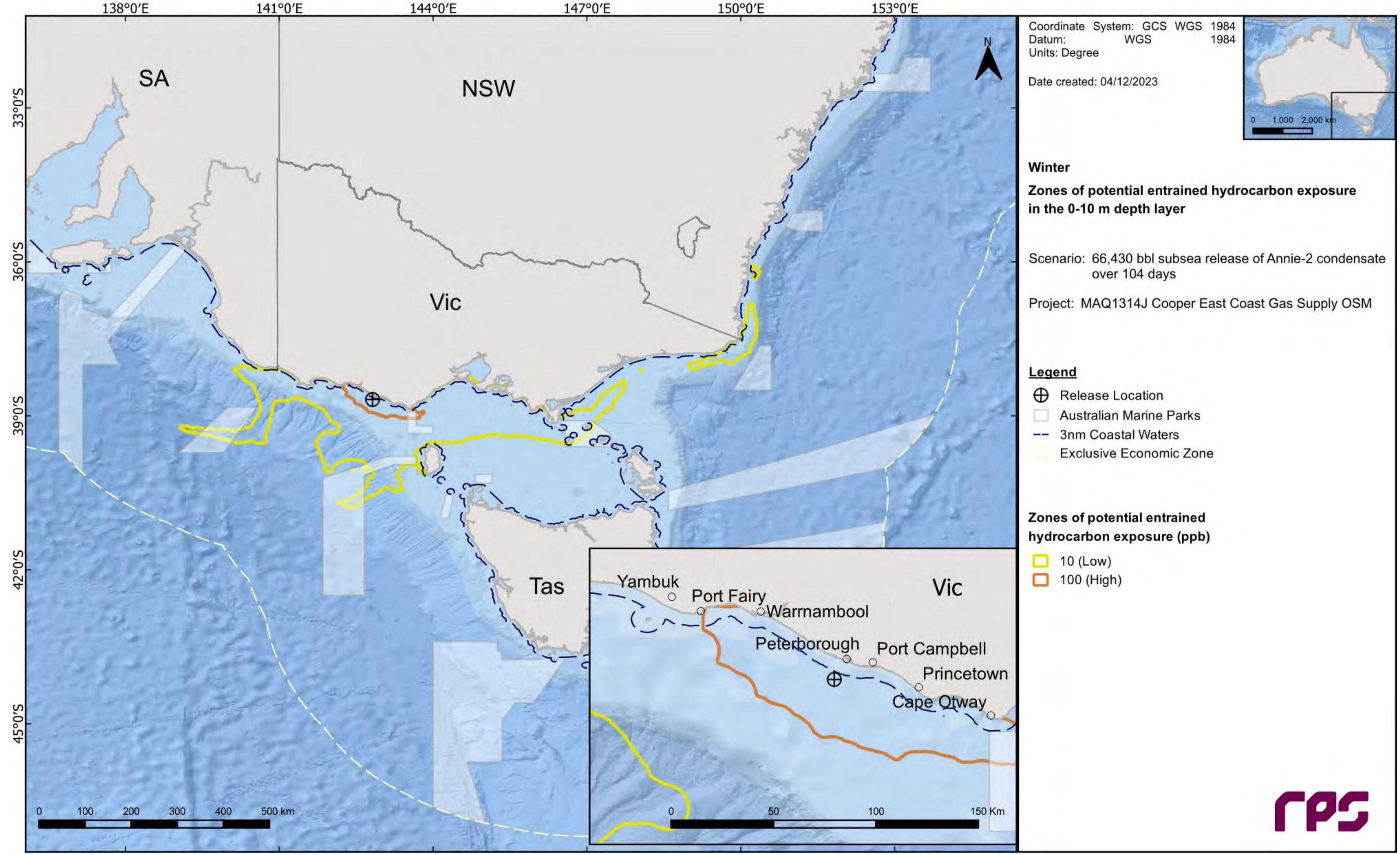


Figure 13.14 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

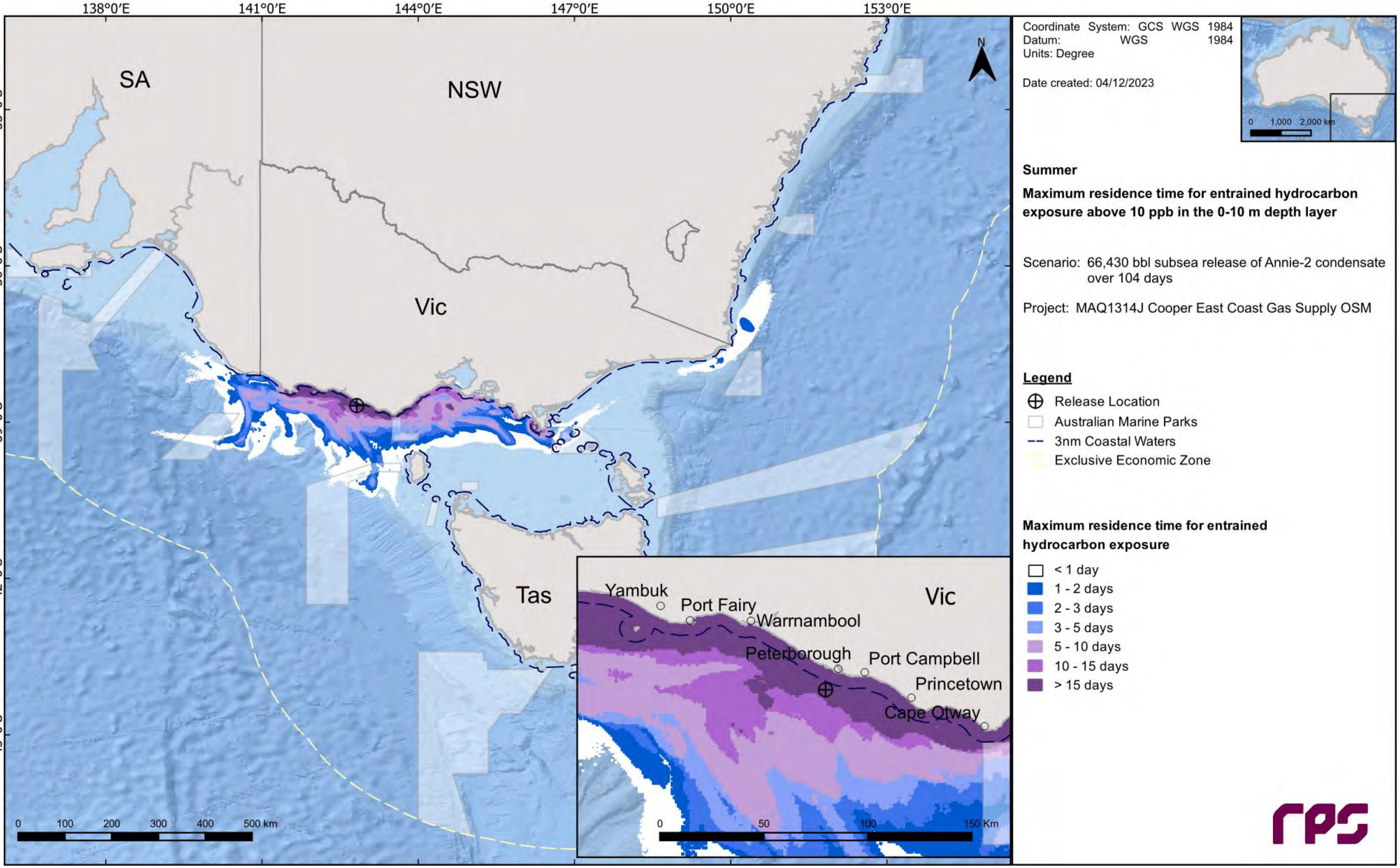


Figure 13.15 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

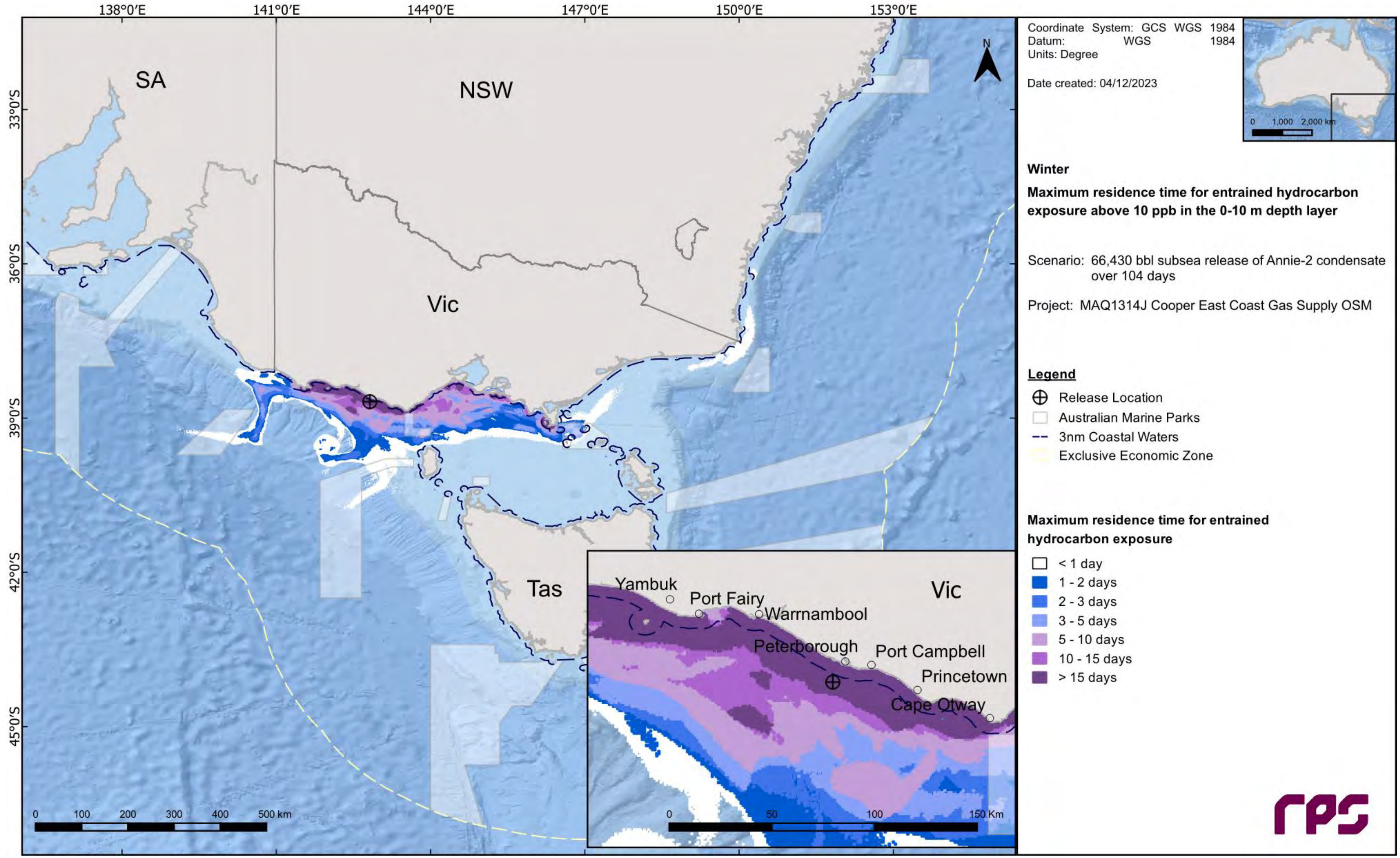


Figure 13.16 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea in the event of a 66,430 bbl subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

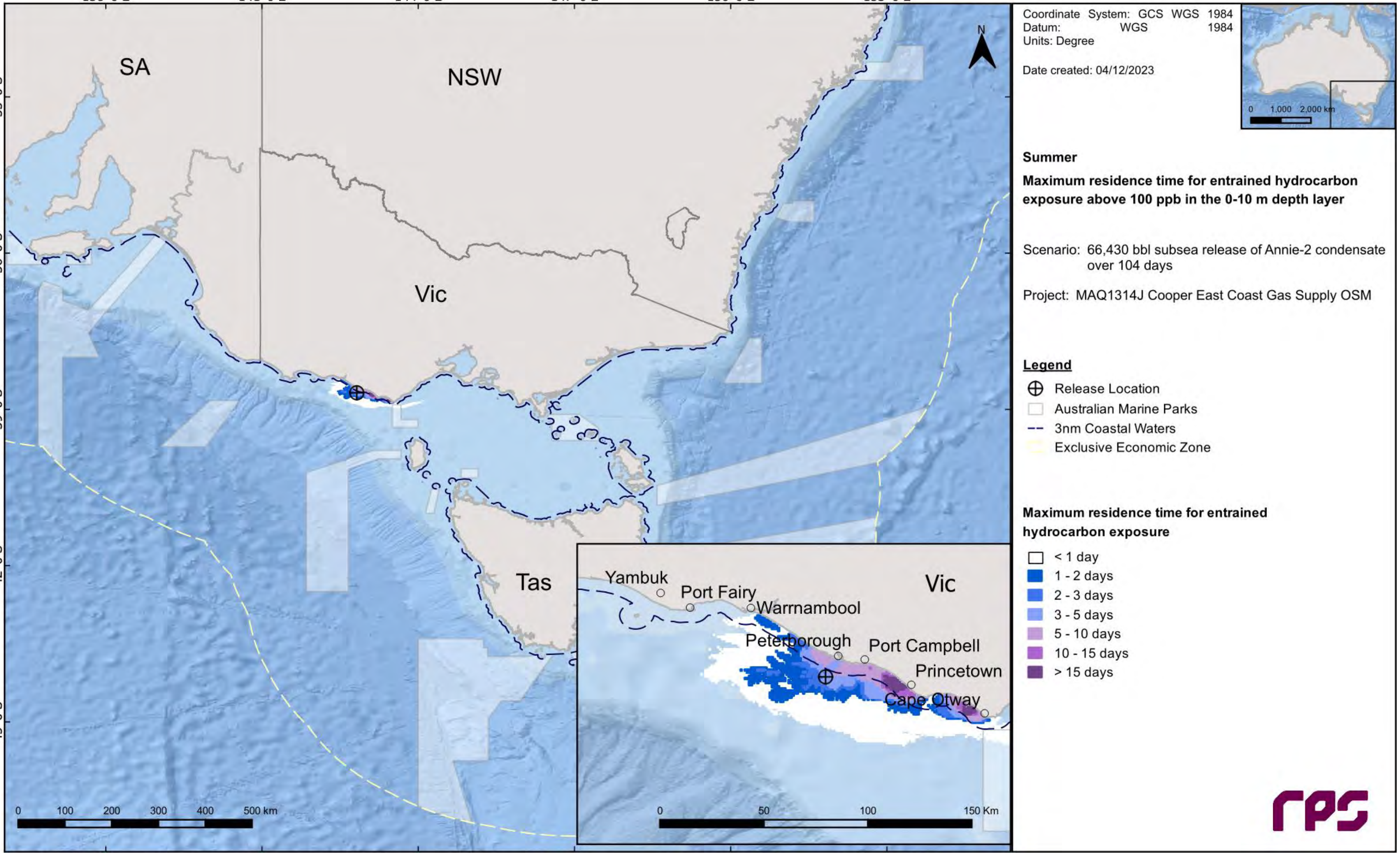


Figure 13.17 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea in the event of a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during summer conditions.

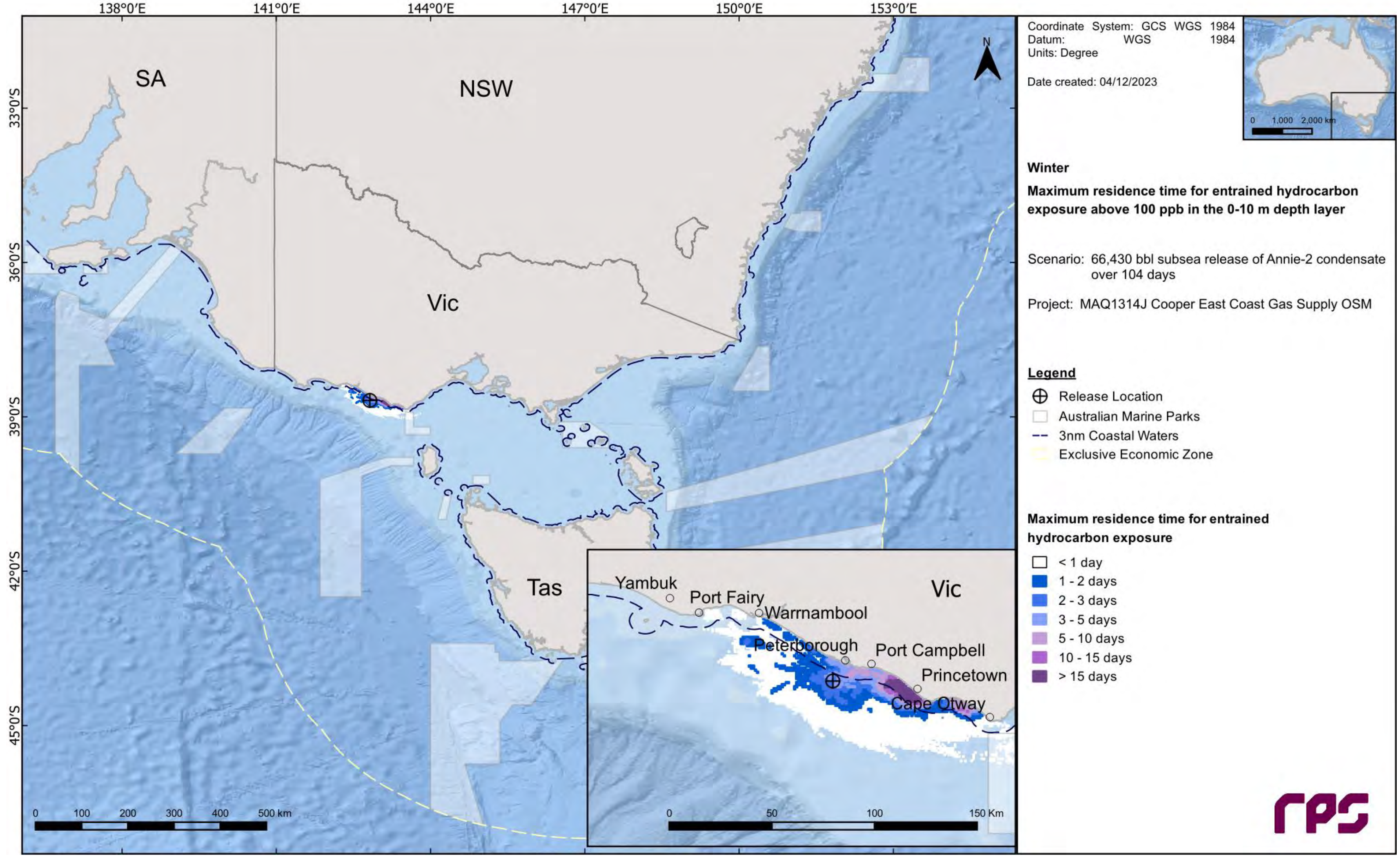


Figure 13.18 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea in the event of a 66,430 bbl (10,562 m^3) subsurface release from a loss of well control at Annie-2 over 104 days. The results were calculated from 100 spill simulations during winter conditions.

13.2 Deterministic Analysis

The stochastic modelling results were assessed, and the “worst case” deterministic runs were identified and are presented below for the following criteria:

a. Largest swept area for surface oil above 10 g/m^2;

b. Largest (total) volume of oil ashore;

c. Longest length of shoreline with oil accumulation above 100 g/m^2; and

d. Largest area of entrained hydrocarbon exposure above 100 ppb.

e. Largest area of dissolved hydrocarbon exposure above 50 ppb.

Note, no dissolved hydrocarbon concentrations above 50 ppb were predicted for this scenario.

Table 13.11 presents a summary of in-water exposure and shoreline accumulation at the assessed thresholds for the identified deterministic simulations.

Table 13.11 Summary of the worst-case deterministic analysis based on the scenario presented in the stochastic analysis section.

Variable	Threshold	Deterministic Analysis Criteria				
		Largest swept area of floating oil >10 g/m²	Largest volume of oil ashore	Longest length of shoreline with accumulation >100 g/m²	Largest area of entrained hydrocarbon exposure >100 ppb	Largest area of dissolved hydrocarbon exposure >50 ppb
Season		Winter	Winter	Winter	Winter	-
Run Number		61	88	88	77	-
Total area of floating Oil exposure (km²)	1 g/m²	291.7	190.4	190.4	251.6	-
	10 g/m²	**4.9**	0.8	0.8	0.8	-
	50 g/m²	-	-	-	-	-
Total length of shoreline accumulation (km)	10 g/m²	175	149	149	114	-
	100 g/m²	25	56	**56**	40	-
	1,000 g/m²	-	3	3	1	-
Minimum time before accumulation on any shoreline (hours)	10 g/m²	272	101	101	102	-
	100 g/m²	380	389	389	284	-
	1,000 g/m²	-	2,020	2,020	2,100	**-**
Total volume of oil ashore (m³)		125	**263**	263	154	-
Total area of entrained hydrocarbon exposure (km²)	10 ppb	28,379	17,526	17,526	17,586	-
	100 ppb	1,449	1,581	1,581	**2,295**	-
Total area of dissolved hydrocarbon exposure (km²)	10 ppb	11	29	29	20	-
	50 ppb	-	-	-	-	**-**
	400 ppb	-	-	-	-	-
Start Date		28th May 2011	3rd July 2010	3rd July 2010	14th May 2013	-

NC = No contact at, or above the specified shoreline accumulation threshold.

13.2.1 Deterministic Case: Largest swept area of floating oil above 10 g/m^2

The deterministic trajectory that resulted in the largest swept area of floating oil above 10 g/m^2 was identified during winter as run number 61, which started on 28th May 2011.

Figure 13.19 illustrates the floating oil exposure and shoreline accumulation over the 118-day simulation.

Figure 13.20 displays the time series of the area of sea surface exposure above the low (1 g/m^2), moderate (10 g/m^2) and high (50 g/m^2) thresholds over the 118-day simulation.

Figure 13.21 presents the fates and weathering graph for the corresponding single spill trajectory and Table 13.12 summarises the mass balance peaks and at the end of the simulation.

Table 13.12 Summary of the mass balance for the trajectory with the largest swept area of floating oil above 10 g/m^2.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 118
Surface (m^3)	194.4	3.8	0.0
Entrained (m^3)	1451.7	95.2	1131.7
Dissolved (m^3)	4.5	14.5	0.2
Evaporation (m^3)	5695.9	118.0	5695.9
Decay (m^3)	2402.3	118.0	2402.3
Ashore (m^3)	126.3	113.4	125.1

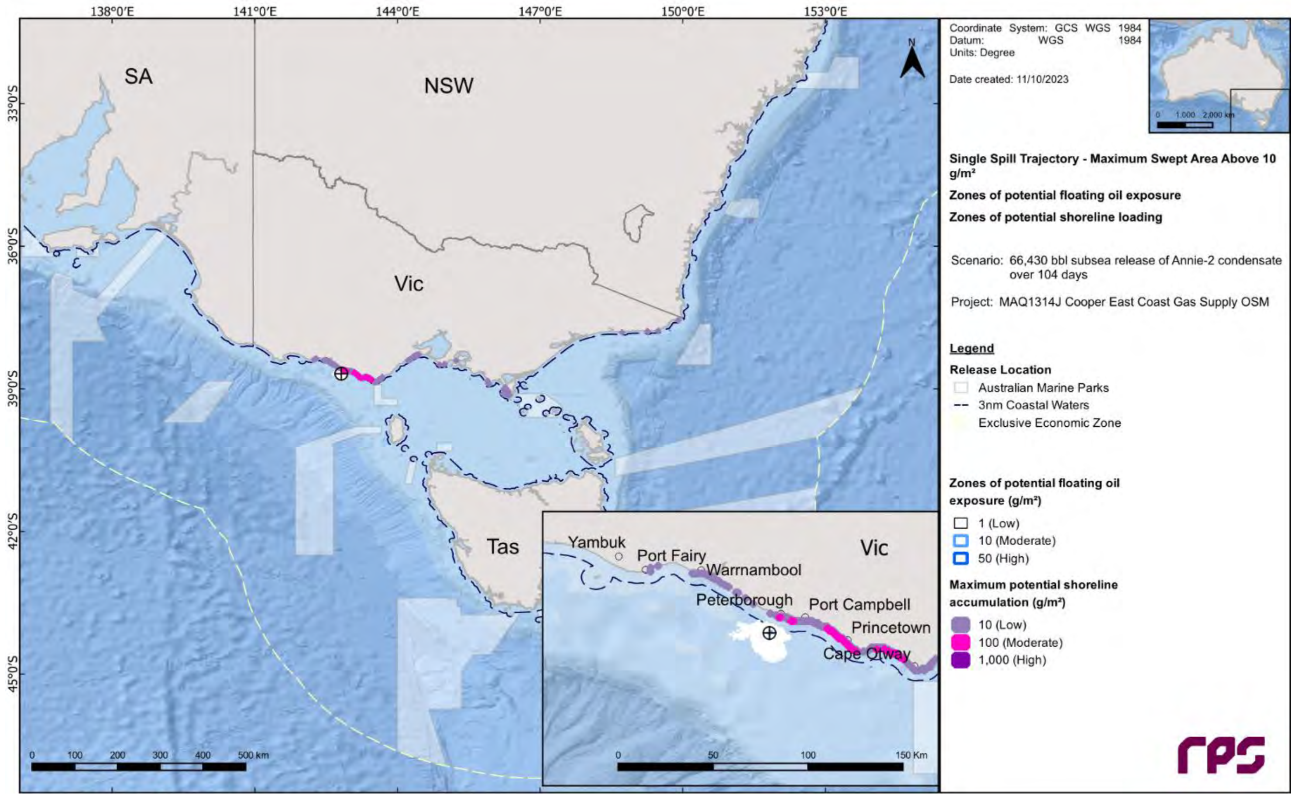


Figure 13.19 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest swept area of floating oil above 10 g/m^2.

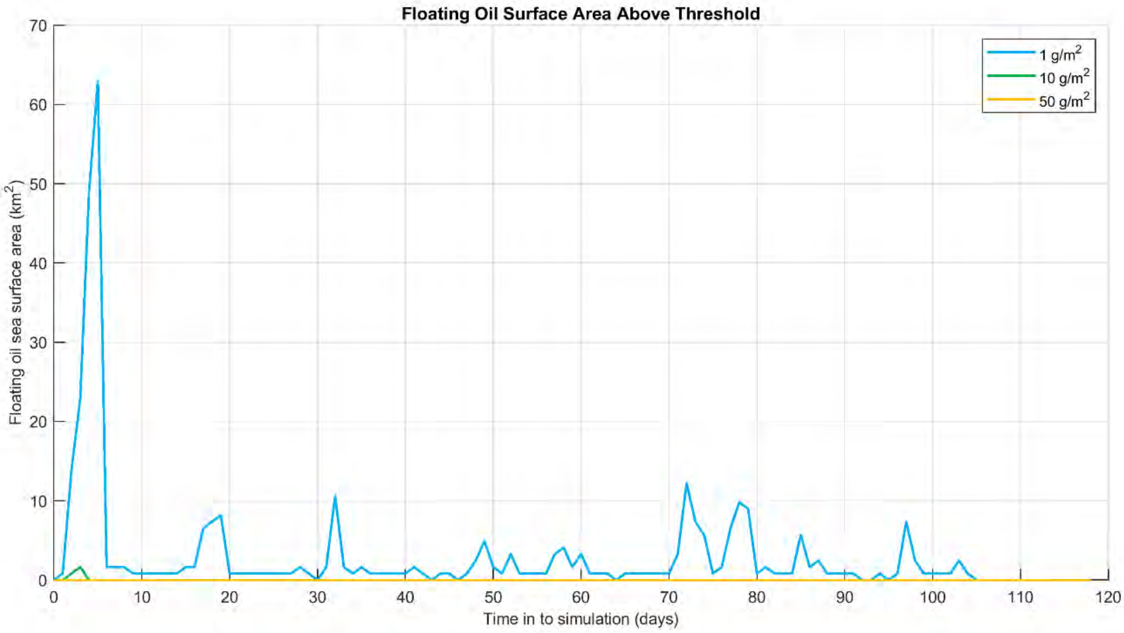


Figure 13.20 Time series of the sea surface exposure above each threshold for the trajectory with the largest swept area of floating oil above 10 g/m².

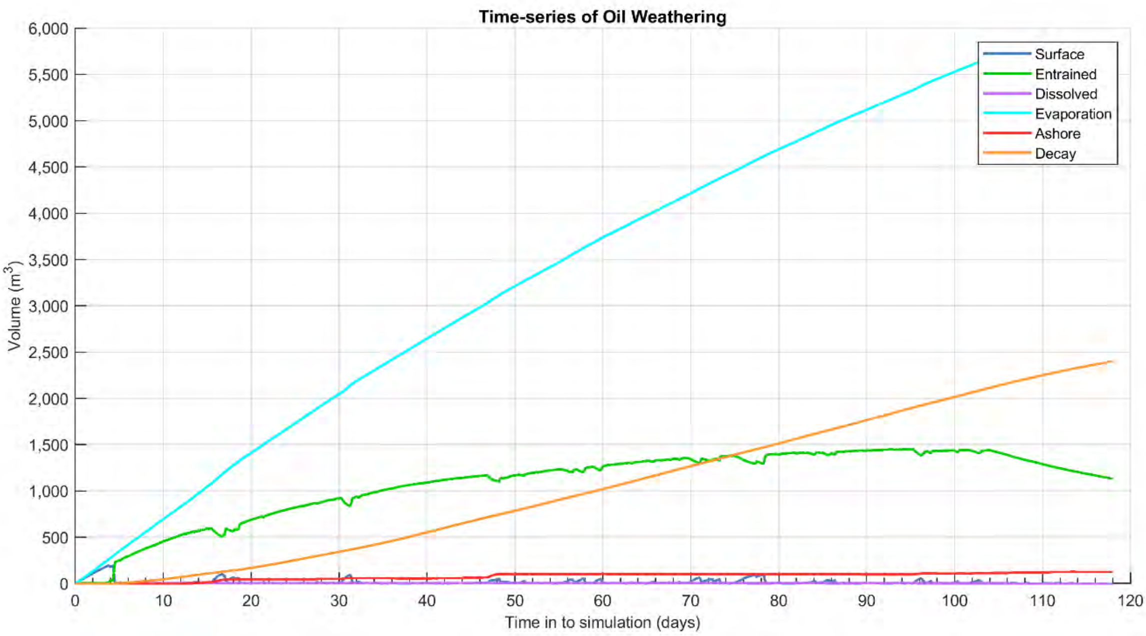


Figure 13.21 Predicted weathering and fates graph for the trajectory with the largest swept area of floating oil above 10 g/m².

13.2.2 Deterministic Case: Largest volume of oil ashore and longest length of shoreline with accumulation above 100 g/m²

The deterministic trajectory that resulted in the largest volume of oil ashore and the longest length of shoreline with accumulation above 100 g/m² was identified during winter as run number 88, which started on 3rd July 2010.

Figure 13.22 illustrates the floating oil exposure and shoreline accumulation over the 118-day simulation.

Figure 13.23 displays the time series of the volume of oil accumulating on shorelines at the low (10 g/m²), moderate (100 g/m²) and high (1,000 g/m²) thresholds over the 118-day simulation.

Figure 13.24 presents the fates and weathering graph for the corresponding single spill trajectory and Table 13.13summarises the mass balance peaks and at the end of the simulation.

Table 13.13 Summary of the mass balance for the trajectory with the largest volume ashore and the longest length of shoreline with accumulation above 100 g/m².

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 118
Surface (m³)	137.4	5.2	0.3
Entrained (m³)	1363.9	96.2	1057.9
Dissolved (m³)	4.8	28.3	0.4
Evaporation (m³)	5695.2	118.0	5695.2
Decay (m³)	2338.5	118.0	2338.5
Ashore (m³)	264.9	113.0	263.0

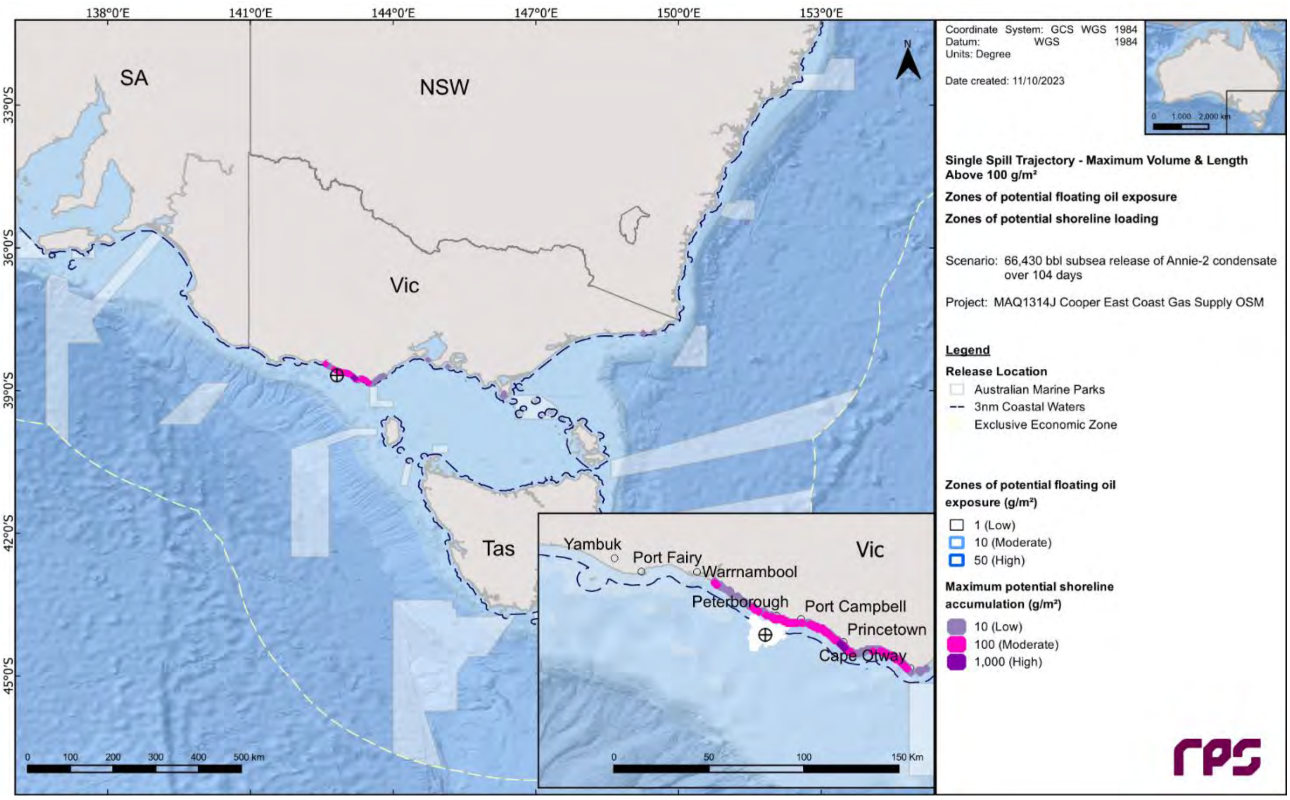


Figure 13.22 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest volume ashore and the longest length of shoreline with accumulation above 100 g/m².

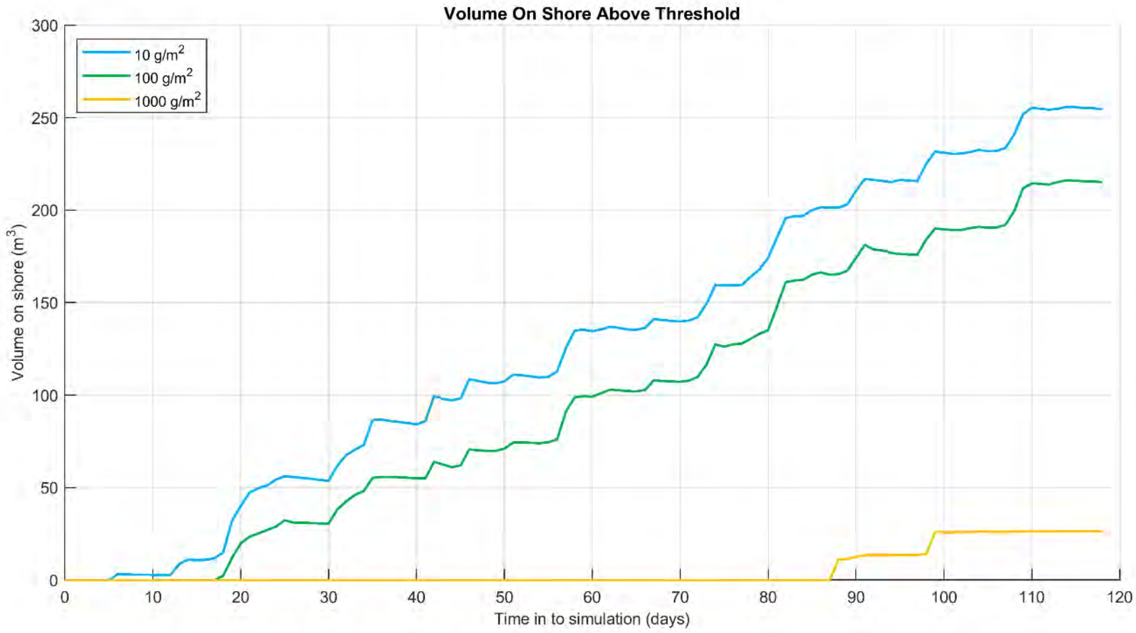


Figure 13.23 Time series of oil accumulation on the shoreline above each threshold for the trajectory with the largest volume ashore and the longest length of shoreline with accumulation above 100 g/m².

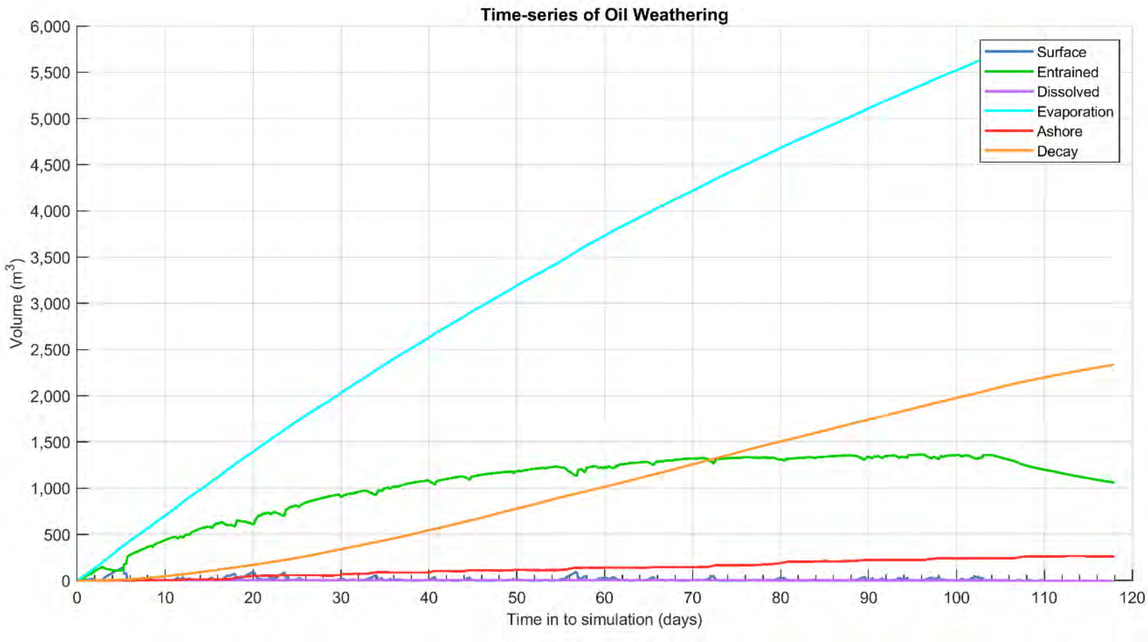


Figure 13.24 Predicted weathering and fates graph for the trajectory with the largest volume ashore and the longest length of shoreline with accumulation above 100 g/m².

13.2.3 Deterministic Case: Largest area of entrained hydrocarbon exposure above 100 ppb

The deterministic trajectory that resulted in the largest area of entrained hydrocarbon exposure above 100 ppb was identified during winter as run number 77, which started on 14th May 2014.

Figure 13.25 illustrates the zones of potential entrained hydrocarbon exposure over the 118-day simulation.

Figure 13.26 displays the time series of the area of entrained hydrocarbon exposure at the low (10 ppb) and high (100 ppb) thresholds over the 118-day simulation.

Figure 13.27 presents the fates and weathering graph for the corresponding single spill trajectory and Table 13.14 summarises the mass balance peaks and at the end of the simulation.

Table 13.14 Summary of the mass balance for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 118
Surface (m^3)	169.6	21.9	0.1
Entrained (m^3)	1417.1	102.2	1120.2
Dissolved (m^3)	5.2	17.9	0.4
Evaporation (m^3)	5736.8	118.0	5736.8
Decay (m^3)	2344.2	118.0	2344.2
Ashore (m^3)	154.9	111.7	153.5

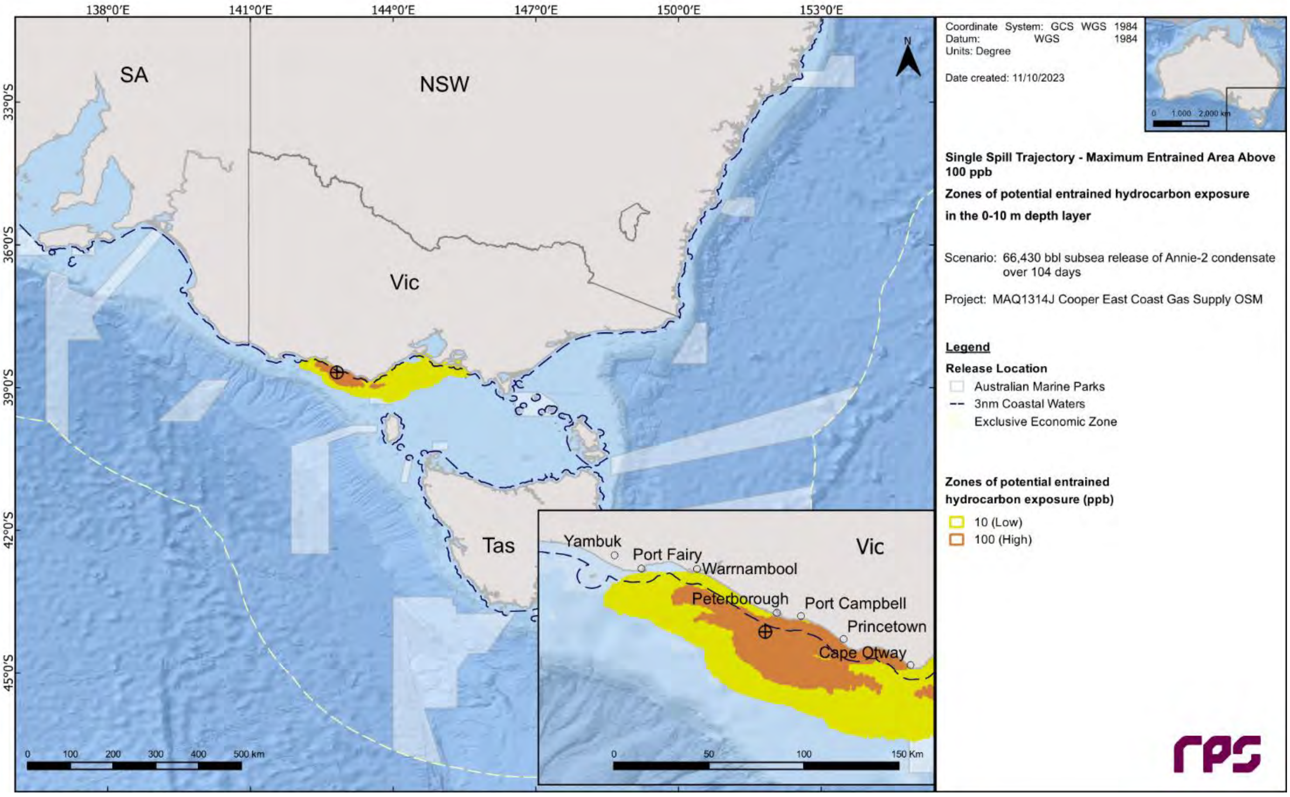


Figure 13.25 Zones of potential entrained hydrocarbon exposure, for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

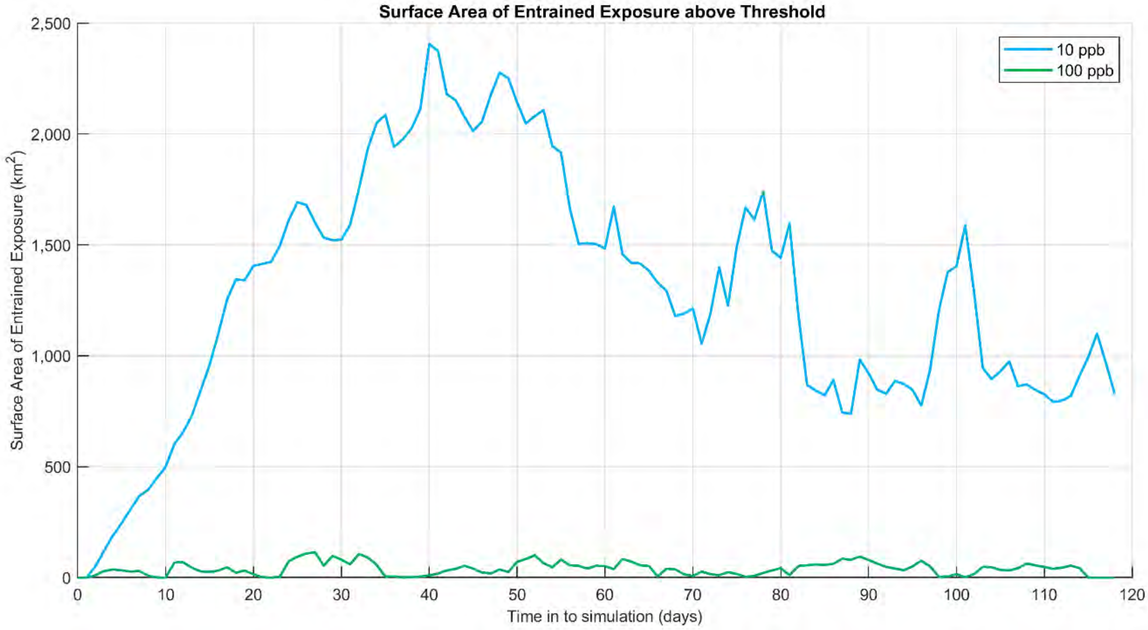


Figure 13.26 Time series of the entrained hydrocarbon exposure area above each threshold for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

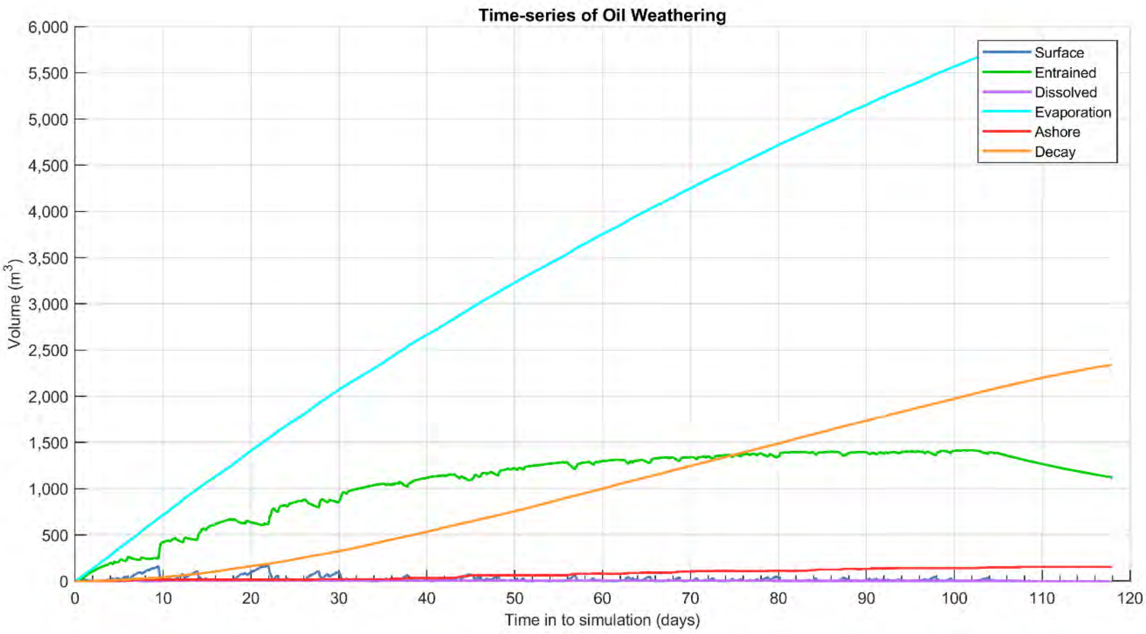


Figure 13.27 Predicted weathering and fates graph for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb.

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ANNIE-2 – VESSEL COLLISION

Oil Spill Modelling

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Prepared by:

RPS

Jeremie Bernard
Senior Coastal Engineer

Lakeside Corporate Space, Suite 425
Level 2, 34-38 Glenferrie Drive
Robina, QLD, 4226, Australia

T [redacted]
E [redacted]

Prepared for:

Cooper Energy

[redacted]
Environment & Sustainability

Level 15, 123 St Georges Tce
Perth WA 6000 Australia

T [redacted]
E [redacted]

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TERMS AND ABBREVIATIONS

AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
API	American Petroleum Institute gravity. A measure of how heavy or light a petroleum liquid is compared to water.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASTM	American Society for Testing and Materials
BIA	Biologically Important Area
Bonn Agreement	An agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances, 1983, includes: Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union.
BP	Boiling point. The temperature at which the vapor pressure of the liquid is equal to the pressure exerted on it by the surrounding atmosphere
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CFSR	Climate Forecast System Reanalysis
Decay	The process where oil components are changed either chemically or biologically (biodegradation) to another compound. It includes breakdown to simpler organic carbon compounds by bacteria and other organisms, photo-oxidation by solar energy, and other chemical reactions.
Deterministic oil spill modelling	Oil spill modelling involving a computer simulation of a single hypothetical oil spill event subject to a single sequence of wind, current and other sea conditions over time. Single oil spill modelling, also referred to as “deterministic modelling” provides a simulation of one possible outcome of a given spill scenario, subject to the metocean conditions that are imposed. Single oil spill modelling is commonly used to consider the fate and effects of ‘worst-case’ oil spill scenarios that are carefully selected in consideration of the nature and scale of the offshore petroleum activity and the local environment (NOPSEMA, 2017). Because the outcomes of a single oil spill simulation can only represent the outcome of that scenario under one sequence of metocean conditions, worst-case conditions are often identified from stochastic modelling. It is impossible to calculate the likelihood of any outcome from a single oil spill simulation. Single oil spill modelling is generally used for response planning, preparedness planning and for supporting oil spill response operations in the event of an actual spill
Dynamic viscosity	The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds.
Floating oil exposure	Contact by floating oil on the sea surface at concentrations equal to or exceeding defined threshold concentrations. The consequence will vary depending on the threshold and the receptors
GODAE	Global Ocean Data Assimilation Experiment
HYCOM	Hybrid Coordinate Ocean Model. A data-assimilative, three-dimensional ocean model
HYDROMAP	Advanced ocean/coastal tidal model used to predict tidal water levels, current speed and current direction.
IMCRA	Integrated marine and coastal regionalisation areas
IOA	Index of Agreement
ITOPF	International Tanker Owners Pollution Federation Limited
KEF	Key Ecological Feature
LGA	Local Government Areas
MAE	Mean Absolute Error
MAHs	Monoaromatic Hydrocarbons
MDO	Marine diesel oil
MNP	Marine National Park
MP	Marine Park

MS	Marine Sanctuary
NASA	National Aeronautics and Space Administration (USA)
NCEP	National Centres for Environmental Prediction (USA)
NOAA	National Oceanic and Atmospheric Administration (USA)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NP	National Park
NR	Nature Reserve
PAH	Polynuclear Aromatic Hydrocarbons
Pour Point	The pour point of a liquid is the temperature below which the liquid loses its flow characteristics
ppb	Parts per billion (concentration)
psu	Practical salinity units
Ramsar site	A site listed under the Ramsar Convention on wetlands which is an international intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources.
RSB	Reefs, Shoals and Banks
Shoreline accumulation	Arrival of oil at or near shorelines at on-water concentrations equal to or exceeding defined threshold concentrations. Shoreline contact is judged for floating oil arriving within a 2 km buffer zone from any shoreline as a conservative measure
SIMAP	Spill Impact Model Application Package. SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for surface or subsea releases
SRTM	Shuttle Radar Topography Mission
State Waters	Low water mark seaward for three nautical miles
STB	Standard Barrel
Stochastic oil spill modelling	Stochastic oil spill modelling is created by overlaying and statistically analysing the outcomes of many single oil-spill simulations of a defined spill scenario, where each simulation was subject to a different sequence of metocean conditions, selected objectively (typically by random selection) from a long sequence of historic conditions for the study area. Analysis of this larger set of simulations provides a more accurate indication of the area of hydrocarbon exposure and indicates which locations are more likely to be exposed (as well as other statistics). Stochastic oil spill modelling avoids biases that affect single oil spill modelling (due to the reliance on only one possible sequence of conditions). However, when interpreting stochastic modelling, which is based on a wide range of potential conditions that might happen to occur, it is essential to understand that calculations will encompass a much larger area than could be exposed in any single spill event, where a more limited set of conditions will occur. Consequently, it is misleading to imply that the region derived from stochastic modelling indicate the outcomes expected from a single spill event (NOPSEMA, 2017) Stochastic modelling is generally used for risk assessment and preparedness planning by indicating locations that could be exposed and may require response or subsequent impact assessment
Sub-LGA	Sub-Local Government Areas
TOPEX/Poseidon	A joint satellite mission between NASA and CNES to map ocean surface topography using an array of satellites equipped with detailed altimeters
US EPA	United States Environmental Protection Agency
US CG	United States Coast Guard
World Ocean Atlas	A collection of physicochemical parameters (e.g. temperature, salinity, oxygen, phosphate, silicate, and nitrate) based on profile data from the World Ocean Database (NCEI, 2021) established by NOAA's National Centers for Environmental Information (NCEI)
WGS 1984	World Geodetic System 1984 (WGS84); reference coordinate system

EXECUTIVE SUMMARY

Background

Cooper Energy (Cooper) plans to drill and operate the Annie-2 well in the Otway Basin (Figure 1.1).

In order to inform the offshore environmental impact and risk assessments Cooper commissioned RPS to conduct a detailed oil spill modelling study assessing a 250 m^3 surface release of marine diesel oil over 6 hours following a vessel collision.

The modelling assessment was undertaken on an annual basis.

The purpose of the modelling is to provide an understanding of a conservative 'outer envelope' of the potential area of exposure in the unlikely event of hydrocarbon spill. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill. Therefore, the modelling results represent the maximum extent of hydrocarbon exposure.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Model Application Program (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

Methodology

The modelling study was carried out in several stages. Firstly, a ten-year wind and current dataset (2010–2019) was generated and the currents included the combined influence of three-dimensional large-scale ocean currents and tidal currents. Secondly, the currents, winds and detailed hydrocarbon characteristics were used as inputs in the three-dimensional oil spill model (SIMAP) to simulate the drift, spread, weathering and fate of the spilled oil.

As spills can occur during any set of wind and current conditions, modelling was conducted using a stochastic (random or non-deterministic) approach, which involved running 100 randomly selected single trajectory simulations per scenario, with each simulation having the same spill information (location, spill volume, duration and composition of hydrocarbons) but varying start times. This ensured that each spill simulation was subject to a unique set of wind and current conditions

The SIMAP system, the methods and analysis presented herein, use modelling algorithms which have been anonymously peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the ASTM Standard F2067-13 "*Standard Practice for Development and Use of Oil Spill Models*".

Oil Properties

The marine diesel oil (MDO) used for the scenario has an API of 24 and a density of 890 kg/m^3 (at 25 ºC) with a viscosity value (14.0 cP at 25 ºC) classifying it as a Group II (light-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2014) and US EPA/USCG classifications.

The MDO is a mixture of volatile and persistent hydrocarbons with high proportions of semi- and low-volatile components. In favourable evaporation conditions, about 4.0% of the oil mass should evaporate within the first 12 hours (BP < 180°C), a further 32% should evaporate within the first 24 hours (180°C < BP < 265°C) and a further 54% should evaporate over several days (265°C < BP < 380°C). Approximately 10% of the oil is shown to be persistent.

Results

Scenario: 250 m³ loss of containment from a vessel collision

- The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) floating oil exposure zones was 32.5 km (west), 10.3 km (west) and 2.8 km (east-southeast), respectively.
- The probability of accumulation to any shoreline at, or above, the low (10 g/m^2) threshold was 60%. The minimum time before oil accumulation at, or above, the low threshold was 22 hours whilst the maximum total volume ashore for a single spill trajectory was 43.2 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 32 km, 11 km and 1 km, respectively.
- Excluding the 13 BIAs that the release location resides within, the highest probability of low dissolved hydrocarbon exposure ranged between 1% (Short-tailed Shearwater - Foraging) and 2% (Southern Right Whale - Aggregation).
- The highest probability of low entrained hydrocarbon exposure was recorded for the Twelve Apostles MNP (65%) and Short-tailed Shearwater – Foraging BIA (64%). Additional receptors including LGAs, sub-LGAs, and AMPs were predicted with entrained hydrocarbon exposure.

1 INTRODUCTION

1.1 Background

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Note that the oil spill model, the method and analysis presented herein uses modelling algorithms which have been anonymously peer reviewed and published in international journals. Furthermore, RPS warrants that this work meets and exceeds the American Society for Testing and Materials (ASTM) Standard F2067-13 "*Standard Practice for Development and Use of Oil Spill Models*".

Table 1-1 Coordinates of the release location.

Infrastructure	Latitude	Longitude	Water Depth (m)
Annie-2	38.68375° S	142.82456° E	36

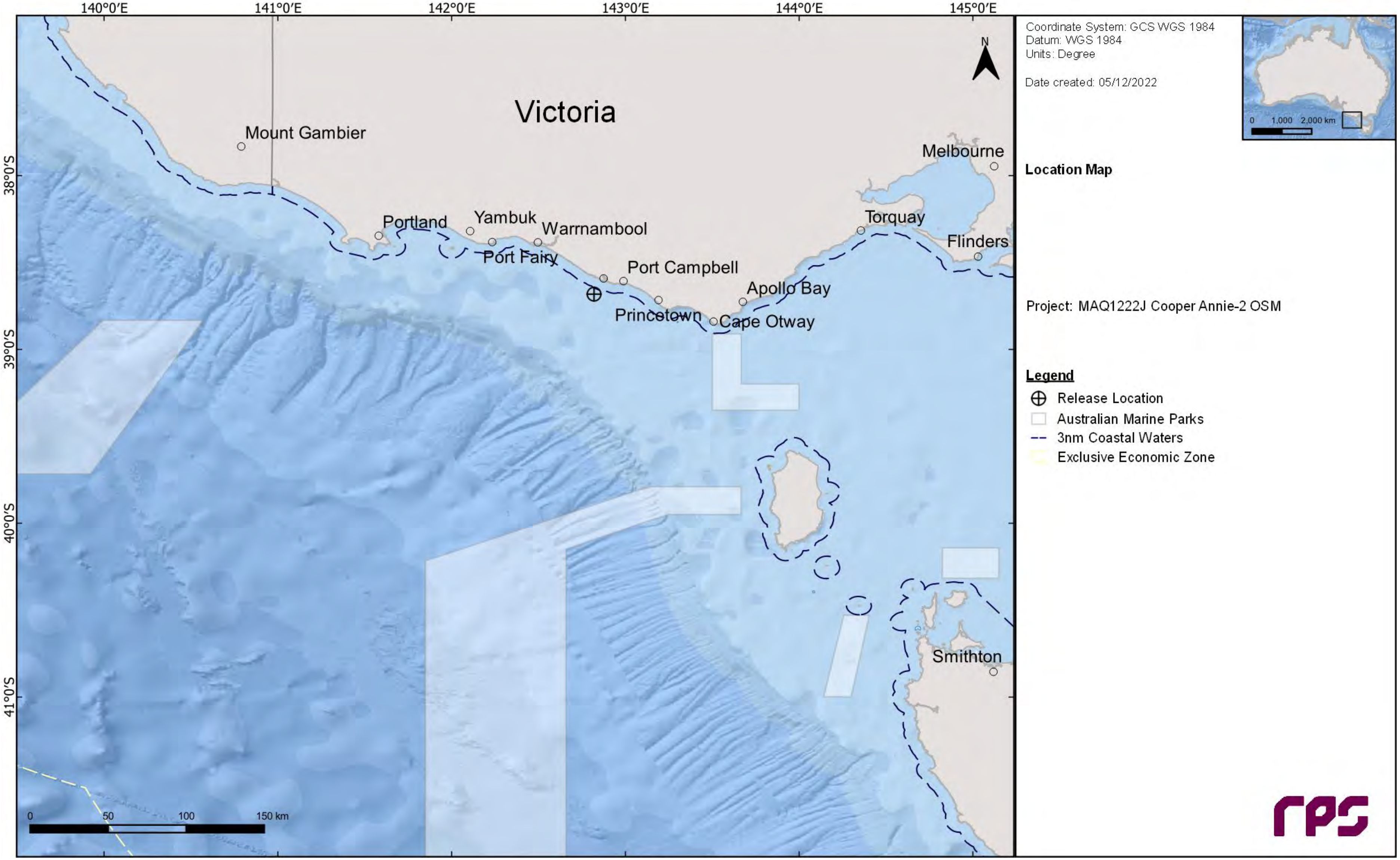


Figure 1.1 Map of the Annie-2 release location.

1.2 What is Oil Spill Modelling?

Oil spill modelling is a valuable tool widely used for risk assessment, emergency response and contingency planning where it can be particularly helpful to proponents and decision makers. By modelling a series of the most likely oil spill scenarios, decisions concerning suitable response measures and strategic locations for deploying equipment and materials can be made, and the locations at most risk can be identified. The two types of oil spill modelling often used are stochastic (Section 1.2.1) and deterministic (Section 1.2.2) modelling.

1.2.1 Stochastic Modelling (Multiple Spill Simulations)

Stochastic oil spill modelling is created by overlaying a great number (often hundreds) of individual, computer-simulated hypothetical spills (NOPSEMA, 2018; Figure 1.2).

Stochastic modelling is a common means of assessing the potential risks from oil spills related to new projects and facilities. Stochastic modelling typically utilises hydrodynamic data for the location in combination with historic wind data. Typically, 100 iterations of the model will be run utilising the data that is most relevant to the season or timing of the project.

The outcomes are often presented as a probability of exposure and is primarily used for risk assessment purposes in view to understand the range of environments that may be affected or impacted by a spill. Elements of the stochastic modelling can also be used in oil spill preparedness and planning.

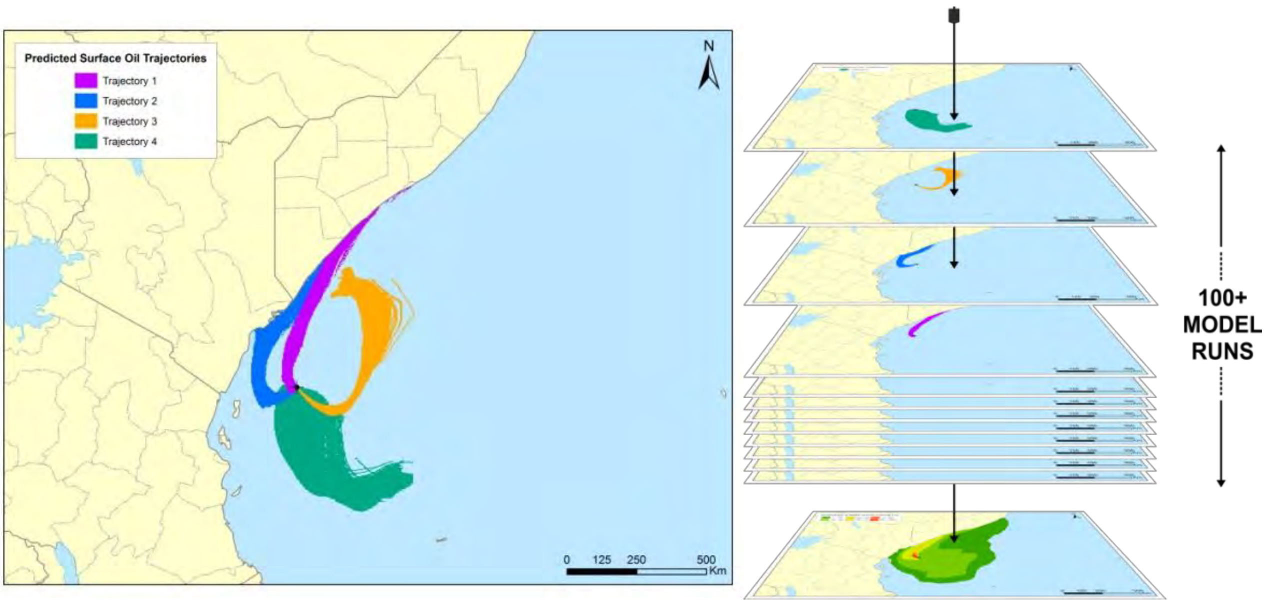


Figure 1.2 Examples of four individual spill trajectories (four replicate simulations) predicted by SIMAP for a spill scenario. The frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability.

1.2.2 Deterministic Modelling (Single Spill Simulation)

Deterministic modelling is the predictive modelling of a single incident subject to a single sample of wind and weather conditions over time (NOPSEMA, 2018; Figure 1.3).

Deterministic modelling is often paired with stochastic modelling to place the large stochastic footprint into perspective. This deterministic analysis is generally a single run selected from the stochastic analysis and serves as the basis for developing the plans and equipment needs for a realistic spill response. Deterministic spills can be selected on several basis such as minimum time to shoreline, largest swept area, maximum volume ashore, longest length of shoreline contacted by oil or largest area of entrained or dissolved hydrocarbons.

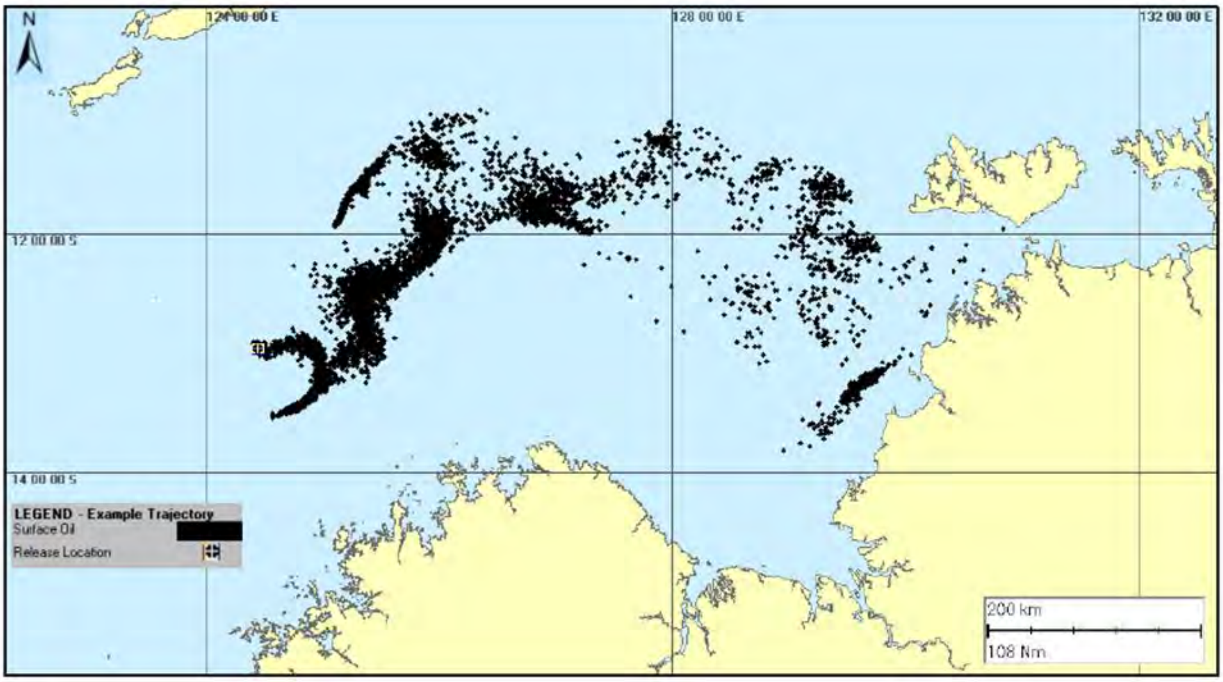


Figure 1.3 Example of an individual spill trajectory predicted by SIMAP for a spill scenario. Note, this image represents surface oil as spillets and do not take any thresholds into consideration.

2 SCOPE OF WORK

The scope of work included the following components:

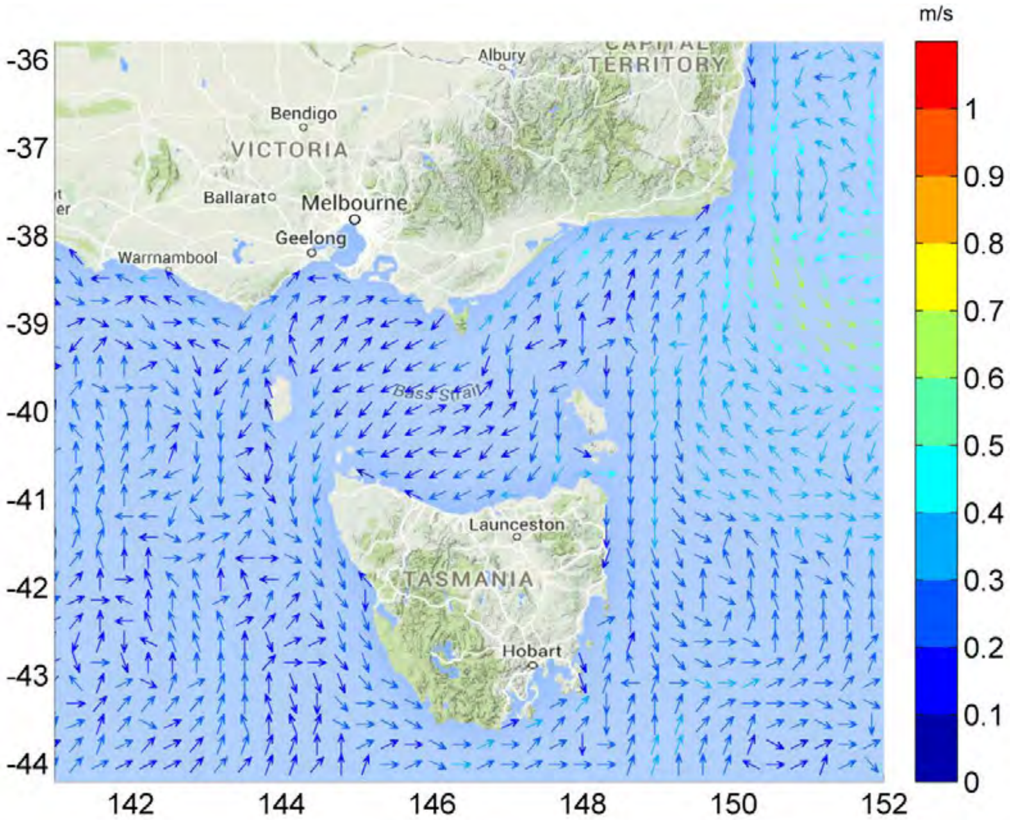
- Generate 10 years of winds and three-dimensional currents from 2010 to 2019 (inclusive). The currents included the combined influence of tidal and ocean currents.
- Include the wind and current data and characteristics of the MDO as input into the three-dimensional oil spill model (SIMAP), to model the movement, spreading, weathering and shoreline contact by hydrocarbons over time.
- Use SIMAP's stochastic model (also known as a probability model) to calculate exposure to surround waters and shorelines. This involved running 100 randomly selected single trajectory simulations for the scenario, with each simulation having the same spill information (spill volume, duration and composition of hydrocarbons) but varying start times. This ensured that each spill simulation was subject to a unique set of wind and current conditions.
- Results were assessed to determine the exposure to surrounding waters and contact to shorelines based upon the thresholds outlined in the NOPSEMA Oil Spill Modelling Bulletin (NOPSEMA 2019).
- The stochastic modelling results were reviewed, and the "worst case" deterministic runs were identified and presented based on the following criteria (if applicable):
  a. Largest swept area for surface oil above 10 g/m^2
  b. Largest swept area for surface oil above 50 g/m^2
  c. Largest volume of oil ashore
  d. Longest length of shoreline with oil accumulation above 100 g/m^2
  e. Largest area of entrained hydrocarbon exposure above 100 ppb
  f. Largest area of dissolved hydrocarbon exposure above 50 ppb

3 REGIONAL CURRENTS

Bass Strait is a body of water separating Tasmania from the southern Australian mainland, specifically the state of Victoria. The strait is a relatively shallow area of the continental shelf, connecting the southeast Indian Ocean with the Tasman Sea. Currents within the straight are primarily driven by tides, winds, incident continental shelf waves and density driven flows; high winds and strong tidal currents are frequent within the area (Jones, 1980).

The varied geography and bathymetry of the region, in addition to the forcing of the south-eastern Indian Ocean and local meteorology lead to complex shelf and slope circulation patterns (Middleton & Bye, 2007). Figure 3.1 displays seasonal current trends within the Bass Strait. During winter there is a strong eastward water flow due to the strengthening of the South Australian Current (fed by the Leeuwin Current in the Northwest Shelf), which bifurcates with one extension moving though the Bass Strait, and another forming the Zeehan Current off western Tasmania (Sandery & Kämpf, 2007). During summer, water flow reverses off Tasmania, King Island and the Otway Basin travelling eastward, as the coastal current develops due to south-easterly winds.

To accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining deep ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with surface tidal currents developed by RPS. The following sections provide a summary of the hybrid regional dataset.



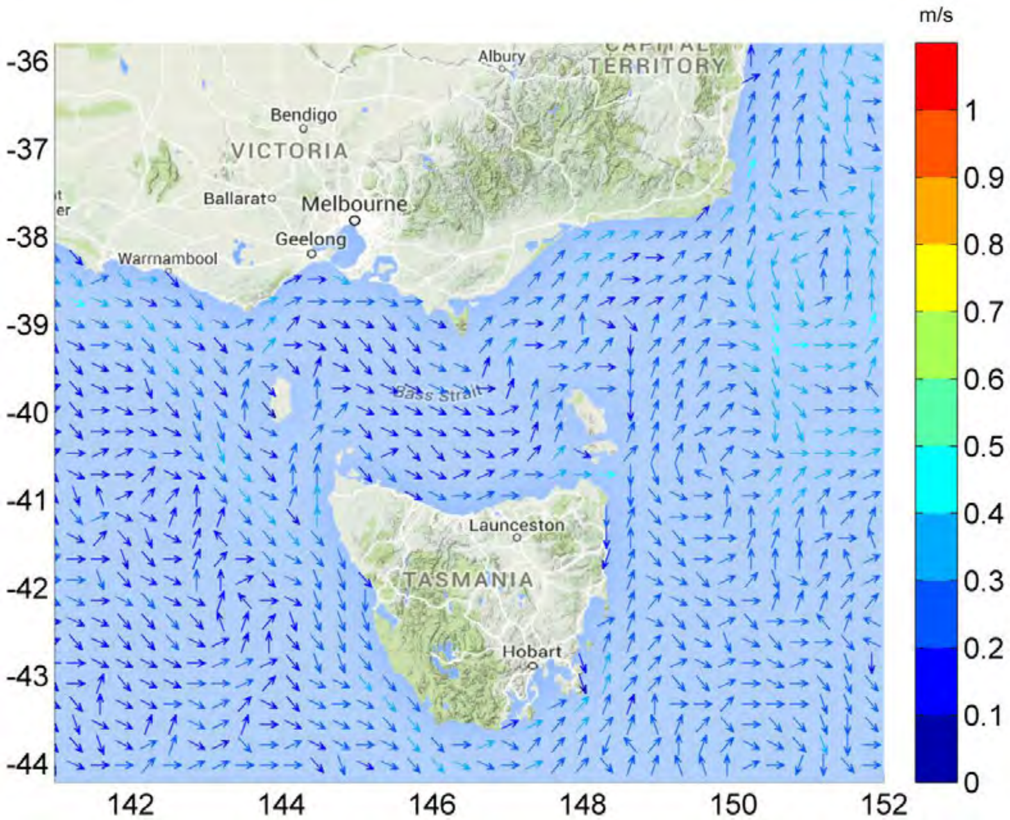


Figure 3.1 HYCOM averaged seasonal surface drift currents during summer (upper image) and winter (lower image).

3.1 Tidal currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world for more than 30 years (Isaji & Spaulding, 1984; Isaji, et al., 2001; Zigic, et al., 2003). HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) pollutant spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of interest to a study.

The numerical solution methodology follows that of Davies (1977a and 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji and Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

The tidal model domain is sub-gridded to a resolution of 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of 8 km. The finer grids are progressively allocated in a step-wise fashion to more accurately resolve flows along the coastline, around islands and over regions with more complex bathymetry. Figure 3.2 shows the tidal model grid covering the study domain.

A combination of datasets was used and merged to describe the shape of the seabed within the grid domain (Figure 3.3). These included spot depths and contours which were digitised from nautical charts released by the hydrographic offices as well as Geoscience Australia database and depths extracted from the Shuttle Radar Topography Mission (SRTM30_PLUS) Plus dataset (see Becker et al., 2009).

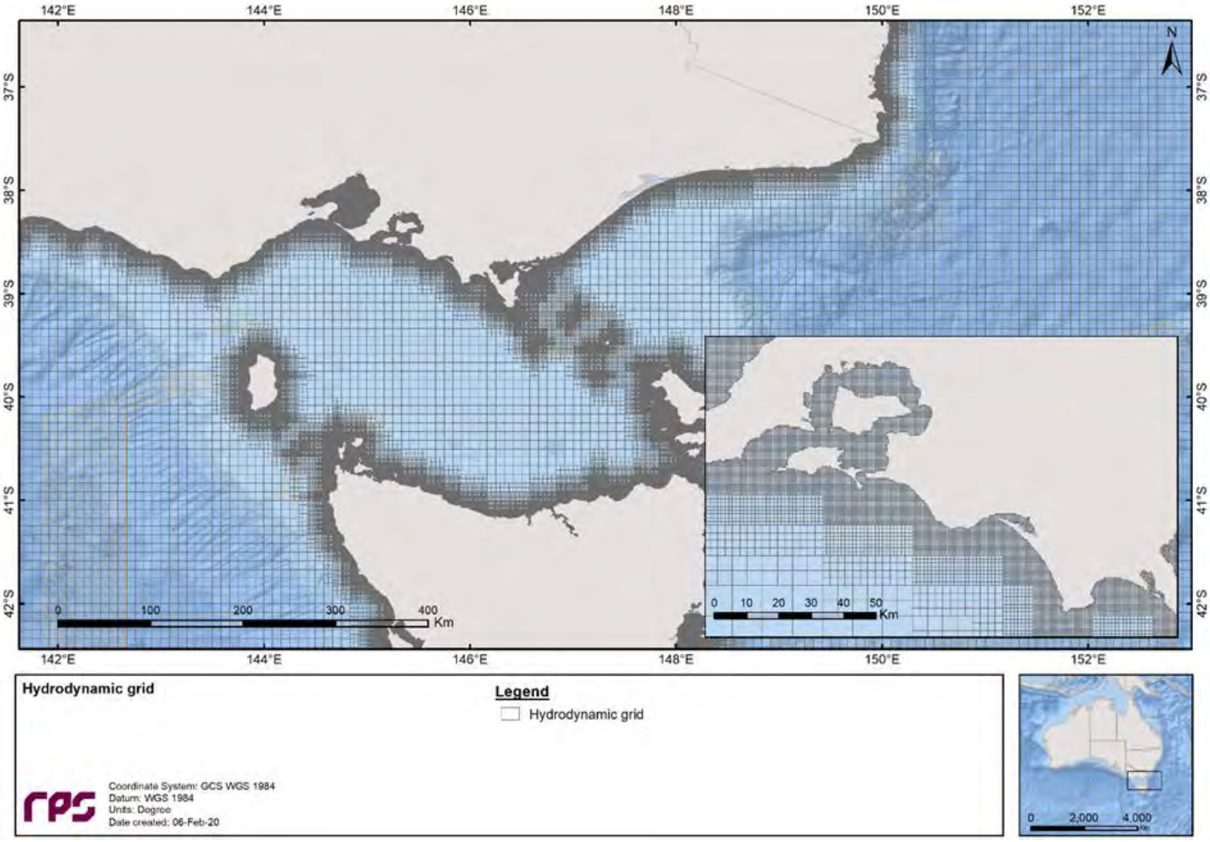


Figure 3.2 Sample of the model grid used to generate the tidal currents for the study region. Higher resolution areas are shown by the denser mesh.

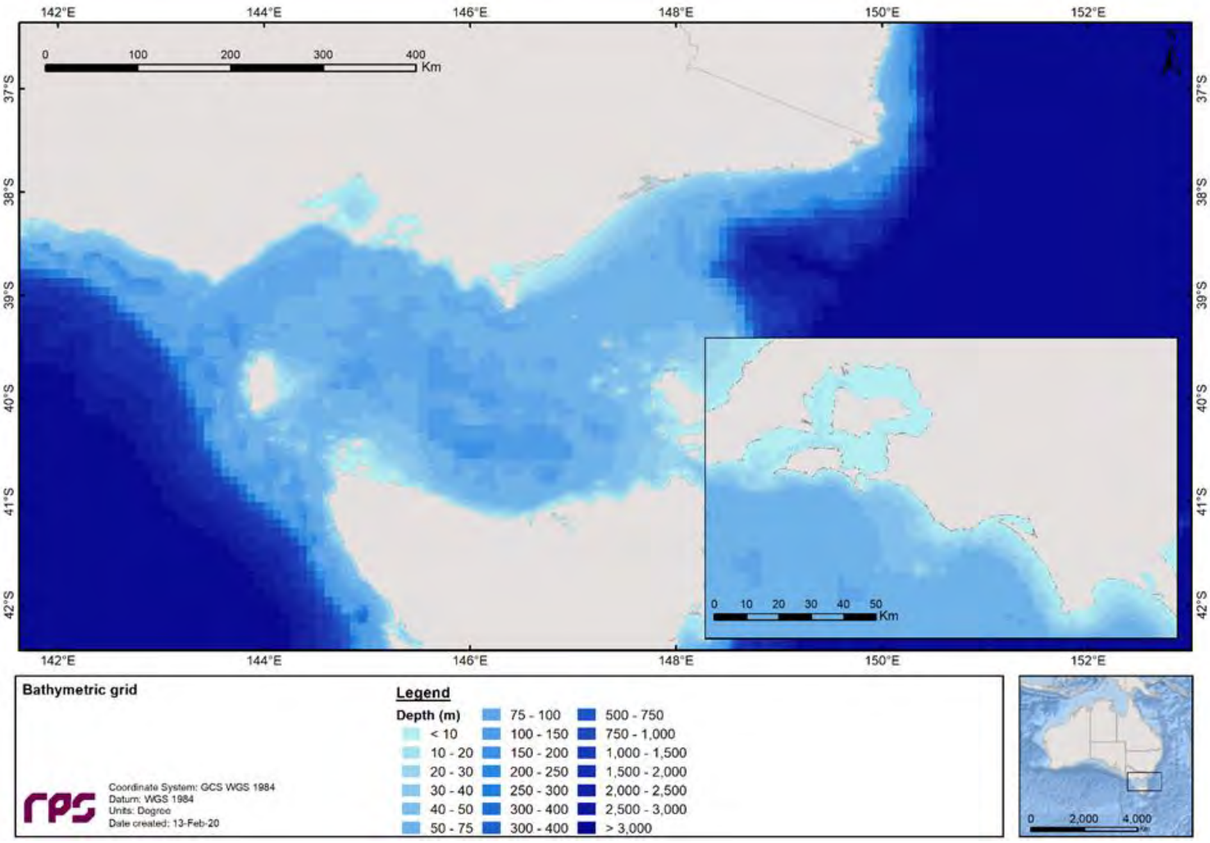


Figure 3.3 Bathymetry defined throughout the tidal model domain.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 8.0) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, time series surface heights were calculated along the open boundaries for the simulation period.

The Topex/Poseidon satellite data has a resolution of 0.25 degrees globally, with higher resolution in coastal regions, and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The data capturing satellites, equipped with two altimeters capable of taking sea level measurements accurate to less than ± 5 cm, measured oceanic surface elevations (and the resultant tides) for the period 1992–2005. In total these satellites carried out 62,000 orbits of the planet. The Topex/Poseidon tidal data has been widely used amongst the oceanographic community, being refereced in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk & Tangdong, 2004; Qiu & Chen 2010). The Topex/Poseidon tidal data is considered suitably accurate for this study.

3.1.3 Surface Elevation Validation

To ensure that tidal predictions were accurate, predicted surface elevations were compared to data observed at a location situated within the study area (Figure 3.4).

To provide a statistical measure of the model performance, the Index of Agreement (IOA – Willmott, 1981) and the Mean Absolute Error (MAE – Willmott, 1982; Willmott & Matsuura, 2005) were used.

The MAE (Eq.1) is simply the average of the absolute values of the difference between the model-predicted (P) and observed (O) variables. It is a more natural measure of the average error (Willmott and Matsuura, 2005) and more readily understood. The MAE is determined by:

$$MAE = N^{-1} \sum_{i=1}^{N} |P_i - O_i| \qquad \text{Eq.1}$$

Where: N = Number of observations

P_i = Model predicted surface elevation

O_i = Observed surface elevation

The Index of Agreement (IOA; Eq. 2) in contrast, gives a non-dimensional measure of model accuracy or performance. A perfect agreement between the model predicted and observed surface elevations exists if the index gives an agreement value of 1, and complete disagreement between model and observed surface elevations will produce an index measure of 0 (Wilmott, 1981). Willmott et al. (1985) also suggests that values larger than 0.5 may represent good model performance. The IOA is determined by:

$$IOA = 1 - \frac{\sum |X_{model} - X_{obs}|^2}{\sum (|X_{model} - \overline{X_{obs}}| + |X_{obs} - \overline{X_{obs}}|)^2} \qquad \text{Eq.2}$$

Where: X_{model} = Model predicted surface elevation

X_{obs} = Observed surface elevation

Clearly, a greater IOA and lower MAE represent a better model performance.

Figure 3.5 and Figure 3.6 illustrate a comparison of the predicted and observed surface elevations in February 2014. As shown on the graph, the model accurately reproduced the phase and amplitudes throughout the spring and neap tidal cycles.

Table 3-1 shows the IOA and MAE values for the selected tide station locations indicating that the model is performing well.

Table 3-1 Statistical comparison between the observed and HYDROMAP predicted surface elevations.

Tide Station	IOA	MAE (m)
Gabo Island	0.98	0.08
Port MacDonnell	0.98	0.05
Port Welshpool	0.92	0.30
Portland	0.97	0.07
Stack Island	0.96	0.22

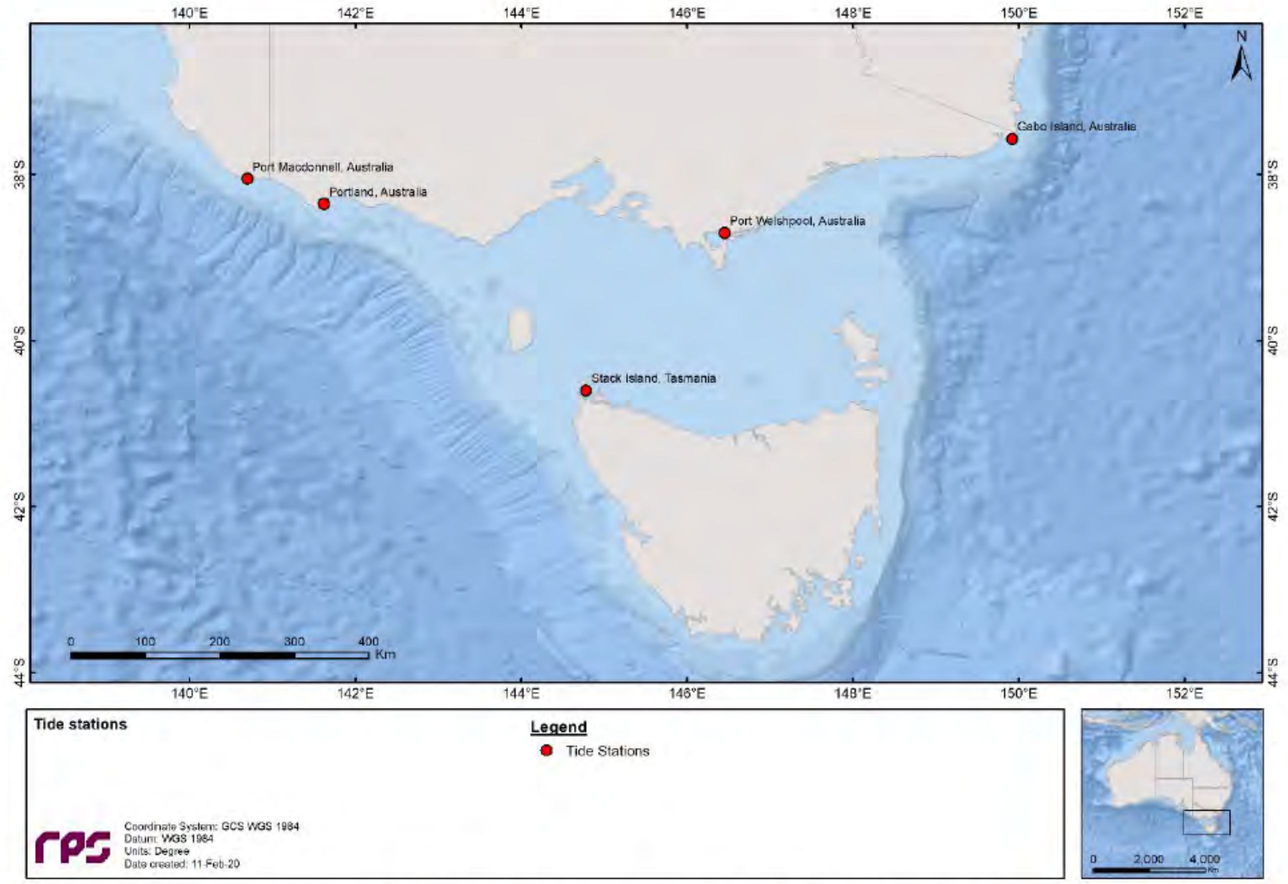


Figure 3.4 Location of the tide stations used in the surface elevation validation.

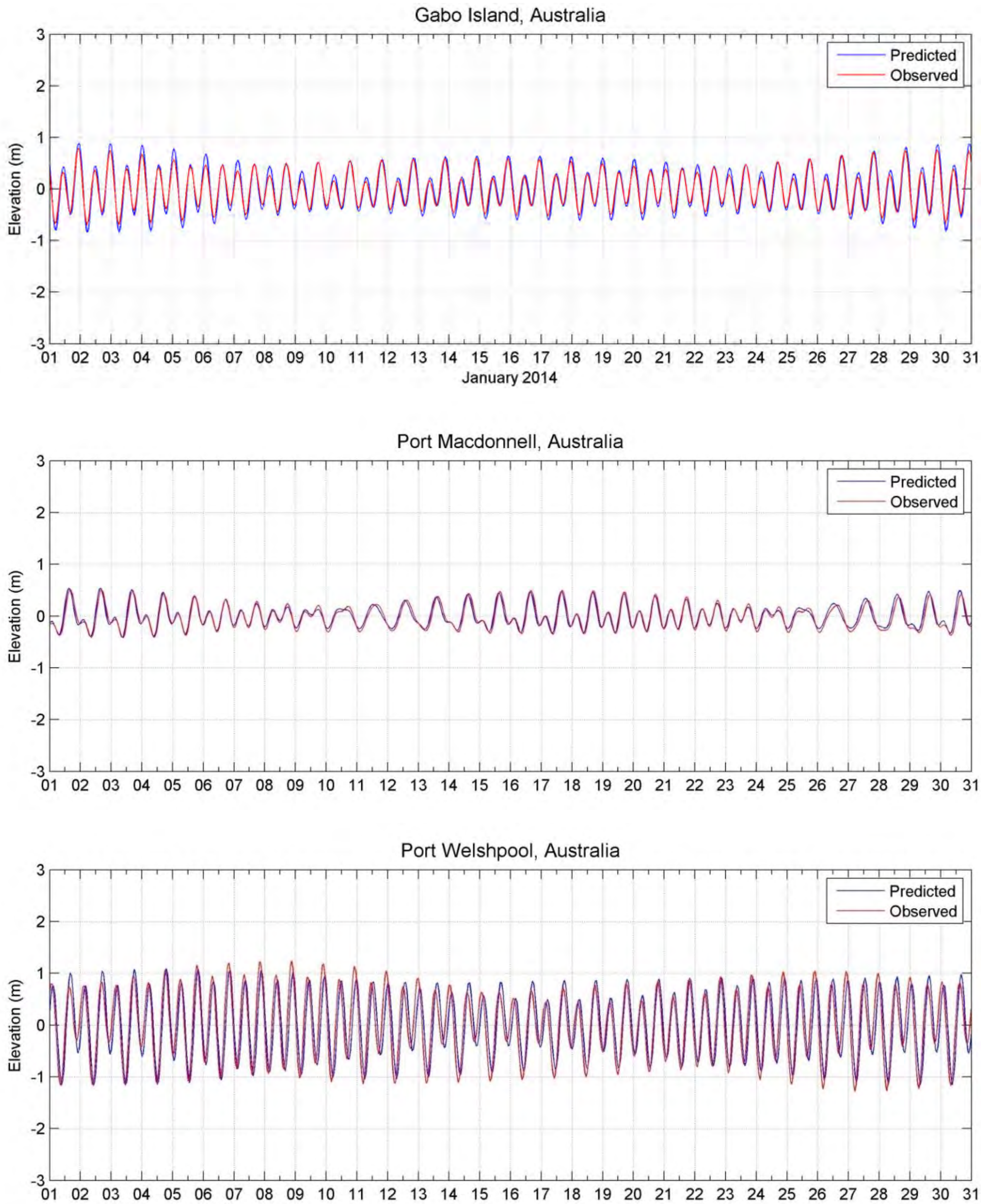


Figure 3.5 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Gabo Island (upper image), Port MacDonnell (middle image) and Port Welshpool (lower image).

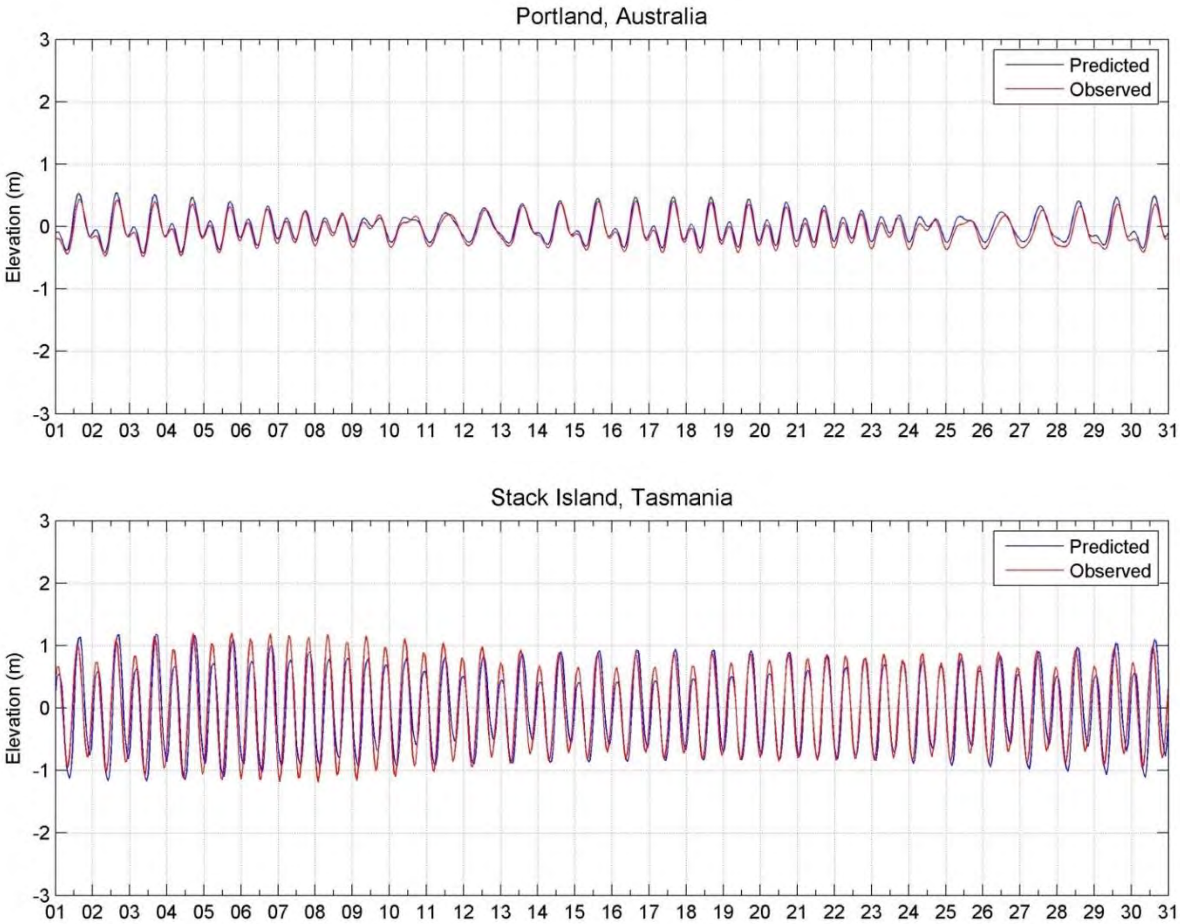


Figure 3.6 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Portland (upper image) and Stack Island (lower image).

3.2 Ocean Currents

Data describing the flow of ocean currents for the years 2010 to 2019 (inclusive) was obtained from HYCOM (Hybrid Coordinate Ocean Model, (Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of once per day. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain-following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas.

3.3 Surface Currents

Table 3-2 presents the average and maximum net surface current speeds nearby the release location by combining the ocean and tidal currents. Current speeds varied throughout the year with maximum current speeds ranging between approximately 0.72 m/s (February) and 1.10 m/s (September). The dominant surface current directions throughout the year were identified as (towards) the west during summer months and east during the winter months.

Figure 3.7 and Figure 3.8 show the monthly and total surface current rose distributions for the selected location.

Note the convention for defining current direction is the direction the current flows towards, which is used to reference current direction throughout this report. Each branch of the rose represents the currents flowing to that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are predominantly used in these current roses. The length of each coloured segment is relative to the proportion of currents flowing within the corresponding speed and direction.

Table 3-2 Predicted monthly average and maximum surface current speeds for the selected location. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.17	0.77	West
February	0.19	0.72	West
March	0.18	0.92	West
April	0.15	0.83	East and West
May	0.19	0.90	East
June	0.19	1.07	East
July	0.24	1.07	East
August	0.23	1.05	East
September	0.20	1.10	East
October	0.19	0.88	East
November	0.18	0.82	East and West
December	0.18	0.92	East and West
Minimum	**0.15**	**0.72**	
Maximum	**0.24**	**1.10**	

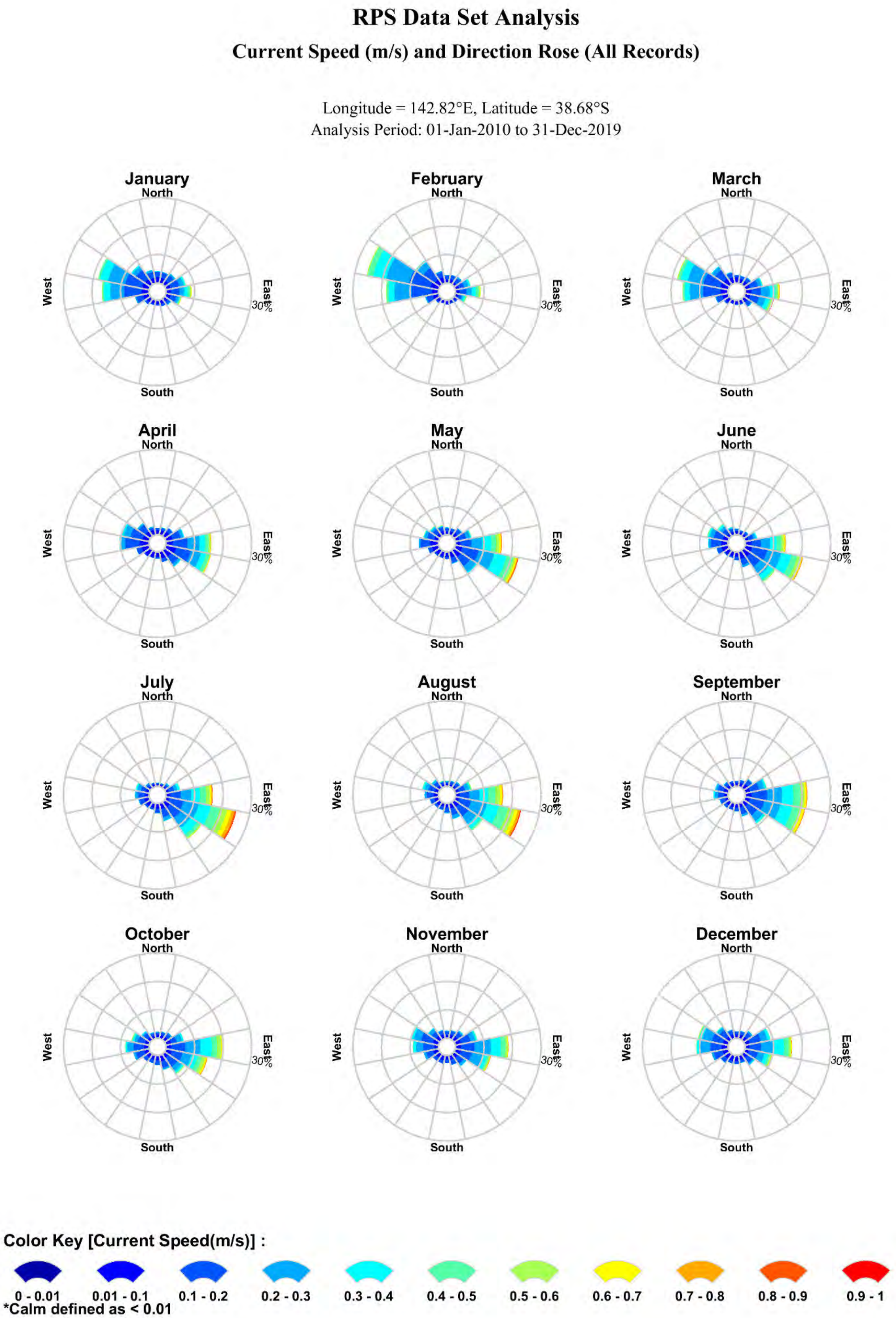


Figure 3.7 Monthly surface current rose plots nearby the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

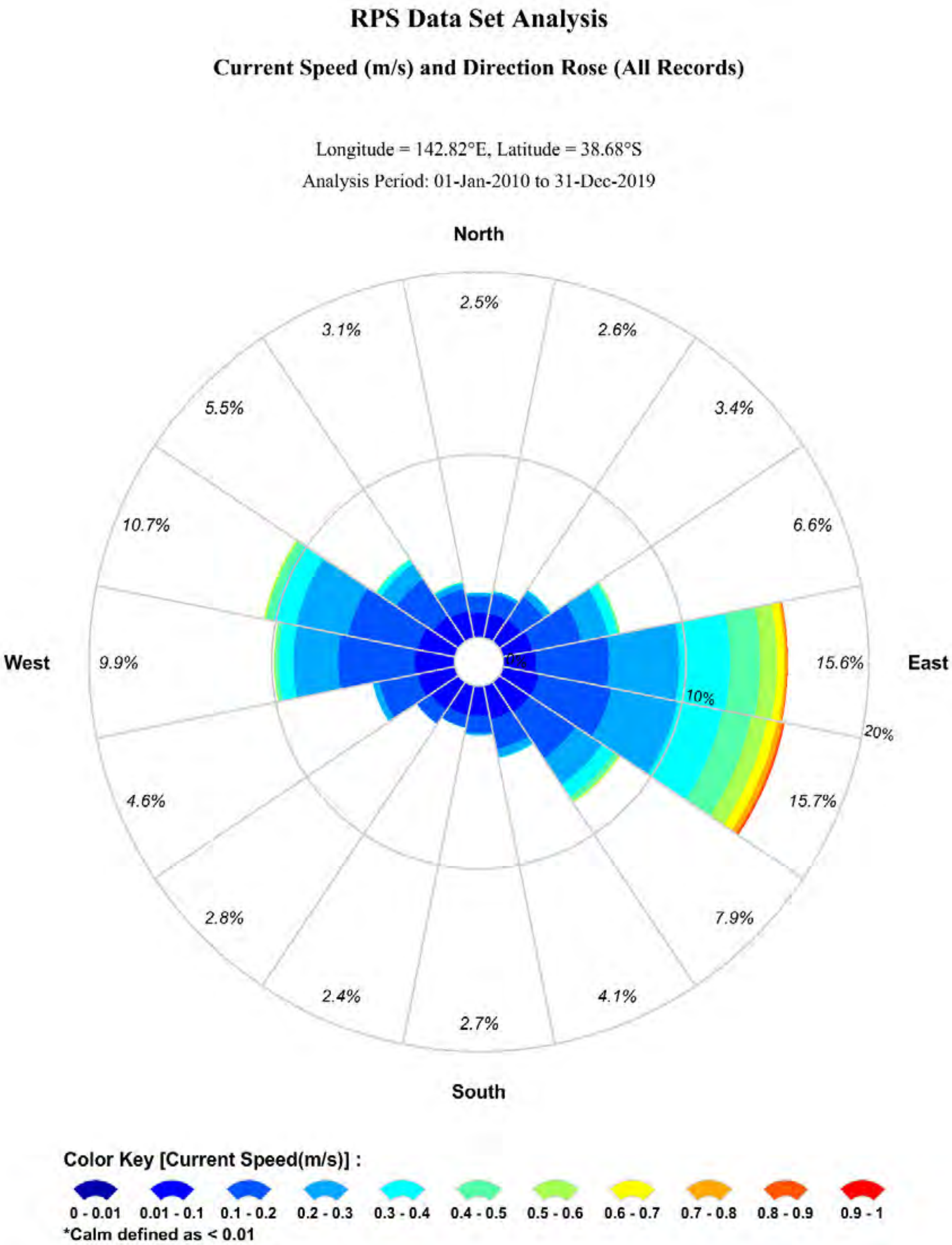


Figure 3.8 Total surface current rose plot nearby the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

4 WIND DATA

High resolution wind data for the years 2010 to 2019 (inclusive) was sourced from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis dataset (CFSR; see Saha et al., 2010). The CFSR wind model is a fully coupled, data-assimilative hindcast model representing the interaction between the earth's oceans, land and atmosphere. The gridded wind data output is available at ¼ of a degree resolution (~33 km) and 1-hourly time intervals. Figure 4.1 shows the spatial resolution of the wind field used as input into the oil spill model.

Table 4-1 presents the monthly average and maximum winds derived from a CFSR wind node nearby the release location. The wind data demonstrated average monthly wind speeds ranging from 10 knots during summer to 13 knots during winter, with maximums ranging between 30 knots (January and November) and 42 knots (June). The dominant wind direction throughout the year ranged from the southeast in summer, through the westerly sectors to the northwest for winter, before returning to the southeast at the end of the year.

Figure 4.2 and Figure 4.3 show the monthly and total wind rose distributions derived from the CFSR data for the selected node nearby the release location.

Note that the atmospheric convention for defining wind direction, that is, the direction the wind blows from, is used to reference wind direction throughout this report. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent wind speed ranges from that direction. Speed ranges of 5 knots are typically used in these wind roses. The length of each segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction.

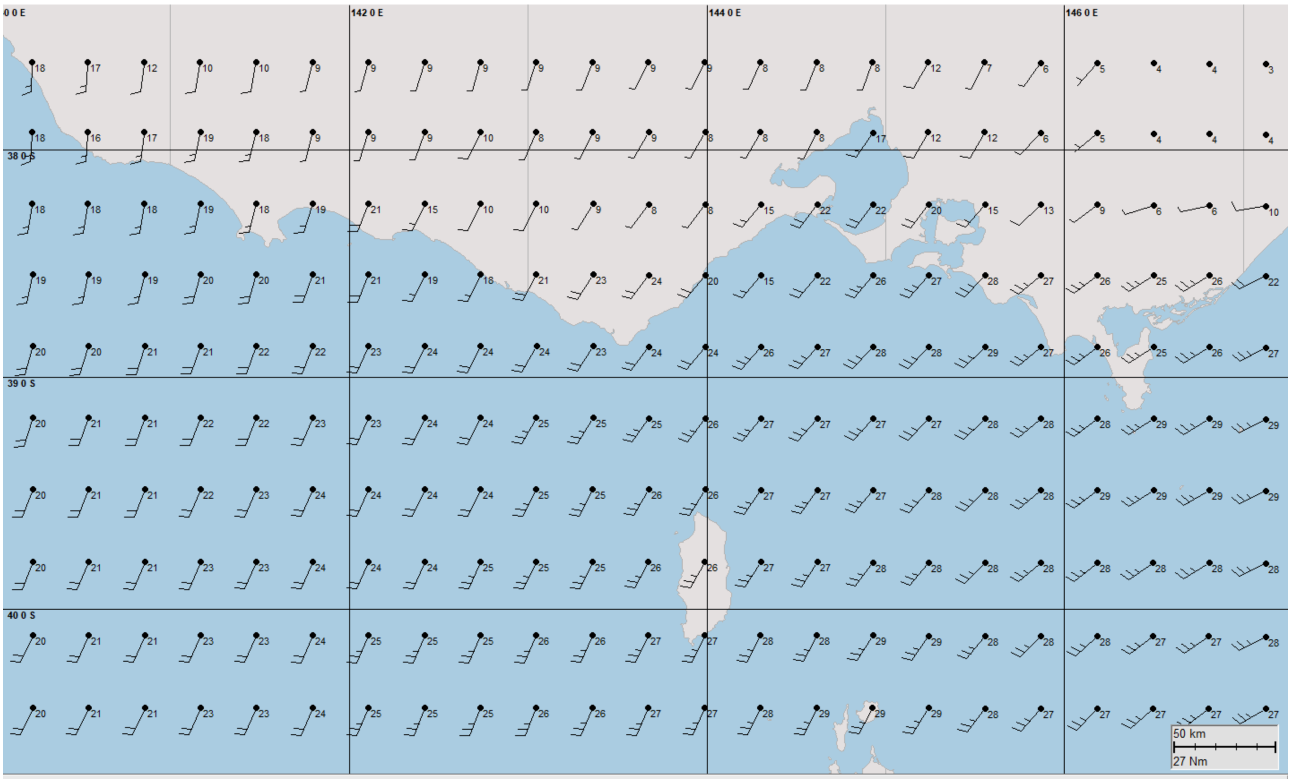


Figure 4.1 Spatial resolution of the CFSR modelled wind data used as input into the oil spill model.

Table 4-1 Predicted average and maximum winds representative for the selected node nearby the release location. Data derived from CFSR hindcast model from 2010–2019 (inclusive).

Month	Average wind speed (knots)	Maximum wind speed (knots)	General direction(s) (From)
January	10	30	South-Southeast
February	10	31	South-Southeast
March	10	34	Southeast
April	10	33	West
May	11	32	West
June	11	42	Northwest
July	13	35	Northwest
August	13	39	Northwest
September	12	41	West
October	11	31	West
November	10	30	West
December	10	31	West and Southeast
Minimum	**10**	**30**	
Maximum	**13**	**42**	

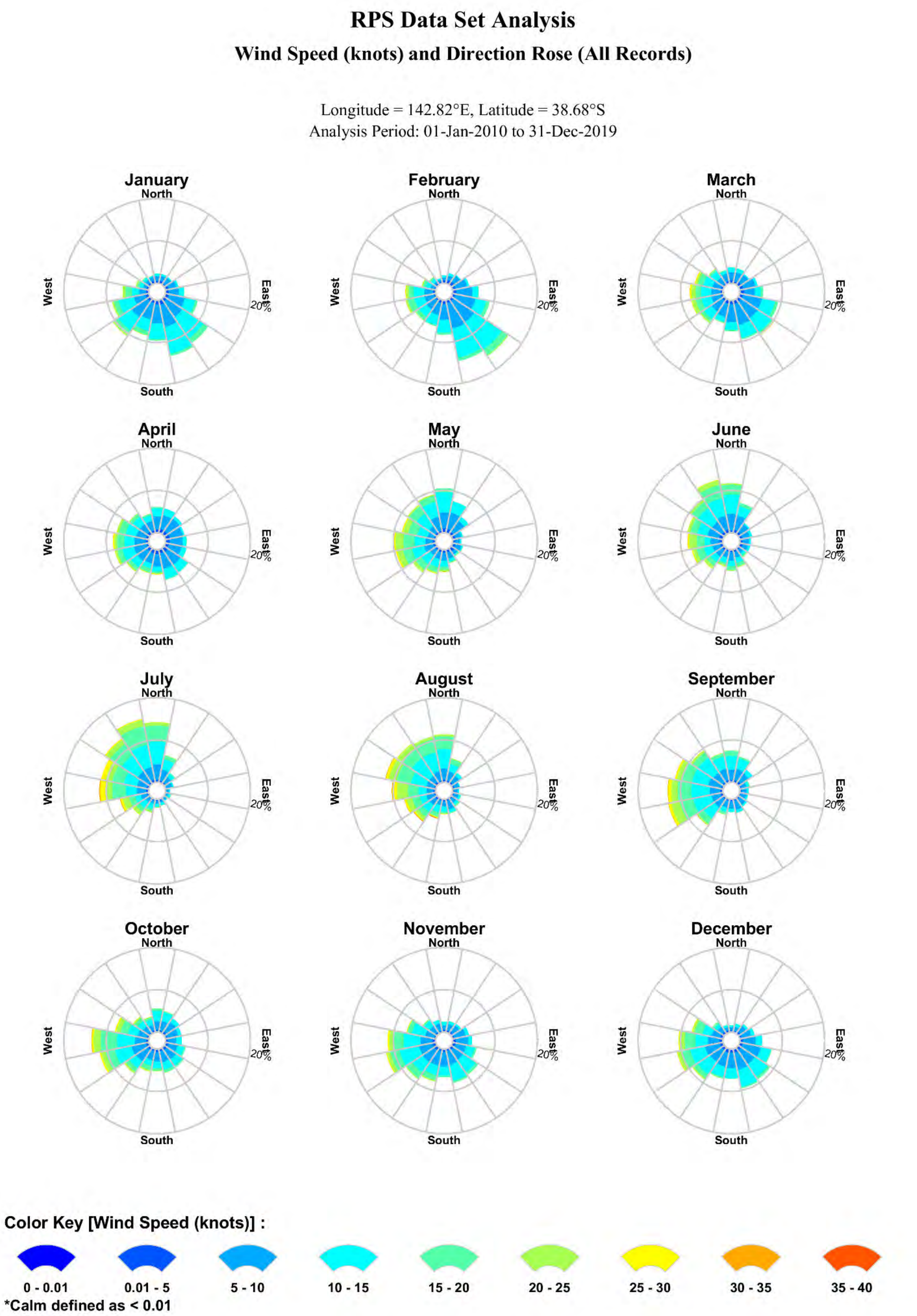


Figure 4.2 Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the release location.

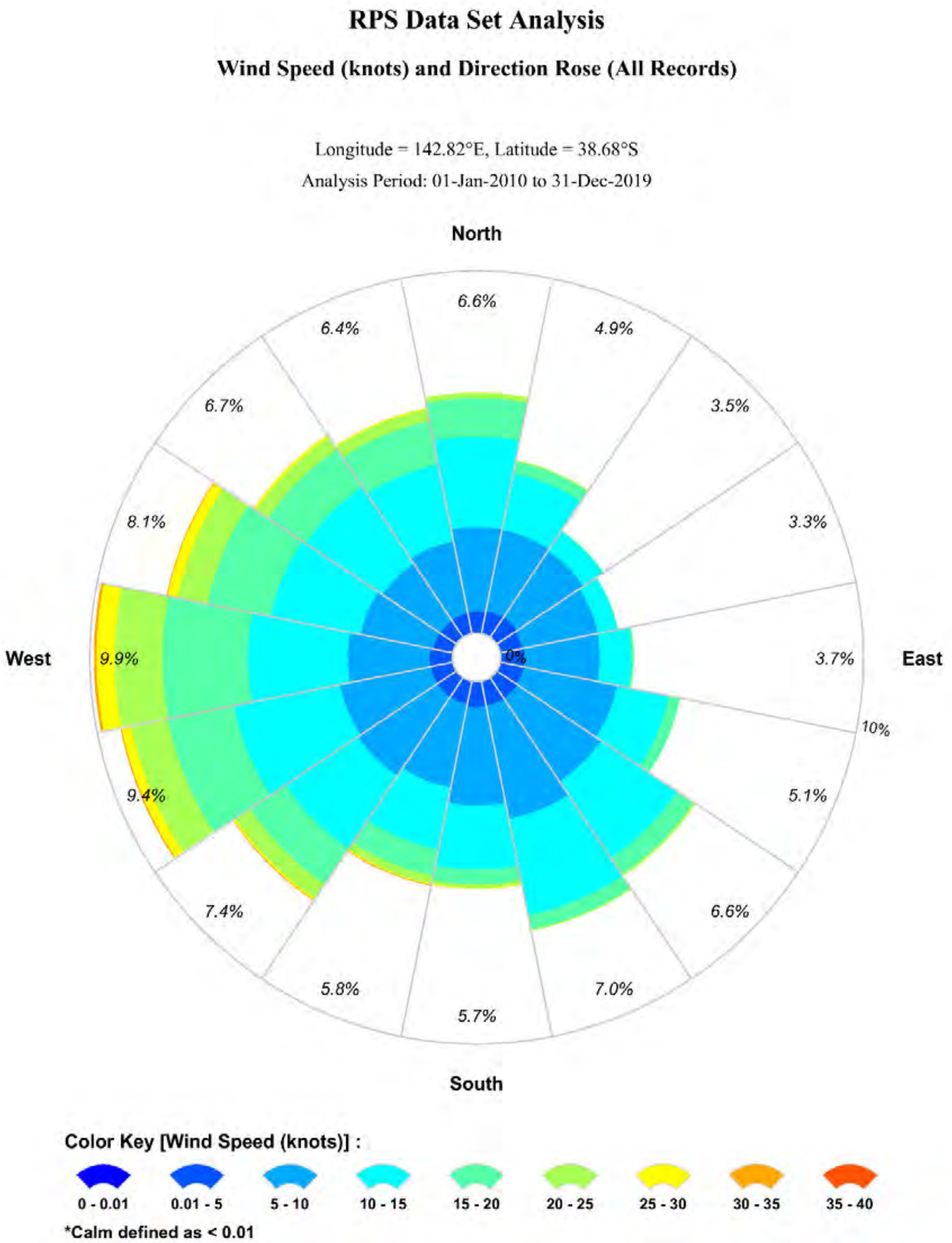


Figure 4.3 Modelled total wind rose distributions from 2010–2019 (inclusive) for the node nearby the release location.

5 WATER TEMPERATURE AND SALINITY

The monthly sea temperature and salinity profiles of the water column within the study was obtained from the World Ocean Atlas 2013 database produced by the National Oceanographic Data Centre (National Oceanic and Atmospheric Administration) and its co-located World Data Center for Oceanography (see Levitus et al., 2013). These parameters were used as factors to inform the weathering, movement and evaporative loss of hydrocarbon spills in the surface and sub-surface layers.

Table 5-1 presents the sea temperature and salinity of the surface layer nearby the selected location. The monthly average sea surface temperatures ranged between 13.4°C (September) and 18.2°C (March). The monthly average surface salinity values remain relatively consistent ranging between 35.4 psu and 35.6 psu.

Table 5-1 Monthly average sea surface temperature and salinity in the study area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (ºC)	18.0	17.8	18.2	16.7	16.4	15.8	15.0	14.7	13.4	14.6	15.2	17.5
Salinity (psu)	35.5	35.4	35.6	35.4	35.5	35.5	35.6	35.5	35.4	35.4	35.5	35.5

6 OIL SPILL MODEL – SIMAP

Modelling of the fate of oil was performed using the Spill Impact Mapping Analysis Program (SIMAP). SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for both the surface and subsurface releases (Spaulding et al., 1994; French et al., 1999; French-McCay, 2003, 2004; French-McCay et al., 2004).

SIMAP has been used to predict the weathering and fate of oil spills during and after major incidents including: Montara (Australia) well blowout August 2009 in the Timor Sea (Asia-Pacific ASA, 2010); Macondo (USA) well blowout April 2010 in the Gulf of Mexico; Bohai Bay (China) oil spill August 2011; and the pipeline oil spill July 2013 in the Gulf of Thailand.

The SIMAP model calculates the transport, spreading, entrainment, evaporation and decay of surface hydrocarbon slicks as well as the entrained and dissolved oil components in the water column, either from surface slicks or from oil discharged subsea. The movement and weathering of the spilled oil is calculated for specific oil types. Input specifications for oil mixtures include the density, viscosity, pour point, distillation curve (volume lost versus temperature) and the aromatic/aliphatic component ratios within given boiling point (BP) ranges.

SIMAP is a three-dimensional model that allows for various response actions to be modelled including oil removal from skimming, burning, or collection booms, and surface and subsurface dispersant application.

The SIMAP oil spill model includes advanced weathering algorithms, specifically focussed on unique oils that tend to form emulsions and/or tar balls. The weathering algorithms are based on 5 years of extensive research conducted in response to the Deepwater Horizon oil spill in the Gulf of Mexico (French-McCay et al., 2015).

Biodegradation is included in the oil spill model. In the model, SIMAP, degradation is calculated for the surface slick, deposited oil on the shore, the entrained oil and dissolved constituents in the water column, and oil in the sediments. For surface oil, water column oil and sedimented oil a first order degradation rate is specified. Biodegradation rates are relatively high for hydrocarbons in dissolved state or in dispersed small droplets.

6.1 Stochastic Modelling

For the stochastic modelling presented herein, 100 oil spills were modelled for the scenarios using the same spill information (release location, spill volume, duration and oil type) but with varied start dates. During each simulation, the model records whether any grid cells are exposed to any oil concentrations, the concentrations involved and the elapsed time before exposure. The results of all 100 oil spill simulations were analysed to determine the following statistics for every grid cell:

- Exposure load (concentrations and volumes);
- Minimum time before exposure;
- Probability of contact above defined concentrations;
- Volume of oil that may accumulate on shorelines from any single simulation;
- Concentration that might occur on sections of individual shorelines;
- Exposure (instantaneous and/or over a specified duration) to dissolved hydrocarbons in the water column; and
- Exposure (instantaneous and/or over a specified duration) to entrained hydrocarbons in the water column.

6.2 Floating, Shoreline and In-Water Thresholds

The thresholds and their relationship to exposure for the sea surface, shoreline and water column (entrained and dissolved hydrocarbons) are presented in Sections 6.2.1 to 6.2.3. Supporting justifications of the adopted thresholds applied during the study and additional context relating to the area of potential exposure are also provided. It is important to note that the thresholds herein are based on NOPSEMA (2019).

6.2.1 Floating Oil Exposure Thresholds

The modelling results can be presented to any levels; therefore, thresholds have been specified (based on scientific literature) to record floating oil exposure to the sea-surface at meaningful levels only, described in the following paragraphs.

The low threshold to assess the potential for floating oil exposure, was 1 g/m^2, which equates approximately to an average thickness of 1 µm, referred to as visible oil. Oil of this thickness is described as rainbow sheen in appearance, according to the Bonn Agreement Oil Appearance Code (Bonn Agreement, 2009; AMSA, 2014) (see Table 6-1). Figure 6.1 shows photographs highlighting the difference in appearance between a silvery sheen, rainbow sheen and metallic sheen. This threshold is considered below levels which would cause environmental harm and it is more indicative of the areas perceived to be affected due to its visibility on the sea surface and potential to trigger temporary closures of areas (i.e. fishing grounds) as a precautionary measure. Table 6-1 provides a description of the appearance in relation to exposure zone thresholds used to classify the zones of floating oil exposure.

Ecological impact has been estimated to occur at 10 g/m^2 (a film thickness of approximately 10 µm or 0.01 mm) according to French et al. (1996) and French-McCay (2009) as this level of fresh oiling has been observed to mortally impact some birds through adhesion of oil to their feathers, exposing them to secondary effects such as hypothermia. The appearance of oil at this average thickness has been described as a metallic sheen (Bonn Agreement, 2009).

Scholten et al. (1996) and Koops et al. (2004) indicated that at oil concentrations on the sea surface of 25 g/m^2 (or greater), would be harmful for all birds that have landed in an oil film due to potential contamination of their feathers, with secondary effects such as loss of temperature regulation and ingestion of oil through preening. The appearance of oil at this thickness is also described as metallic sheen (Bonn Agreement, 2009). For this study the high exposure threshold was set to 50 g/m^2 and above based on NOPSEMA (2019). This threshold can also be used to inform response planning.

Table 6-2 defines the thresholds used to classify the zones of floating oil exposure reported herein.

Table 6-1 The Bonn Agreement Oil Appearance Code.

Code	Description Appearance	Layer Thickness Interval (g/m^2 or µm)	Litres per km^2
1	Sheen (silvery/grey)	0.04 – 0.30	40 – 300
2	Rainbow	0.30 – 5.0	300 – 5,000
3	Metallic	5.0 – 50	5,000 – 50,000
4	Discontinuous True Oil Colour	50 – 200	50,000 – 200,000
5	Continuous True Oil Colour	≥ 200	≥ 200,000

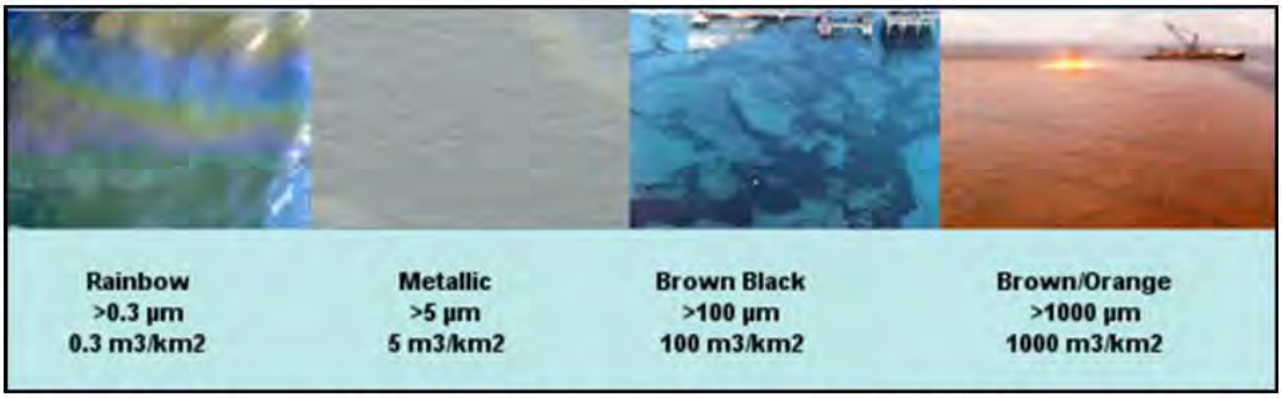


Figure 6.1 Photographs showing the difference between oil colour and thickness on the sea surface (source: adapted from Oil Spill Solutions, 2015).

Table 6-2 Floating oil exposure thresholds used in this report (in alignment with NOPSEMA (2019)).

Threshold level	Floating oil (g/m^2)	Description
Low	1	Approximates range of socioeconomic effects and establishes planning area for scientific monitoring
Moderate	10	Approximates lower limit for harmful exposures to birds and marine mammals
High	50	Approximates surface oil slick and informs response planning

6.2.2 Shoreline Accumulation Thresholds

There are many different types of shorelines, ranging from cliffs, rocky beaches, sandy beaches, mud flats and mangroves, and each of these influences the volume of oil that can remain stranded ashore and its thickness before the shoreline saturation point occurs. For instance, a sandy beach may allow oil to percolate through the sand, thus increasing its ability to hold more oil ashore over tidal cycles and various wave actions than an equivalent area of water; hence oil can increase in thickness onshore over time. A sandy beach shoreline was assumed as the default shoreline type for the modelling herein, as it allows for the highest carrying capacity of oil (of the available open/exposed shoreline types). Hence the results contained herein would be indicative of a worst-case scenario, where the highest volume of oil may be stranded on the shoreline (when compared to other shoreline types, such as exposed rocky shores).

In previous risk assessment studies, French-McCay et al. (2005a; 2005b) used a threshold of 10 g/m^2 to assess the potential for shoreline accumulation. This is a conservative threshold used to define regions of socio-economic impact, such as triggering temporary closures of adjoining fisheries or the need for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.). It would equate to approximately 2 teaspoons of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a stain/film. On that basis, the 10 g/m^2 shoreline accumulation threshold has been selected to define the zone of potential “low shoreline accumulation”.

French et al. (1996) and French-McCay (2009) define a shoreline oil accumulation threshold of 100 g/m^2, or above, would potentially harm shorebirds and wildlife (furbearing aquatic mammals and marine reptiles on or along the shore) based on studies for sub-lethal and lethal impacts. This threshold has been used in previous environmental risk assessment studies (see French-McCay, 2003; French-McCay et al., 2004, French-McCay et al., 2011; 2012; NOAA, 2013). Additionally, a shoreline concentration of 100 g/m^2, or above, is the minimum limit that the oil can be effectively cleaned according to the AMSA (2015) guideline. This threshold equates to approximately ½ a cup of oil per square meter of shoreline accumulation. The appearance is described as a thin oil coat. Therefore, 100 g/m^2 has been selected to define the zone of potential “moderate shoreline accumulation”.

Observations by Lin & Mendelssohn (1996), demonstrated that loadings of more than 1,000 g/m^2 of hydrocarbon during the growing season would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing hydrocarbon impacts on mangroves (Grant et al., 1993; Suprayogi & Murray, 1999). Hence, 1,000 g/m^2 has been selected to define the zone of potential “high shoreline accumulation”. It equates to approximately 1 litre of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a hydrocarbon cover.

It is worth noting that the shoreline accumulation thresholds derived from extensive literature review (outlined in Table 6-3) agree with the commonly used threshold values for oil spill modelling specified in NOPSEMA (2019).

Table 6-3 Thresholds used to assess shoreline accumulation.

Threshold level	Shoreline loading (g/m^2)	Description
Low (socioeconomic/sublethal)	10	Predicts potential for some socio-economic impact
Moderate	100	Loading predicts area likely to require clean-up effort
High	> 1,000	Loading predicts area likely to require intensive clean-up effort

6.2.3 In-water Exposure Thresholds

Oil is a mixture of thousands of hydrocarbons of varying physical, chemical, and toxicological characteristics, and therefore, demonstrate varying fates and impacts on organisms. As such, for in-water exposure, the SIMAP model provides separate outputs for dissolved and entrained hydrocarbons from oil droplets. The consequences of exposure to dissolved and entrained components will differ because they have different modes and magnitudes of effect.

Entrained hydrocarbon concentrations were calculated based on oil droplets that are suspended in the water column, though not dissolved. The composition of this oil would vary with the state of weathering (oil age) and may contain soluble hydrocarbons when the oil is fresh. Calculations for dissolved hydrocarbons specifically calculates oil components which are dissolved in water, which are known to be the primary source of toxicity exerted by oil.

6.2.3.1 Dissolved Hydrocarbons

Laboratory studies have shown that dissolved hydrocarbons exert most of the toxic effects of oil on aquatic biota (Carls et al., 2008; Nordtug et al., 2011; Redman, 2015). The mode of action is a narcotic effect, which is positively related to the concentration of soluble hydrocarbons in the body tissues of organisms (French-McCay, 2002). Dissolved hydrocarbons are taken up by organisms directly from the water column by absorption through external surfaces and gills, as well as through the digestive tract. Thus, soluble hydrocarbons are termed “bioavailable”.

Hydrocarbon compounds vary in water-solubility and the toxicity exerted by individual compounds is inversely related to solubility, however bioavailability will be modified by the volatility of individual compounds (Nirmalakhandan & Speece, 1988; Blum & Speece, 1990; McCarty, 1986; McCarty et al., 1992a, 1992b; Mackay et al., 1992; McCarty & Mackay, 1993; Verhaar et al., 1992, 1999; Swartz et al., 1995; French-McCay, 2002; McGrath and Di Toro, 2009). Of the soluble compounds, the greatest contributor to toxicity for water-column and benthic organisms are the lower-molecular-weight aromatic compounds, which are both volatile and soluble in water. Although they are not the most water-soluble hydrocarbons within most oil types, the polynuclear aromatic hydrocarbons (PAHs) containing 2-3 aromatic ring structures typically exert the largest narcotic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant accumulation to occur (Anderson et al., 1974, 1987; Neff & Anderson, 1981; Malins & Hodgins, 1981; McAuliffe, 1987; NRC, 2003). The monoaromatic hydrocarbons (MAHs), including the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes (straight chain hydrocarbons) also contribute to toxicity, but these compounds are highly volatile, so that their contribution will be low when oil is exposed to evaporation and higher when oil is discharged at depth where volatilisation does not occur (French-McCay, 2002).

French-McCay (2002) reviewed available toxicity data, where marine biota was exposed to dissolved hydrocarbons prepared from oil mixtures, finding that 95% of species and life stages exhibited 50% population mortality (LC_{50}) between 6 and 400 ppb total PAH concentration after 96 hrs exposure, with an average of 50 ppb. Hence, concentrations lower than 6 ppb total PAH value should be protective of 97.5% of species and life stages even with exposure periods of days (at least 96 hours). Early life-history stages of fish appear to be more sensitive than older fish stages and invertebrates.

Exceedances of 10, 50 or 400 ppb over a 1 hour timestep (see Table 6-4) was applied to indicate increasing potential for sub-lethal to lethal toxic effects (or low to high), based on NOPSEMA (2019).

6.2.3.2 Entrained Hydrocarbons

Entrained hydrocarbons consist of oil droplets that are suspended in the water column and insoluble. As such, insoluble compounds in oil cannot be absorbed from the water column by aquatic organisms, hence are not bioavailable through absorption of compounds from the water. Exposure to these compounds would require routes of uptake other than absorption of soluble compounds. The route of exposure of organisms to whole oil alone include direct contact with tissues of organisms and uptake of oil by direct consumption, with potential for biomagnification through the food chain (NRC, 2005).

The 10 ppb threshold represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC & ARMCANZ (2000) water quality guidelines. Due to the requirement for relatively long exposure times (> 24 hours) for these concentrations to be significant, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes, or when entrained hydrocarbons adhere to organisms or trapped against a shoreline for periods of several days or more.

This exposure zone is not considered to be of significant biological impact and is therefore outside the adverse exposure zone. This exposure zone represents the area contacted by the spill. This area does not define the area of influence as it is considered that the environment will not be affected by the entrained hydrocarbon at this level.

Thresholds of 10 ppb and 100 ppb were applied over a 1-hour time exposure (Table 6-4), to cover the range of thresholds outlined in ANZECC & ARMCANZ (2000) water quality guidelines, the incremental change for greater potential effect and is per NOPSEMA (2019).

A complicating factor that should be considered when assessing the consequence of dissolved and entrained oil distributions is that there will be some areas where both physically entrained oil droplets and dissolved hydrocarbons co-exist. Higher concentrations of each will tend to occur close to the source where sea conditions can force mixing of relatively unweathered oil into the water column, resulting in more rapid dissolution of soluble compounds.

Table 6-4 Dissolved and entrained hydrocarbon exposure values assessed over a 1-hour time step, as per NOPSEMA (2019).

	Exposure level	In-water threshold (ppb)	Description
Dissolved hydrocarbons	Low	10	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
	Moderate	50	Approximates potential toxic effects, particularly sublethal effects to sensitive species
	High	400	Approximates toxic effects including lethal effects to sensitive species
Entrained hydrocarbons	Low	10	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
	High	100	As appropriate given oil characteristics for informing risk evaluation

7 HYDROCARBON PROPERTIES

7.1 Physical Properties

Table 7-1 and Table 7-2 present the physical properties and boiling point ranges of the MDO.

The MDO has an API of 24 and a density of 890 kg/m^3 (at 25 ºC) with a viscosity value (14.0 cP at 25 ºC) classifying it as a Group II (light-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2014) and US EPA/USCG classifications.

The MDO is a mixture of volatile and persistent hydrocarbons with high proportions of semi- and low-volatile components. In favourable evaporation conditions, about 4.0% of the oil mass should evaporate within the first 12 hours (BP < 180°C), a further 32% should evaporate within the first 24 hours (180°C < BP < 265°C) and a further 54% should evaporate over several days (265°C < BP < 380°C). Approximately 10% of the oil is shown to be persistent.

The boiling points (BP) are dictated by the length of the carbon chains, with the longer and more complex compounds having a higher boiling point, and therefore lower volatility and evaporation rate. Typical evaporation times once the hydrocarbons reach the surface and are exposed to the atmosphere are:

- Up to 12 hours for the C_4 to C_{10} compounds (BP <180 °C).
- Up to 24 hours for the C_{11} to C_{15} compounds (BP 180-265 °C).
- Several days for the C_{16} to C_{20} compounds (BP 265-380 °C).
- Not applicable for the residual compounds (BP >380°C), which will resist evaporation, persist in the marine environment for longer periods, and be subject to relatively slow degradation.

Table 7-1 Physical properties of MDO.

Characteristic	MDO
Density (kg/m^3)	890 (@ 25 °C)
API	24
Dynamic viscosity (cP)	14.0 (@ 25 °C)
Pour point (°C)	-9
Hydrocarbon property category	Group II
Hydrocarbon property classification	Light - Persistent

Table 7-2 Boiling point ranges of MDO.

Oil Type	Component	Volatile (%)	Semi-volatile (%)	Low-volatility (%)	Residual (%)
	Boiling point (°C)	<180 C_4 to C_{10}	180-265 C_{11} to C_{15}	265-380 C_{16} to C_{20}	>380 $>C_{20}$
MDO	% of total	4.0	32.0	54.0	10.0

7.2 Weathering Properties

7.2.1 MDO

A series of model weathering tests were conducted to illustrate the potential behaviour of the MDO when exposed to idealised and representative environmental conditions:

- A 50 m^3 surface release over 1-hour under calm wind conditions (constant 5 knots), assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.
- A 50 m^3 surface release over 1-hour under variable wind conditions (1-23. knots, drawn from representative data files), assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.

The first case is indicative conditions that would not generate entrainment, while the second case represents conditions that would likely cause entrainment. Both scenarios provide examples of potential behaviour during a spill once the oil is on the sea surface.

The mass balance for the MDO under the constant 5 knot wind case (Figure 7.1) shows that 34.3% of the oil is shown to evaporate within 24 hours. Under calm conditions, the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the low volatile, longer-chain compounds. Evaporation shall cease when the residual compounds remain, and they will be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 7.2), where the winds are of greater strength on average, entrainment of MDO into the water column is shown to increase. Approximately 24 hours after the spill, 83.1% of the oil mass is shown to have entrained and a further 11.4% is shown to have evaporated, leaving only a small proportion of the oil floating on the water surface (1.3%).

The increased level of entrainment in the variable-wind case result in a higher percentage decaying at an approximate rate of 3% per day with 22% after 7 days, compared to 0.4% per day and a total of 2.6% after 7 days for the constant-wind case. Given the proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

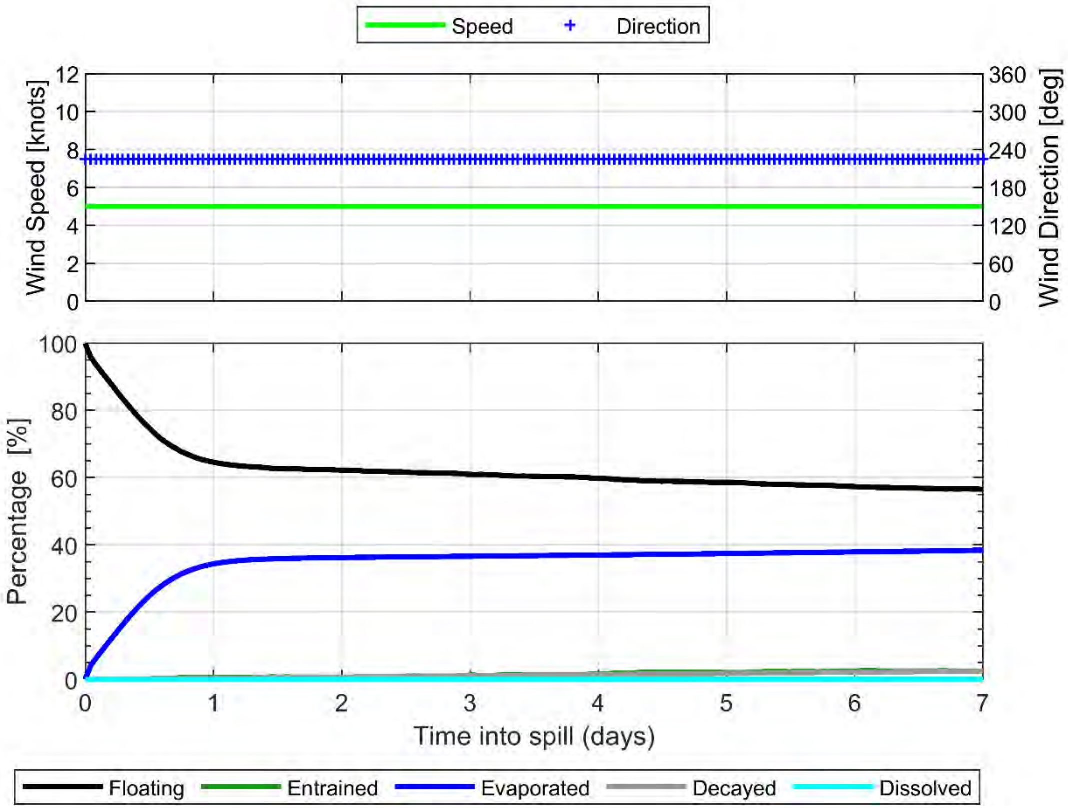


Figure 7.1 Proportional mass balance plot representing the weathering of MDO spilled onto the water surface over 1 hour and subject to a constant 5 knots wind speed at 15°C water temperature.

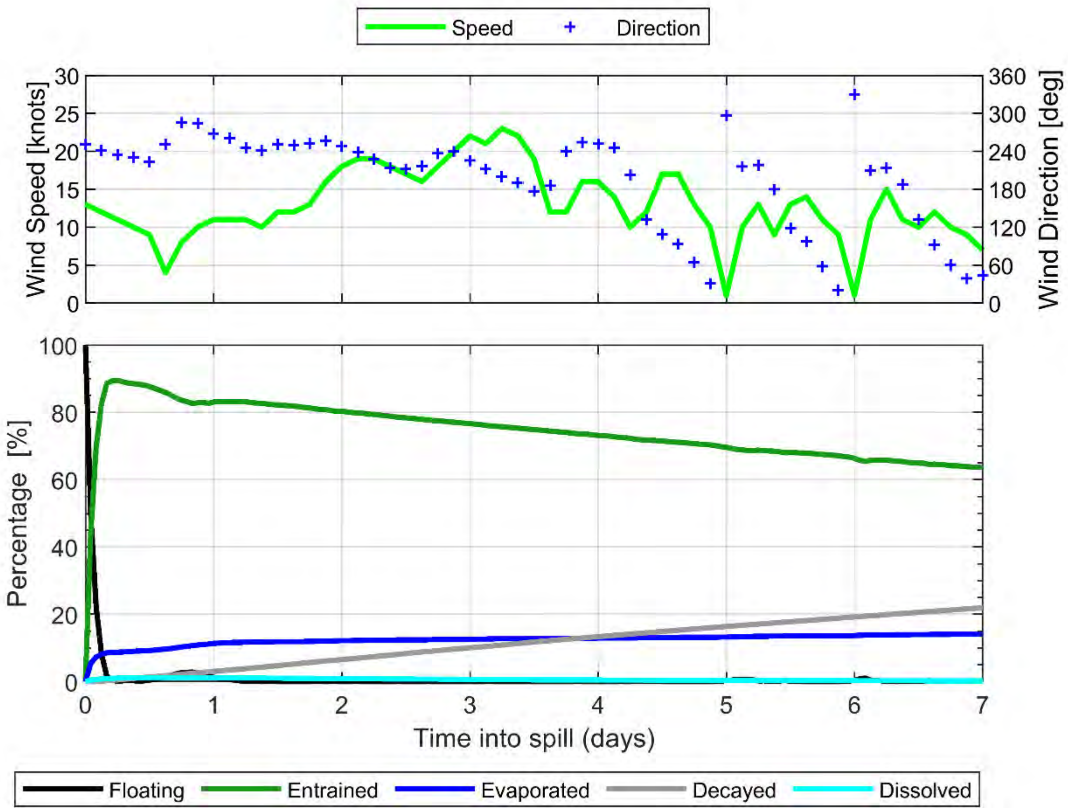


Figure 7.2 Proportional mass balance plot representing the weathering of MDO spilled onto the water over 1 hour and subject to variable wind speeds (1-23 knots) at 15°C water temperature.

8 MODEL SETTINGS

Table 8-1 provides a summary of the oil spill model settings.

Table 8-1 Summary of the oil spill model settings and thresholds used in this assessment.

Parameter	Scenario
Description	Vessel Collision
Number of randomly selected spill start times	100
Model period	Annual
Oil type	MDO
Spill volume	250 m^3
Release type	Surface
Release duration	6 hours
Simulation length (days)	30
Surface oil concentration thresholds (g/m^2) ^	1 (low); 10 (moderate); 50 (high)
Shoreline oil accumulation thresholds (g/m^2) ^	10 (low); 100 (moderate); 1,000 (high)
Dissolved hydrocarbon concentrations (ppb) ^	10 (low); 50 (moderate); 400 (high)
Entrained hydrocarbon concentrations (ppb) ^	10 (low); 100 (high)

^Thresholds based on NOPSEMA (2019)

9 PRESENTATION AND INTERPRETATION OF MODEL RESULTS

The results from the modelling study are presented in a number of tables and figures, which aim to provide an understanding of potential sea-surface and water column exposure and shoreline accumulation.

9.1 Annual Analysis

The statistics are based on the following principles:

- The ***greatest distance travelled by a spill trajectory*** – is determined by a) recording the maximum and b) second greatest distance travelled (or 99th percentile) by a single trajectory, within a scenario, from the release location to the identified exposure thresholds.
- The ***probability of oil exposure to a receptor*** – is determined by recording the number of spill trajectories to reach a specified sea surface or subsea threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.
- The ***minimum time before oil exposure to a receptor*** – is determined by ranking the elapsed time before sea surface exposure, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value.
- The ***maximum residence time for oil exposure within a receptor*** – is determined by recording the longest continuous length of time a grid cell is exposed to either floating, entrained or dissolved hydrocarbon above each threshold, within a receptor.
- The ***probability of oil accumulation at a receptor*** – is determined by recording the number of spill trajectories to reach a specified shoreline accumulation threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.
- The ***maximum (total) volume of oil ashore*** – is the total volume of oil stranded on the shorelines throughout the duration of the simulation.
- The ***maximum potential oil loading within a receptor*** – is determined by identifying the maximum loading to any grid cell within a receptor polygon, for a scenario.
- The ***dissolved and entrained hydrocarbon exposure*** – is determined by recording the maximum instantaneous concentrations at each grid cell.

9.2 Deterministic Trajectories

The stochastic modelling results were assessed for each scenario, and the deterministic runs were identified and are presented in the result section based on the following criteria;

a. Largest swept area for surface oil above 10 g/m^2

b. Largest swept area for surface oil above 50 g/m^2

c. Largest (total) volume of oil ashore

d. Longest length of shoreline with oil accumulation above 100 g/m^2

e. Largest area of entrained hydrocarbon exposure above 100 ppb

f. Largest area of dissolved hydrocarbon exposure above 50 ppb

9.3 Receptors Assessed

A range of environmental receptors and shorelines were assessed for floating oil exposure, shoreline accumulation and water column exposure as part of the study (see Figure 9.1 to Figure 9.11). Receptor categories (see Table 9-1) include sections of shorelines which are defined by local government areas (LGAs), sub-LGAs and offshore islands. All other sensitive receptors other than submerged reefs, shoals and banks (RSB) were sourced from Australian Government Department of Climate Change, Energy, the Environment and Water (http://www.environment.gov.au/).

Risks of exposure were separately calculated for each sensitive receptor area and have been tabulated.

Table 9-2 summarises the receptors that the release locations reside within.

Table 9-1 Summary of receptors used to assess floating oil, shoreline and in-water exposure to hydrocarbons.

Receptor Category	Acronym	Hydrocarbon Exposure Assessment			Figure reference
		Water Column	Floating oil	Shoreline	
Australian Marine Park	AMP	✓	✓	×	Figure 9.1
Integrated Marine and Coastal Regionalisation Areas	IMCRA	✓	✓	×	Figure 9.2
Marine National Park	MNP	✓	✓	×	Figure 9.3
Marine Park	MP	✓	✓	×	Figure 9.4
Nature Reserve	NR	✓	✓	×	Figure 9.5
Ramsar	Ramsar	✓	✓	✓	Figure 9.6
Reefs, Shoals and Banks	RSB	✓	✓	×	Figure 9.7
Key Ecological Feature	KEF	✓	✓	×	Figure 9.8
State Waters	State Waters	✓	✓	×	
Local and Sub-Local Government Area	LGA and Sub-LGA	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Shore)	Figure 9.9 to Figure 9.11

Table 9-2 Summary of the receptors that the release locations reside within.

Acronym	Receptor
BIA	Antipodean Albatross – Foraging
	Black-browed Albatross – Foraging
	Buller's Albatross – Foraging
	Campbell Albatross – Foraging
	Common Diving-petrel – Foraging
	Indian Yellow-nosed Albatross – Foraging
	Pygmy Blue Whale – Distribution
	Pygmy Blue Whale – Foraging (annual high use area)
	Shy Albatross – Foraging
	Wandering Albatross – Foraging
	Wedge-tailed Shearwater – Foraging
	White Shark – Distribution
IMCRA	Otway

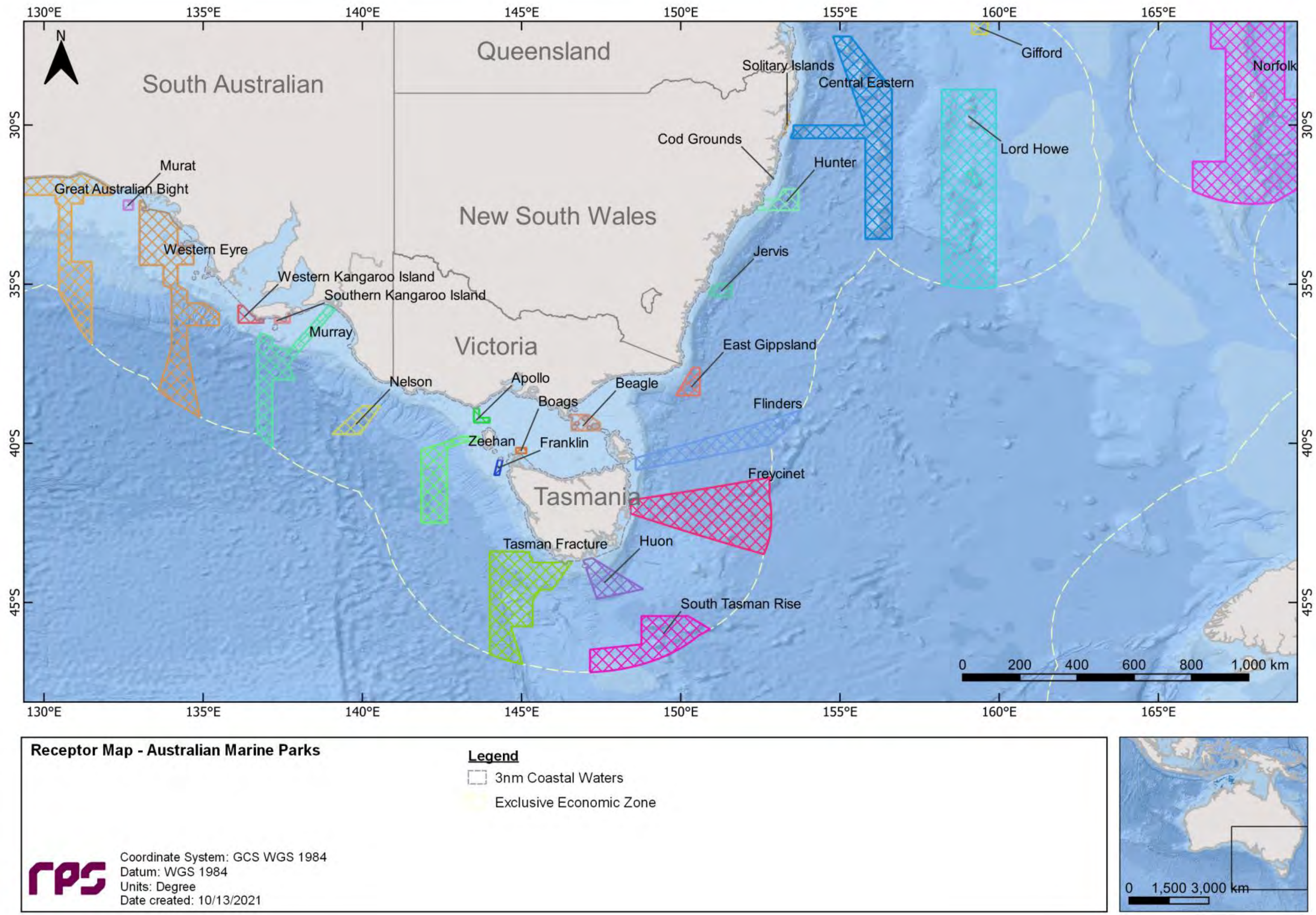


Figure 9.1 Receptor map for Australian Marine Parks (AMP).

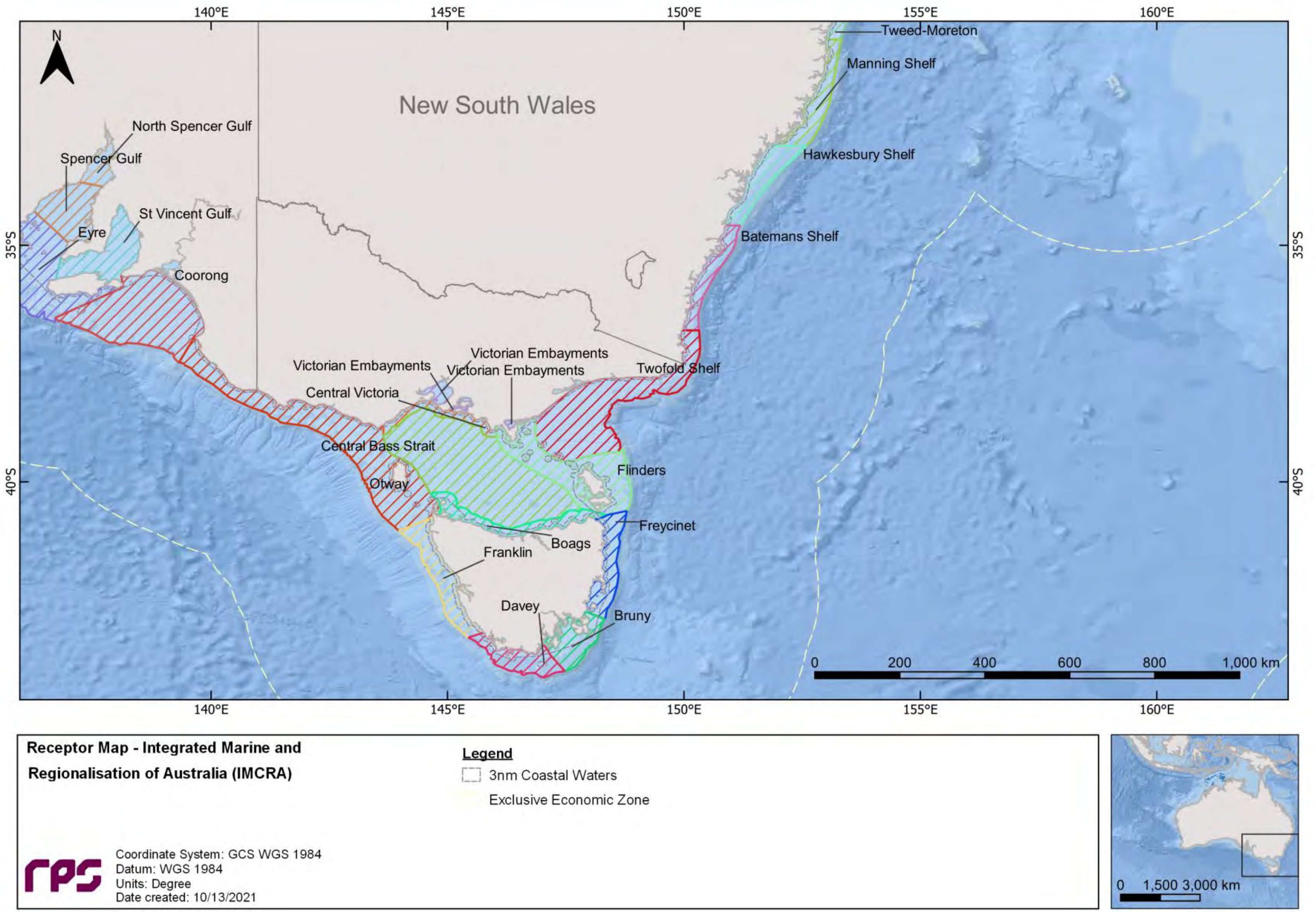


Figure 9.2 Receptor map for integrated marine and coastal regionalisation (IMCRA) areas.

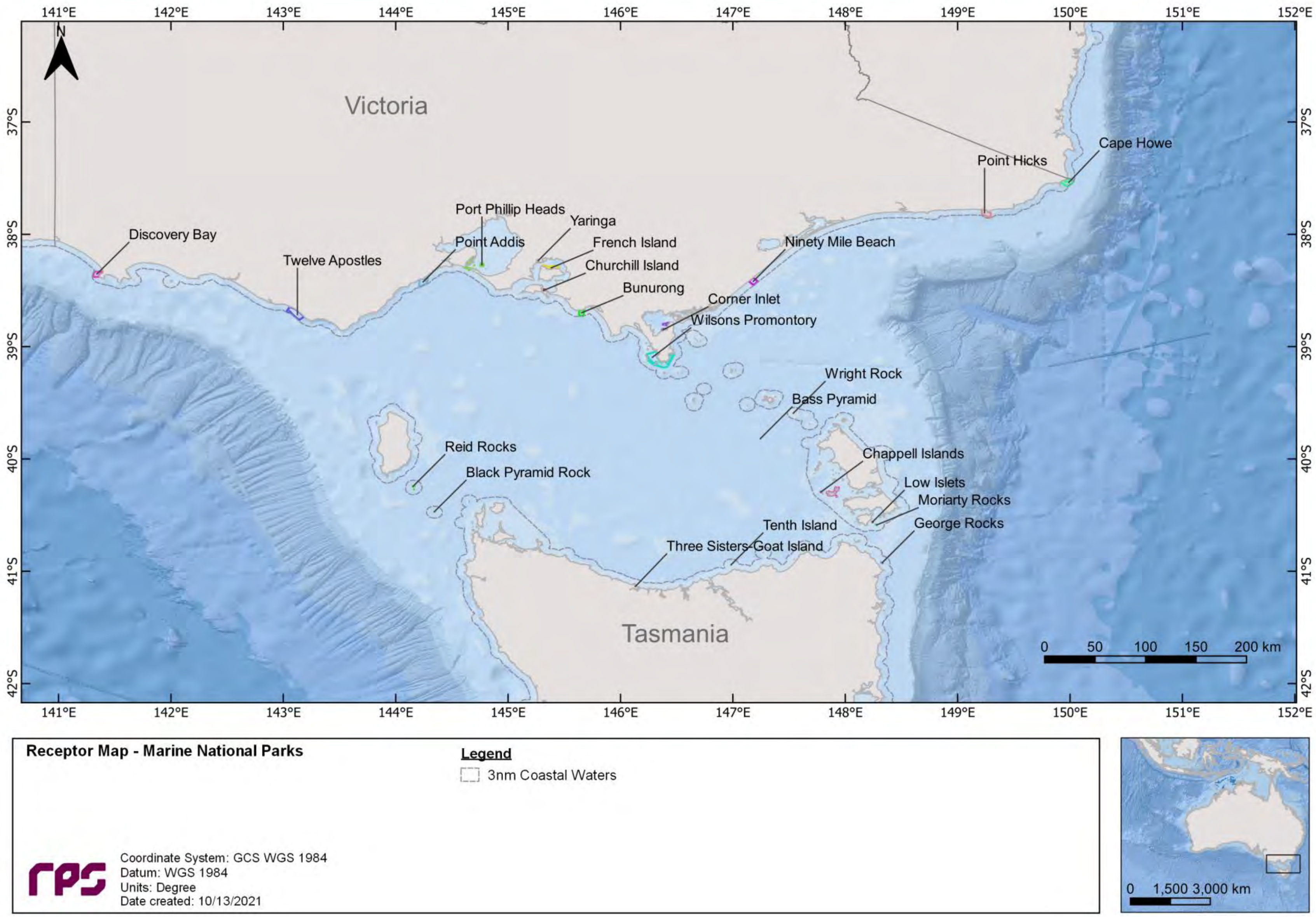


Figure 9.3 Receptor map for Marine National Parks (MNP).

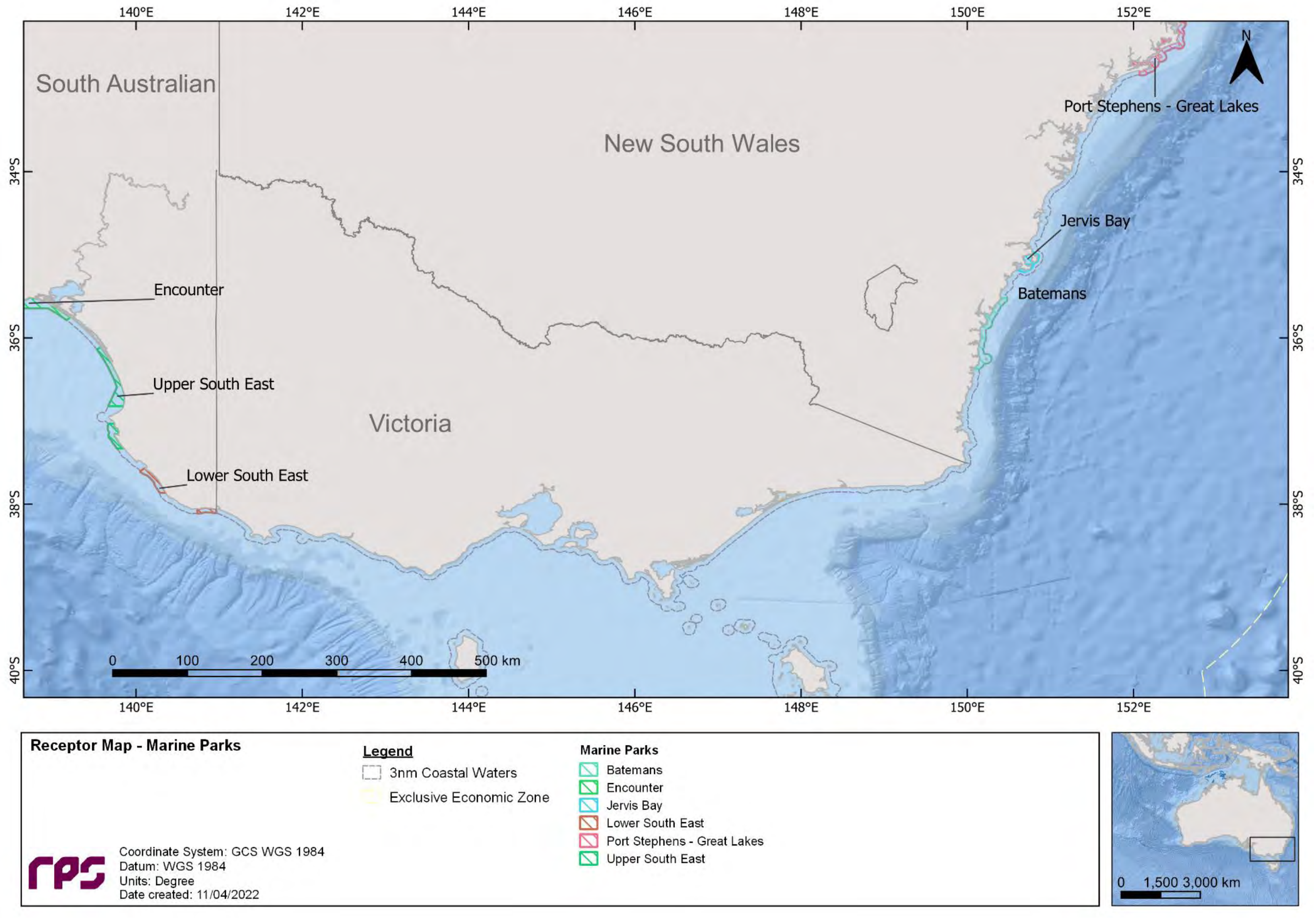


Figure 9.4 Receptor map for Marine Parks (MP).

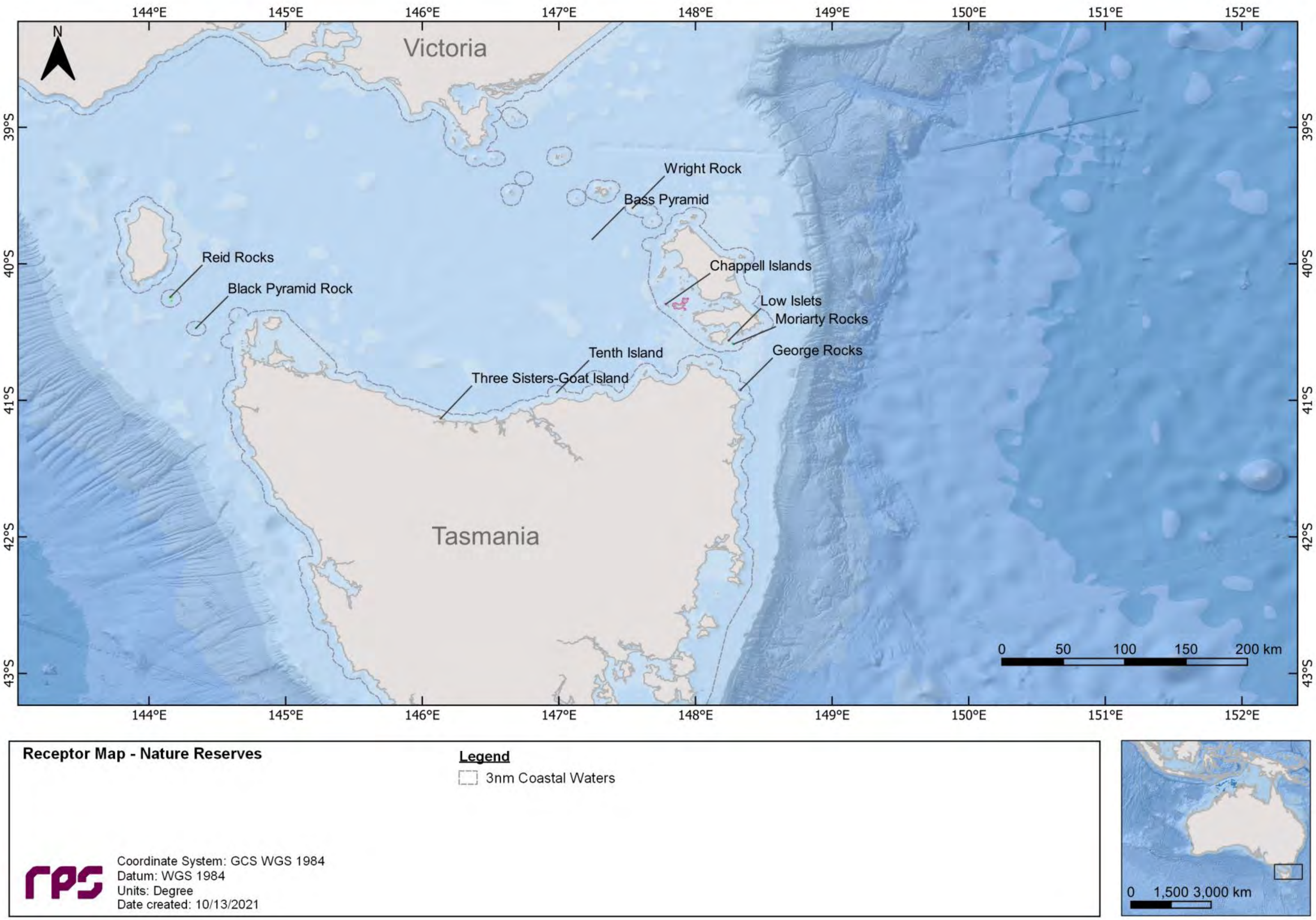


Figure 9.5 Receptor map for Nature Reserves (NR).

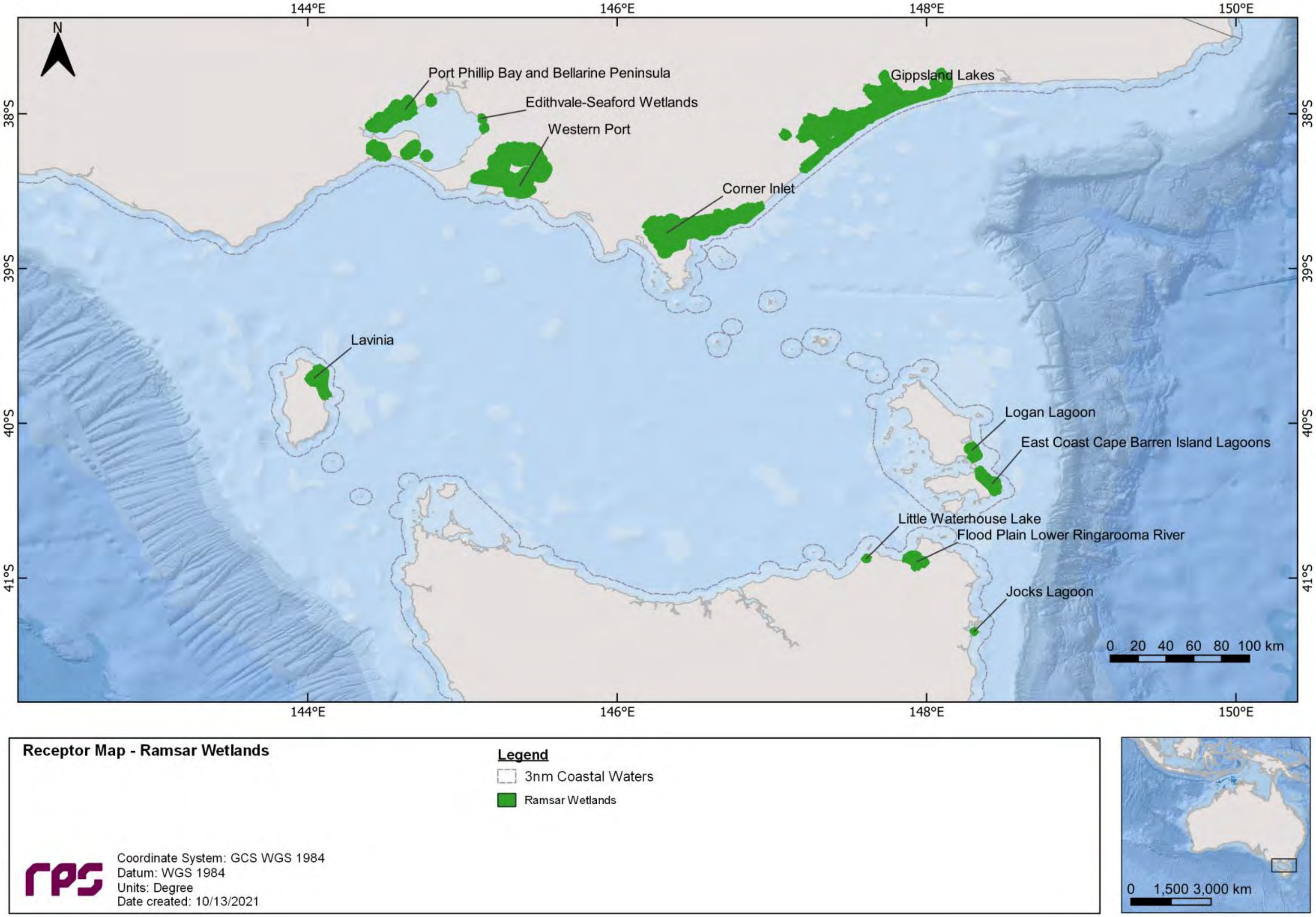


Figure 9.6 Receptor map for Ramsar Sites (Ramsar).

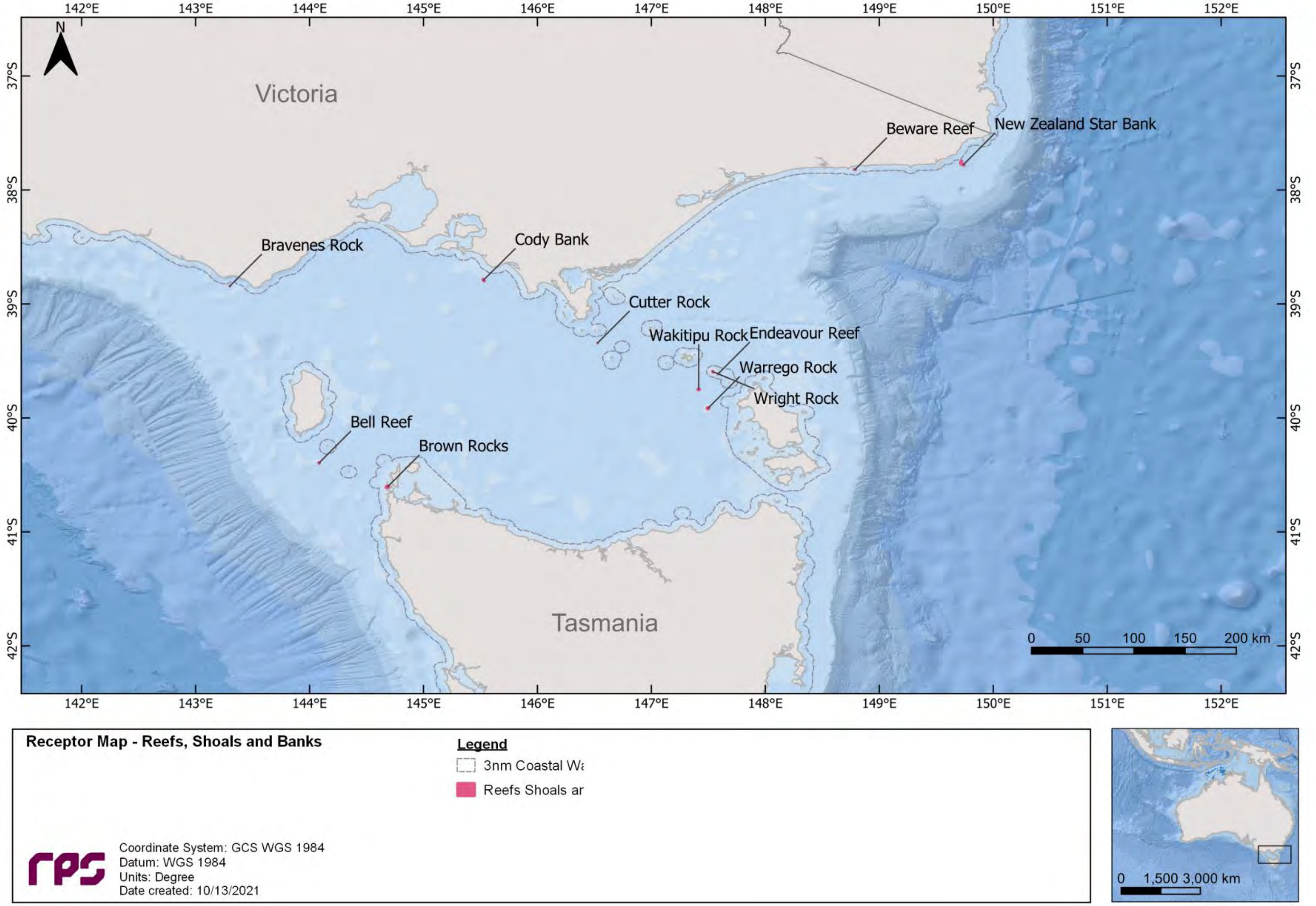


Figure 9.7 Receptor map for Reefs, Shoals and Banks (RSB).

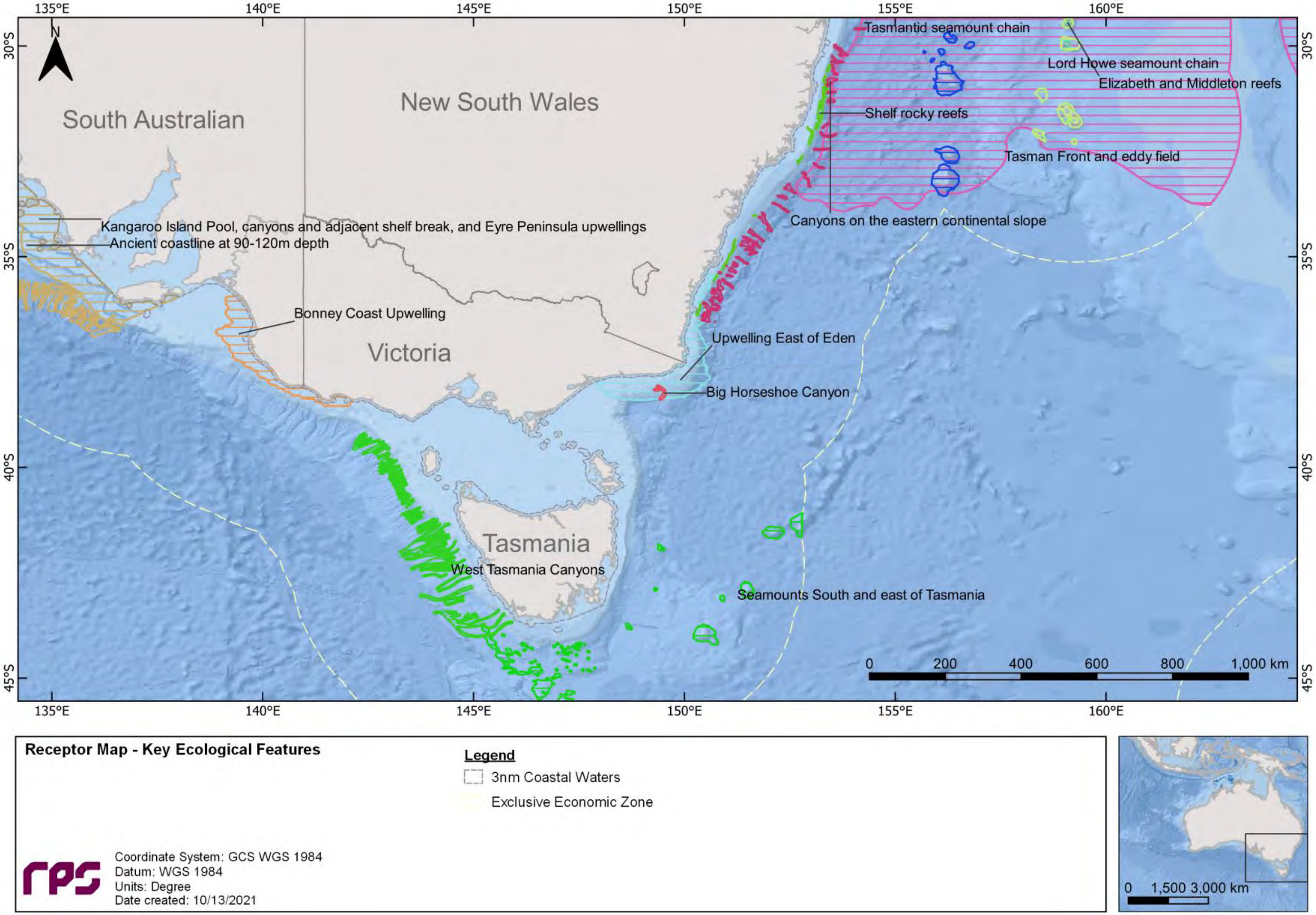


Figure 9.8 Receptor map for Key Ecological Features (KEF).

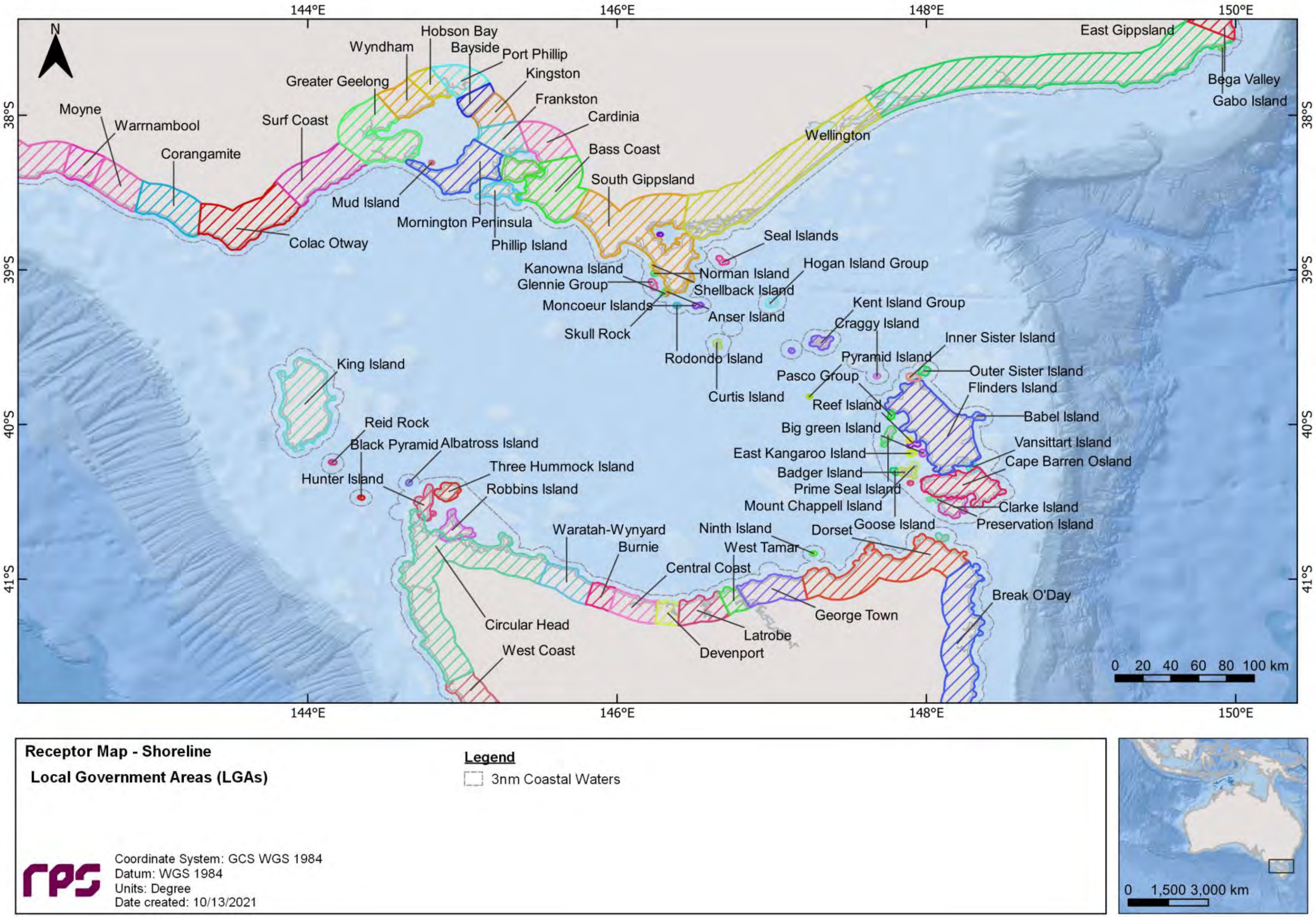


Figure 9.9 Receptor map for shorelines (1 of 3).

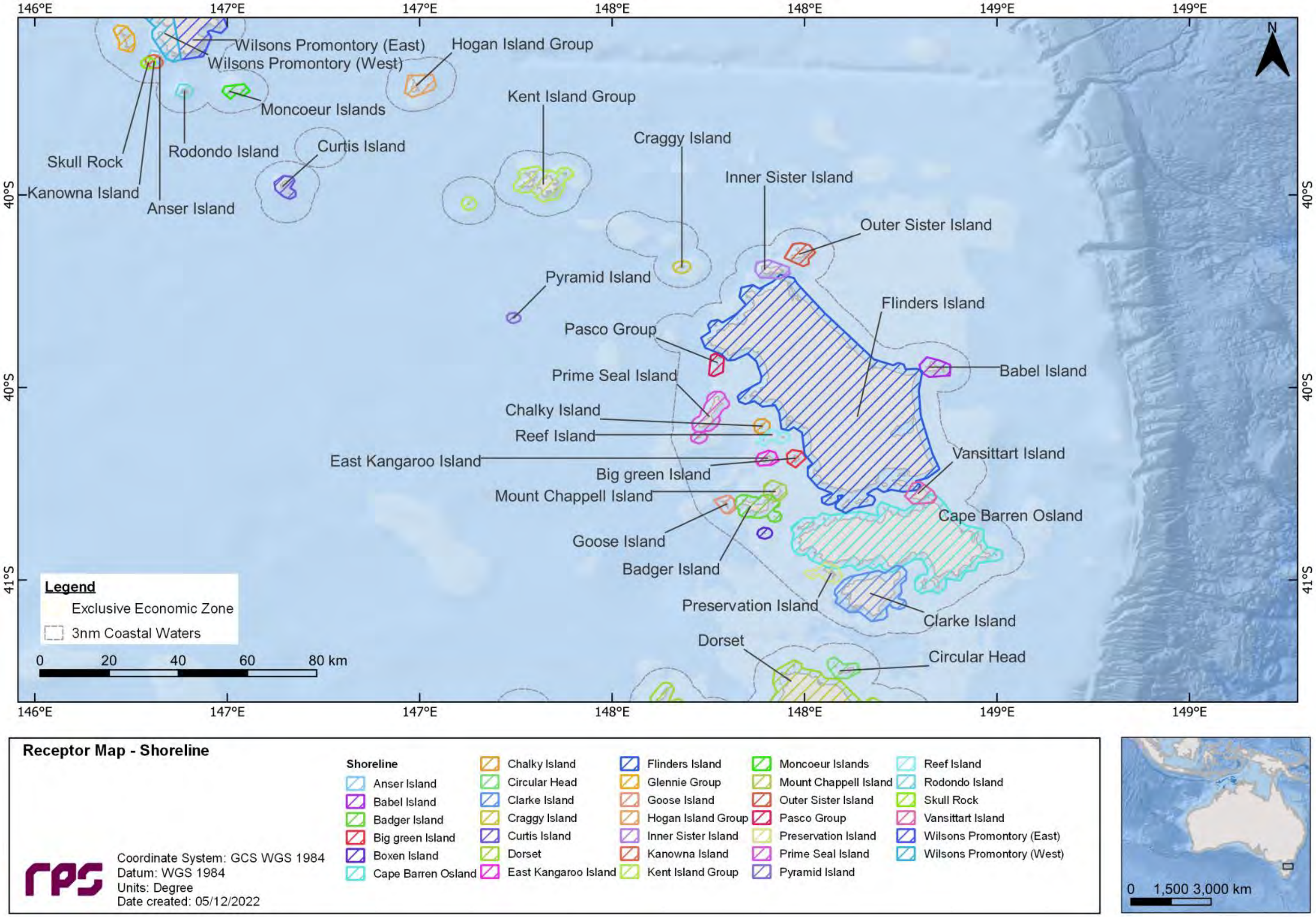


Figure 9.10 Receptor map for shorelines (2 of 3).

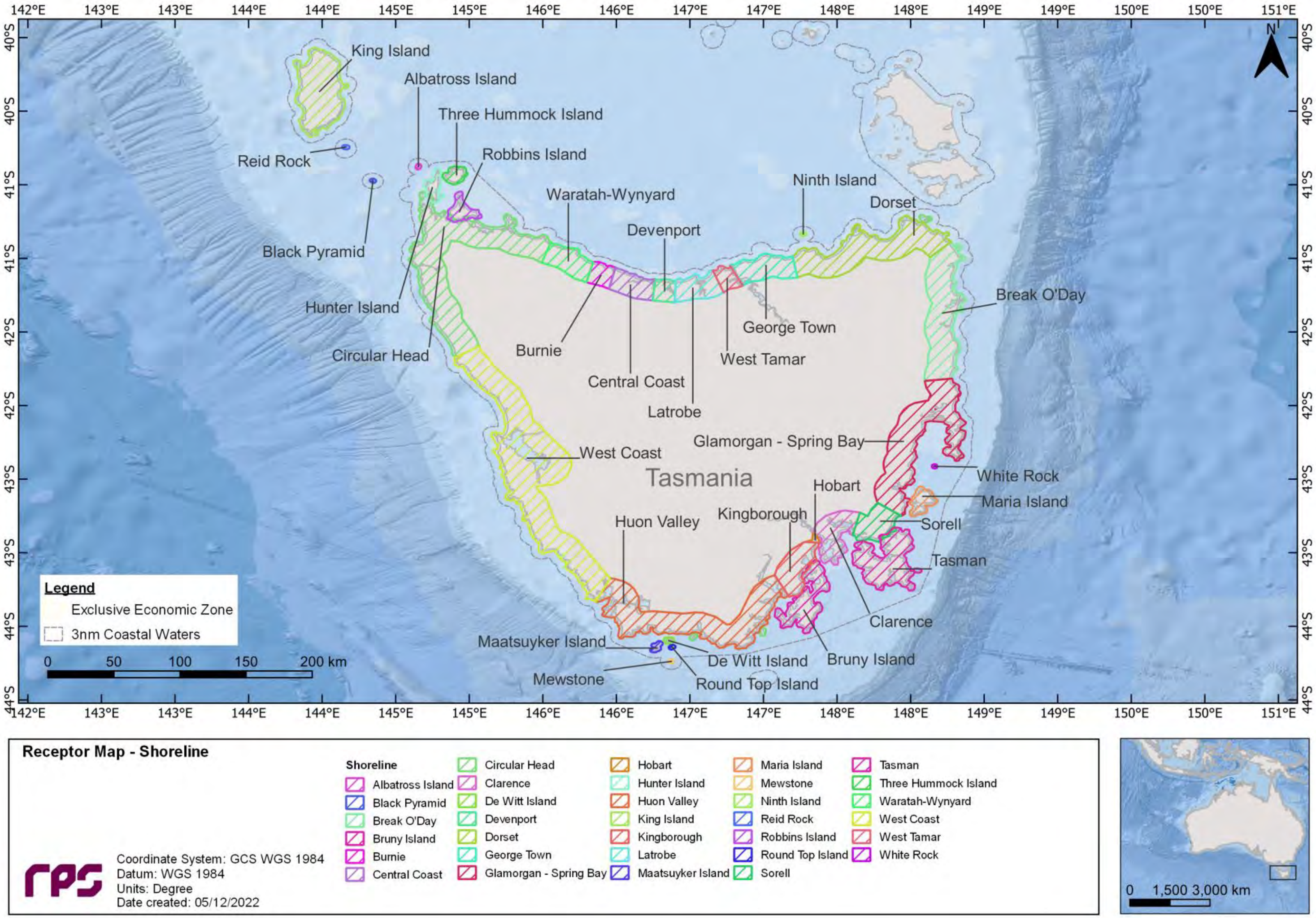


Figure 9.11 Receptor map for shorelines (3 of 3).

10 RESULTS – 250 m³ LOSS OF CONTAINMENT FROM A VESSEL COLLISION

This scenario examined a 250 m^3 surface release of MDO over 6 hours to represent a loss of containment from a vessel collision. A total of 100 spill simulations were run and tracked for 30 days. The results for all 100 simulations were combined and are presented on an annual basis.

Sections 10.1 and 10.2 present the annual stochastic analysis and deterministic analysis results, respectively.

10.1 Stochastic Analysis

10.1.1 Area of Exposure

Figure 10.1 presents the area of exposure based on the low thresholds produced by overlaying the results from all 100 simulations.

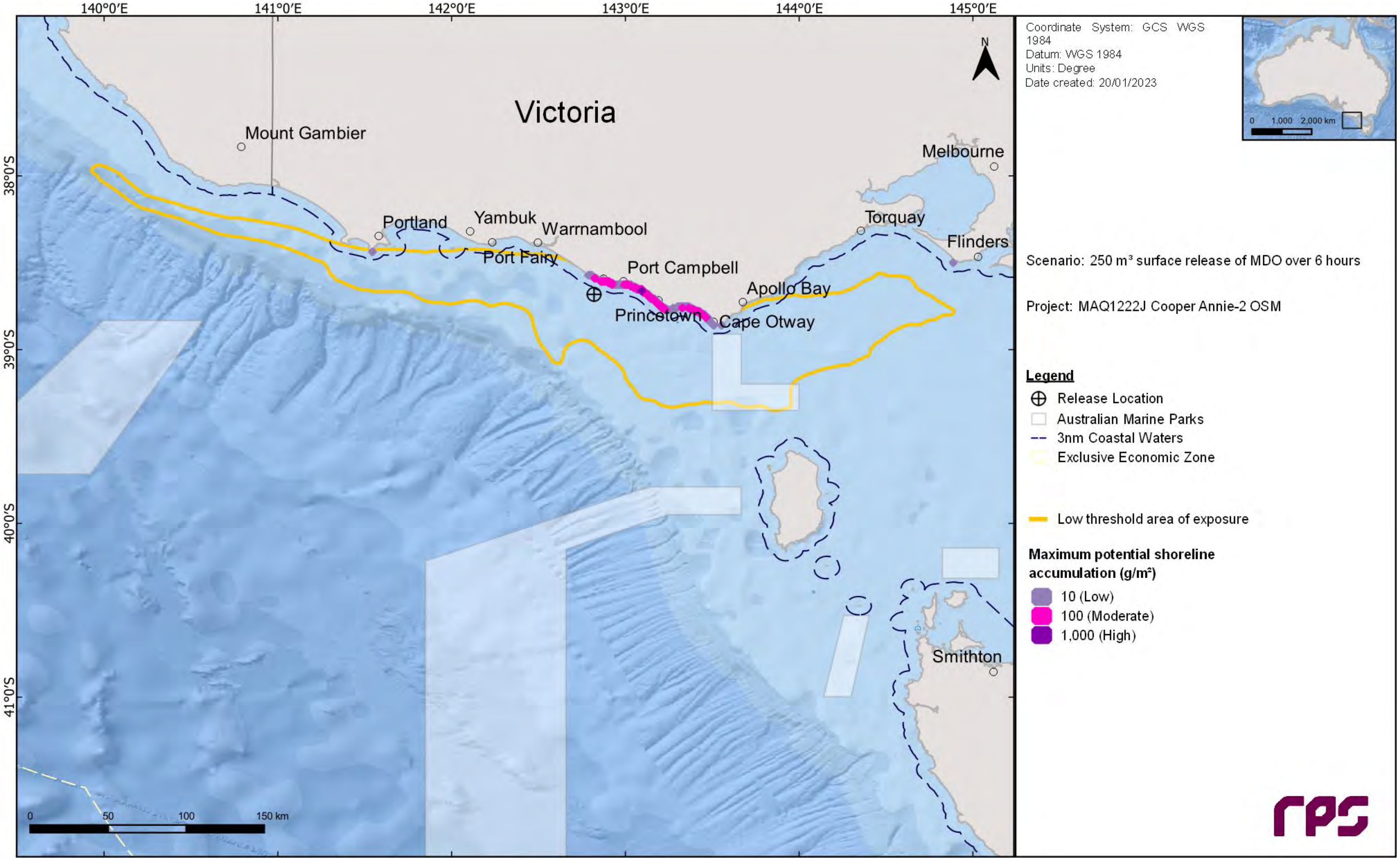


Figure 10.1 Predicted area of exposure for low thresholds produced by overlaying the results from 100 simulations of a 250 m^3 surface release of MDO over 6 hours.

10.1.2 Floating Oil Exposure

Table 10-1 summarises the maximum distance travelled by floating oil on the sea surface at each threshold. The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) exposure zones was 32.5 km (west), 10.3 km (west) and 2.8 km (east-southeast), respectively.

Table 10-2 summarises the potential floating oil exposure to individual receptors.

A total of 14 Biologically Important Areas (BIAs) were predicted to be exposed to floating oil at, or above, the low threshold. Excluding the 13 BIAs that the release location resides within (see Section 9.3), the highest probability (3%) of low exposure were predicted at the Southern Right Whale – Aggregation BIA. The minimum time before low exposure to the Southern Right Whale – Aggregation ranged between 28 hours.

Additionally, Twelve Apostles MNP, Corangamite LGA and Moonlight Head sub-LGA recorded a probability of low floating oil exposure of 2%.

Table 10.3 presents the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor.

Figure 10.2 presents the zones of potential floating oil exposure whilst Figure 10.3 to Figure 10.4 present the maximum residence time of floating oil exposure for the NOPSEMA thresholds.

Table 10-1 Maximum distance and direction from the release location to the edge of floating oil exposure. Results are based on a 250 m^3 surface release of MDO over 6 hours. The results were calculated from 100 spill simulations.

Distance and direction travelled	Zones of potential floating oil exposure		
	Low	Moderate	High
Maximum distance (km) from release location	32.5	10.3	2.8
Maximum distance (km) from release location (99th percentile)	30.3	10.3	2.8
Direction	W	W	ESE

Table 10-2 Summary of the potential floating oil exposure to individual receptors. Results are based on a 250 m^3 surface release of MDO over 6 hours. The results were calculated from 100 spill simulations.

Receptor		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (hours)		
		Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	100	100	38	1	1	1
	Black-browed Albatross – Foraging*	100	100	38	1	1	1
	Buller's Albatross – Foraging*	100	100	38	1	1	1
	Campbell Albatross – Foraging*	100	100	38	1	1	1
	Common Diving-petrel – Foraging*	100	100	38	1	1	1
	Indian Yellow-nosed Albatross – Foraging*	100	100	38	1	1	1
	Pygmy Blue Whale – Distribution*	4	-	-	23	1	1
	Pygmy Blue Whale – Foraging (annual high use area) *	100	100	38	1	1	1
	Shy Albatross – Foraging*	100	100	38	1	1	1
	Southern Right Whale – Aggregation	4	-	-	23	-	-
	Southern Right Whale – Migration and resting on migration	100	100	38	1	1	1
	Wandering Albatross – Foraging*	100	100	38	1	1	1
	Wedge-tailed Shearwater – Foraging*	100	100	38	1	1	1
	White Shark – Distribution*	100	100	38	1	1	1
IMCRA	Otway*	100	100	38	1	1	1
MNP	Twelve Apostles	2	-	-	32	-	-
Nearshore Waters (LGA)	Corangamite	2	-	-	36	-	-
Nearshore Waters (Sub-LGA)	Moonlight Head	2	-	-	35	-	-
State Waters	Victoria State Waters*	10	2	-	6	16	-

*The release location resides within the receptor boundaries.

Table 10.3 Summary of the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor. Results are based on a 250 m^3 surface release of MDO over 6 hours. The results were calculated from 100 spill simulations.

Receptor		Maximum residence time of floating oil exposure (hours)		
		Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	31.92	18	6.96
	Black-browed Albatross – Foraging*	31.92	18	6.96
	Buller's Albatross – Foraging*	31.92	18	6.96
	Campbell Albatross – Foraging*	31.92	18	6.96
	Common Diving-petrel – Foraging*	31.92	18	6.96
	Indian Yellow-nosed Albatross – Foraging*	31.92	18	6.96
	Pygmy Blue Whale – Distribution*	31.92	18	6.96
	Pygmy Blue Whale – Foraging*	31.92	18	6.96
	Shy Albatross – Foraging*	31.92	18	6.96
	Southern Right Whale - Aggregation	9.12	-	-
	Southern Right Whale – Migration and resting on migration	31.92	18	6.96
	Wandering Albatross – Foraging*	31.92	18	6.96
	Wedge-tailed Shearwater – Foraging*	31.92	18	6.96
	White Shark – Distribution*	31.92	18	6.96
IMCRA	Otway*	31.92	18	6.96
MNP	Twelve Apostles	3.12	-	-
Nearshore Waters (LGA)	Corangamite	3.12	-	-
Nearshore Waters (Sub-LGA)	Moonlight Head	3.12	-	-
State Waters*	Victoria State Waters	19.92	3.12	-

*The release location resides within the receptor boundaries.

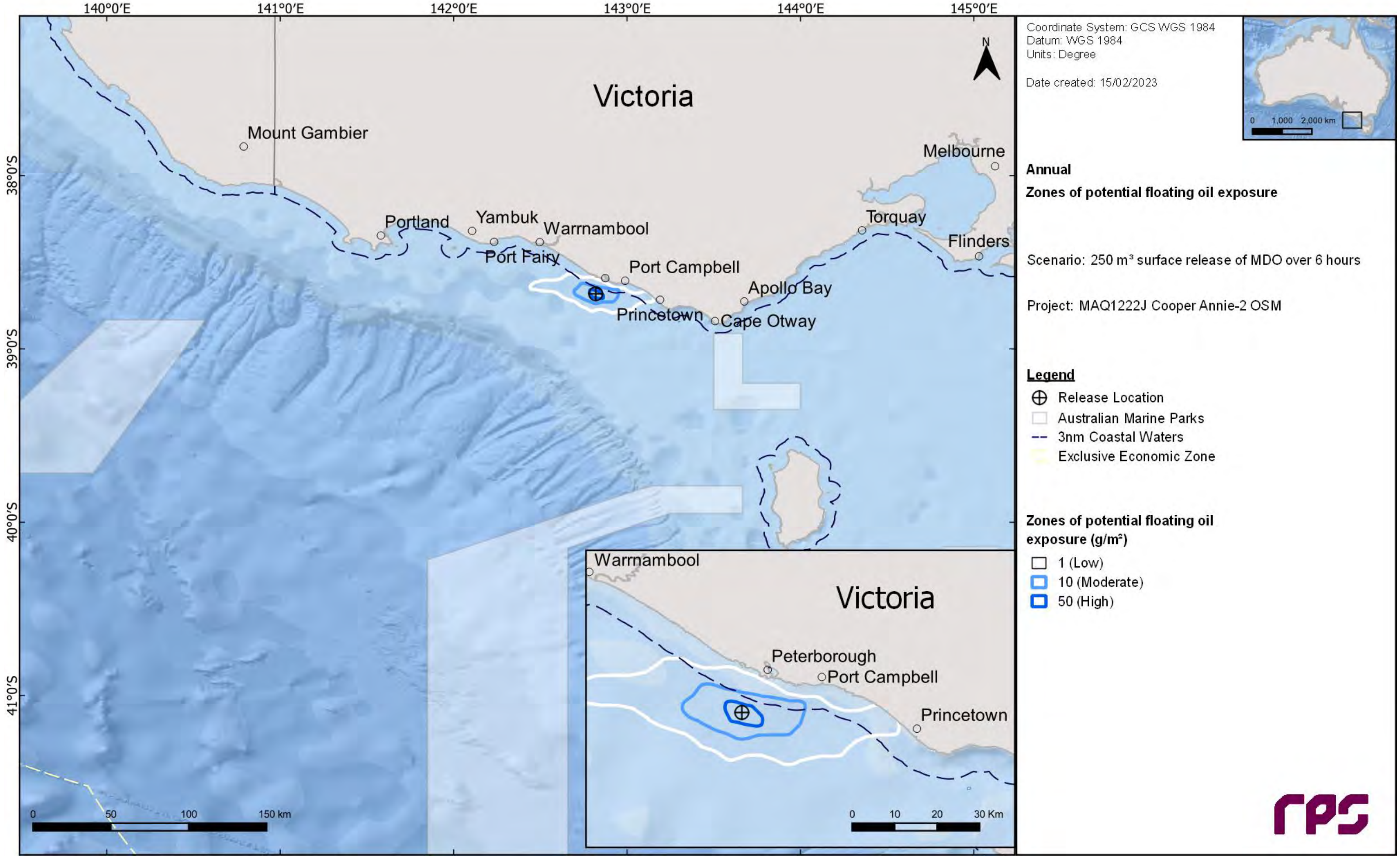


Figure 10.2 Zones of potential floating oil exposure in the event of a 250 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

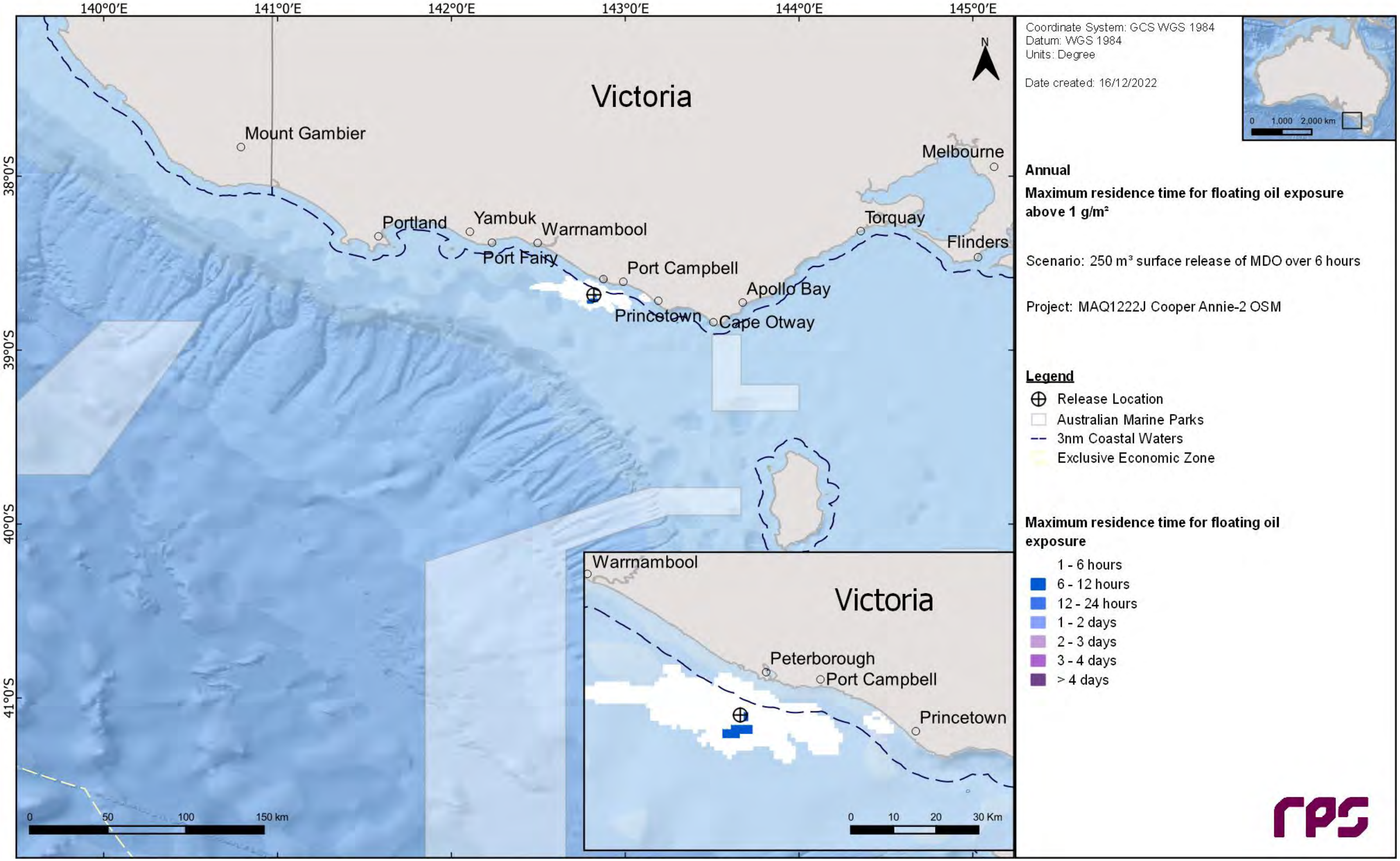


Figure 10.3 Maximum residence time of floating oil exposure above 1 g/m², in the event of a 250 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

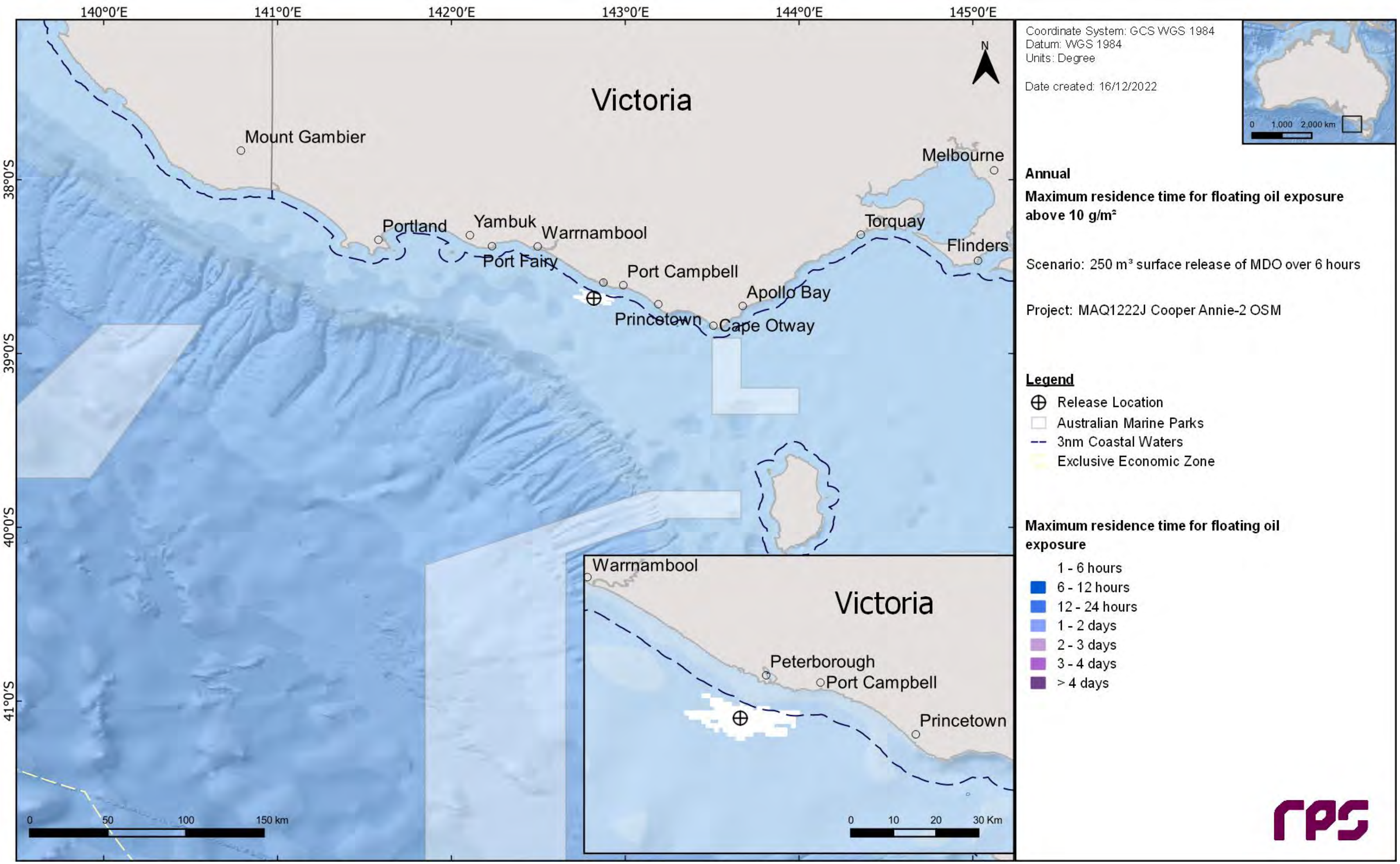


Figure 10.4 Maximum residence time of floating oil exposure above 10 g/m², in the event of a 250 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

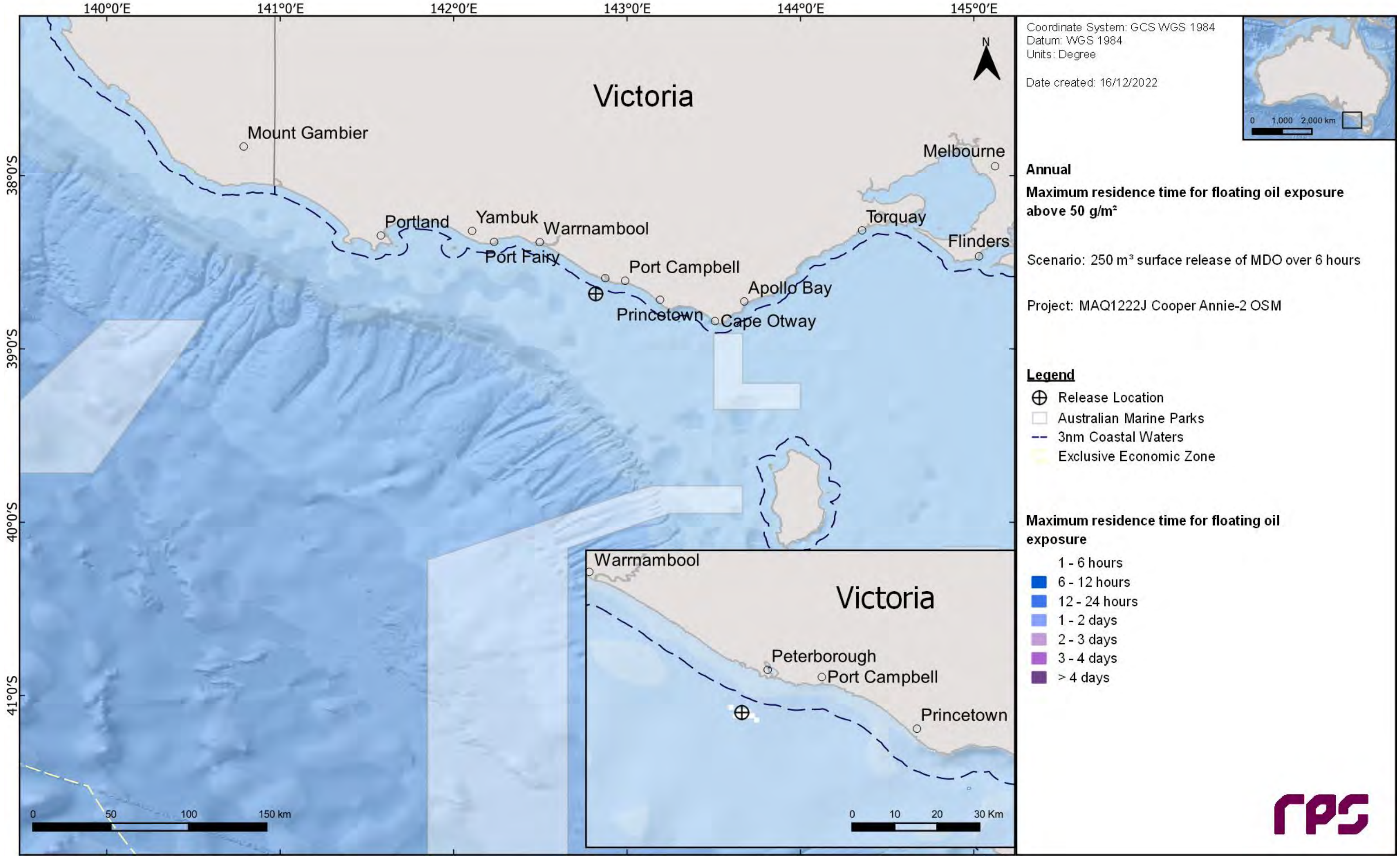


Figure 10.5 Maximum residence time of floating oil exposure above 50 g/m^2, in the event of a 250 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

10.1.3 Shoreline Accumulation

Table 10-4 presents a summary of the potential shoreline accumulation. The probability of accumulation to any shoreline at, or above, the low (10 g/m^2) threshold was 60%. The minimum time before oil accumulation at, or above, the low threshold was 22 hours. The maximum total volume ashore for a single spill trajectory was 43.2 m^3, and the maximum length of shoreline with accumulation above the low, moderate and high thresholds were 32 km, 11 km and 1 km, respectively.

Table 10-5 summarises the shoreline accumulation on individual receptors.

The shoreline segment of Corangamite had the highest probability of accumulation above all three thresholds. The minimum time for low threshold shoreline accumulation was less than 1 day for several shoreline segments and Sub-LGAs.

The maximum potential shoreline loading above each shoreline thresholds is presented in Figure 10.6.

Table 10-4 Summary of oil accumulation across all shorelines. Results are based on a 250 m^3 surface release of MDO over 6 hours. The results were calculated from 100 spill simulations.

Shoreline Statistics	Annual
Probability of accumulation on any shoreline (%)	60
Absolute minimum time for visible oil to shore (hours)	22
Maximum total volume of hydrocarbons ashore (m^3)	43.2
Average total volume of hydrocarbons ashore (m^3)	7.5
Maximum length of the shoreline at **10 g/m^2** (km)	32
Average shoreline length (km) at **10 g/m^2** (km)	13
Maximum length of the shoreline at **100 g/m^2** (km)	11
Average shoreline length (km) at **100 g/m^2** (km)	4.8
Maximum length of the shoreline at **1,000 g/m^2** (km)	1
Average shoreline length (km) at **1,000 g/m^2** (km)	1

Table 10-5 Summary of oil accumulation on individual shoreline receptors. Results are based on a 250 m³ surface release of MDO over 6 hours. The results were calculated from 100 spill simulations.

Shoreline Receptor		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m²)		Volume on shoreline (m³)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA	Colac Otway	26	5	-	2	3	-	5	272	1.3	25.1	8.1	3.3	-	24.5	7.3	-
	Corangamite	47	28	1	1	1	4	19	1,015	5.4	43.1	10.1	4.3	0.9	24.5	10	0.9
	Glenelg	1	-	-	8	-	-	< 1	13	< 0.1	0.3	0.9	-	-	0.9	-	-
	Mornington Peninsula	1	-	-	13	-	-	< 1	15	< 0.1	0.8	0.9	-	-	0.9	-	-
	Moyne	6	2	-	1	2	-	4	160	0.2	6.8	3.9	2.3	-	8.2	3.6	-
Sub-LGA	Apollo Bay	2	-	-	5	-	-	< 1	33	< 0.1	0.5	0.9	-	-	0.9	-	-
	Bay of Islands	6	2	-	1	2	-	4	160	0.2	6.8	3.9	2.3	-	8.2	3.6	-
	Cape Nelson	1	-	-	8	-	-	< 1	13	< 0.1	0.3	0.9	-	-	0.9	-	-
	Cape Otway West	26	5	-	2	3	-	5	272	1.3	24.8	8	3.3	-	24.5	7.3	-
	Moonlight Head	43	23	-	1	1	-	18	793	4	40.9	8.4	3.9	-	17.3	8.2	-
	Mornington Peninsula (S)	1	-	-	13	-	-	1	15	< 0.1	0.5	0.9	-	-	0.9	-	-
	Port Campbell	16	8	1	1	2	4	16	1,015	1.4	34.7	7.1	3.7	0.9	16.4	7.3	0.9

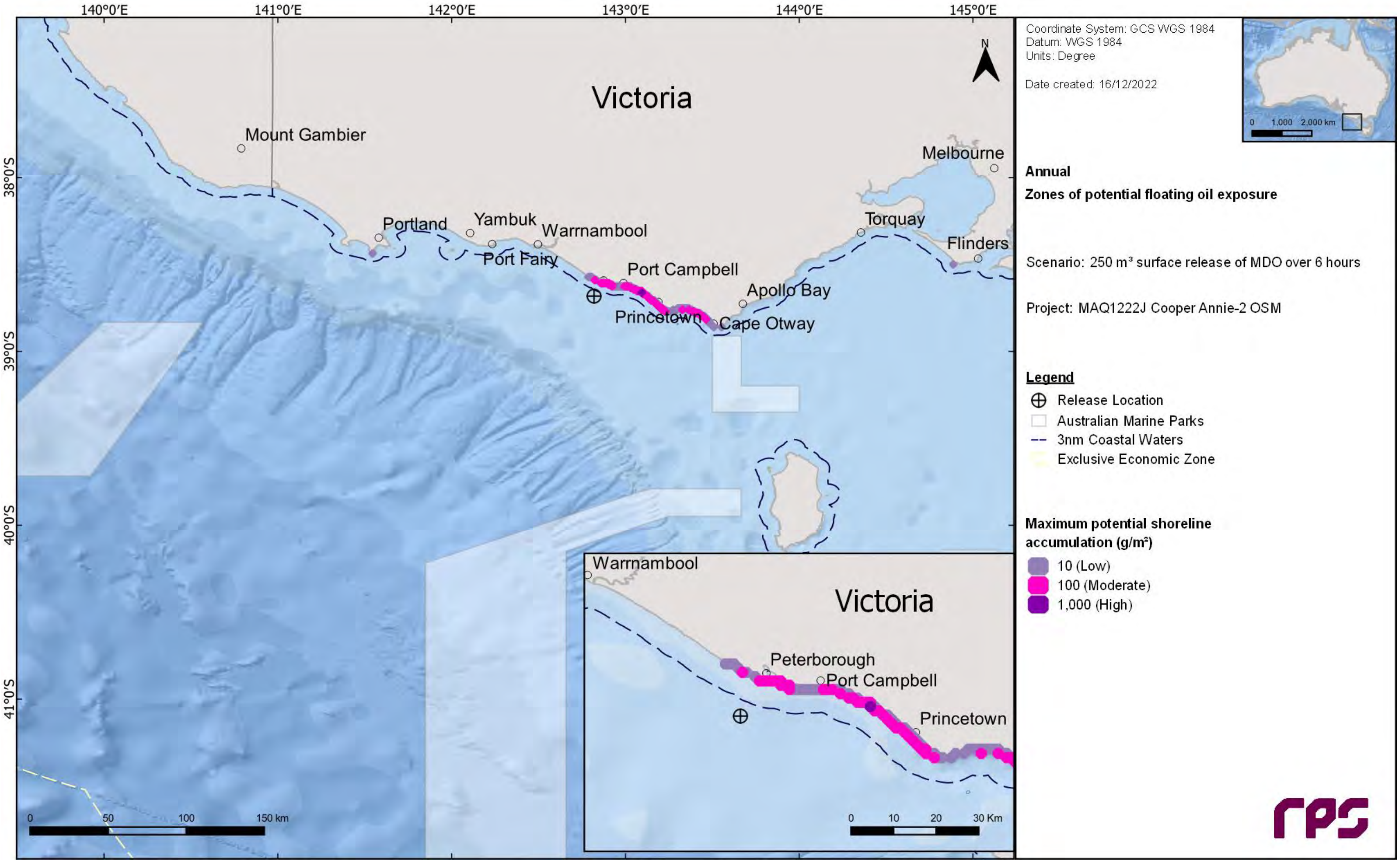


Figure 10.6 Maximum potential shoreline loading in the event of a 250 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

10.1.4 In-water exposure

10.1.4.1 Dissolved Hydrocarbons

Table 10-6 summarises the potential in-water exposure to individual receptors from dissolved hydrocarbons in the 0-10 m layer.

A total of 15 BIAs were predicted to be exposed to dissolved hydrocarbon at, or above, the low threshold. Excluding the 13 BIAs that the release location resides within (see Section 9.3), the highest probability of low exposure ranged between 1% (Short-tailed Shearwater - Foraging) and 2% (Southern Right Whale - Aggregation).

Additionally, the Twelve Apostles MNP recorded a probability of low dissolved hydrocarbon exposure of 1%.

The maximum dissolved hydrocarbon concentration at any given receptor(s) was shown to be 77 ppb.

Table 10.7 presents the predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors, in the 0-10 m depth layer, for all thresholds assessed.

Figure 10.7 presents the zones of potential dissolved hydrocarbon exposure for the 0-10 m depth layer whilst Figure 10.8 to Figure 10.9 present the maximum residence time of dissolved hydrocarbon exposure for the NOPSEMA thresholds.

Table 10-6 Probability of dissolved hydrocarbons exposure to marine based receptors in the 0–10 m depth. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations.

Receptor		Maximum dissolved hydrocarbon exposure (ppb)	Probability of dissolved hydrocarbon exposure		
			Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	77	29	3	-
	Black-browed Albatross – Foraging*	77	29	3	-
	Buller's Albatross – Foraging*	77	29	3	-
	Campbell Albatross – Foraging*	77	29	3	-
	Common Diving-petrel – Foraging*	77	29	3	-
	Indian Yellow-nosed Albatross – Foraging*	77	29	3	-
	Pygmy Blue Whale – Distribution *	77	29	3	-
	Pygmy Blue Whale – Foraging	20	1	-	-
	Pygmy Blue Whale – Foraging (annual high use area) *	77	29	3	-
	Short-tailed Shearwater - Foraging	12	1	-	-
	Shy Albatross – Foraging*	77	29	3	-
	Southern Right Whale – Aggregation	18	2	-	-
	Southern Right Whale – Migration and resting on migration	77	29	3	-
	Wandering Albatross – Foraging*	77	29	3	-
	Wedge-tailed Shearwater – Foraging*	77	29	3	-
	White Shark – Distribution*	77	29	3	-
IMCRA	Otway*	77	29	3	-
MNP	Twelve Apostles	12	1	-	-
State Waters	Victoria State Waters*	18	2	-	-

*The release location resides within the receptor boundaries.

Table 10.7 Predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations.

Receptor		Minimum time before dissolved hydrocarbon exposure (hours)			Maximum residence time for dissolved hydrocarbon exposure (hours)		
		Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	2	5	-	16	3	-
	Black-browed Albatross – Foraging*	2	5	-	16	3	-
	Buller's Albatross – Foraging*	2	5	-	16	3	-
	Campbell Albatross – Foraging*	2	5	-	16	3	-
	Common Diving-petrel – Foraging*	2	5	-	16	3	-
	Indian Yellow-nosed Albatross – Foraging*	2	5	-	16	3	-
	Pygmy Blue Whale – Distribution *	2	5	-	16	3	-
	Pygmy Blue Whale – Foraging	39	-	-	1	-	-
	Pygmy Blue Whale – Foraging (annual high use area) *	2	5	-	16	3	-
	Short-tailed Shearwater - Foraging	39	-	-	1	-	-
	Shy Albatross – Foraging*	2	5	-	16	3	-
	Southern Right Whale – Aggregation	34	-	-	16	3	-
	Southern Right Whale – Migration and resting on migration	2	5	-	16	3	-
	Wandering Albatross – Foraging*	2	5	-	16	3	-
	Wedge-tailed Shearwater – Foraging*	2	5	-	16	3	-
	White Shark – Distribution*	2	5	-	16	3	-
IMCRA	Otway*	2	5	-	16	3	-
MNP	Twelve Apostles	34	-	-	1	-	-
State Waters	Victoria State Waters*	18	-	-	2	-	-

*The release location resides within the receptor boundaries.

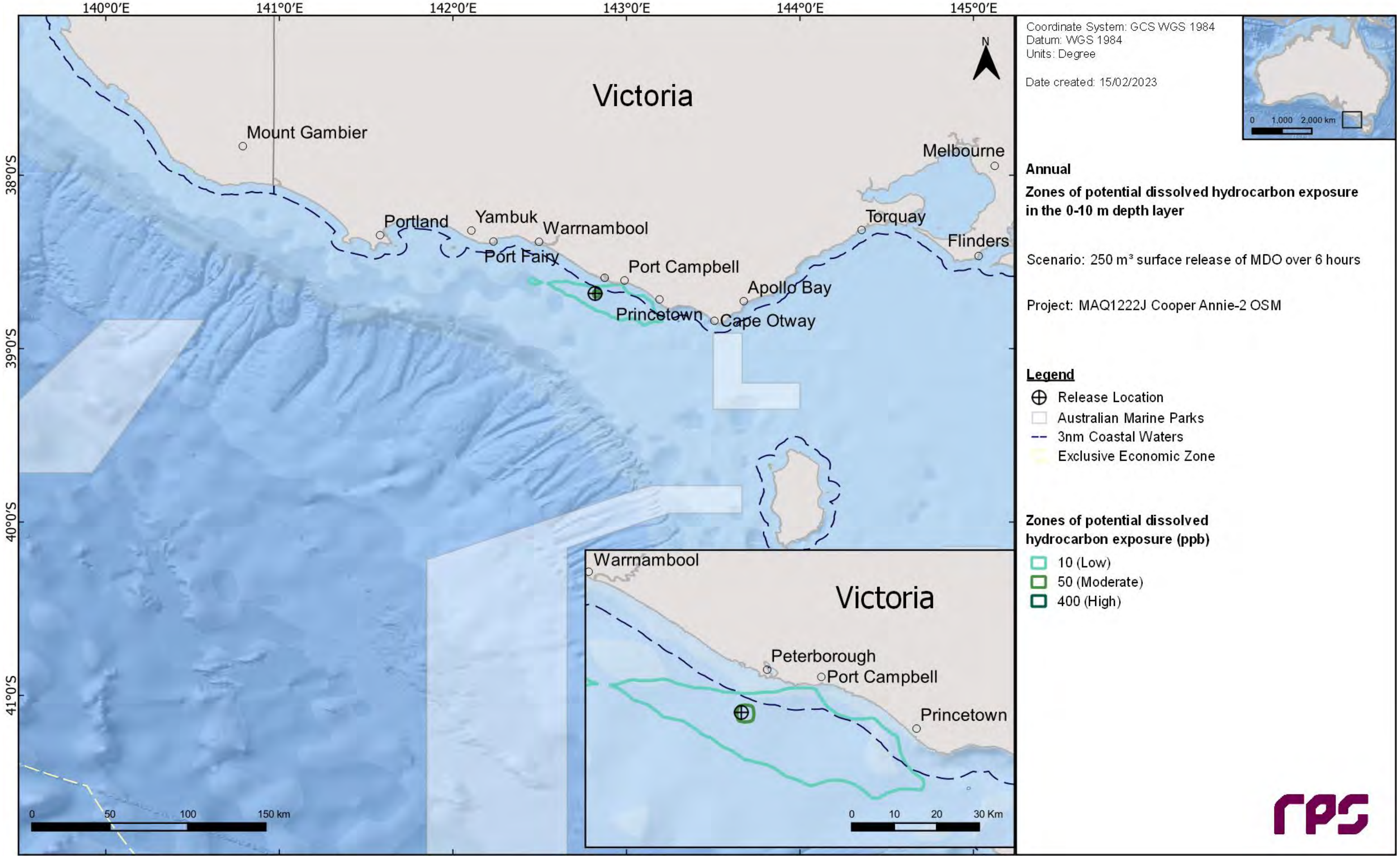


Figure 10.7 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 250 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

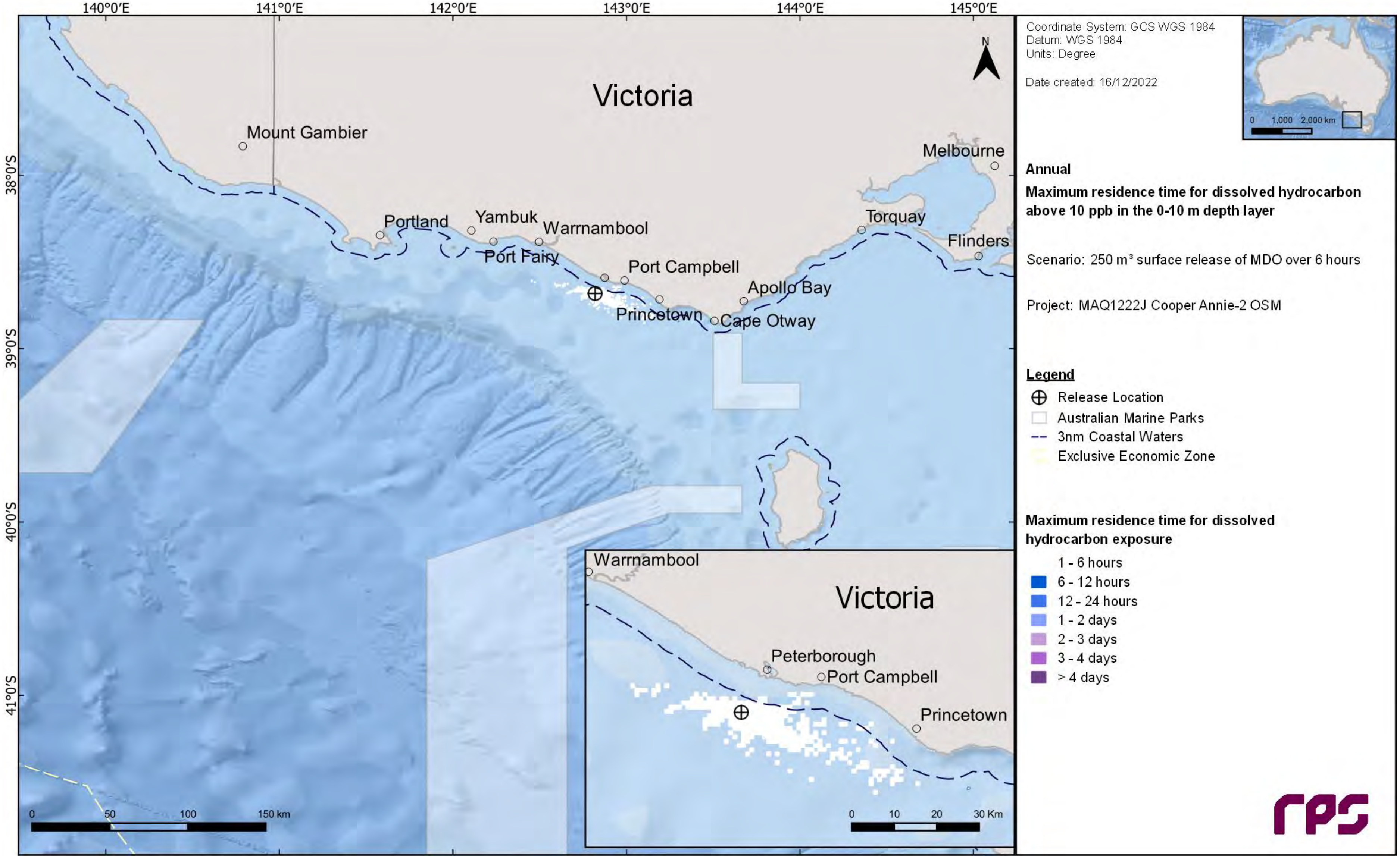


Figure 10.8 **Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 250 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.**

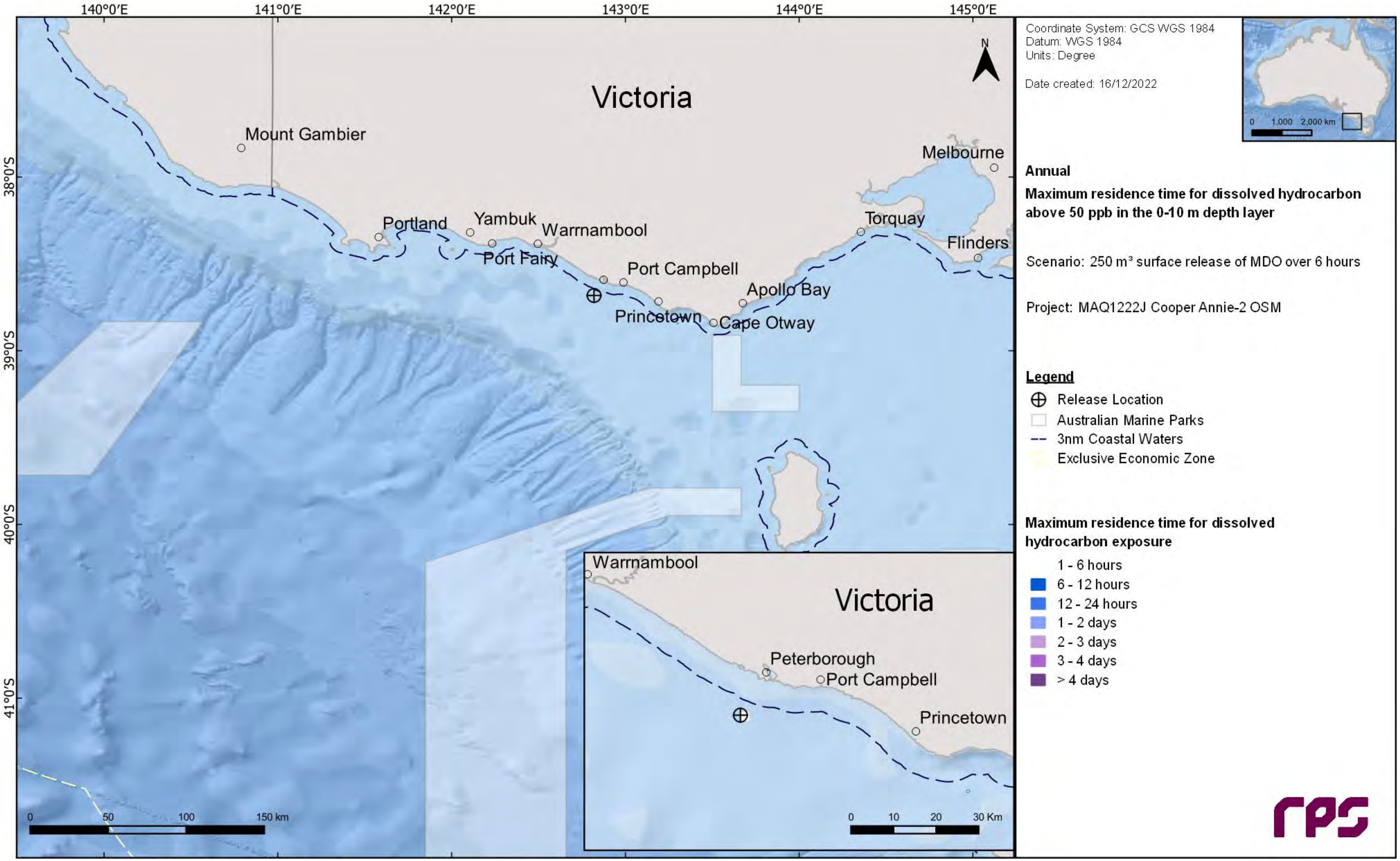


Figure 10.9 **Maximum residence time for dissolved hydrocarbon exposure above 50 ppb, at 0-10 m below the sea surface in the event of a 250 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.**

10.1.4.2 Entrained Hydrocarbons

Table 10-8 summarises the potential in-water exposure to individual receptors from entrained hydrocarbons in the 0-10 m depth layer.

Many receptors were exposed above the low and high thresholds, however the majority of these receptors coincided with the release location.

The highest probability of low entrained hydrocarbon exposure was recorded for the Twelve Apostles MNP (65%) and Short-tailed Shearwater – Foraging BIA (64%). Additional receptors including LGAs, sub-LGAs, and AMPs were predicted with entrained hydrocarbon exposure (refer to Table 10-8).

Table 10.9 presents the predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer, for all thresholds assessed.

Figure 10.10 presents the zones of potential entrained hydrocarbon exposure for the 0-10 m depth layer whilst Figure 10.11 and Figure 10.12 present the maximum residence time of entrained hydrocarbon exposure for the NOPSEMA thresholds.

Table 10-8 Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer. Results are based on a 250 m^3 surface release of MDO over 6 hours. The results were calculated from 100 spill simulations.

Receptor		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High
AMP	Apollo	80	25	-
BIA	Antipodean Albatross – Foraging*	5,819	94	75
	Australasian Gannet - Foraging	56	9	-
	Black-browed Albatross – Foraging*	5,819	94	75
	Buller's Albatross – Foraging*	5,819	94	75
	Campbell Albatross – Foraging*	5,819	94	75
	Common Diving-petrel – Foraging*	5,819	94	75
	Indian Yellow-nosed Albatross – Foraging*	5,819	94	75
	Pygmy Blue Whale – Distribution *	5,819	94	75
	Pygmy Blue Whale – Foraging	666	68	21
	Pygmy Blue Whale – Foraging (annual high use area) *	5,819	94	75
	Short-tailed Shearwater - Foraging	463	64	15
	Shy Albatross – Foraging*	5,819	94	75
	Southern Right Whale – Aggregation	644	20	11
	Southern Right Whale – Migration and resting on migration	5,819	94	75
	Wandering Albatross – Foraging*	5,819	94	75
	Wedge-tailed Shearwater – Foraging*	5,819	94	75
	White Shark – Distribution*	5,819	94	75
	White Shark - Foraging	109	12	1
	White-faced Storm-petrel - Foraging	101	25	1
IMCRA	Central Bass Strait	55	12	-
	Central Victoria	95	25	-
	Otway*	5,819	94	75
KEF	Bonney Coast Upwelling	55	8	-
MNP	Twelve Apostles	843	65	29
RSB	Bravenes Rock	162	40	2
Nearshore Waters (LGA)	Colac Otway	326	41	5
	Corangamite	685	61	18

Receptor		Maximum entrained hydrocarbon exposure (ppb)	Probability of entrained hydrocarbon exposure (%)	
			Low	High
	Glenelg	14	1	-
	Moyne	282	14	3
Nearshore Waters (Sub-LGA)	Apollo Bay	76	17	-
	Bay of Islands	282	14	3
	Cape Nelson	14	1	-
	Cape Otway West	324	41	5
	Childers Cove	12	1	-
	Moonlight Head	666	61	18
	Port Campbell	685	38	10
State Waters	Victoria State Waters*	2,164	68	30

*The release location resides within the receptor boundaries.

Table 10.9 Predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 250 m^3 surface release of MDO over 6 hours. The results were calculated from 100 spill simulations.

Receptor		Minimum time before entrained hydrocarbon exposure (hours)		Maximum residence time for entrained hydrocarbon exposure (hours)	
		Low	High	Low	High
AMP	Apollo	50	-	67	-
BIA	Antipodean Albatross – Foraging*	1	1	333	86
	Australasian Gannet - Foraging	92	-	67	-
	Black-browed Albatross – Foraging*	1	1	333	86
	Buller's Albatross – Foraging*	1	1	354	86
	Campbell Albatross – Foraging*	1	1	333	86
	Common Diving-petrel – Foraging*	1	1	420	117
	Indian Yellow-nosed Albatross – Foraging*	1	1	333	86
	Pygmy Blue Whale – Distribution *	1	1	420	117
	Pygmy Blue Whale – Foraging	14	15	388	117
	Pygmy Blue Whale – Foraging (annual high use area) *	1	1	420	117
	Pygmy Blue Whale – Known Foraging Area	59	60	106	1
	Short-tailed Shearwater - Foraging	16	17	420	68
	Shy Albatross – Foraging*	1	1	420	117
	Southern Right Whale – Aggregation	13	15	388	117
	Southern Right Whale – Migration and resting on migration	1	1	420	117
	Wandering Albatross – Foraging*	1	1	333	86
	Wedge-tailed Shearwater – Foraging*	1	1	420	117
	White Shark – Distribution*	1	1	333	86
	White Shark - Foraging	59	78	120	5
	White-faced Storm-petrel - Foraging	60	61	106	1
IMCRA	Central Bass Strait	82	-	106	-
	Central Victoria	60	-	64	-
	Otway*	1	1	420	117
KEF	Bonney Coast Upwelling	89	-	71	-
MNP	Twelve Apostles	11	13	388	110

Receptor		Minimum time before entrained hydrocarbon exposure (hours)		Maximum residence time for entrained hydrocarbon exposure (hours)	
		Low	High	Low	High
RSB	Bravenes Rock	27	47	144	9
Nearshore Waters (LGA)	Colac Otway	23	38	420	67
	Corangamite	13	17	388	117
	Glenelg	131	-	5	-
	Moyne	20	25	317	40
Nearshore Waters (Sub-LGA)	Apollo Bay	59	-	86	-
	Bay of Islands	20	25	317	40
	Cape Nelson	131	-	5	-
	Cape Otway West	23	39	420	67
	Childers Cove	193	-	19	-
	Moonlight Head	17	19	388	117
	Port Campbell	13	17	314	89
State Waters	Victoria State Waters*	4	4	420	117

*The release location resides within the receptor boundaries.

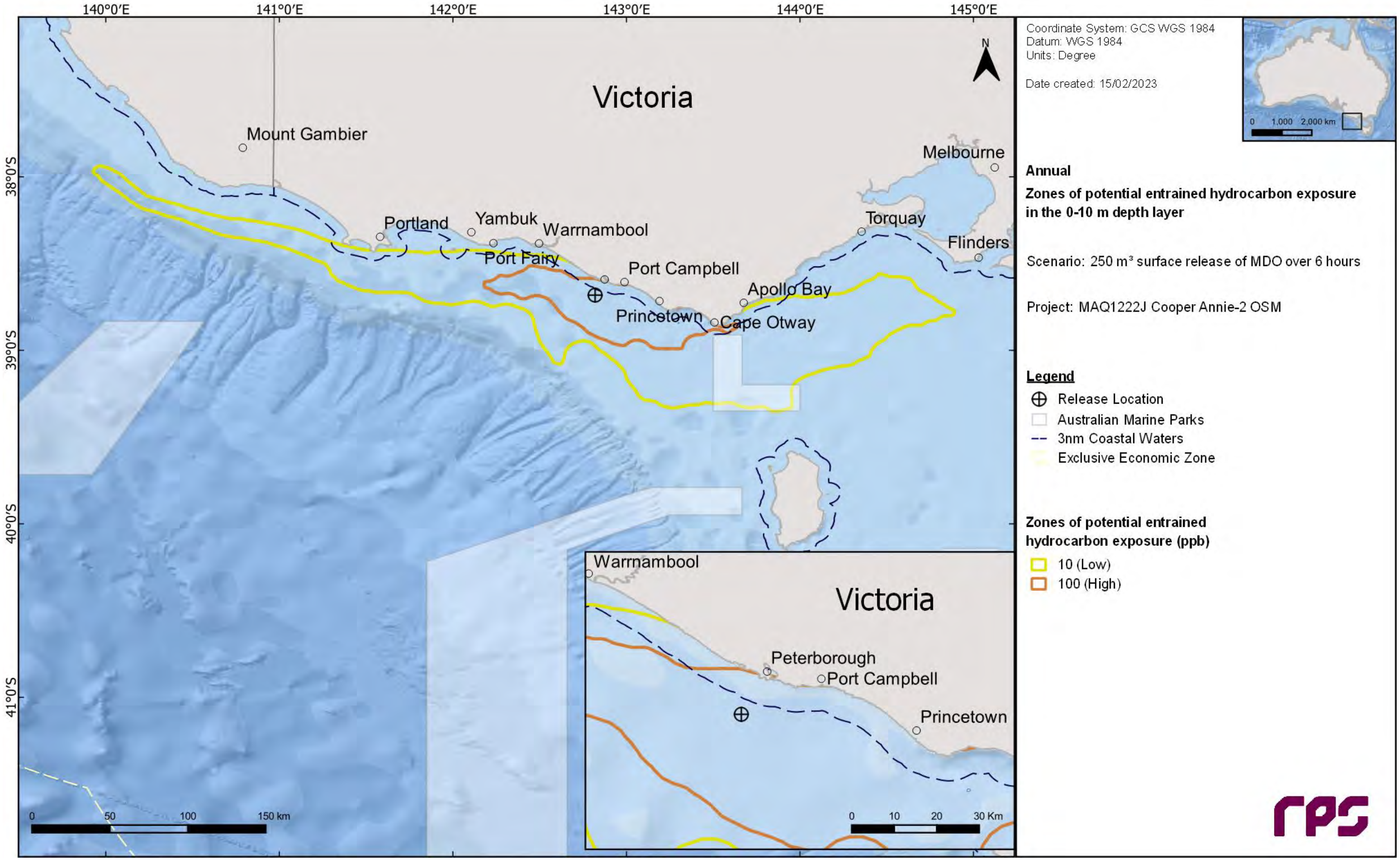


Figure 10.10 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 250 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

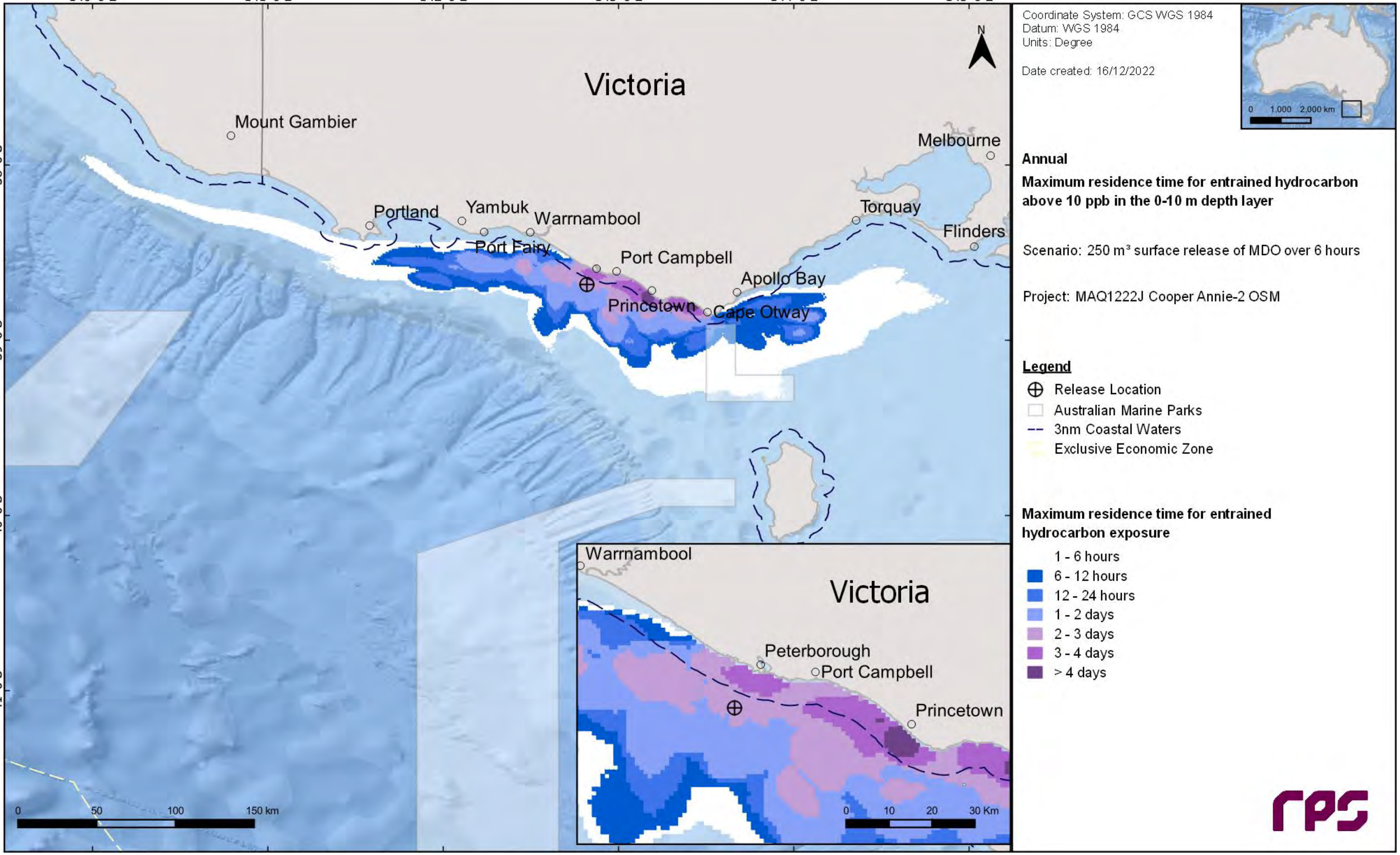


Figure 10.11 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea in the event of a 250 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

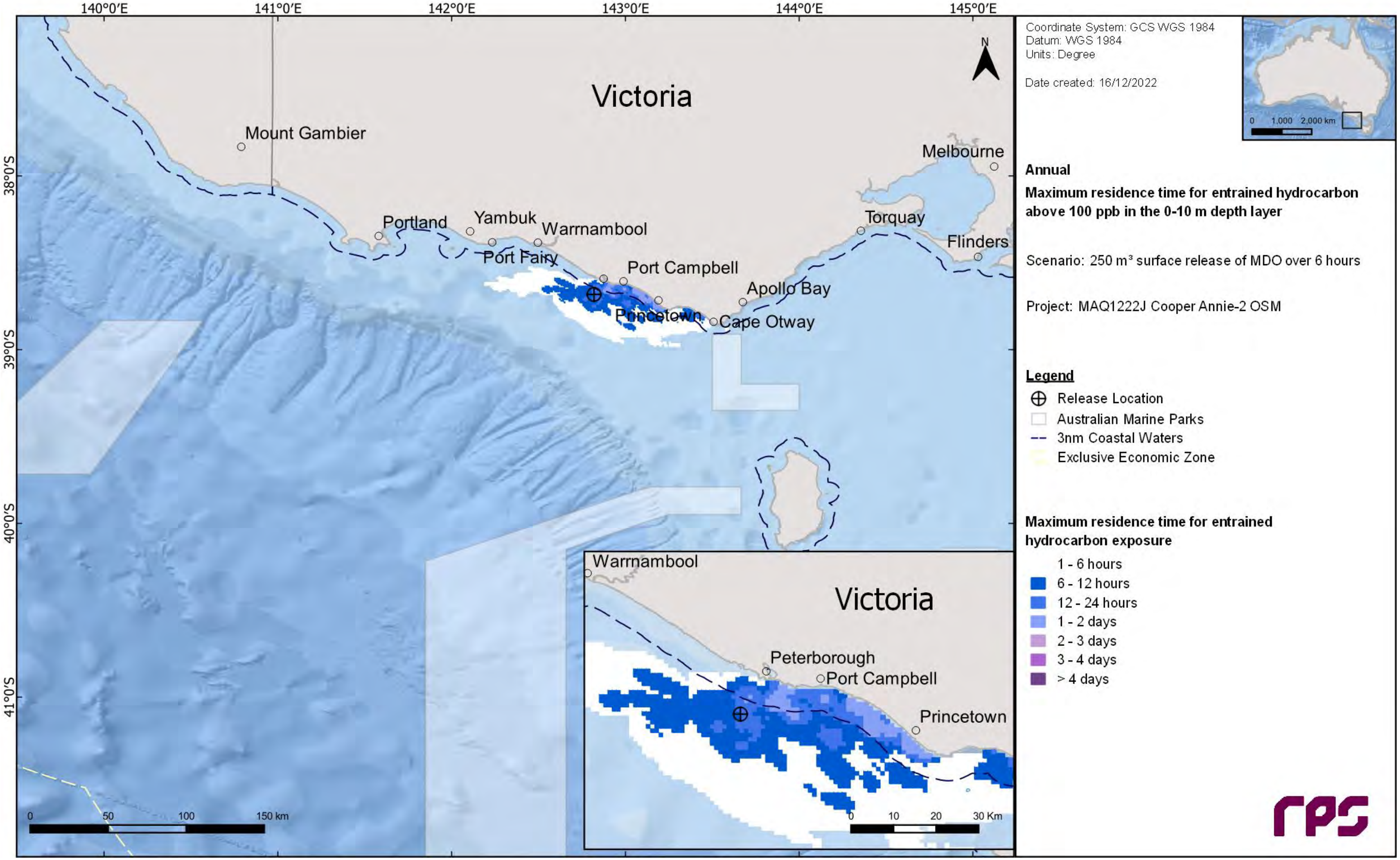


Figure 10.12 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea in the event of a 250 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations.

10.2 Deterministic Analysis

The stochastic modelling results were assessed, and the “worst case” deterministic runs were identified and are presented below for the following criteria:

a. Largest swept area for surface oil above 10 g/m^2
b. Largest swept area for surface oil above 50 g/m^2
c. Largest (total) volume of oil ashore
d. Longest length of shoreline with oil accumulation above 100 g/m^2
e. Largest area of entrained hydrocarbon exposure above 100 ppb
f. Largest area of dissolved hydrocarbon exposure above 50 ppb

Table 10-10 presents a summary of sea surface and in-water exposure and shoreline accumulation at the assessed thresholds for the identified deterministic simulations.

Table 10-10 Summary of the worst-case deterministic analysis based on the scenario presented in the Stochastic Analysis Section.

Variable	Threshold	Deterministic Analysis Criteria					
		Largest swept area of floating oil >10 g/m²	Largest swept area of floating oil >50 g/m²	Largest volume of oil ashore	Longest length of shoreline with accumulation >100 g/m²	Largest area of entrained hydrocarbon exposure >100 ppb	Largest area of dissolved hydrocarbon exposure >50 ppb
Run Number		**91**	**20**	**50**	**50**	**36**	**39**
Total area of floating Oil exposure (km²)	1 g/m²	149	57	4	4	8	18
	10 g/m²	**29**	27	1	1	2	2
	50 g/m²	2	**5**	0	0	0	1
Total length of shoreline accumulation (km)	10 g/m²	0	14	24	24	0	0
	100 g/m²	0	1	11	**11**	0	0
	1,000 g/m²	0	0	0	0	0	0
Minimum time before accumulation on any shoreline (hours)	10 g/m²	-	55	45	45	-	-
	100 g/m²	-	185	59	59	-	-
	1,000 g/m²	-	-	0	0	-	-
Total volume of oil ashore (m³)		1	9	**43**	43	-	1
Total area of entrained hydrocarbon exposure (km²)	10 ppb	1,062	513	383	383	2,044	1,066
	100 ppb	83	236	165	165	**636**	215
Total area of dissolved hydrocarbon exposure (km²)	10 ppb	-	-	-	-	43	18
	50 ppb	-	-	-	-	-	**2**
	400 ppb	-	-	-	-	-	-
Start Date		21 July 2012	9 January 2017	11 May 2012	11 May 2012	28 June 2016	18 September 2016

NC = No contact at, or above the specified shoreline accumulation threshold.

10.2.1 Deterministic Case: Largest swept area of floating oil above 10 g/m^2

The deterministic trajectory that resulted in the largest swept area of floating oil above 10 g/m^2 was identified as run number 91, which started on 21st July 2012.

Figure 10.13 illustrates the floating oil exposure and shoreline accumulation over the 30-day simulation.

Figure 10.14 displays the time series of the area of sea surface exposure above the low (1 g/m^2), moderate (10 g/m^2) and high (50 g/m^2) thresholds over the 30-day simulation.

Figure 10.15 presents the fates and weathering graph for the corresponding single spill trajectory and Table 10.11 summarises the mass balance peaks and at the end of the simulation.

Table 10.11 Summary of the mass balance for the trajectory with the largest swept area of floating oil above 10 g/m^2. Results are based on a 250 m^3 surface release of MDO over 6 hours.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m^3)	168.6	0.3	0.0
Entrained (m^3)	124.4	2.8	41.1
Dissolved (m^3)	0.3	4.7	0.0
Evaporation (m^3)	123.8	29.7	123.8
Decay (m^3)	86.8	30.0	86.8
Ashore (m^3)	0.5	11.2	0.1

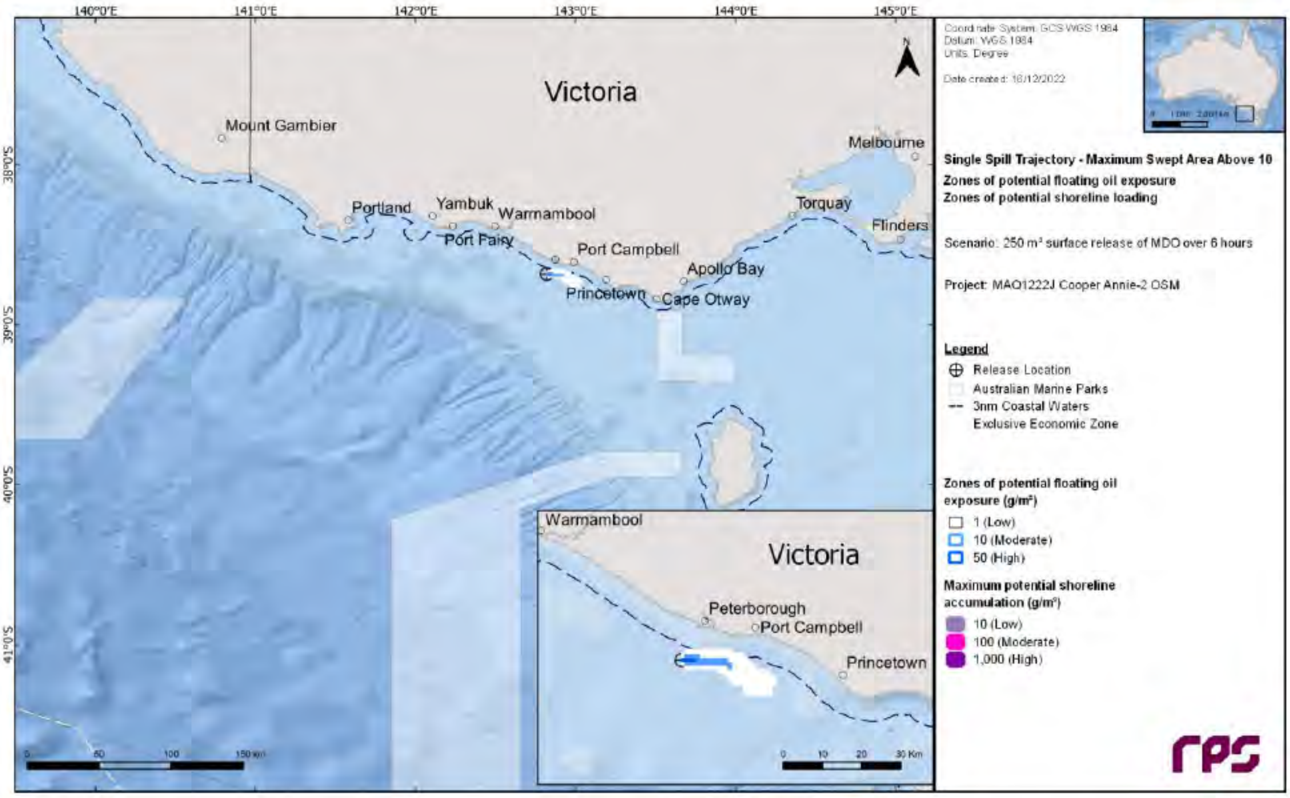


Figure 10.13 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest swept area of floating oil above 10 g/m^2. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

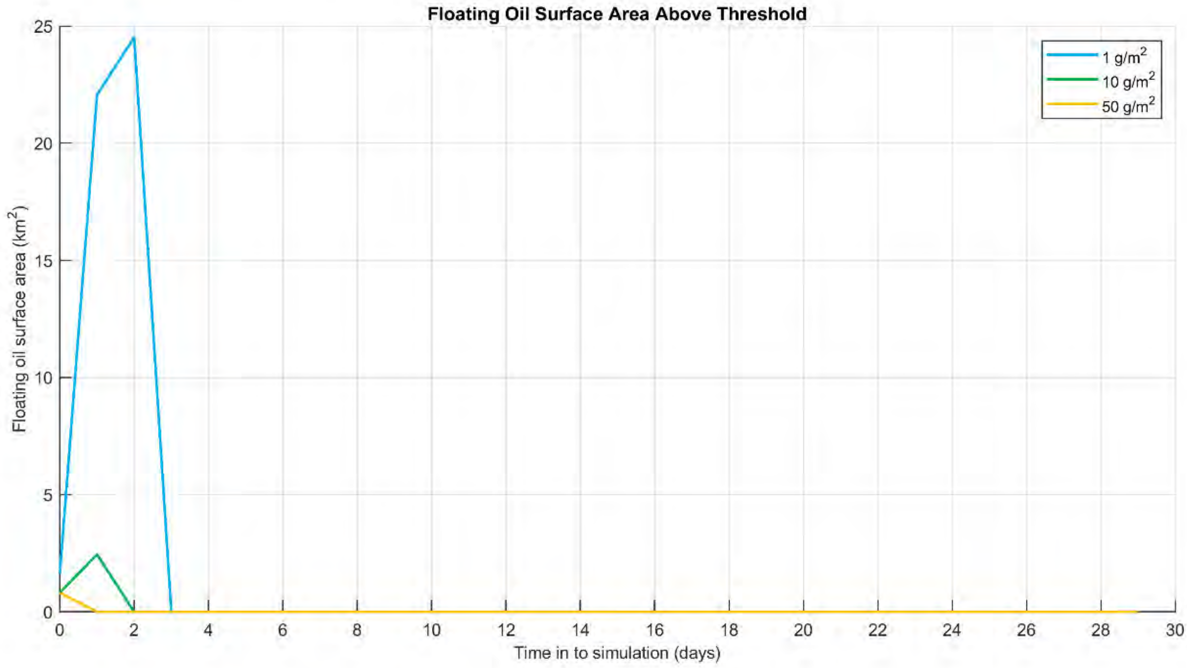


Figure 10.14 Time series of the sea surface exposure above each threshold for the trajectory with the largest swept area of floating oil above 10 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

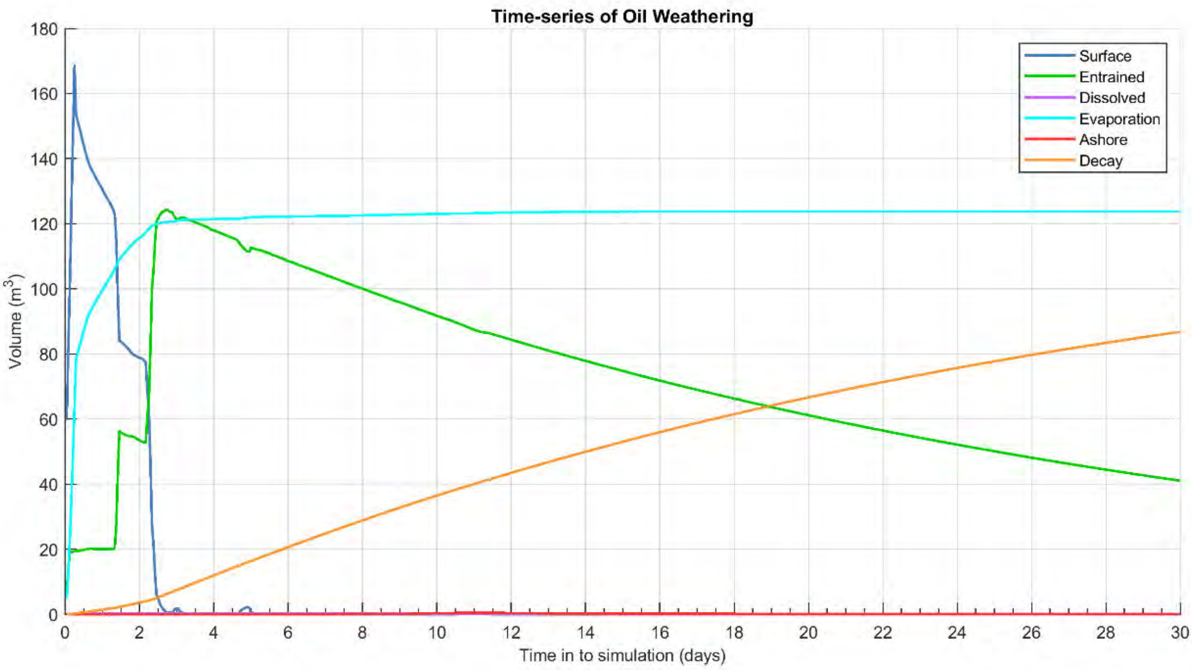


Figure 10.15 Predicted weathering and fates graph for the trajectory with the largest swept area of floating oil above 10 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

10.2.2 Deterministic Case: Largest swept area of floating oil above 50 g/m²

The deterministic trajectory that resulted in the largest swept area of floating oil above 50 g/m² was identified as run number 20, which started on 9th January 2017.

Figure 10.13 illustrates the floating oil exposure and shoreline accumulation over the 30-day simulation.

Figure 10.14 displays the time series of the area of sea surface exposure above the low (1 g/m²), moderate (10 g/m²) and high (50 g/m²) thresholds over the 30-day simulation.

Figure 10.15 presents the fates and weathering graph for the corresponding single spill trajectory and Table 10.11 summarises the mass balance peaks and at the end of the simulation.

Table 10.12 Summary of the mass balance for the trajectory with the largest swept area of floating oil above 50 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m³)	183	0	0
Entrained (m³)	140	1	40
Dissolved (m³)	0	5	0
Evaporation (m³)	120	30	120
Decay (m³)	88	30	88
Ashore (m³)	7	8	3

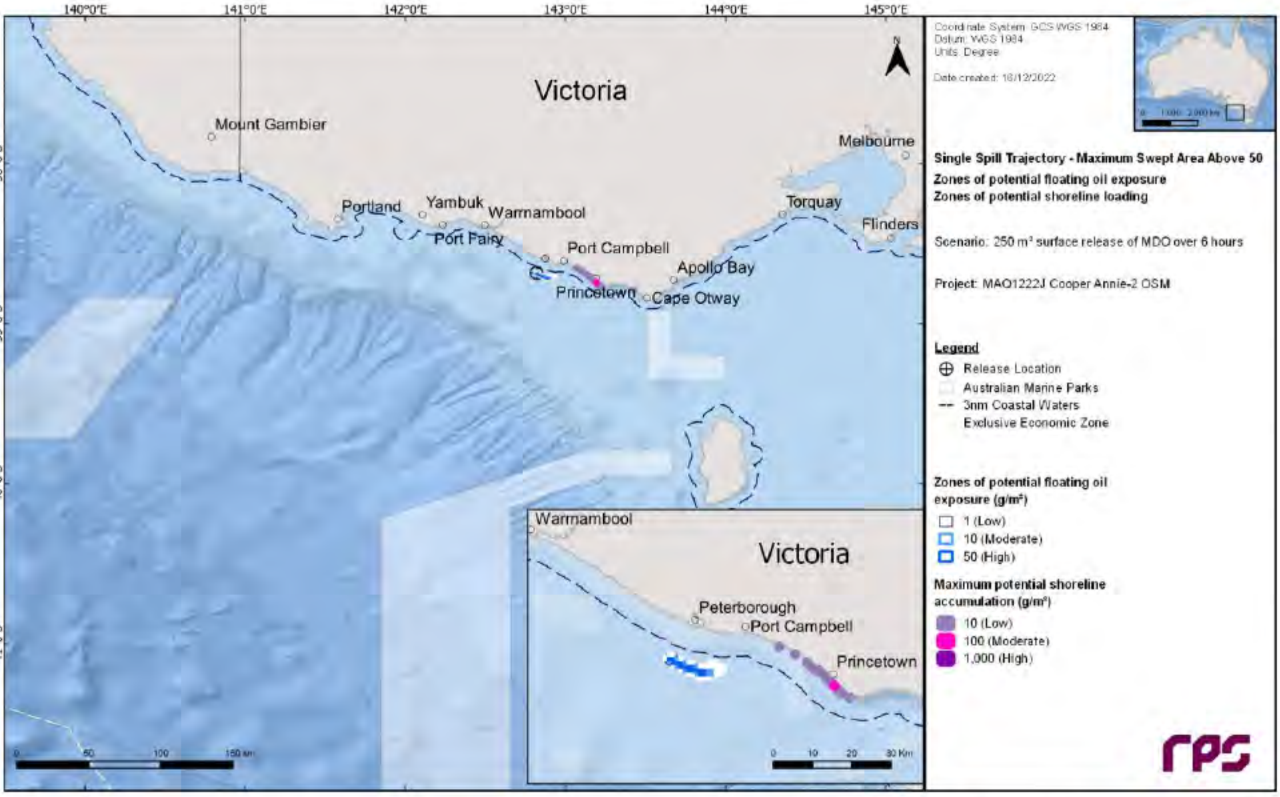


Figure 10.16 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest swept area of floating oil above 50 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

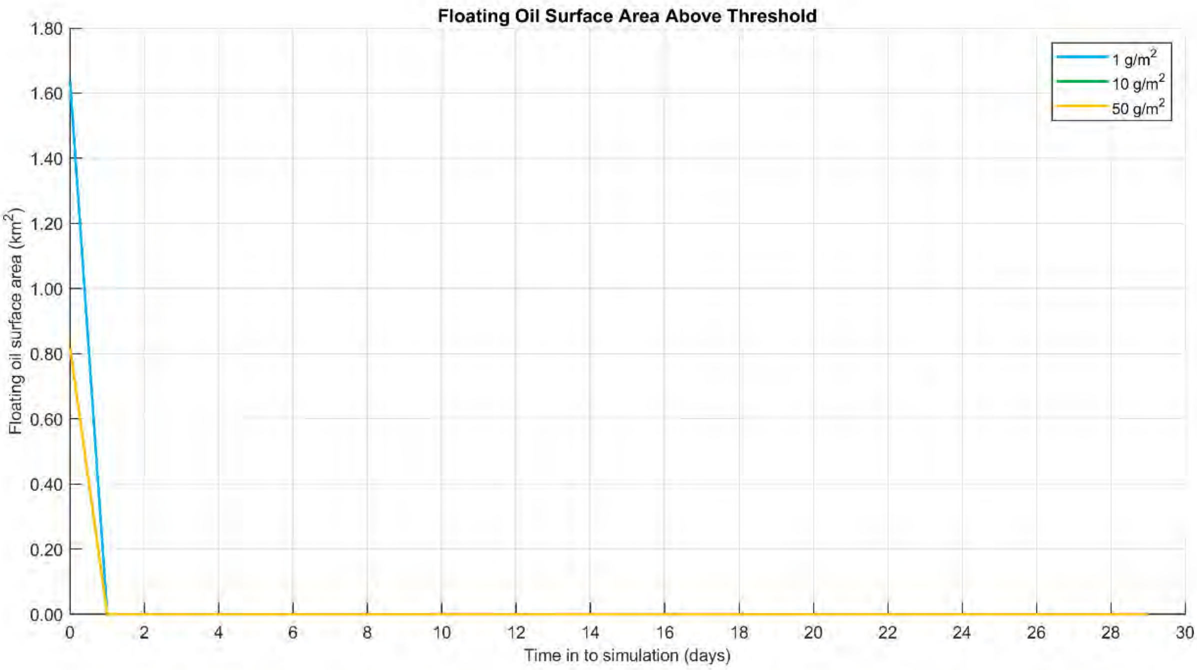


Figure 10.17 Time series of the sea surface exposure above each threshold for the trajectory with the largest swept area of floating oil above 50 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

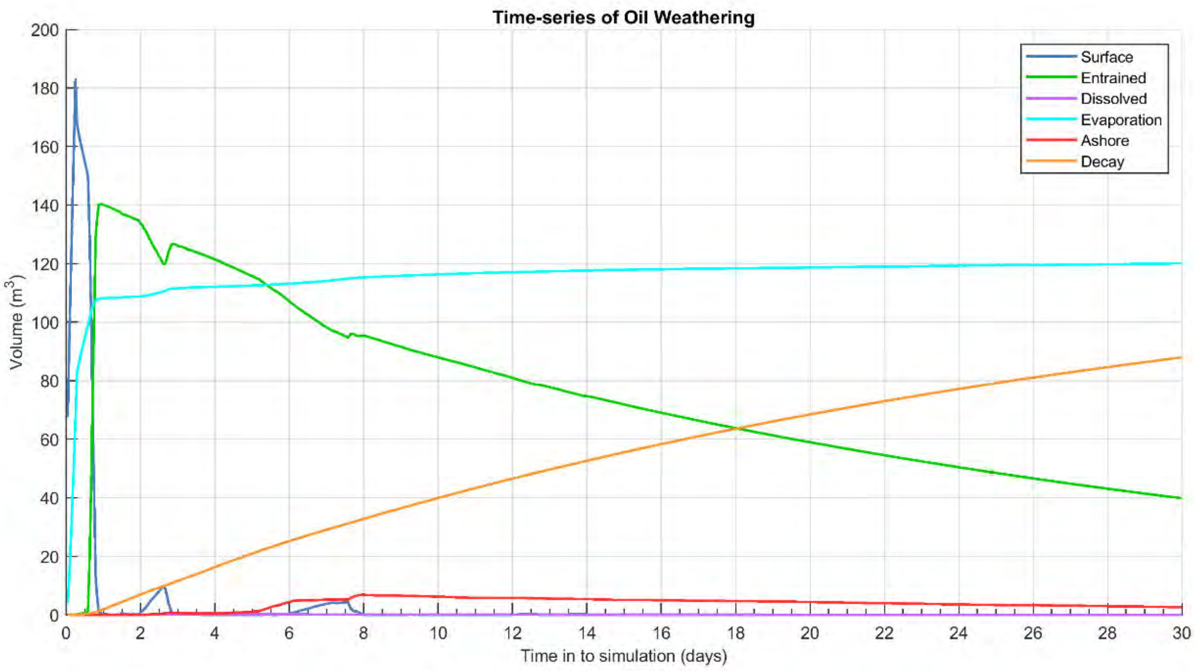


Figure 10.18 Predicted weathering and fates graph for the trajectory with the largest swept area of floating oil above 50 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

10.2.3 Deterministic Case: Largest volume of oil ashore and longest length of shoreline with accumulation above 100 g/m²

The deterministic trajectory that resulted in the largest volume ashore and longest length of shoreline with accumulation above 100 g/m² was identified as run number 50, which started on 11th May 2012.

Figure 10.19 illustrates the floating oil exposure and shoreline accumulation over the 30-day simulation.

Figure 10.20 displays the time series of the length of shoreline with accumulation at the low (10 g/m²), moderate (100 g/m²) and high (1,000 g/m²) thresholds over the 30-day simulation.

Figure 10.22 presents the fates and weathering graph for the corresponding single spill trajectory and Table 10.13 summarises the mass balance peaks and at the end of the simulation.

Table 10.13 Summary of the mass balance for the trajectory with the largest volume ashore and longest length of shoreline with accumulation above 100 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m³)	39	0	0
Entrained (m³)	193	0	36
Dissolved (m³)	0	2	0
Evaporation (m³)	92	30	92
Decay (m³)	96	30	96
Ashore (m³)	37	9	28

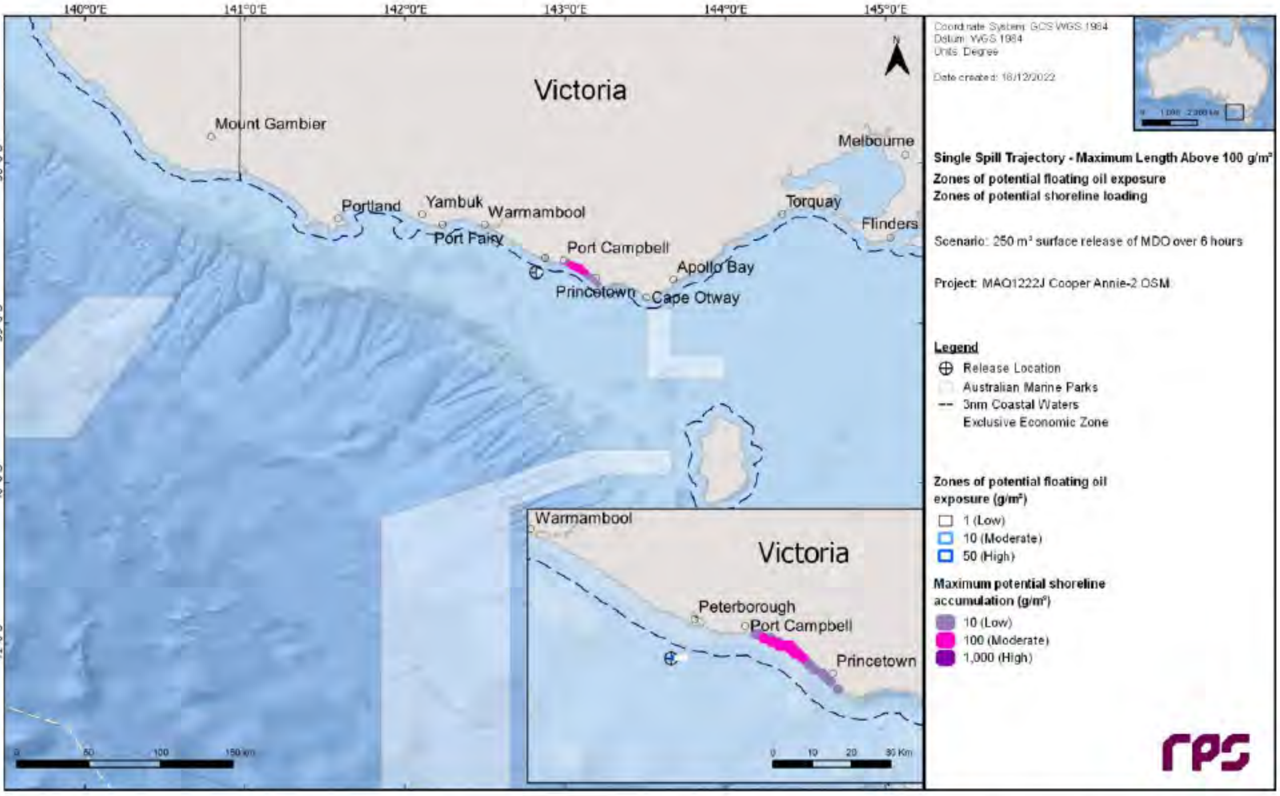


Figure 10.19 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest volume ashore and longest length of shoreline with accumulation above 100 g/m². Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

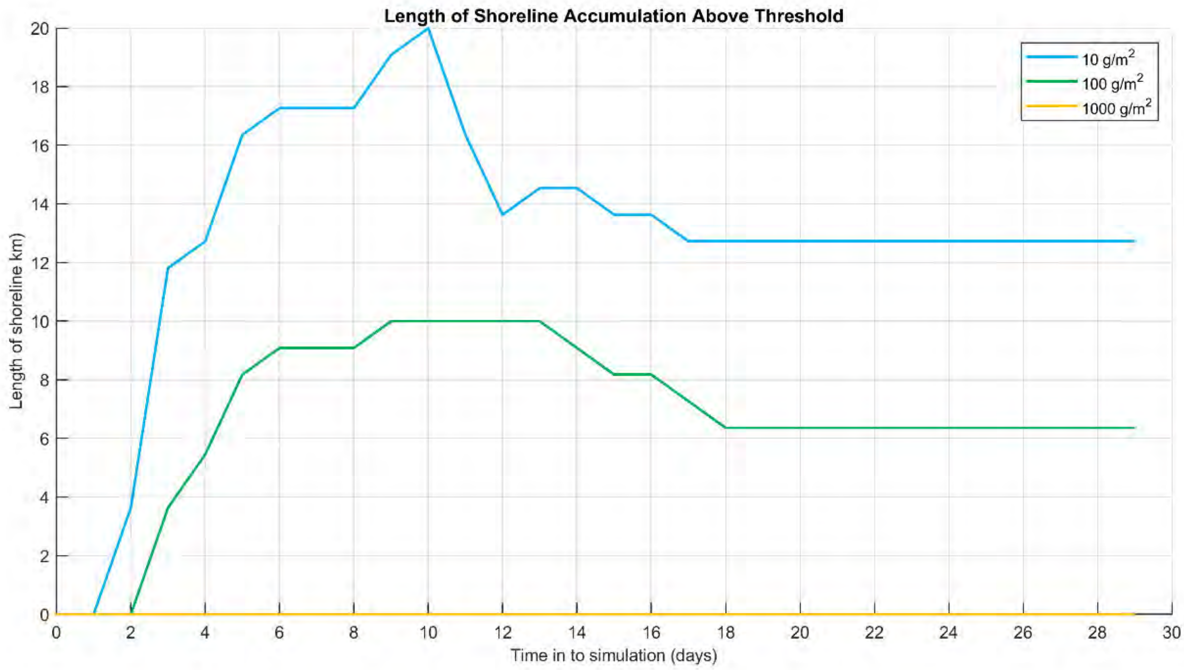


Figure 10.20 Time series of the length of shoreline with accumulation above each threshold for the trajectory with the largest volume ashore and longest length of shoreline with accumulation above 100 g/m^2. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

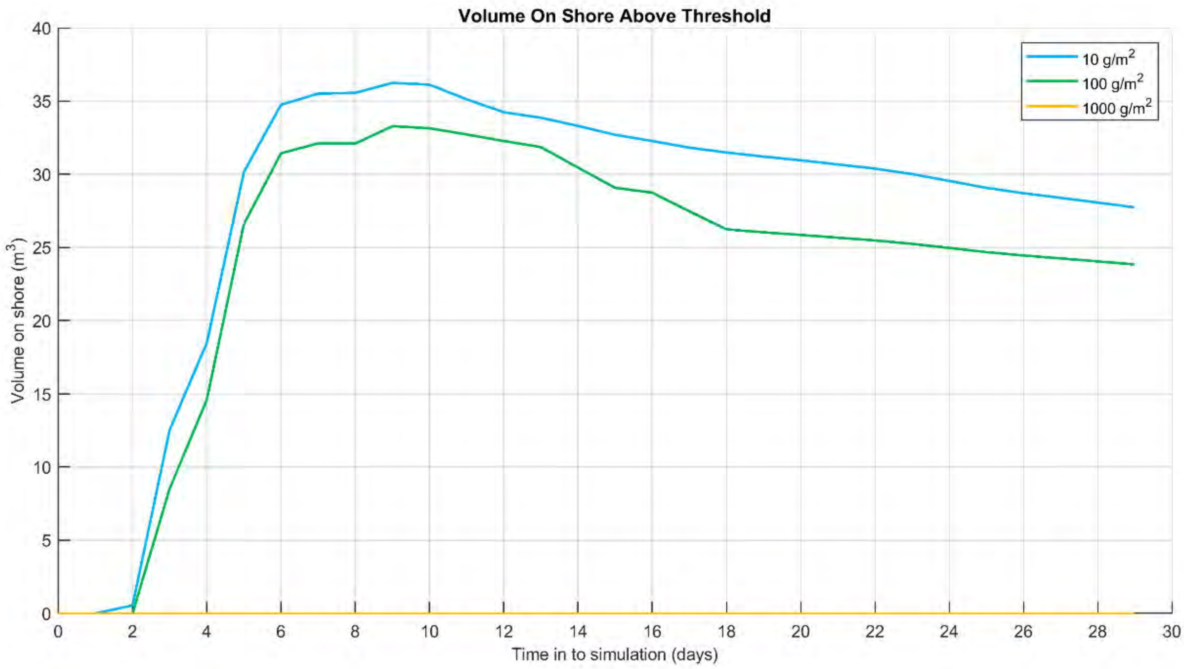


Figure 10.21 Time series of oil accumulation on the shoreline above each threshold for the trajectory with the largest volume ashore and longest length of shoreline with accumulation above 100 g/m^2. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

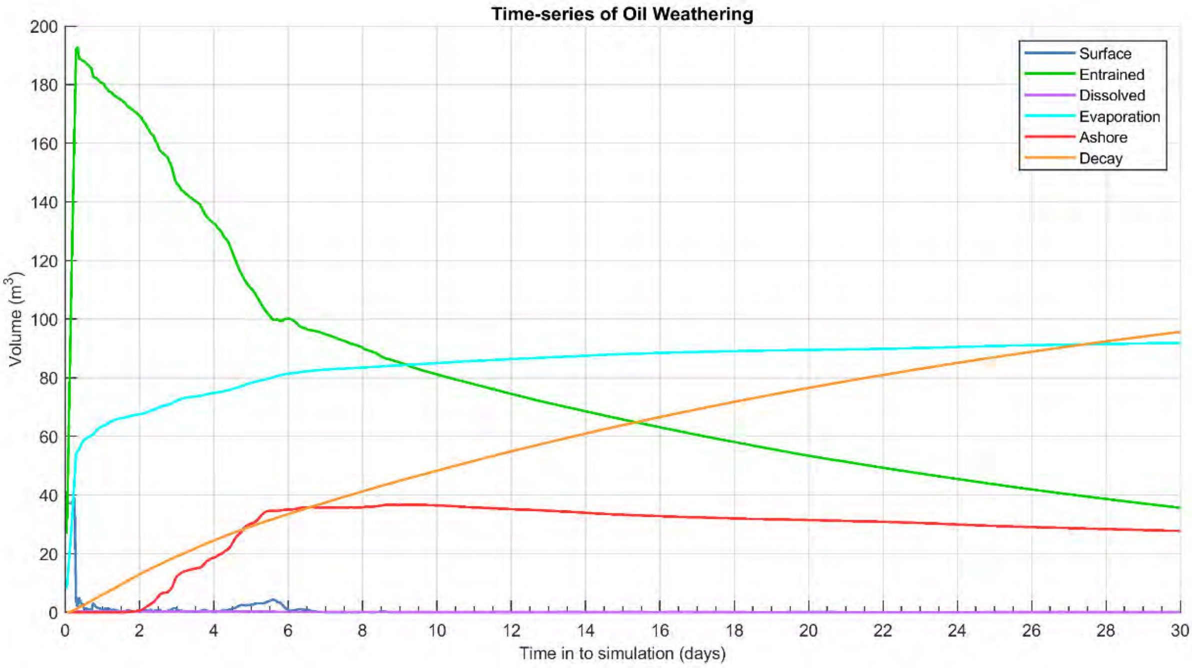


Figure 10.22 Predicted weathering and fates graph for the trajectory with the largest volume ashore and longest length of shoreline with accumulation above 100 g/m^2. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

10.2.4 Deterministic Case: Largest area of entrained hydrocarbon exposure above 100 ppb

The deterministic trajectory that resulted in the largest area of entrained hydrocarbon exposure above 100 ppb was identified as run number 36, which started on 28th June 2016.

Figure 10.23 illustrates the floating oil exposure and shoreline accumulation over the 30-day simulation.

Figure 10.24 displays the time series of the area of entrained hydrocarbon exposure at the low (10 ppb) and high (100 ppb) thresholds over the 30-day simulation.

Figure 10.25 presents the fates and weathering graph for the corresponding single spill trajectory and Table 10.14 summarises the mass balance peaks and at the end of the simulation.

Table 10.14 Summary of the mass balance for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m^3)	59	0	0
Entrained (m^3)	209	0	52
Dissolved (m^3)	2	0	0
Evaporation (m^3)	65	30	65
Decay (m^3)	134	30	134
Ashore (m^3)	0	5	0

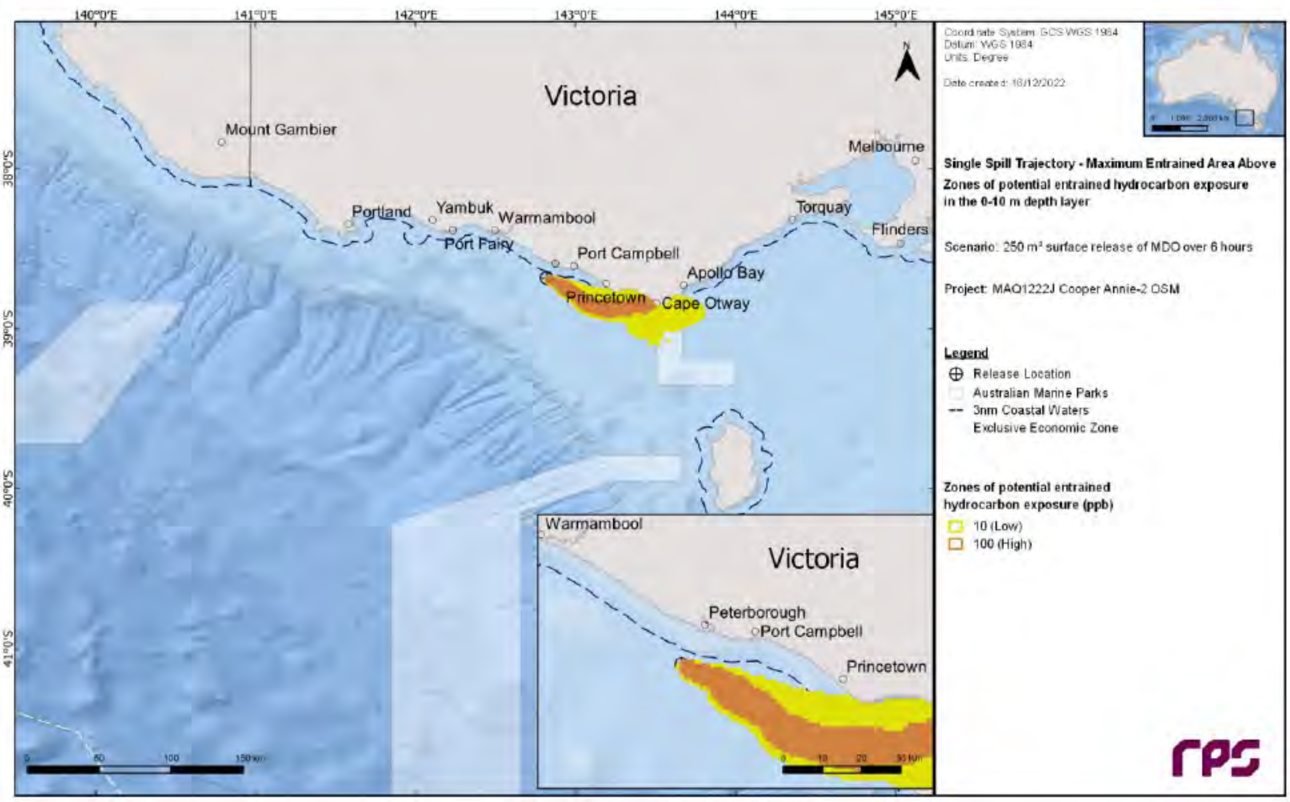


Figure 10.23 Zones of potential entrained hydrocarbon exposure, for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

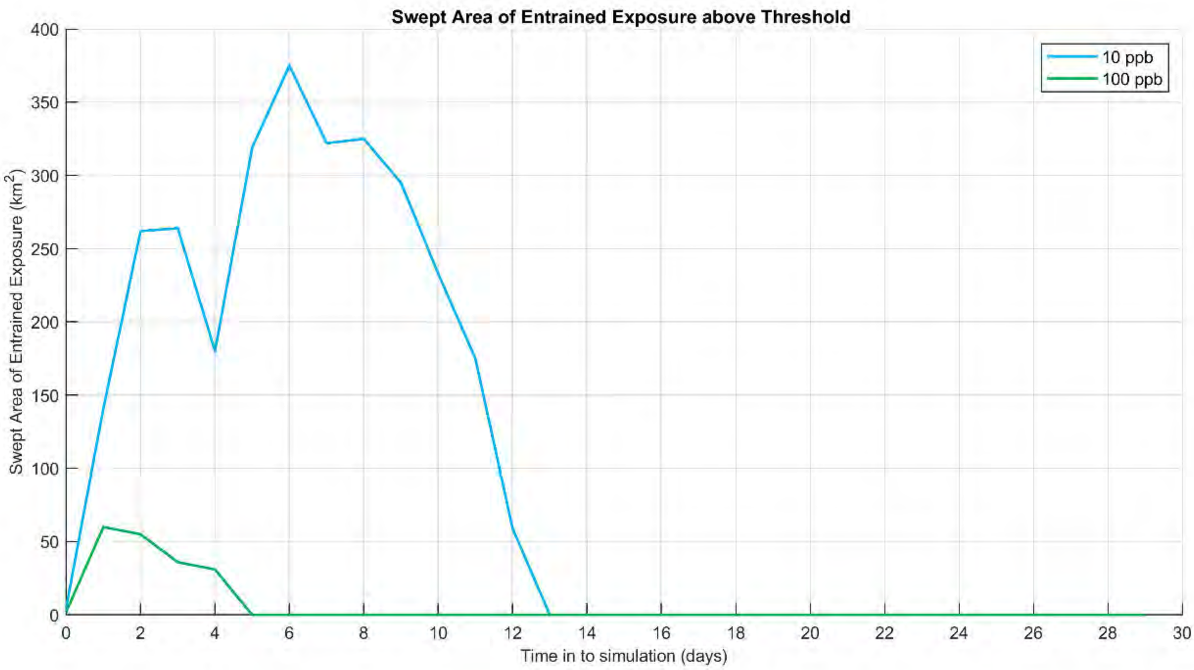


Figure 10.24 Time series of the entrained hydrocarbon exposure area above each threshold for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

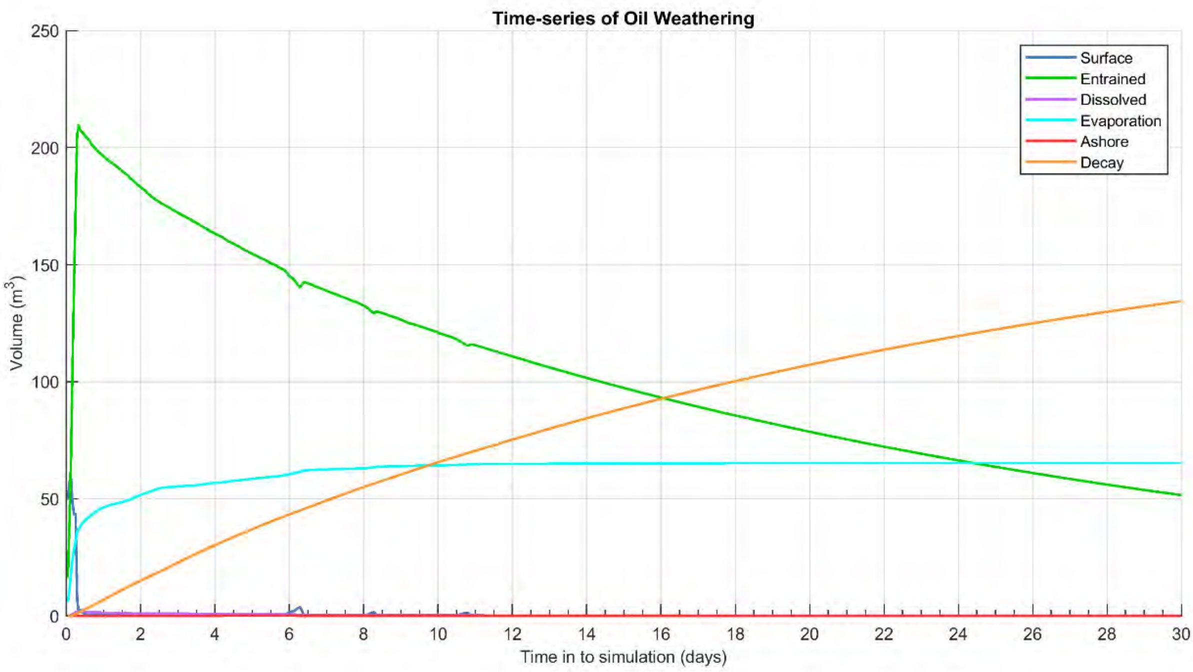


Figure 10.25 Predicted weathering and fates graph for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

10.2.5 Deterministic Case: Largest area of dissolved hydrocarbon exposure above 50 ppb

The deterministic trajectory that resulted in the largest area of dissolved hydrocarbon exposure above 50 ppb was identified as run number 39, which started on 18th September 2016.

Figure 10.26 illustrates the floating oil exposure and shoreline accumulation over the 30-day simulation.

Figure 10.27 displays the time series of the area of dissolved hydrocarbon exposure at the low (10 ppb), moderate (50 ppb) and high (400 ppb) thresholds over the 30-day simulation.

Figure 10.28 presents the fates and weathering graph for the corresponding single spill trajectory and Table 10.15 summarises the mass balance peaks and at the end of the simulation.

Table 10.15 Summary of the mass balance for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb. Results are based on a 250 m^3 surface release of MDO over 6 hours.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m^3)	61	0	0
Entrained (m^3)	210	0	49
Dissolved (m^3)	2	0	0
Evaporation (m^3)	83	30	83
Decay (m^3)	120	30	120
Ashore (m^3)	0	10	0

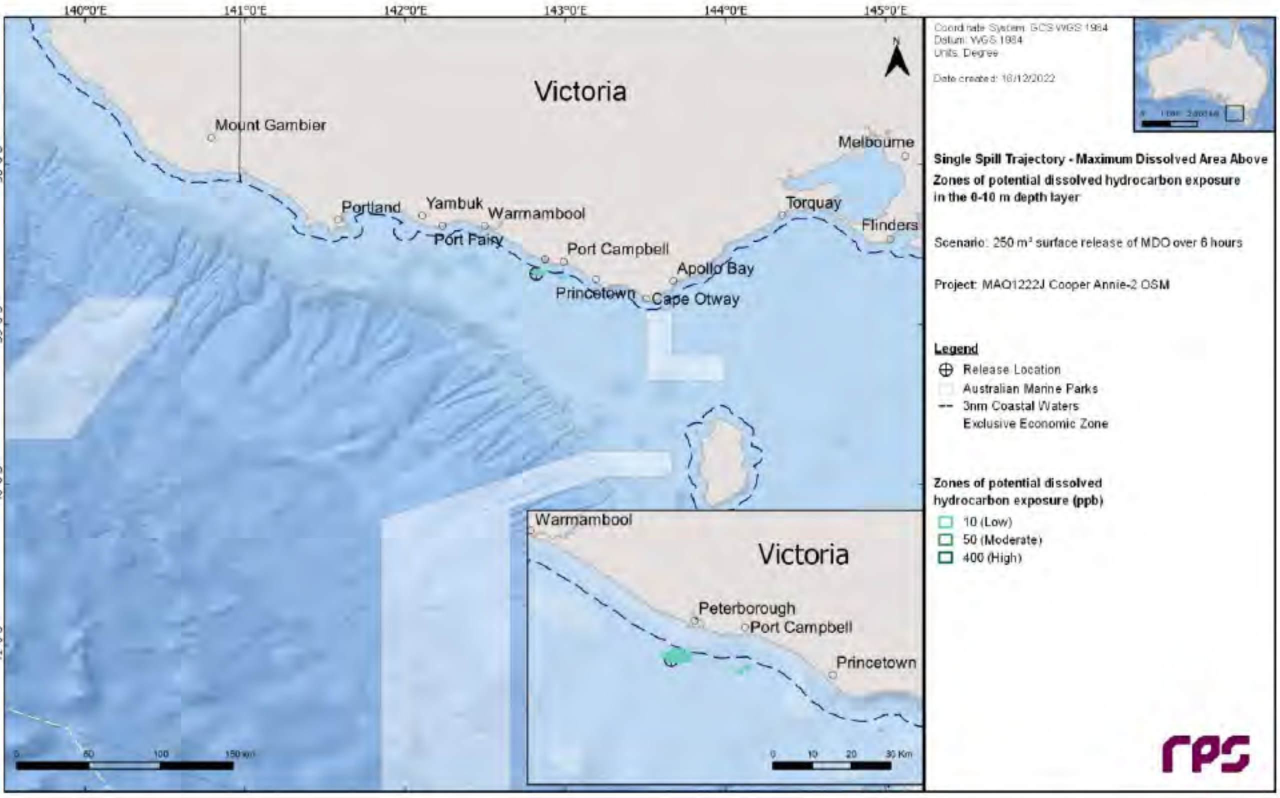


Figure 10.26 Zones of potential dissolved hydrocarbon exposure, for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb. Results are based on a 250 m^3 surface release of MDO over 6 hours, tracked for 30 days.

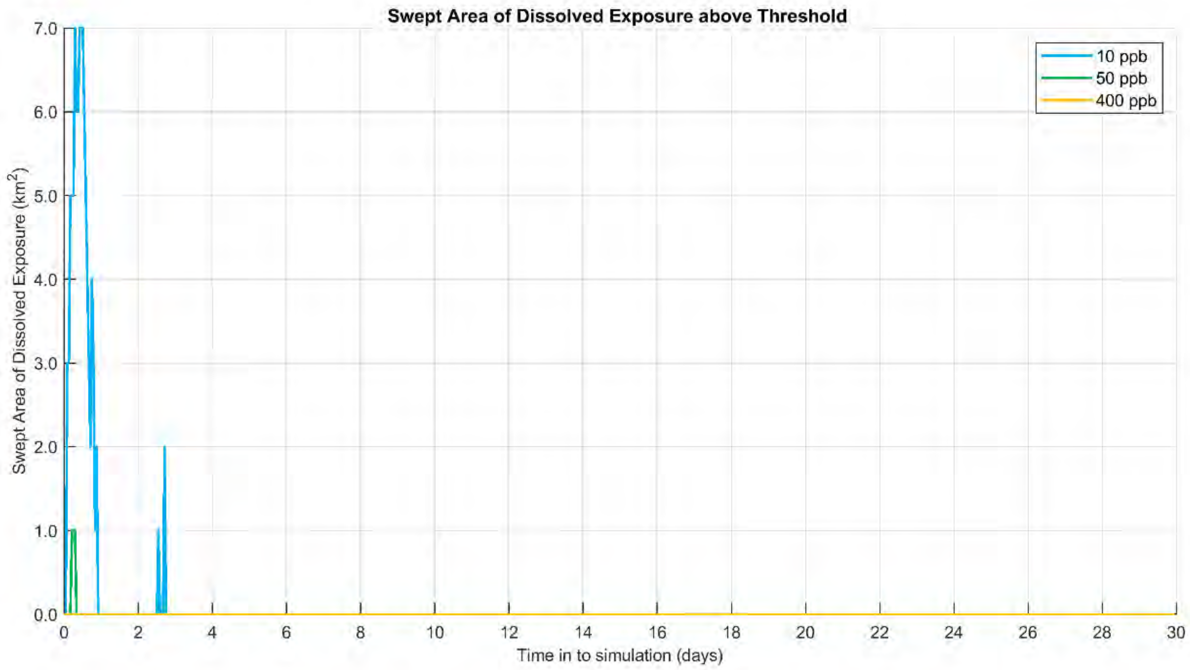


Figure 10.27 Time series of the dissolved hydrocarbon exposure area above each threshold for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb. Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

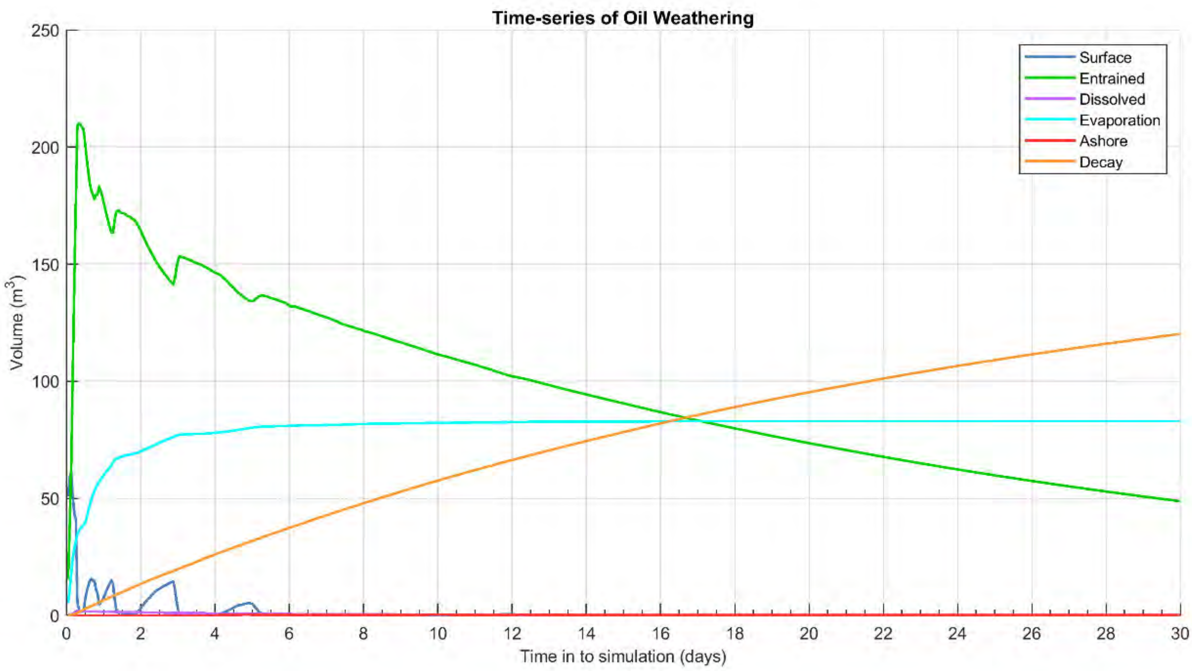


Figure 10.28 Predicted weathering and fates graph for the trajectory with the largest area of dissolved hydrocarbon exposure above 50 ppb. Results are based on a 250 m³ surface release of MDO over 6 hours, tracked for 30 days.

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Appendix 4. Subsea Noise Modelling

Cooper Energy Otway Subsea Noise Modelling

Acoustic Modelling for Assessing Marine Fauna Sound Exposures

JASCO Applied Sciences (Australia) Pty Ltd

20 September 2023

Submitted to:

Joe Morris
Cooper Energy Limited

Authors:

Steven C. Connell
Matthew W. Koessler
Alina M. Muellenmeister
Craig R. McPherson

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Executive Summary

JASCO Applied Sciences (JASCO) performed a modelling study of underwater sound levels associated with Cooper Energy's Otway current and potential future offshore activities.

The modelling study considers the activities associated with drilling and vessel operations. These operations include an anchored Mobile Offshore Drilling Unit (MODU) conducting drilling operations, and an associated Anchor Handling Tug and Supply Vessel (AHTS), conducting re-supply of the MODU under dynamic positioning (DP), and standing by near the MODU, as well as pre-lay, pipelaying and dive support scenarios. This study considered scenarios to represent operations, which could occur within Cooper's Title holdings. The representative modelled scenarios are located at the Annie-2 and Elanora-1 locations along with pipelay between Annie-2 and Casino-5. A concurrent operations scenario was also considered involving simultaneous drilling activities at Elanora-1 and pipelay operations between Annie-2 and Casion-5.

The study assessed distances from operations to where underwater sound levels reached thresholds corresponding to various levels of potential impact to marine fauna. The animals considered here included marine mammals, turtles, and fish. Due to the variety of species considered, there are several different thresholds for evaluating effects, including: mortality, injury, temporary reduction in hearing sensitivity, and behavioural disturbance. Of particular note, whilst the newly published Southall et al. (2021) provides recommendations and discusses the nuances of assessing behavioural response, the authors do not recommend new numerical thresholds for onset of behavioural responses for marine mammals.

The modelling methodology considered scenario specific source levels and range-dependent environmental properties. Estimated underwater acoustic levels for non-impulsive (continuous) noise sources presented as sound pressure levels (SPL, L_p), and as accumulated sound exposure levels (SEL, L_E) as appropriate for different noise effect criteria. In this report, the duration of the SEL accumulation is defined as integrated over an 8- or 24-hour period.

The SPL metric is the root-mean-square pressure level over a stated frequency band over a specified time window. In this study, for continuous noise, a time window of 1 s was used. An animal travelling within the threshold can be exposed to a sound level could be exposed to behavioural disturbance. The SEL_{24h} is a cumulative metric that reflects the dosimetric impact of noise levels within 24 hours based on the assumption that an animal is consistently exposed to such noise levels at a fixed position. The corresponding SEL_{24h} radii represent an unlikely worst-case scenario. More realistically, marine mammals (as well as fish and turtles) would not stay in the same location for 24 hours. Therefore, a reported radius for SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with impairment if it remained in that location for 24 hours.

Maps are provided in the report to assist with contextualising tabulated distances. The key results of this modelling study are summarised in Tables 1 and 6.

Marine mammals:

The maximum distances to the (NOAA) (2019) marine mammal behavioural response criterion of 120 dB re 1 µPa (SPL) are presented in Table 1. The results for the criteria from Southall et al. (2019) for marine mammal Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) for MODU and vessel operations are assessed at in-field, the maximum distances and total ensonified areas are presented in Table 2.

Table 1. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to the marine mammal behavioural response criterion of 120 dB re 1 µPa (SPL) from the most appropriate location for considered sources per scenario. MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel

Location	Operation	Description	R_{max} (km)	$R_{95\%}$ (km)
Annie-2	Drilling Prelays	1x anchor handler within 2km of location DP/slow transit	0.44	0.41
	Mooring	Moored Semi Sub idle (no noise) 1x anchor handler on bridle 2x anchor handle within 2km of location (hooking up anchors)	7.87	7.32
	MODU Drilling	Anchored MODU Drilling	1.10	1.02
	MODU Drilling + OSV Under Standby	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust)	1.13	1.03
	MODU Drilling Operations with Standby OSV and resupply	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust) 1x anchor Handler at rig doing resupply	7.46	7.11
Elanora-1	Drilling Prelays	1x anchor handler within 2km of location DP/slow transit	0.75	0.72
	Mooring	Moored Semi Sub idle (no noise) 1x anchor handler on bridle 2x anchor handle within 2km of location (hooking up anchors)	21.7	18.8
	MODU Drilling	Anchored MODU Drilling	1.89	1.79
	MODU Drilling + OSV Under Standby	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust)	2.91	2.58
	MODU Drilling Operations with Standby OSV and resupply	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust) 1x anchor Handler at rig doing resupply	21.7	18.7
Between Annie-2 & Casino-5†	Pipeline/Umbilical installation (ISV) Annie EHU	Laying Pipes and umbilicals - 600m/hour	5.97	5.41
Annie-2	Installation (DSV)	DSV + HRV (no noise) stationary on location	2.56	2.30
Between Annie-2 & Casino-5, with Elanora-1†	MODU Drilling Operations, Standby OSV, OSV resupply and Pipeline/Umbilical installation (ISV) Annie EHU	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust) 1x anchor Handler at rig doing resupply Laying Pipes and umbilicals - 600m/hour	30.7	28.2

† These scenarios consider several source locations, the presented distances in the summary table are the largest. Results in Section 4.1 provide additional detail.

Table 2. Summary: Maximum (R_{max}) horizontal distances (in km) and ensonified area (km^2) for the frequency-weighted LF-cetacean SEL_{24h} TTS threshold of 179 dB re 1 $\mu Pa^2 \cdot s$ from the most appropriate location for the considered scenario. MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel

Location	Operation	Description	R_{max} (km)	Area (km^2)
Annie-2	Drilling Prelays	1x anchor handler within 2km of location DP/slow transit	0.02	0.082
	Mooring	Moored Semi Sub idle (no noise) 1x anchor handler on bridle 2x anchor handle within 2km of location (hooking up anchors)	3.03	15.46
	MODU Drilling	Anchored MODU Drilling	0.37	0.398
	MODU Drilling + OSV Under Standby	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust)	0.37	0.531
	MODU Drilling Operations with Standby OSV and resupply	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust) 1x anchor Handler at rig doing resupply	1.22	4.909
Elanora-1	Drilling Prelays	1x anchor handler within 2km of location DP/slow transit	0.02	0.682
	Mooring	Moored Semi Sub idle (no noise) 1x anchor handler on bridle 2x anchor handle within 2km of location (hooking up anchors)	5.23	74.85
	MODU Drilling	Anchored MODU Drilling	0.40	0.466
	MODU Drilling + OSV Under Standby	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust)	0.40	1.139
	MODU Drilling Operations with Standby OSV and resupply	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust) 1x anchor Handler at rig doing resupply	3.38	21.11
Between Annie-2 & Casino-5	Installation (ISV) Annie EHU	Laying Pipes and umbilicals - 600m/hour	0.32	7.144
Annie-2	Installation (DSV)	DSV + HRV (no noise) stationary on location	0.77	1.777
Between Annie-2 & Casino-5, with Elanora-1†	MODU Drilling Operations, Standby OSV, OSV resupply and Pipeline/Umbilical installation (ISV) Annie EHU†	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (not DP, minimal thrust) 1x anchor Handler at rig doing resupply Laying Pipes and umbilicals - 600m/hour	3.38	28.52

† This scenario is a combination of Scenario 5 at Elanora-1 and Scenario 6 to represent concurrent operations.

Fish:

Sound produced by the MODU and/or vessel operations reach the sound levels associated with physiological effects, recoverable injury, and TTS for some fish species in close proximity to the sound sources (Table 3), but in order for the thresholds to be exceeded, the fish must remain at those distances for either 12 or 48 h.

Table 3. Summary: *SPL*: Maximum (R_{max}) horizontal distances (in km) to sound pressure level (SPL) criteria (Popper et al. 2014) from most appropriate location for considered sources per scenario.

Location	Maximum (R_{max}) distance to threshold (km)	
	TTS (12 h)	Recoverable injury (48 h)
Annie-2	0.13	0.03
Elanora-1	0.13	0.03

1. Introduction

JASCO Applied Sciences (JASCO) performed a modelling study of underwater acoustic noise levels associated with Cooper Energy's Otway activities. The modelling study specifically predicted the distances from operations at which underwater sound levels reached noise effect thresholds and criteria. The corresponding marine mammal thresholds include levels associated with behavioural response, permanent threshold shift (PTS) and temporary threshold shift (TTS). The marine mammal functional hearing groups considered were low-, high-, very high-frequency cetaceans, and otariid seals. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), and accumulated sound exposure levels (over 24 hours) (SEL_{24h}, $L_{E,24h}$), as appropriate for non-impulsive (continuous) noise sources.

This report is further structured as follows, the remainder of Section 1 provides details on the scenarios considered for modelling, Section 2 explains the metrics used to represent underwater acoustic fields and the effect criteria considered. Section 2.1.1 details the methodology for predicting the source levels and modelling the sound propagation, including the specifications of the considered sound sources and the environmental parameters. Section 4.1 presents the acoustic results as tabulated ranges to thresholds, Section 4.2 provides sound level contour maps. The acoustic modelling results are then discussed in Section 5.

1.1. Modelling Scenarios

Three well locations, Elanora-1, Annie-2, and Casino-5, were considered in this report to capture, and be representative of, the different geographic locations where activities may occur. Figure 1 displays an overview of the modelling area showing locations, the southern right whale BIA, the pygmy blue whale BIA, and the regional bathymetry. This study considered the following sound-producing activities:

- Drilling noise from an anchored Mobile Offshore Drilling Unit (MODU),
- Vessel noise from an Anchor Handling Tug Supply (AHTS) on slow transit in prelay and hookup operations which was modelled as following a random track in a 2x2 km box centred around either Annie-2 or Elanora-1,
- Vessel noise from an Anchor Handling Tug Supply (AHTS) on slow transit in standby operation which was modelled as following a random track and was confined to a 2x4 km area approximately 2 km from either Annie-2 or Elanora-1,
- Vessel noise from an AHTS conducting resupply operations under dynamic positioning (DP),
- Vessel noise from an Infield Support Vessel (ISV) conducting pipelay operations following a track and making headway at a rate 600 m/hr,
- Vessel noise from a Dive Support Vessel (DSV) and a Hyperbaric Rescue Vessel (HRV) under DP.
- Concurrent operations involving drilling activities at Elanora-1 and pipelay operations between Annie-2 and Casion-5.

These activities are typical and representative of operations that may be conducted within Cooper Energy's Title areas. Table 4 and Table 5 outline the modelling locations and scenarios. The scenario numbering in Table 5 refers to a unique activity, which may occur at a stated location. Hence results are presented with the scenario number together with a location as a unique identifier.

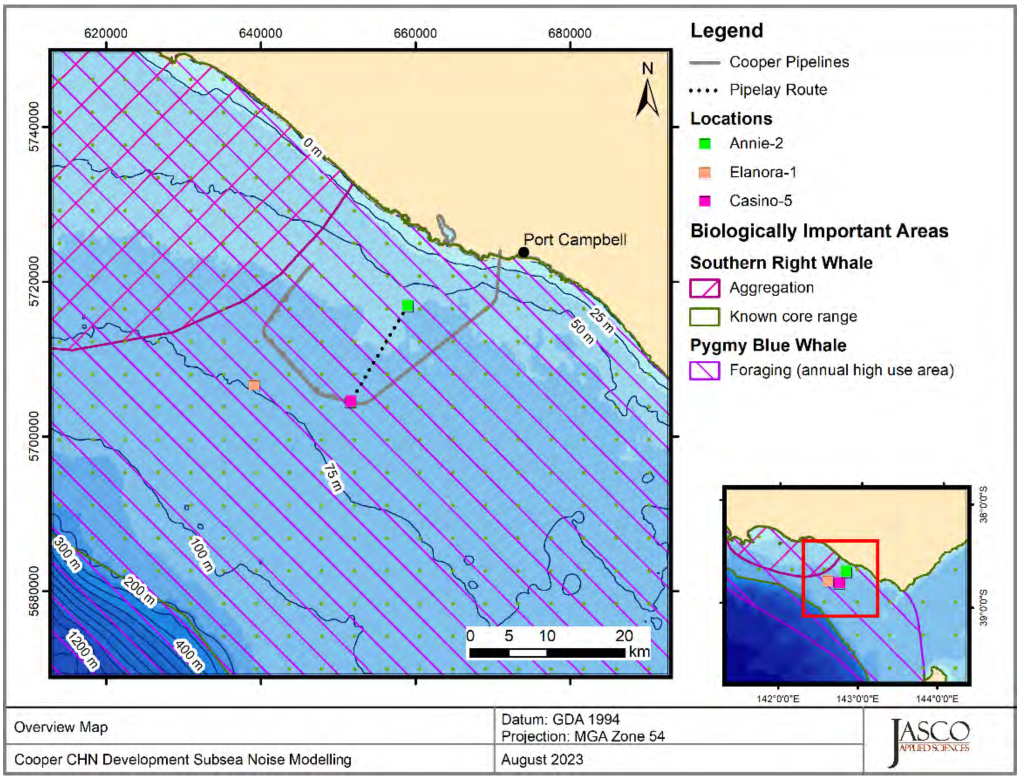

Figure 1. Overview map of the relevant features of the Cooper Energy Otway Offshore Facilities.

Table 4. Modelled site locations and source information.

Site	Source/Vessel	Location	Latitude (°S)	Longitude (°E)	MGA[1] Zone 54		Water depth (m)
					X (m)	Y (m)	
1	AHTS (Transit)	Annie-2	38° 40' 57.62"	142° 48' 16.37"	656960	5716892	55.8
2	AHTS (DP)		38° 41' 12.43"	142° 49' 39.68"	658964	5716395	59.2
3	AHTS (Transit)		38° 40' 53.76"	142° 51' 01.78"	660959	5716931	61.8
4	MODU (Drilling)		38° 40' 56.22"	142° 49' 39.10"	658960	5716895	57.9
5	AHTS (Transit)		38° 40' 57.62"	142° 48' 16.37"	656960	5716892	55.8
6	AHTS (DP)		38° 40' 57.19"	142° 49' 39.15"	658961	5716865	58.0
7	AHTS (Transit)	Elanora-1	38° 46' 43.61"	142° 34' 41.43"	637085	5706589	77.0
8	AHTS (DP)		38° 46' 58.70"	142° 36' 04.82"	639089	5706089	75.7
9	AHTS (Transit)		38° 46' 40.93"	142° 37' 27.11"	641085	5706602	74.0
10	MODU (Drilling)		38° 46' 42.49"	142° 36' 04.28"	639085	5706589	75.0
11	AHTS (Transit)		38° 46' 43.61"	142° 34' 41.43"	637085	5706589	77.0
12	AHTS (DP)		38° 46' 43.46"	142° 36' 04.29"	639085	5706559	75.0
13	ISV (Pipelay)	Between Annie-2 & Casino-5	38° 44' 19.97"	142° 47' 12.03"	655284	5710684	61.0
14	ISV (Pipelay)	Annie-2	38° 40' 56.22"	142° 49' 39.10"	658960	5716895	57.9
15	ISV (Pipelay)	Casino-5	38° 46' 42.49"	142° 36' 04.28"	639085	5706589	75.0
16	DSV (Standby)	Annie-2	38° 40' 56.22"	142° 49' 39.10"	658960	5716895	58.0

[1]Map Grid of Australia (MGA)

Table 5. Description of modelled scenarios.

Scenario	Site(s)	Location	Operation Name	Operation Description	Operation Time	Vessel(s)
1	1	Annie-2	Drilling Prelays	1x anchor handler within 2km of location DP/slow transit	24h	Anchor Handler
	7	Elanora-1			24h	Anchor Handler
2	1,2,3	Annie-2	Mooring	Moored Semi Sub idle (no noise) 1x anchor handler on bridle 2x anchor handle within 2km of location (hooking up anchors)	24h	Ocean Onyx Anchor Handler x3
	7,8,9	Elanora-1			24h	Ocean Onyx Anchor Handler x3
3	4	Annie-2	MODU Drilling	Anchored MODU Drilling	24h	Ocean Onyx
	10	Elanora-1	MODU Drilling	Anchored MODU Drilling	24h	Ocean Onyx
4	4,5	Annie-2	MODU Drilling + OSV Under Standby	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (under minimal thrust)	24h	Ocean Onyx Anchor Handler
	10,11	Elanora-1			24h	Ocean Onyx Anchor Handler
5	4,5,6	Annie-2	MODU Drilling Operations with Standby OSV and resupply	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (under minimal thrust) 1x anchor Handler at rig doing resupply (under DP)	MODU: 24hr OSV Standby: 24h OSV Resupply: 8h	Ocean Onyx Anchor Handler x2
	10,11,12	Elanora-1			MODU: 24hr OSV Standby: 24h OSV Resupply: 8h	Ocean Onyx Anchor Handler x2
6	13,14,15	Between Annie-2 & Casino-5	Pipeline/Umbilical installation (ISV) Annie EHU	Laying Pipes and umbilicals – 600 m/hr	24h	ISV
7	16	Annie-2	Installation (DSV + HRV)	DSV + HRV stationary on location	24h	DSV+HRV
8†	10,11,12, 13,14,15	Between Annie-2 & Casino-5, with Elanora-1	MODU Drilling Operations, Standby OSV, OSV resupply and Pipeline/Umbilical installation (ISV) Annie EHU†	Anchored MODU Drilling 1x Anchor Handler on standby within 2km (under minimal thrust) 1x anchor Handler at rig doing resupply (under DP) & Laying Pipes and umbilicals – 600 m/hr	MODU: 24hr OSV Standby: 24h OSV Resupply: 8h Pipelay: 24h	Ocean Onyx Anchor Handler x2 ISV

† This scenario is a combination of Scenario 5 at Elanora-1 and Scenario 6 to represent concurrent operations.

2. Noise Effect Criteria

To assess the potential effects of a sound-producing activity, it is necessary to first establish exposure criteria (thresholds) for which sound levels may be expected to have an adverse effect on animals. Whether acoustic levels might injure or disturb marine fauna is an active research topic. Since 2007, several expert groups have developed SEL-based assessment approaches for evaluating auditory injury, with key works including Southall et al. (2007), Finneran and Jenkins (2012), Popper et al. (2014), United States National Marine Fisheries Service (NMFS 2018a) and Southall et al. (2019). The number of studies that investigate the level of behavioural disturbance to marine fauna by anthropogenic sound has also increased substantially.

Two sound level metrics, SPL and SEL, are commonly used to evaluate non-impulsive noise and its effects on marine life. In this report, the duration of the SEL accumulation is defined as integrated over a 24-hour period. Appropriate subscripts indicate any frequency weighting applied (see Appendix A.4). The acoustic metrics in this report reflect the ANSI and ISO standards for acoustic terminology, ANSI S1.1 (2013) and ISO 18405:2017 (2017).

The following thresholds and guidelines for this study were chosen because they represent the best available science:

1. Frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Southall et al. (2019) for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) in marine mammals for non-impulsive sound sources.
2. Marine mammal behavioural threshold based on the current interim US National Oceanic and Atmospheric Administration (NOAA) (2019) criterion for marine mammals of 120 dB re 1 µPa (SPL; L_p) for non-impulsive sound sources.
3. Sound exposure guidelines for fish, fish eggs, and larvae (Popper et al. 2014).
4. Frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Finneran et al. (2017) for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) in sea turtles.

Section 2.1, along with Appendix A.3 and A.4, expand on the thresholds, guidelines, and sound levels for marine mammals.

2.1. Marine Mammals

The criteria applied in this study to assess possible effects of non-impulsive noise sources on marine mammals are summarised in Table 6. Cetaceans and otariids were identified as the marine mammals requiring assessment. Details on thresholds related to auditory threshold shifts or hearing loss and behavioural response are provided in Appendix A.3, with frequency weighting explained in detail in Appendix A.4. Of particular note, whilst the newly published Southall et al. (2021) provides recommendations and discusses the nuances of assessing behavioural response, the authors do not recommend new numerical thresholds for onset of behavioural responses for marine mammals. As such the interim guidelines from the US National Oceanic and Atmospheric Administration (NOAA) (2019) have been used.

Table 6. Criteria for effects of non-impulsive noise exposure, including vessel noise, for marine mammals: Unweighted SPL and Weighted SEL_{24h} thresholds.

Hearing group	NOAA (2019)	Southall et al. (2019)	
	Behaviour	PTS onset thresholds (received level)	TTS onset thresholds (received level)
	SPL (L_p; dB re 1 µPa)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)
Low-frequency (LF) cetaceans	120	199	179
High-frequency (HF) cetaceans		198	178
Very High-frequency (VHF) cetaceans		173	153
Otariid Seals		219	199

L_p denotes sound pressure level and has a reference value of 1 µPa.
L_E denotes cumulative sound exposure over a 24 h period and has a reference value of 1 µPa^2·s.

2.1.1. Behavioural Response

The NMFS non-pulsed noise criterion was selected for this assessment because it represents the most commonly applied behavioural response criterion by regulators. The distances at which behavioural responses could occur were therefore determined to occur in areas ensonified above an unweighted SPL of 120 dB re 1 µPa (NMFS 2019). Appendix A.4 provides more information about the development of this criteria.

2.1.2. Injury and Hearing Sensitivity Changes

There are two categories of auditory threshold shifts or hearing loss: permanent threshold shift (PTS), a physical injury to an animal's hearing organs; and temporary threshold shift (TTS), a temporary reduction in an animal's hearing sensitivity as the result of receptor hair cells in the cochlea becoming fatigued.

To assist in assessing the potential for effect on marine mammals, this report applies the criteria recommended by Southall et al. (2019), considering both PTS and TTS (see Table 6). Appendix A.3 provides more information about the Southall et al. (2019) criteria.

2.2. Fish, Sea turtles, Fish Eggs, and Fish Larvae

In 2006, the Working Group on the Effects of Sound on Fish and Sea Turtles was formed to continue developing noise exposure criteria for fish and sea turtles, work begun by a NOAA panel two years earlier. The Working Group developed guidelines with specific thresholds for different levels of effects for several species groups (Popper et al. 2014). The guidelines define quantitative thresholds for three types of immediate effects:

- Mortality, including injury leading to death,
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma, and
- TTS.

Masking and behavioural effects can be assessed qualitatively, by assessing relative risk rather than by specific sound level thresholds. However, as these depend upon activity-based subjective ranges, these effects are not addressed in this report and are included in Table 7 for completeness only. Because the presence or absence of a swim bladder has a role in hearing, fish's susceptibility to injury from noise exposure depends on the species and the presence and possible role of a swim bladder in hearing. Thus, different thresholds were proposed for fish without a swim bladder (also appropriate for sharks), fish with a swim bladder not used for hearing, and fish that use their swim bladders for hearing. Sea turtles, fish eggs, and fish larvae are considered separately.

2.2.1. Sea Turtles

There is a paucity of data regarding responses of turtles to acoustic exposure, and no studies of hearing loss due to exposure to loud sounds. Popper et al. (2014) suggested thresholds for onset of mortal injury (including PTS) and mortality for sea turtles and, in absence of taxon-specific information, adopted the levels for fish that do not hear well (suggesting that this likely would be conservative for sea turtles).

Finneran et al. (2017) presented revised thresholds for sea turtle injury and hearing impairment (TTS and PTS). Their rationale is that sea turtles have best sensitivity at low frequencies and are known to have poor auditory sensitivity (Bartol and Ketten 2006, Dow Piniak et al. 2012). Accordingly, TTS and PTS thresholds for turtles are likely more similar to those of fishes than to marine mammals (Popper et al. 2014).

Table 7 lists the relevant effects thresholds from Popper et al. (2014) for vessel and drilling noise. Some evidence suggests that fish sensitive to acoustic pressure show a recoverable loss in hearing sensitivity, or injury when exposed to high levels of noise (Scholik and Yan 2002, Amoser and Ladich 2003, Smith et al. 2006); this is reflected in the SPL thresholds for fish with a swim bladder involved in hearing. Finneran et al. (2017) presented revised thresholds for turtle injury, considering frequency weighted SEL, which have been applied in this study for vessels (Table 8).

Table 7. Criteria for non-impulsive (vessel and drilling) noise exposure for fish, adapted from Popper et al. (2014).

Type of animal	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	(N) Low (I) Low (F) Low	170 dB SPL for 48 h	158 dB SPL for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Sea turtles	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low
Fish eggs and fish larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Sound pressure level dB re 1 µPa.
Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

Table 8. Acoustic effects of non-impulsive noise on sea turtles, weighted SEL_{24h}, Finneran et al. (2017).

PTS onset thresholds* (received level)	TTS onset thresholds* (received level)
220	200

3. Methods and Parameters

The modelled sites for the operations considered in this study were located on the continental shelf of south-eastern Australian (refer to wide regional bathymetry in Appendix B.1.1). The modelled sites were situated in water depths of approximately 56 – 77 m and represent or are considered representative of Cooper Energy's Otway activity locations.

To allow for operational flexibility, the sound speed profile considered for modelling was selected through a sensitivity analysis considering all months. The month of August was found to be the most favourable for sound propagation and was selected for modelling. Additional detail can be found in Appendix B.1.2.

The seabed beneath the modelled sites will likely consist of variably cemented calcarenite (Port Campbell Limestone), for some sites a thin veneer of overlying coarse sand on top of the variably cemented calcarenite may be present. The geologic and geoacoustic profiles of the seabed were generated using lithographic descriptions from geotechnical and geophysical reports supplied by the client and considering previous underwater acoustic modelling and measurement studies. Appendix B.1.3 provides additional detail.

The following sections provided a description of the inputs used for this underwater noise modelling study. The sections are divided into subsections detailing the source inputs for the MODU, AHTS, ISV and DSV (Section 3.1) with Sections 3.2–3.3 providing details on the applied modelling techniques and model configuration information.

3.1. Vessel and Drilling Noise Sources

For the MODU Drilling, AHTS on DP, AHTS standby transiting, the ISV conducting pipelay operations and the DSV and HRV on DP, Figure 2 presents a summary plot of considered source spectra for comparison purposes; additional detail on the sources is provided in Sections 3.1.1–3.1.2.2.

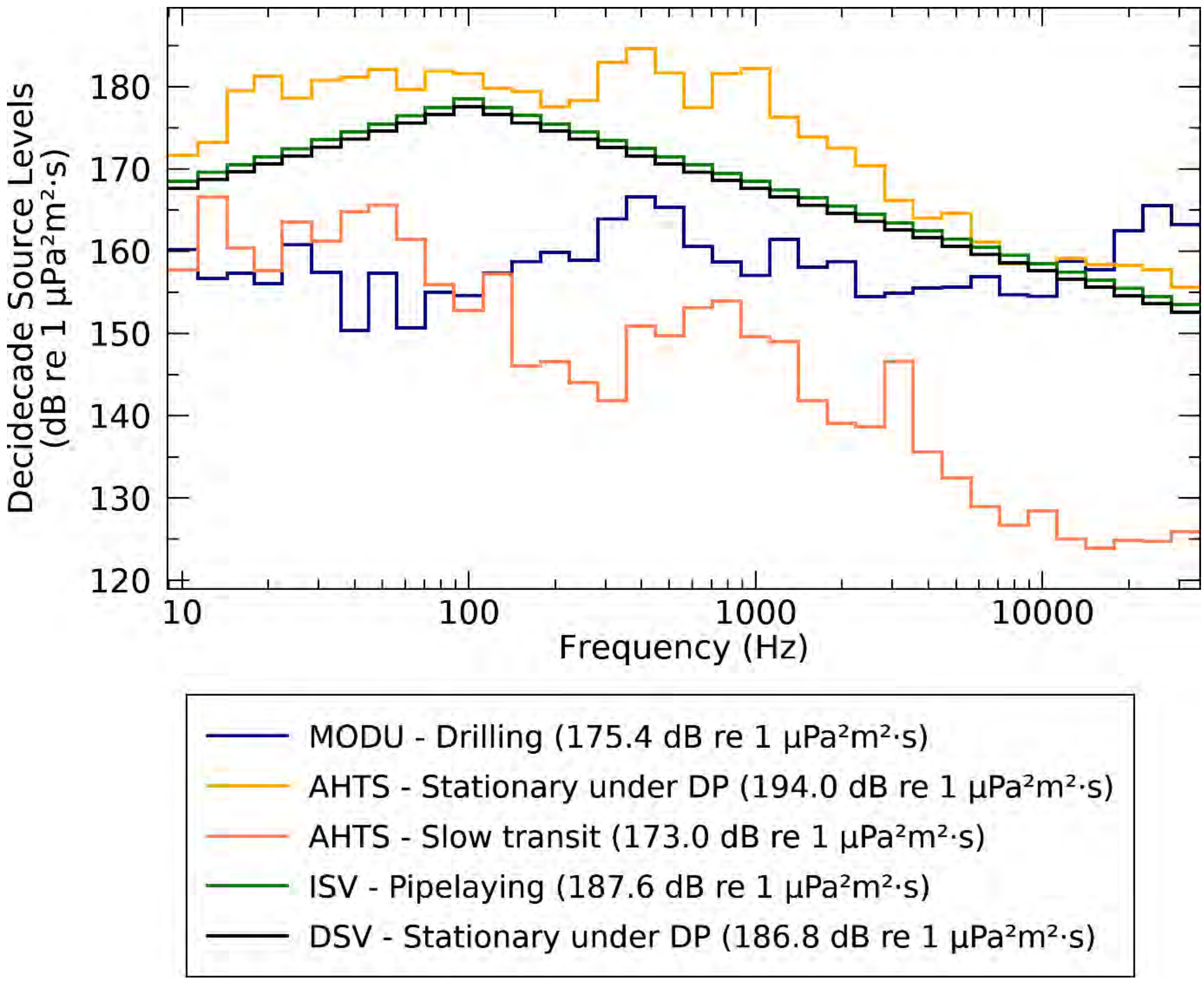

Figure 2. Energy source level (ESL) spectra (in decidecade frequency-band) for all sound sources.

3.1.1. Mobile Offshore Drilling Unit (MODU)

The MODU, or semi-submersible platform, considered in this study is likely similar to the *Ocean Onyx*, (Figure 3). While in operation, it will be held in position via anchors and chains, as opposed to using thrusters. Underwater sound from the MODU while drilling is expected to originate primarily from onboard equipment vibrations, while a smaller portion of the sound is expected to be transmitted directly into the water via the rotating drill string (Austin et al. 2018). Since the dominant vibration sources (e.g. pumps, generators, and machinery) are located on or below the main deck of the platform, the modelled depth of the point source representing the MODU was set to 11.6 m, which is approximately half the draft of the *Ocean Onyx*.

The Ocean Onyx (Figure 3) was measured by JASCO while anchored and drilling (McPherson et al. 2021), and had a broadband (10 Hz to 31 kHz) source level of 175.4 dB re 1 µPa m.

Figure 3. *Ocean Onyx* semi-submersible platform.

3.1.2. Vessel Radiated Noise

Underwater sound that radiates from vessels is produced mainly by propeller and thruster cavitation, with a smaller fraction of noise produced by sound transmitted through the hull, such as by engines, gearing, and other mechanical systems. Sound levels tend to be the highest when thrusters are used to position the vessel and when the vessel is transiting at high speeds. A vessel's sound signature depends on the vessel's size, power output, propulsion system (e.g., conventional propellers vs. Voith Schneider propulsion), and the design characteristics of the given system (e.g., blade shape and size). A vessel produces broadband acoustic energy with most of the energy emitted below a few kilohertz. Sound from onboard machinery, particularly sound below 200 Hz, dominates the sound spectrum before cavitation begins (Spence et al. 2007).

3.1.2.1. Anchor Handling Tug Supply (AHTS)

At this stage, the exact vessel specifications as well as the precise operational scenarios are not known. As such, estimates of the source levels for the Anchor Handling Tug Supply (AHTS) operations were based on a generic design AHTS vessel. The AHTS was based on the Siem VS491 CD design AHTS vessel (Figure 4) and it's specifications (Siem Offshore 2010) were used to form a basis for vessel source level estimation and source depth for acoustic modelling purposes. The general specification of these vessels is that they have a bollard pull of 285-310 t, and an overall length, beam, and draft of 91.0 m, 22.0 m and 7.95 m respectively.

The measured monopole source levels (MSLs) and spectra for the AHTS were taken from McPherson et al. (2021). For scenarios where the AHTS was under dynamic positioning (DP), the spectra from Section 5.5.2 in McPherson et al. (2021) were used.

Figure 4. Photo of an Anchor Handling Tug Supply (AHTS) vessel (Siem Offshore 2010).

3.1.2.2. Infield Support Vessel (ISV) and Dive Support Vessel (DSV)

As with the AHTS, at this stage the exact vessel specifications are not known. As such, estimates of the source levels for the ISV and DSV were based on a generic source spectrum and scaled based on thruster power comparisons.

3.1.2.2.1. Generic Offshore Vessel Source Spectrum

At the time of this study, the ISV and DSV vessels to be used in the project were unconfirmed and generic source spectrum used the estimate of the acoustic source levels for the ISV and DSV. These were estimated by scaling the spectrum based on the maximum utilised thruster power. The modelled source levels or the ISV and DSV were adjusted using Equation (1).

$$\mathrm{SL} = \mathrm{SL}_{\mathrm{ref}} + 10\log_{10}\left(\frac{P}{P_{\mathrm{ref}}}\right) \quad (1)$$

Here the modelled broadband source level (SL) was estimated from the broadband source level of the generic source (SL_{ref}) and the utilised thruster powers of the modelled ISV (or DSV) and generic sources (P and P_{ref}, respectively). The generic source spectrum for the was determined by the method described in Appendix B.2.

3.1.2.2.2. Infield Support Vessel (ISV)

The estimates of the source levels for the ISV were based on a proxy vessel, the Skandi Acergy (Figure 5) which has a total installed thruster power rating of 16,840 kW, and overall length, beam and draft of 156.9 m, 27.0 m and 8.5 m respectively. The propulsion system of the Skandi Acergy contains the following:

- 2 x 1,920 kW tunnel thrusters,
- 2 x 1,500 kW retractable azimuths,
- 2 x 3,000 kW contra-rotating azimuths,
- 1 x 4,000 kW shaft propeller + rudder.

However, while under DP the single rear main is not likely to be in use; therefore, for power scaling it was omitted. The total maximum thruster power while the ISV was on DP of 12,840 kW was used with Equation (1) for scaling.

Figure 5. Photo of the Skandi Acergy - proxy for an Infield Support Vessel (ISV).

3.1.2.2.3. Dive Support Vessel (DSV)

The estimates of the source levels for the ISV were based on a proxy vessel, the Skandi Singapore (Figure 6) which has a total installed thruster power rating of 10,500 kW, and overall length, beam and draft of 107.1 m, 21.0 m, and 6.6 m respectively. The propulsion system of the Skandi Singapore contains the following:

- 2 x 1500 kW bow tunnel thrusters,
- 1 x 1,500 kW retractable azimuth thruster,
- 2 x 3,000 kW stern azimuths thruster.

The total maximum thruster power while the DSV was on DP of 10,500 kW was used for with Equation (1) for scaling.

Figure 6. Photo of the Skandi Singapore proxy for a Dive Support Vessel (DSV).

3.2. Geometry and Modelled Regions

JASCO's Marine Operations Noise Model (MONM-BELLHOP; see Appendices B.3.2 and B.3.4) was used to predict the acoustic field at frequencies of 10 Hz to 25 kHz for all vessels. To supplement the MONM results, high-frequency results for propagation loss were modelled using Bellhop for frequencies from 1.26 to 25 kHz. The sound field modelling calculated propagation losses up to 100 km from the source, with a horizontal separation of 20 m between receiver points along the modelled radials. The sound fields were modelled with a horizontal angular resolution of $\Delta\theta$ = 2.5° for a total of N = 144 radial planes. Receiver depths were chosen to span the entire water column over the modelled areas, from 2 m to a maximum of 2600 m. To supplement the MONM results, high-frequency results for propagation loss were modelled using BELLHOP (Porter and Liu 1994) for frequencies from 1.25 to 10 kHz. The MONM and BELLHOP results were combined to produce results for the full frequency range of interest. For sites where the seabed geoacoustic model consisted of bare calcarenite, an additional broadband correction was applied to the results from MONM-BELLHOP to better account for the additional propagation loss associated with a limestone (calcarenite) seabed (see Appendix B.3.4).

To produce the maps of received sound level isopleths, and to calculate distances to specified sound level thresholds, the maximum-over-depth level was calculated at each sampling point within the modelled region. The radial grids of maximum-over-depth levels were then resampled (by linear triangulation) to produce a regular Cartesian grid. The contours and threshold ranges were calculated from these grids of the modelled acoustic fields.

3.3. Accumulated SEL

In this study, the sound sources were considered to be continuously operating with new sound energy constantly being introduced to the environment. The reported source levels are usually in terms of sound pressure levels (SPL), representing the average instantaneous acoustic level of a considered source. The evaluation of the cumulative sound field (i.e., in terms of SEL_{24h}) depends on the number of seconds of operation during the accumulation period.

For all stationary source (MODU and vessels), the SPL modelling results were converted to SEL by the duration of the measurement, which is appropriate for a non-impulsive noise source. As SEL was assessed over 24 h and for a stationary vessel over a day, the conversion from SPL was obtained by increasing the levels by $10*\log_{10}(T)$, where T is 86,400 (the number of seconds in 24 h). For scenarios where a vessel was transiting along a track a similar adjustment to the SPL was applied, however the time factor was determined based on the step size along the track and the vessel's speed. See Appendix B.2.2 for detail.

4. Results

The maximum-over-depth sound fields for the modelled scenarios are presented below in two formats: as tables of distances to sound levels and, where the distances are long enough, as contour maps showing the directivity and range to various sound levels.

For the results below, the distances to isopleths/thresholds were reported from either the centroid of several sources or from the most dominant single source. When an isopleth completely envelopes multiple sources the centroid was used. When several closed isopleths exist the most dominant source was used. Maps and are provided in Section 4.2 to assist in with contextualising tabulated distances.

4.1. Tabulated Results

Tables 9–11 present the maximum and 95% distances to SPL. The SPL sound footprints presented represent the instantaneous sound field and do not depend on time accumulation. Tables 12–14 present the maximum distances to frequency-weighted SEL_{24h} thresholds, as well as total ensonified area.

Table 9. *Annie-2, SPL*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from most appropriate location for considered sources per scenario. Scenario descriptions are given in Table 4.

SPL (L_p; dB re 1 µPa)	Annie-2									
	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	–	–	–	–	–	–
170[a]	–	–	0.02	0.02	–	–	–	–	0.03	0.03
160	–	–	0.10	0.10	–	–	–	–	0.11	0.11
158[b]	–	–	0.12	0.11	–	–	–	–	0.13	0.12
150	–	–	0.36	0.34	0.02	0.02	0.02	0.02	0.37	0.34
140	0.03	0.03	0.81	0.76	0.11	0.10	0.11	0.10	0.84	0.77
130	0.14	0.13	3.16	2.71	0.42	0.39	0.42	0.39	2.76	2.43
120[c]	0.44	0.41	7.87	7.32	1.10	1.02	1.13	1.03	7.46	7.11
110	0.96	0.92	21.3	18.5	3.54	3.24	4.43	3.99	20.9	18.4
100	2.40	2.13	79.9	61.8	8.30	7.64	9.30	8.18	79.6	61.9

[a] 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).
[b] 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).
[c] Threshold for LF, HF & VHF-cetacean behavioural response to non-impulsive noise (NOAA 2019).
A dash indicates the level was not reached within the limits of the modelled resolution (20 m).

Table 10. *Elanora-1, SPL*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from most appropriate location for considered sources per scenario. Scenario descriptions are given in Table 4.

SPL (L_p; dB re 1 µPa)	Elanora-1									
	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	–	–	–	–	–	–
170[a]	–	–	–	–	–	–	–	–	0.03	0.03
160	–	–	0.06	0.06	0.02	0.02	0.02	0.02	0.07	0.07
158[b]	–	–	0.12	0.12	0.02	0.02	0.02	0.02	0.13	0.13
150	0.02	0.02	0.41	0.39	0.02	0.02	0.02	0.02	0.42	0.40
140	0.03	0.03	1.64	1.53	0.07	0.07	0.07	0.07	1.64	1.54
130	0.17	0.16	6.53	5.88	0.50	0.47	0.50	0.48	6.20	5.77
120[c]	0.75	0.72	21.7	18.8	1.89	1.79	2.91	2.58	21.7	18.7
110	2.09	1.97	81.3	61.2	8.06	7.28	8.83	7.83	81.2	62.4
100	6.31	5.78	>100.0	/	31.4	27.7	31.9	28.1	>100.0	/

[a] 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).
[b] 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).
[c] Threshold for LF, HF & VHF-cetacean behavioural response to non-impulsive noise (NOAA 2019).
A dash indicates the level was not reached within the limits of the modelled resolution (20 m).
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 11. *Pipeline/Umbilical Lay between Annie-2 and Casino-5, ISV, and drilling operations at Elanoa-1, SPL*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from most appropriate location for considered sources per scenario. Scenario descriptions are given in Table 4.

SPL (L_p;dB re 1 µPa)	Annie-2 and Casino-5						Annie-2		Annie-2, Casino-5, and Elanora-1	
	Scenario 6						Scenario 7		Scenario 8[d]	
	Site 7		Site 8		Site 9					
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	–	–	–	–	0.02	0.02
170[a]	–	–	–	–	–	–	–	–	0.03	0.03
160	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.07	0.07
158[b]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.13	0.13
150	0.17	0.17	0.17	0.16	0.17	0.17	0.16	0.15	0.42	0.40
140	0.48	0.43	0.48	0.45	0.69	0.66	0.47	0.44	1.64	1.54
130	1.14	1.07	0.99	0.94	2.08	1.96	0.98	0.93	6.27	5.83
120[c]	2.72	2.61	2.59	2.33	5.97	5.41	2.56	2.30	30.7	28.2
110	7.34	7.11	6.61	6.09	20.2	18.2	6.47	6.08	92.0	69.8
100	21.3	17.9	16.8	15.4	63.7	52.0	17.2	15.6	>100.0	\

[a] 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).
[b] 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).
[c] Threshold for LF, HF & VHF-cetacean behavioural response to non-impulsive noise (NOAA 2019).
[d] Longest distance to threshold along the entire pipelay route is shown. See Figures 21–23 for contour maps at three points along pipelay route.
A dash indicates the level was not reached within the limits of the modelled resolution (20 m).
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 12. *Vessel Scenarios at Annie-2, SEL$_{24h}$*: Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL$_{24h}$ PTS and TTS thresholds based on Southall et al. (2019) and Finneran et al. (2017) from most appropriate location for considered sources per scenario and ensonified area (km^2).

Hearing group	Frequency-weighted SEL$_{24h}$ threshold ($L_{E,24h}$; dB re 1 µPa^2·s)	Annie-2									
		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS											
LF cetaceans	199	–	–	0.31	0.285	0.02	0.001	0.02	0.001	0.18	0.064
HF cetaceans	198	–	–	0.02	0.001	0.02	0.001	0.02	0.001	0.05	0.002
VHF cetaceans	173	–	–	0.16	0.075	0.24	0.169	0.24	0.169	0.26	0.193
Otariid Seals	219	–	–	–	–	–	–	–	–	0.05	0.001
Sea turtles	220	–	–	0.02	0.001	–	–	–	–	0.05	0.001
TTS											
LF cetaceans	179	0.02	0.082	3.03	15.46	0.37	0.398	0.37	0.531	1.22	4.909
HF cetaceans	178	–	–	0.12	0.042	0.14	0.055	0.14	0.055	0.16	0.076
VHF cetaceans	153	–	–	0.83	2.087	1.11	3.857	1.15	3.871	1.13	4.026
Otariid Seals	199	–	–	0.08	0.017	0.02	0.001	0.02	0.001	0.07	0.006
Sea turtles	200	–	–	0.29	0.195	0.02	0.001	0.02	0.001	0.13	0.044

A dash indicates the level was not reached within the limits of the modelled resolution (20 m).

Table 13. *Vessel Scenarios at Elanora-1, SEL_{24h}:* Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on Southall et al. (2019) and Finneran et al. (2017) from most appropriate location for considered sources per scenario and ensonified area (km²).

Hearing group	Frequency-weighted SEL_{24h} threshold ($L_{E,24h}$; dB re 1 µPa²·s)	Elanora-1									
		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS											
LF cetaceans	199	–	–	0.32	0.312	0.02	0.001	0.02	0.001	0.15	0.070
HF cetaceans	198	–	–	0.02	0.001	0.02	0.001	0.02	0.001	0.04	0.002
VHF cetaceans	173	–	–	0.13	0.052	0.21	0.133	0.21	0.133	0.24	0.153
Otariid Seals	219	–	–	0.02	0.001	–	–	–	–	0.01	0.001
Sea turtles	220	–	–	0.02	0.001	–	–	–	–	0.01	0.001
TTS											
LF cetaceans	179	0.02	0.682	5.23	74.85	0.40	0.466	0.40	1.139	3.38	21.11
HF cetaceans	178	–	–	0.09	0.028	0.11	0.039	0.11	0.039	0.16	0.056
VHF cetaceans	153	0.01	0.035	1.58	6.044	1.54	7.373	1.57	7.480	1.67	8.184
Otariid Seals	199	–	–	0.07	0.016	0.02	0.001	0.02	0.001	0.04	0.006
Sea turtles	200	–	–	0.25	0.178	0.02	0.001	0.02	0.001	0.13	0.051

A dash indicates the level was not reached within the limits of the modelled resolution (20 m).

Table 14. *Vessel Scenarios for Pipeline/Umbilical Lay between Annie-2 and Casino-5 and ISV at Annie-2, SPL*: Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on Southall et al. (2019) and Finneran et al. (2017) from most appropriate location for considered sources per scenario and ensonified area (km²).

Hearing group	Frequency-weighted SEL_{24h} threshold ($L_{E,24h}$; dB re 1 µPa²·s)	Annie-2 and Casino-5		Annie-2		Annie-2, Casino-5, and Elanora-1	
		Scenario 6		Scenario 7		Scenario 8	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS							
LF cetaceans	199	0.02	0.23	0.08	0.021	0.15	0.300
HF cetaceans	198	–	–	0.02	0.001	0.04	0.002
VHF cetaceans	173	0.03	0.32	0.10	0.030	0.24	0.468
Otariid Seals	219	–	–	–	–	0.01	0.001
Sea turtles	220	–	–	0.02	0.001	0.01	0.001
TTS							
LF cetaceans	179	0.32	7.144	0.77	1.777	3.38	28.52
HF cetaceans	178	0.02	0.231	0.07	0.013	0.16	0.287
VHF cetaceans	153	0.24	6.496	0.62	1.161	1.67	14.68
Otariid Seals	199	–	–	0.02	0.001	0.04	0.006
Sea turtles	200	0.02	0.231	0.13	0.050	0.13	0.281

A dash indicates the level was not reached within the limits of the modelled resolution (20 m).

4.2. Sound Field Maps

Maps of the estimated sound fields, threshold contours, and isopleths of interest for SPL and SEL_{24h} sound fields are presented for the modelled vessel scenarios. In some cases, the isopleths had several contours. This can occur as a result of the reflection of the sound field off the seafloor, creating an additional ring around the initial isopleth. The first isopleth is generally axially symmetric since it spreads without the influence of the bathymetry, while the second isopleth is more complex due to the interaction between the sound field and the seabed.

4.2.1. SPL Sound level Contour Maps

Maps of the estimated sound fields, threshold contours, and isopleths of interest for SPL and SEL_{24h} sound fields are presented for the Cooper Energy Otway subsea noise modelling.

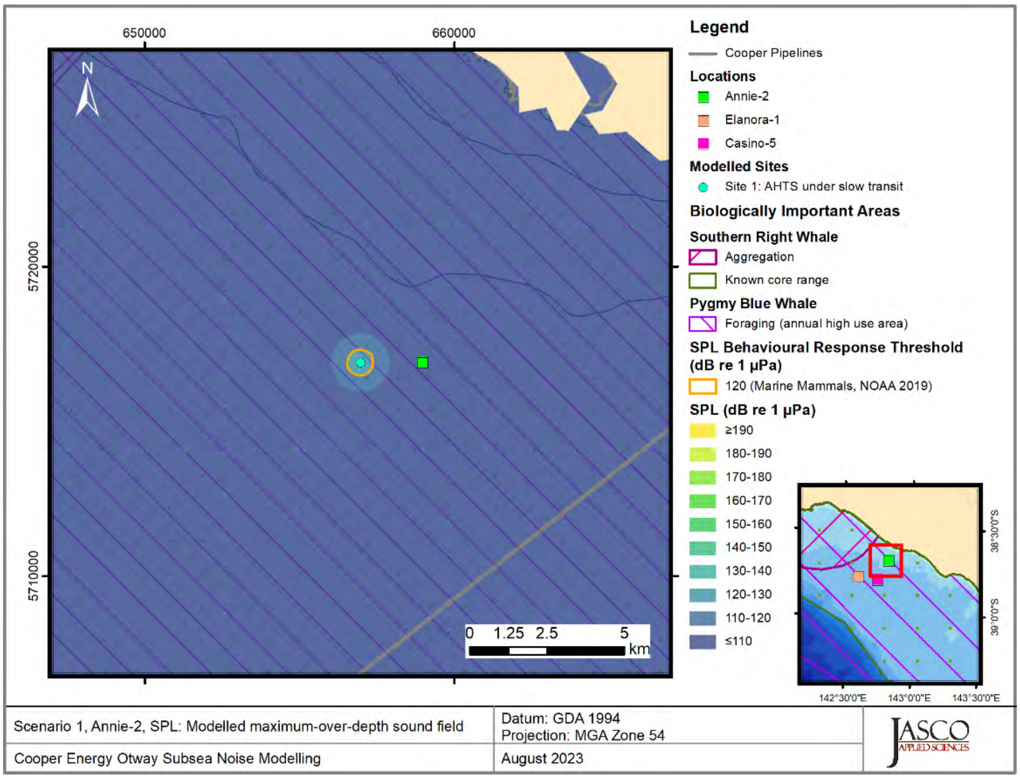

Figure 7. *Scenario 1, Drilling prelays, Annie-2, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

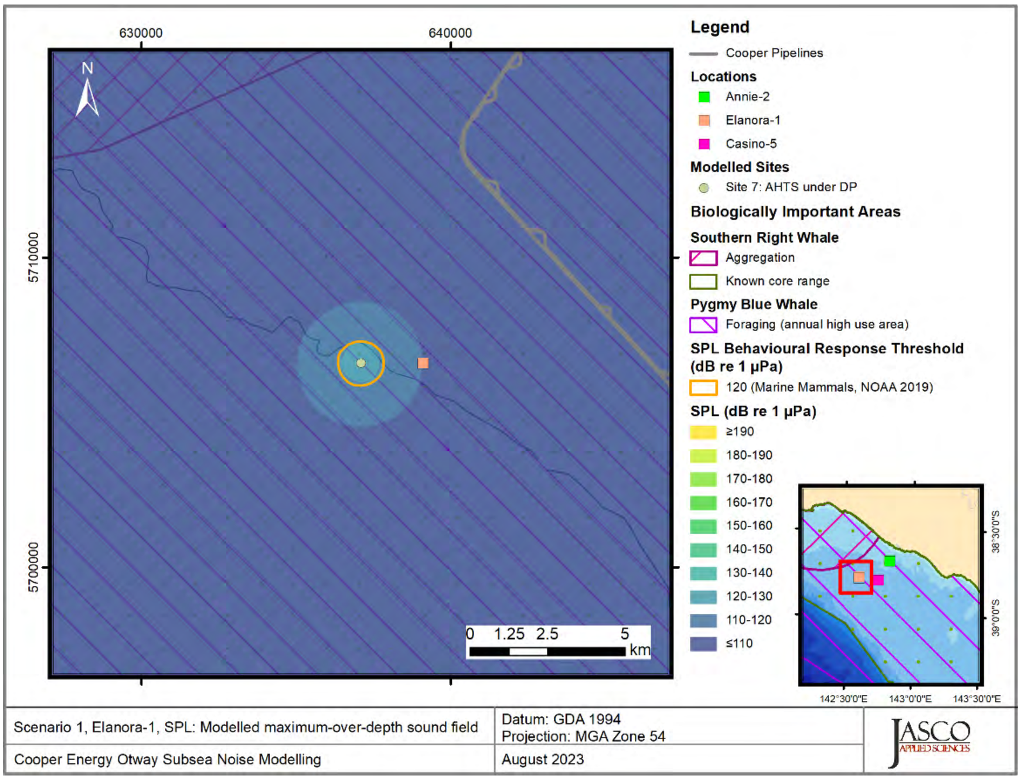

Figure 8. *Scenario 1, Drilling prelays, Elanora-1, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

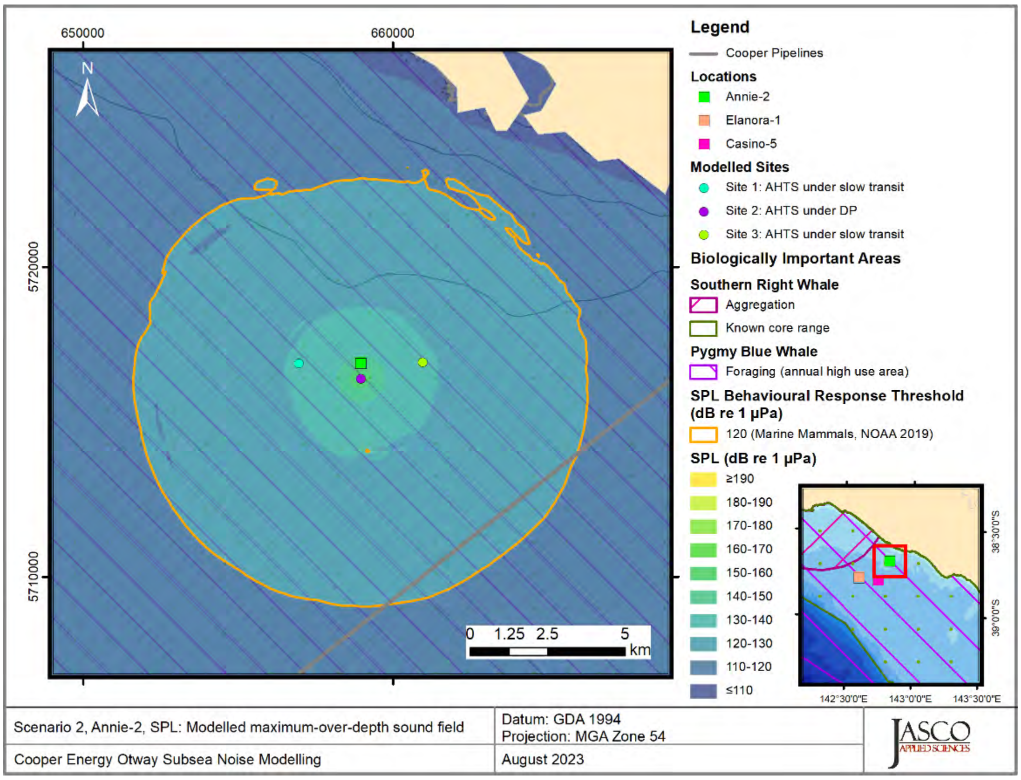

Figure 9. *Scenario 2, Mooring, Annie-2, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

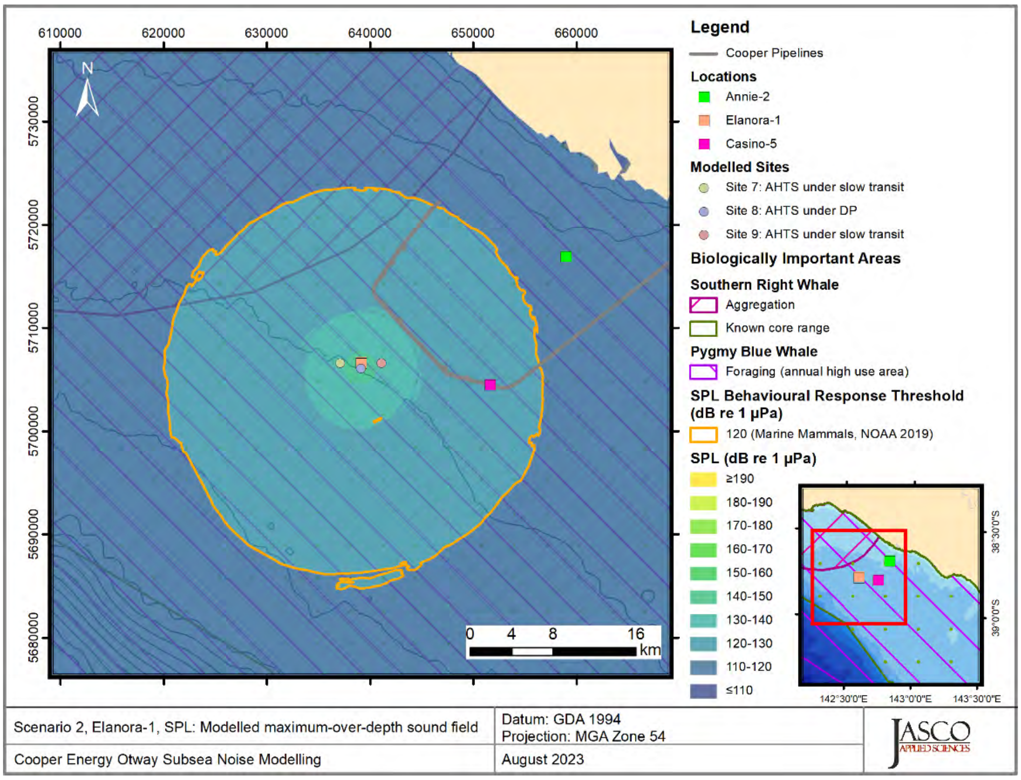

Figure 10. *Scenario 2, Mooring, Elanora-1, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

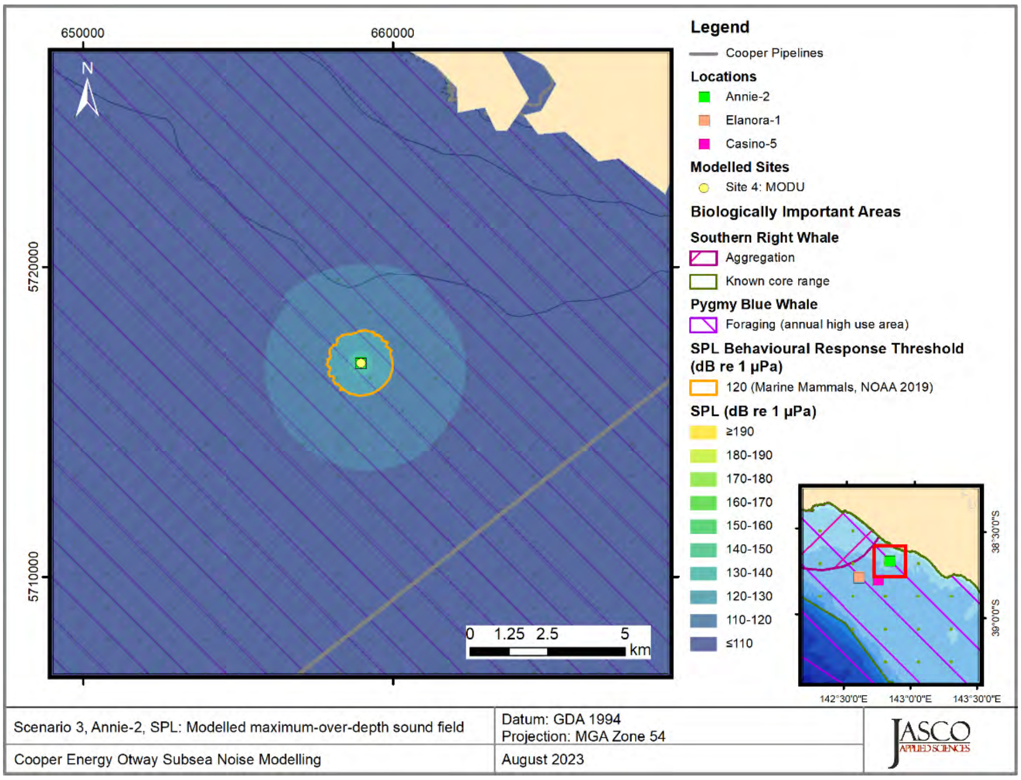

Figure 11. *Scenario 3, MODU Drilling, Annie-2, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

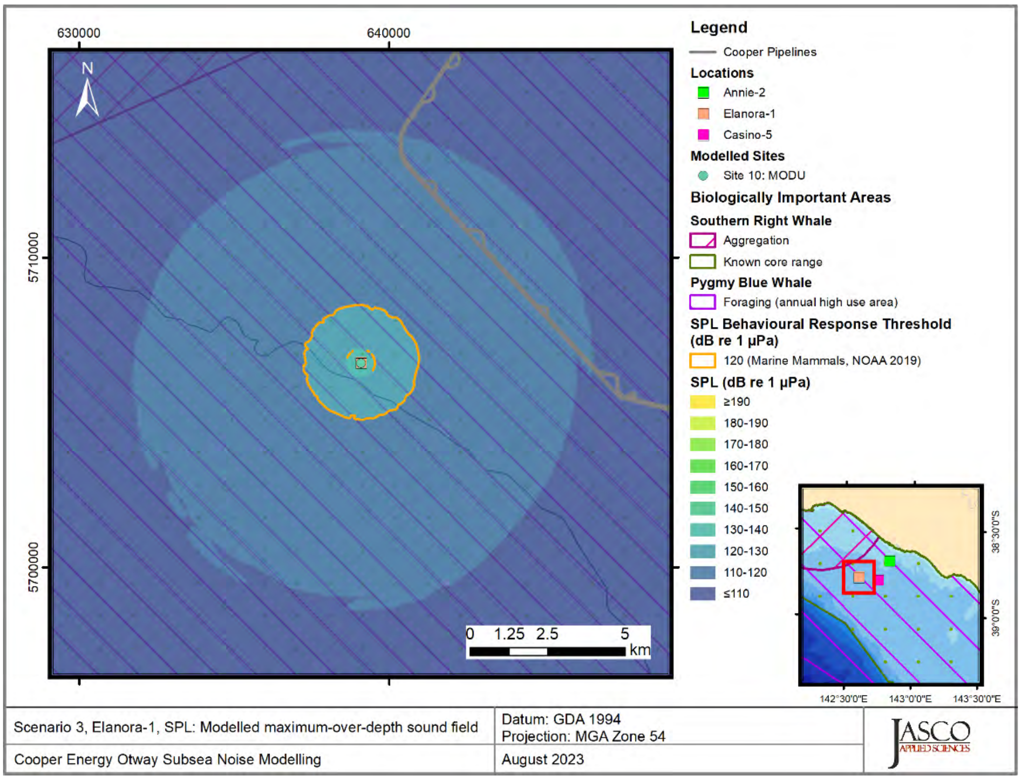

Figure 12. *Scenario 3, MODU Drilling, Elanora-1, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

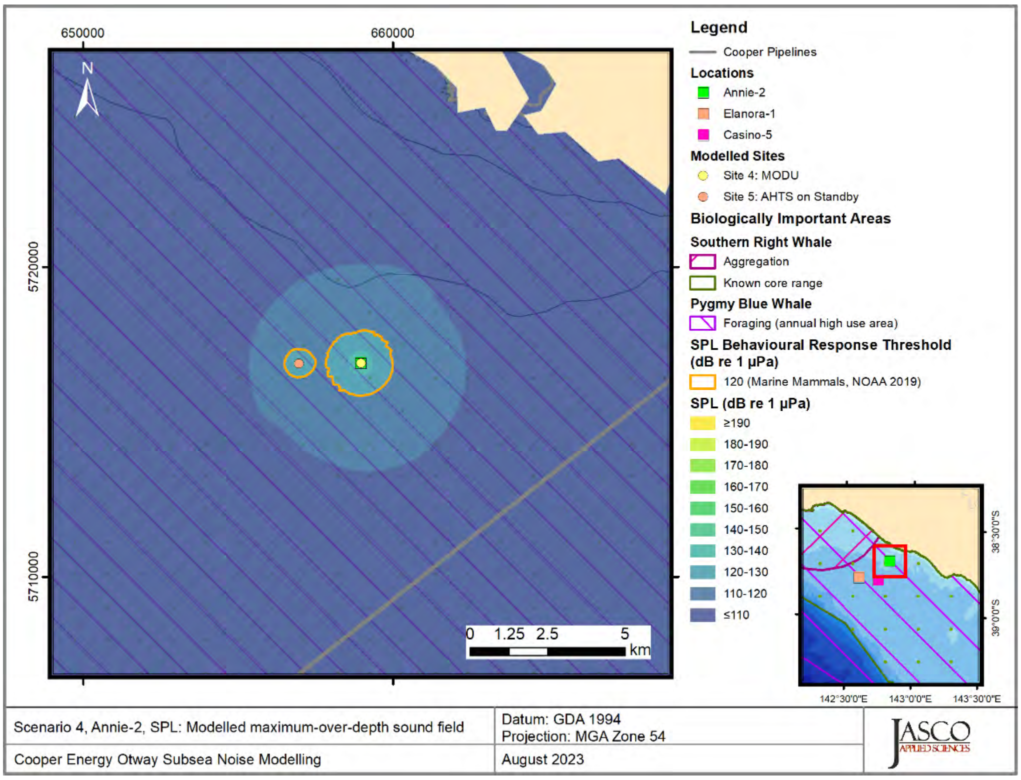

Figure 13. *Scenario 4, Drilling and standby OSV, Annie-2, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

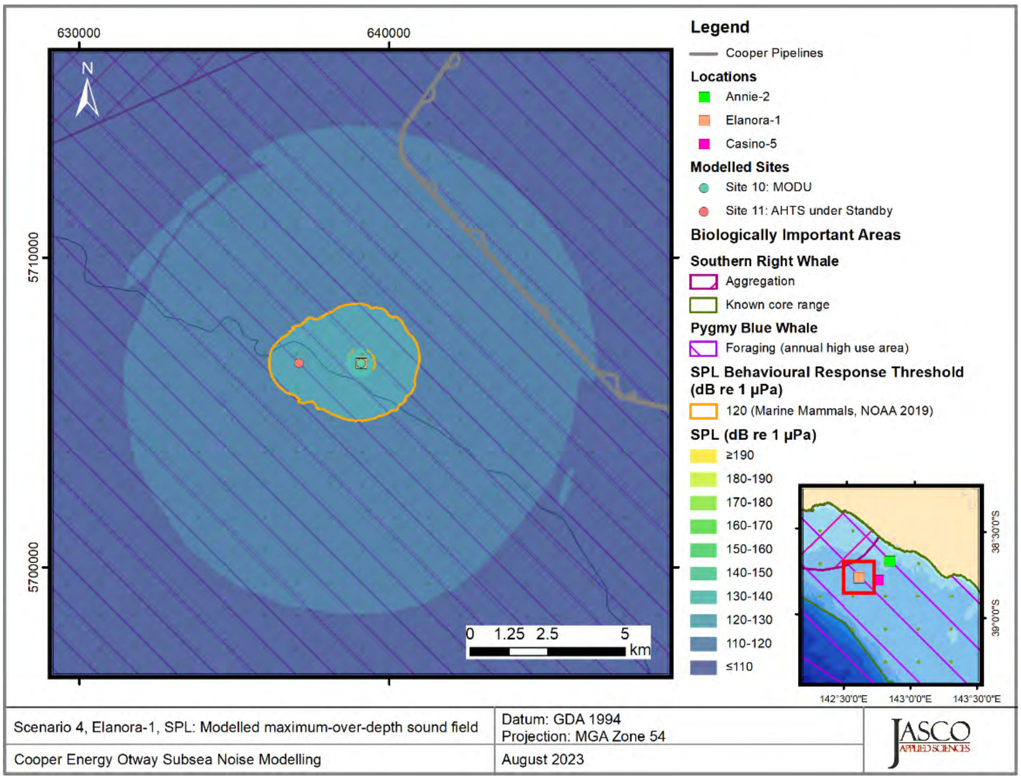

Figure 14. *Scenario 4, Drilling and standby OSV, Elanora-1, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

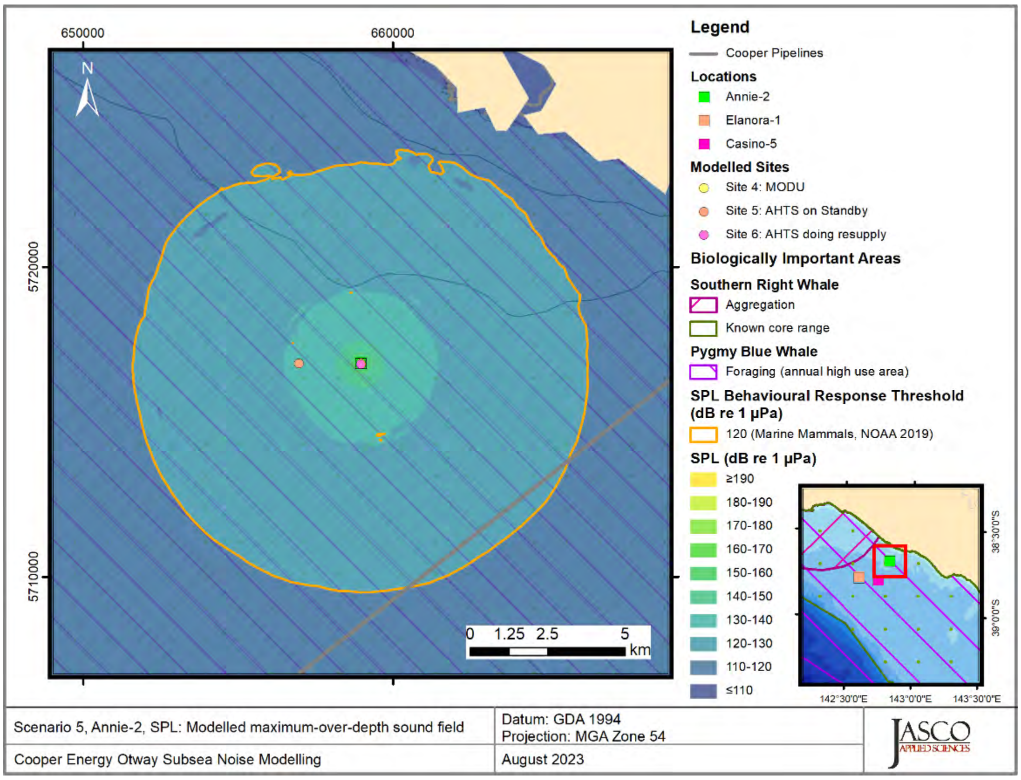

Figure 15. *Scenario 5, Drilling and standby OSV during resupply, Annie-2, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

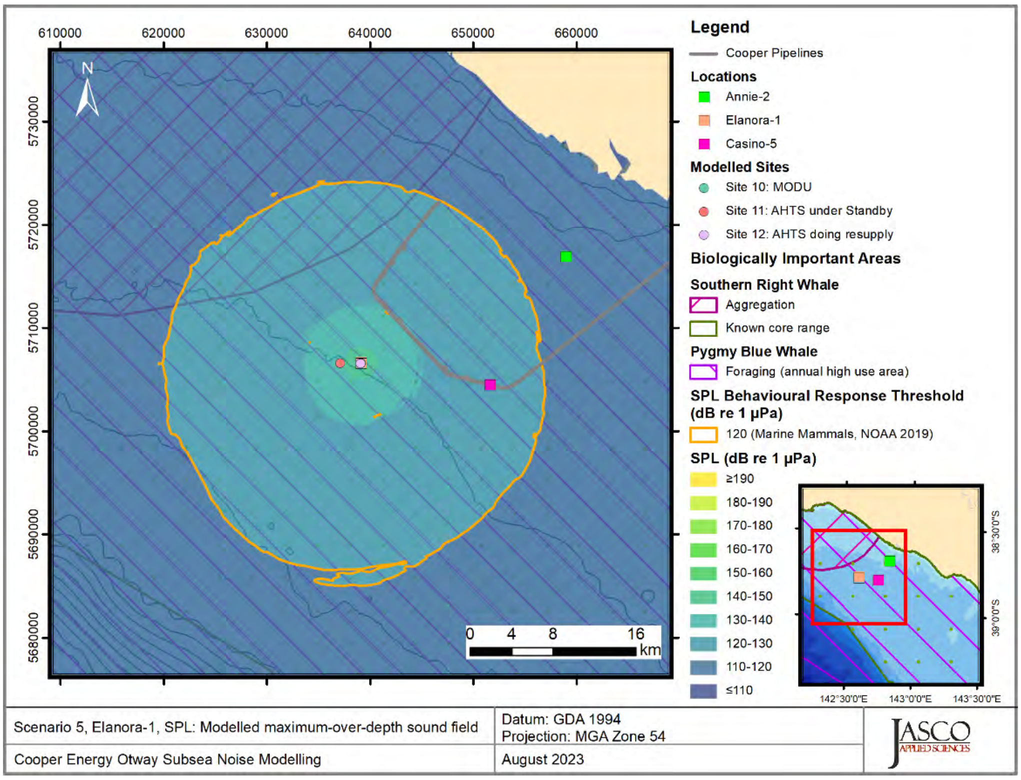

Figure 16. *Scenario 5, Drilling and standby OSV during resupply, Elanora-1, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

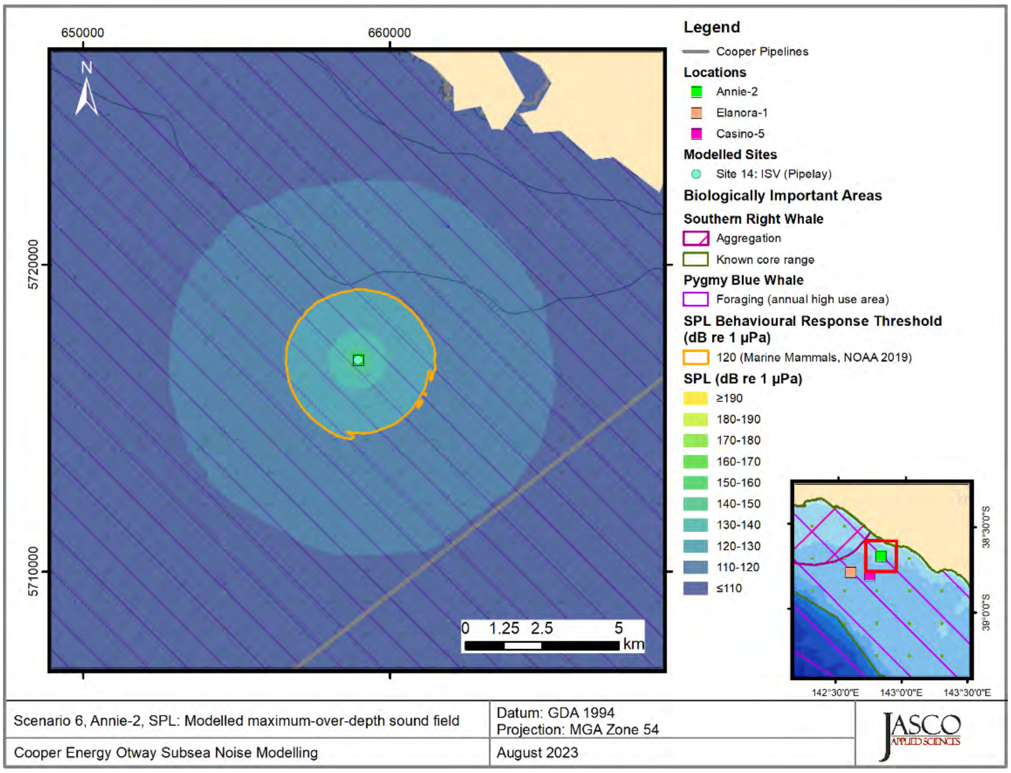

Figure 17. *Scenario 6, Pipelay installation – start, Annie-2, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

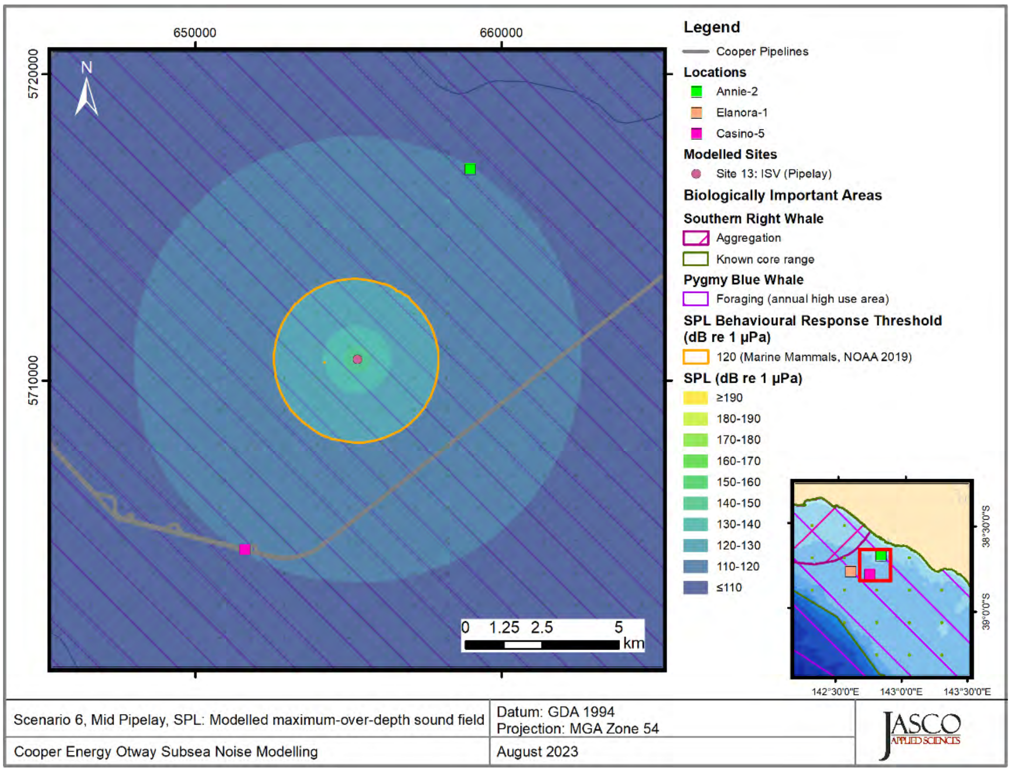

Figure 18. *Scenario 6, Pipelay installation – mid, Casino-5, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

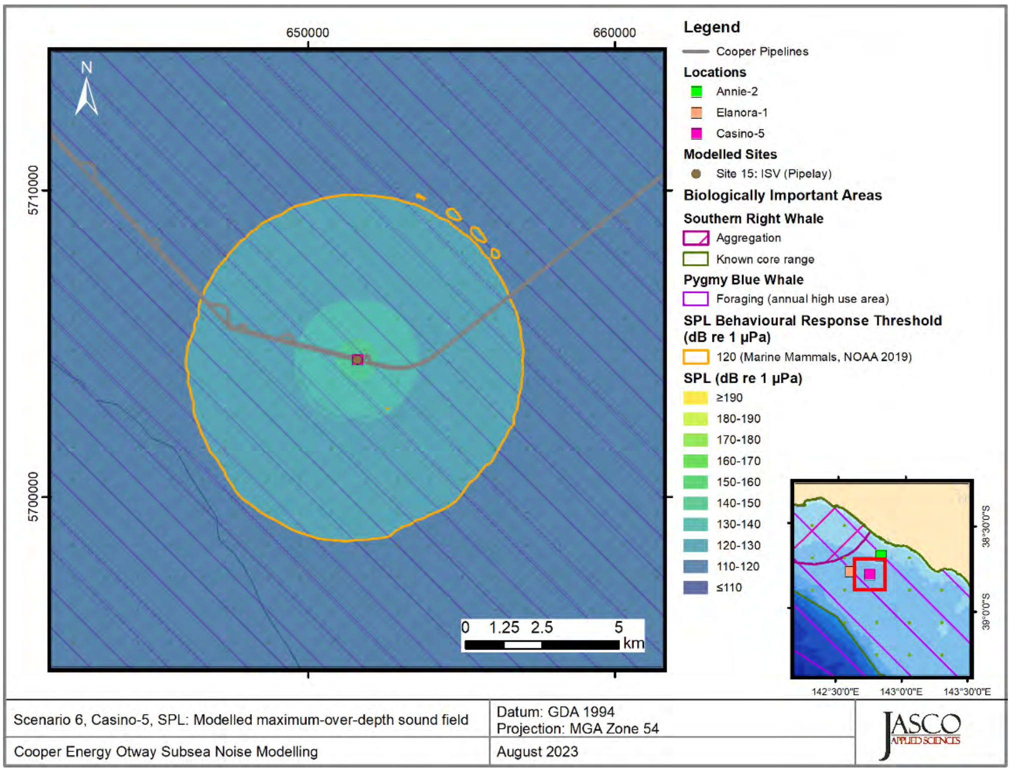

Figure 19. *Scenario 6, Pipelay installation – end, Casino-5, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

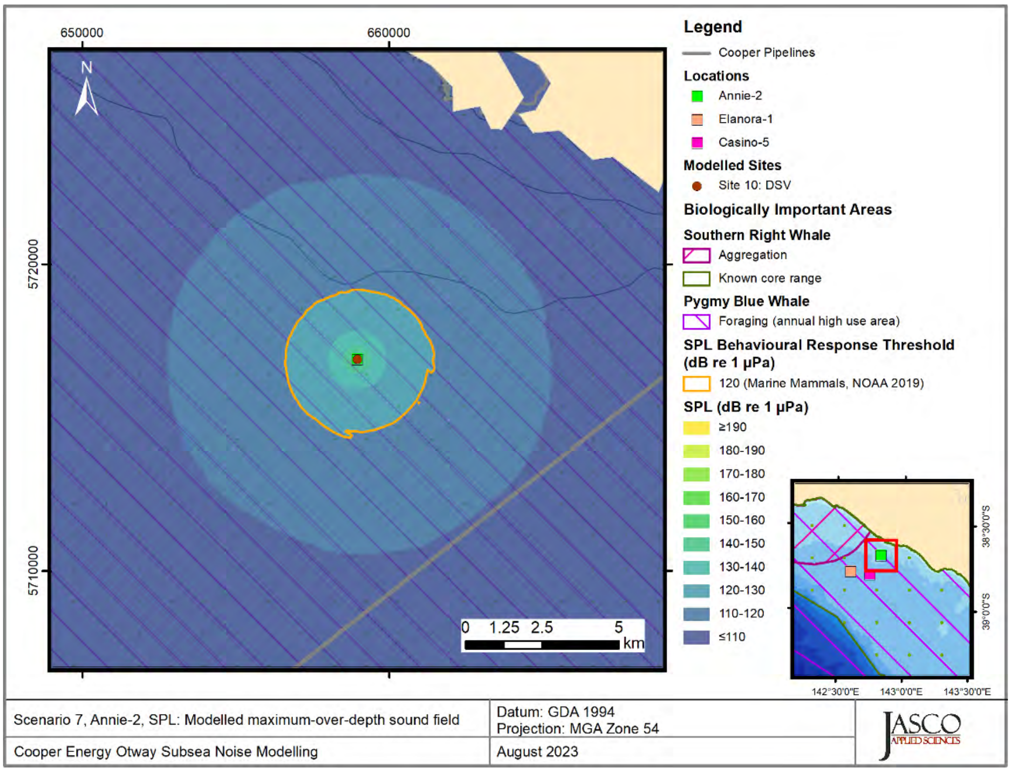

Figure 20. *Scenario 7, Installation, Annie-2, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

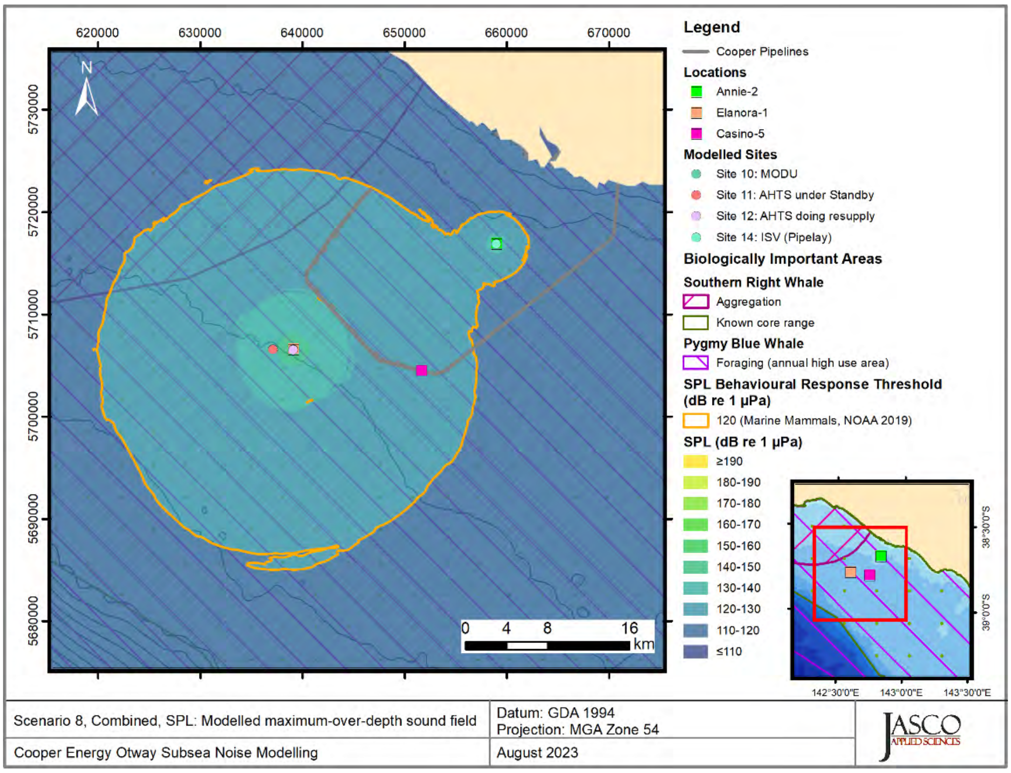

Figure 21. *Scenario 8, Drilling and standby OSV during resupply and pipelay – start, Elanora-1 and Casino-5, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

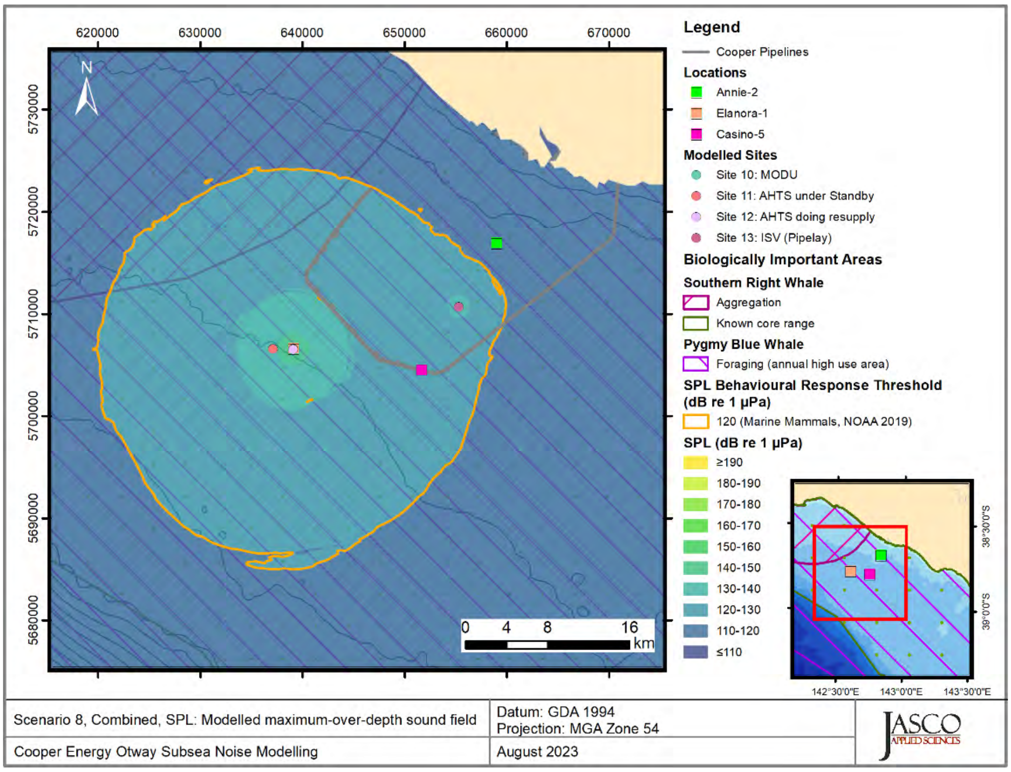

Figure 22. *Scenario 8, Drilling and standby OSV during resupply and pipelay – mid, Elanora-1 and Casino-5, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

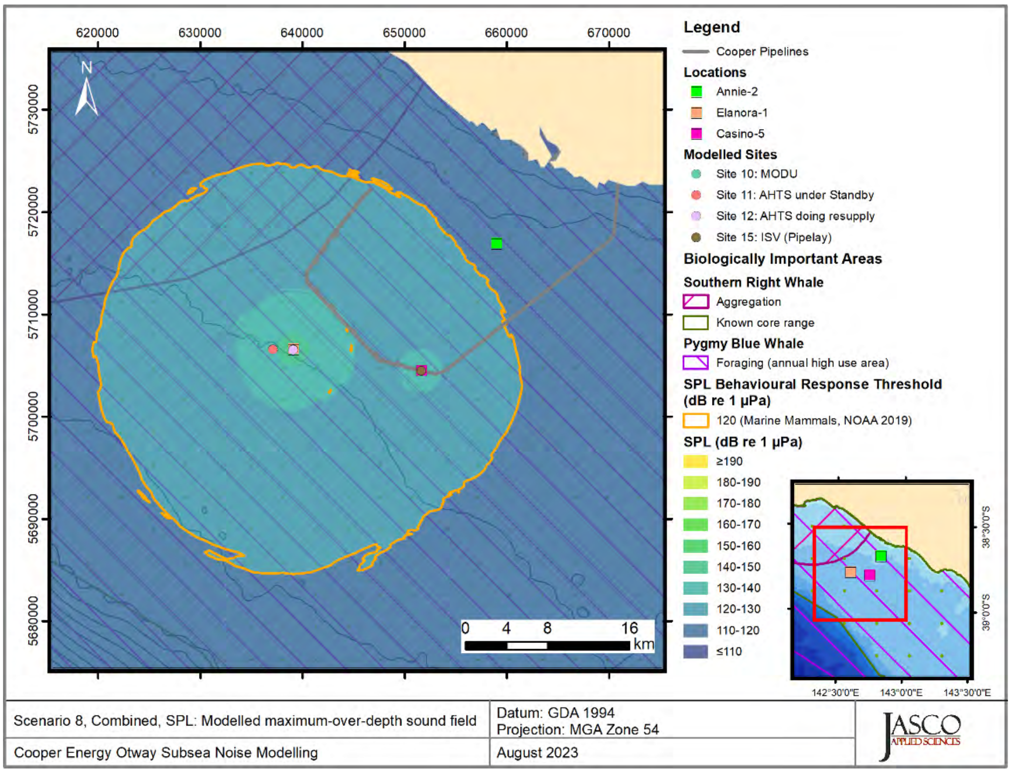

Figure 23. *Scenario 8, Drilling and standby OSV during resupply and pipelay – end, Elanora-1 and Casino-5, SPL*: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response threshold for marine mammals.

4.2.2. Accumulated SEL$_{24h}$ Sound level Contour Maps

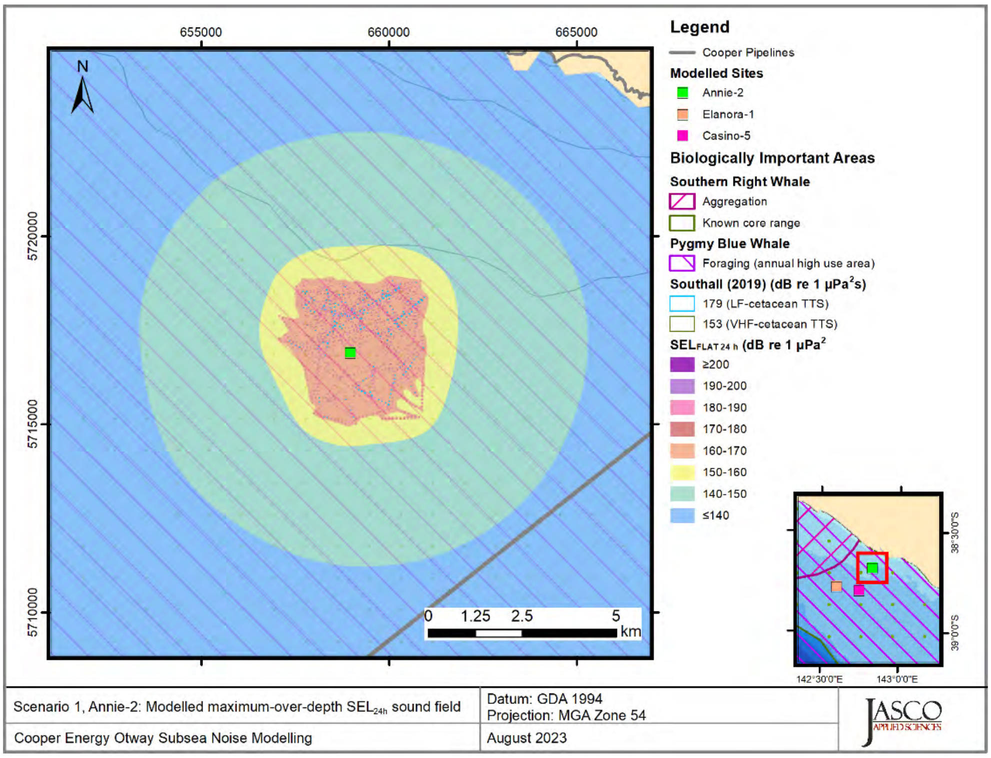

Figure 24. *Scenario 1, Drilling prelays, Annie-2, accumulated SEL$_{24h}$*: Sound level contour map showing weighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

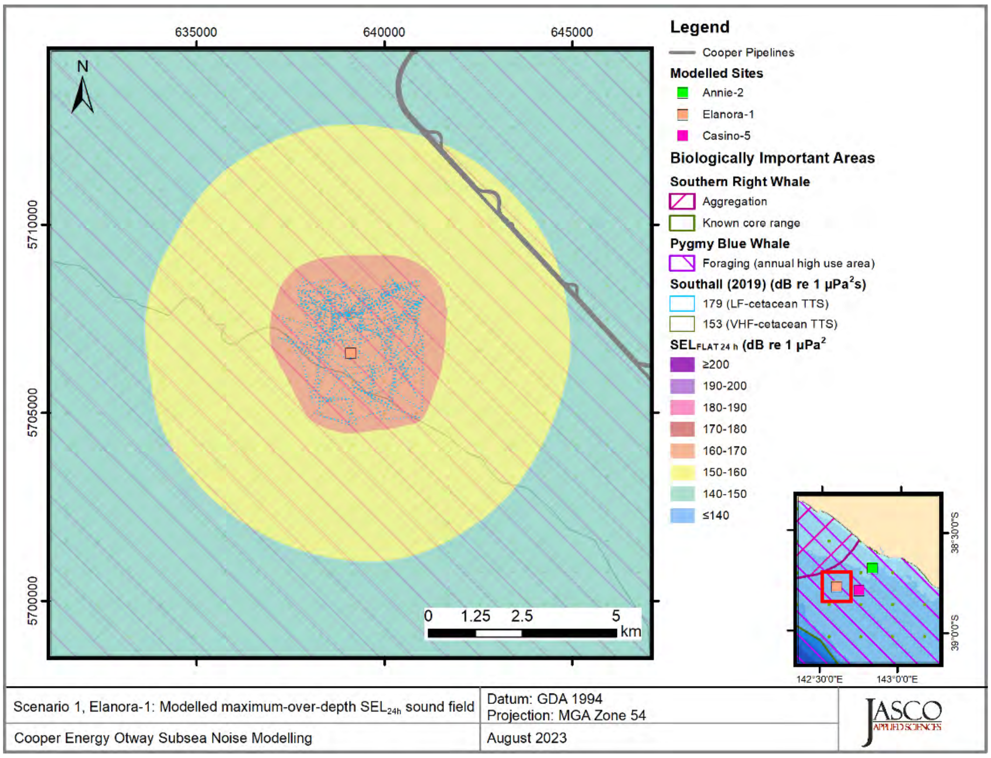

Figure 25. *Scenario 1, Drilling Prelays, Elanora-1, accumulated SEL$_{24h}$*: Sound level contour map showing weighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

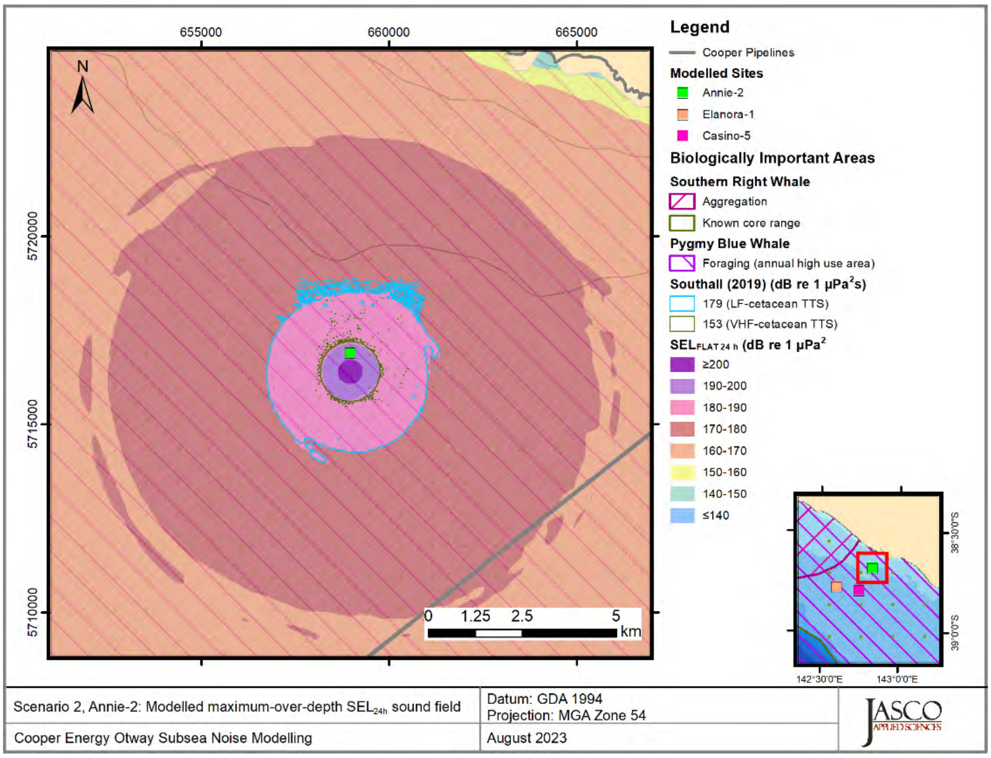

Figure 26. *Scenario 2, Mooring, Annie-2, accumulated SEL$_{24h}$*: Sound level contour map showing weighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

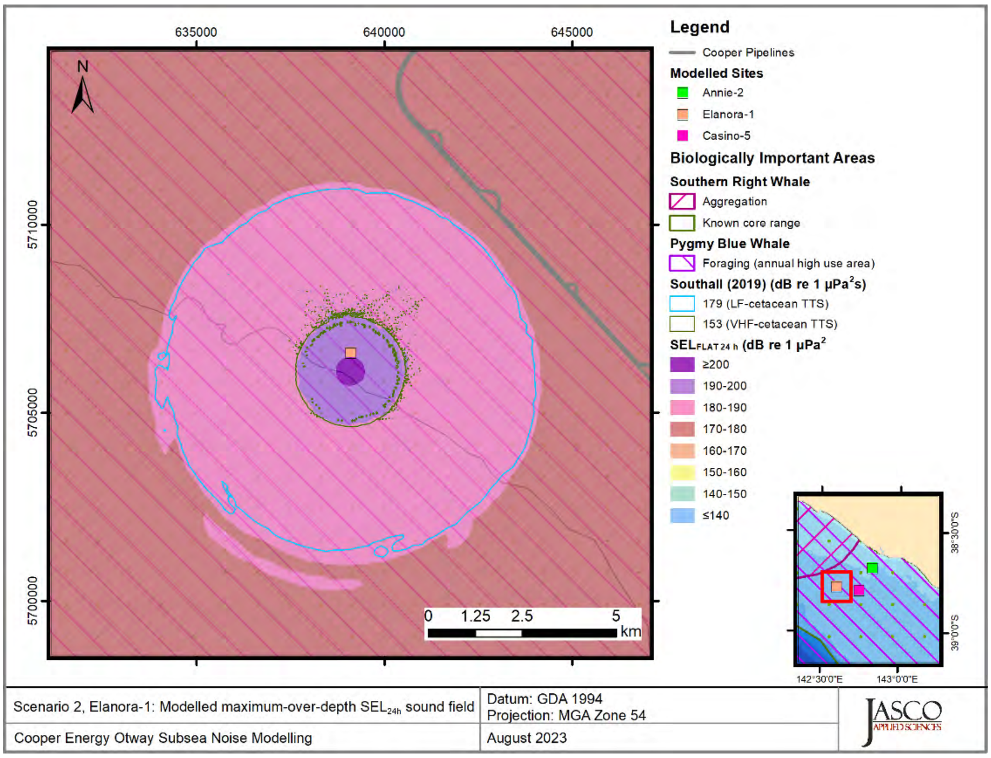

Figure 27. *Scenario 2, Mooring, Elanora-1, accumulated SEL$_{24h}$*: Sound level contour map showing weighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

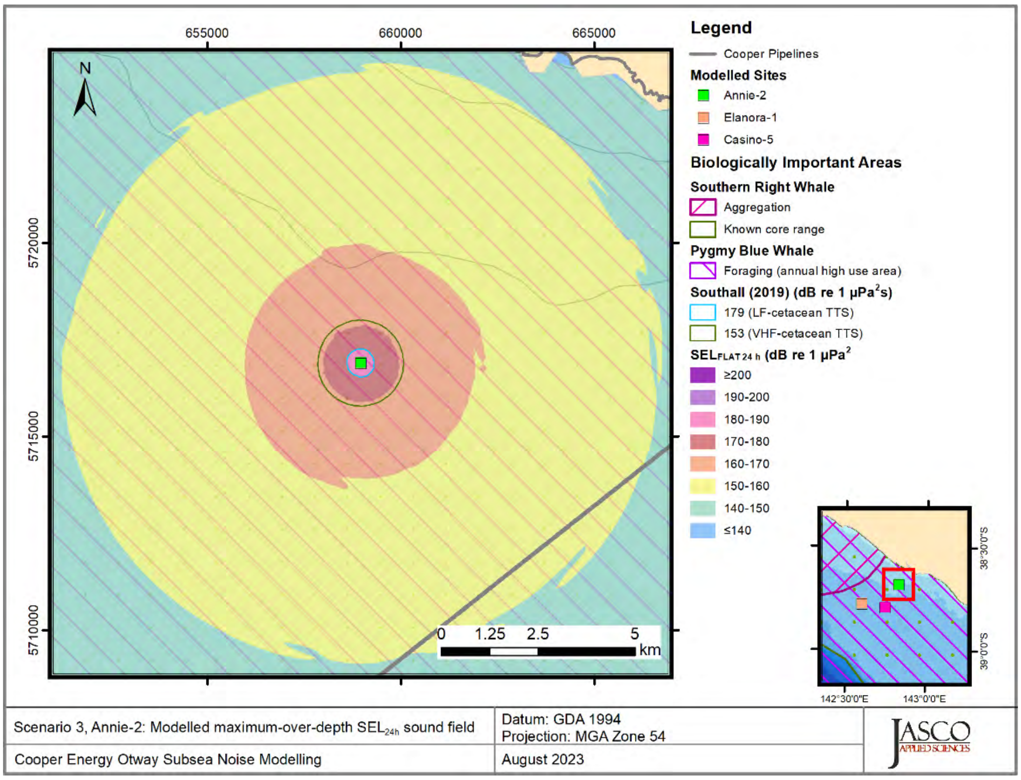

Figure 28. *Scenario 3, MODU Drilling, Annie-2, accumulated SEL_{24h}*: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

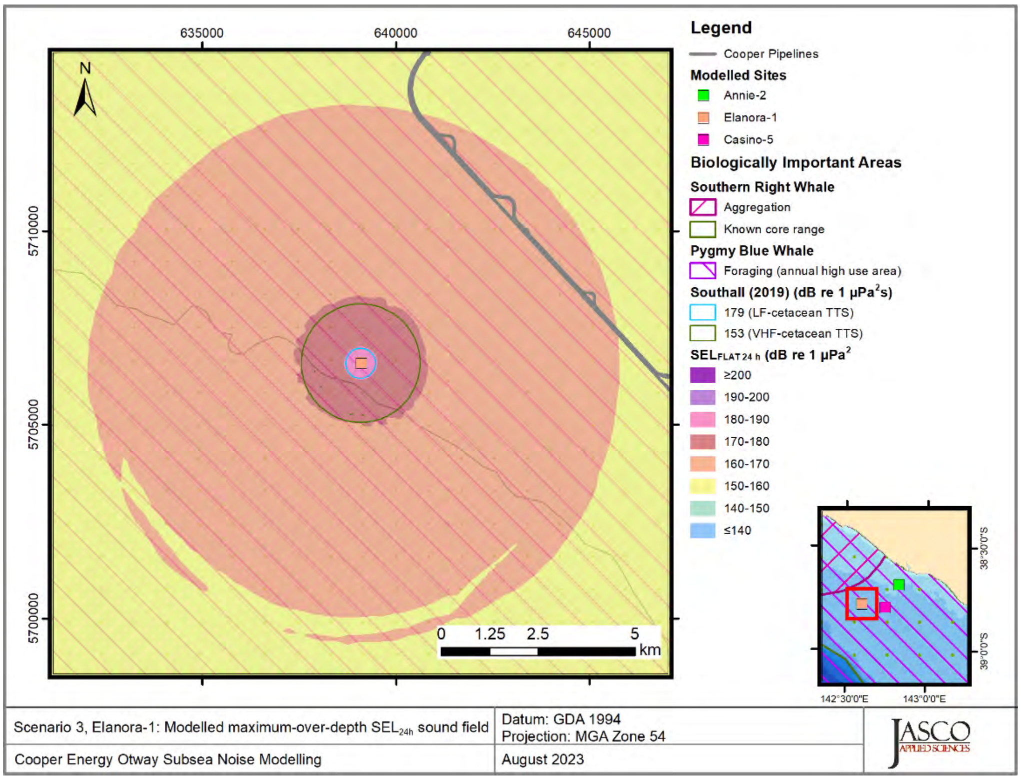

Figure 29. *Scenario 3, MODU Drilling, Elanora-1, accumulated SEL_{24h}*: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

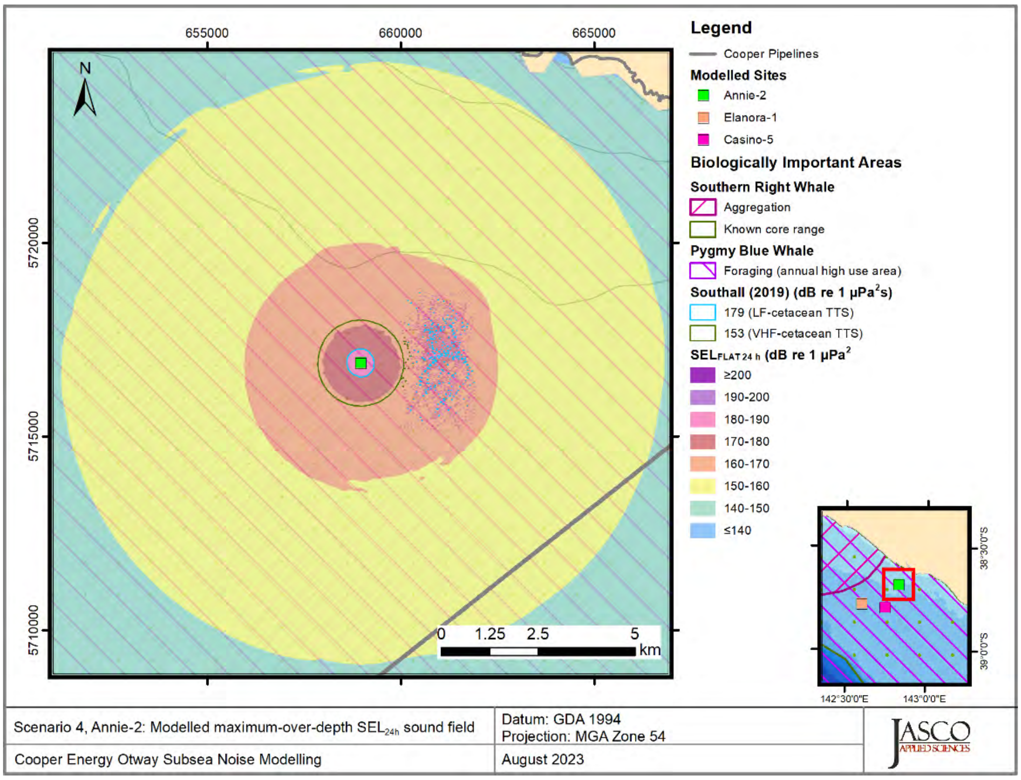

Figure 30. *Scenario 4, Drilling and standby OSV, Annie-2, accumulated* SEL_{24h}: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

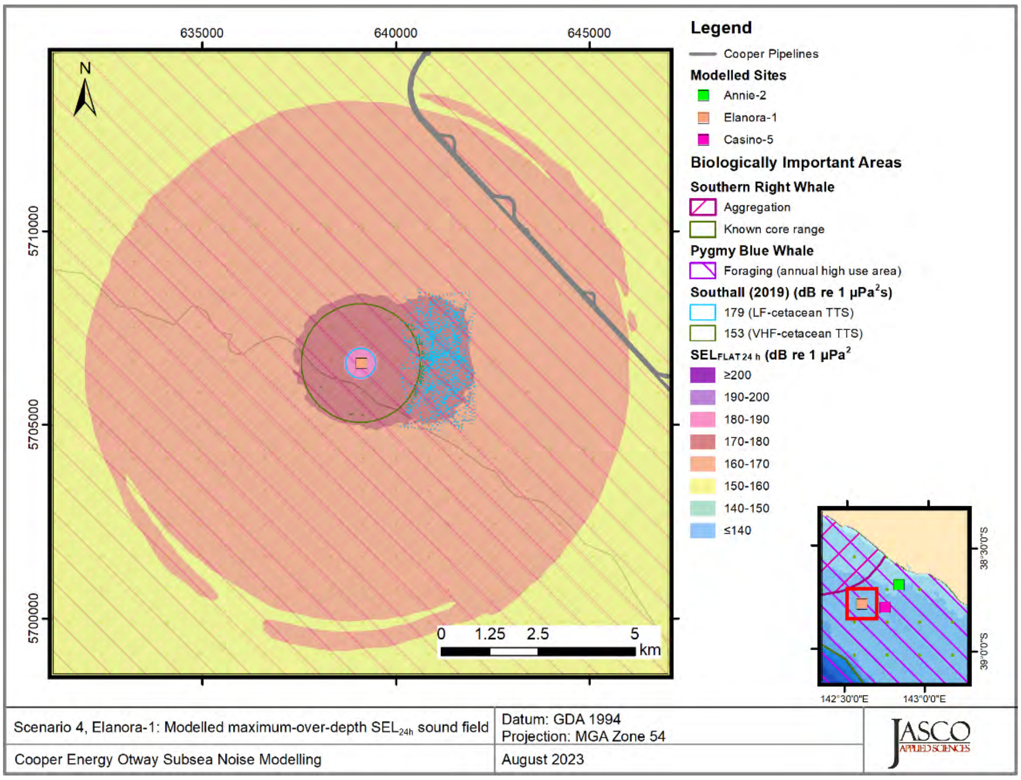

Figure 31. *Scenario 4, Drilling and standby OSV, Elanora-1, accumulated* SEL_{24h}: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

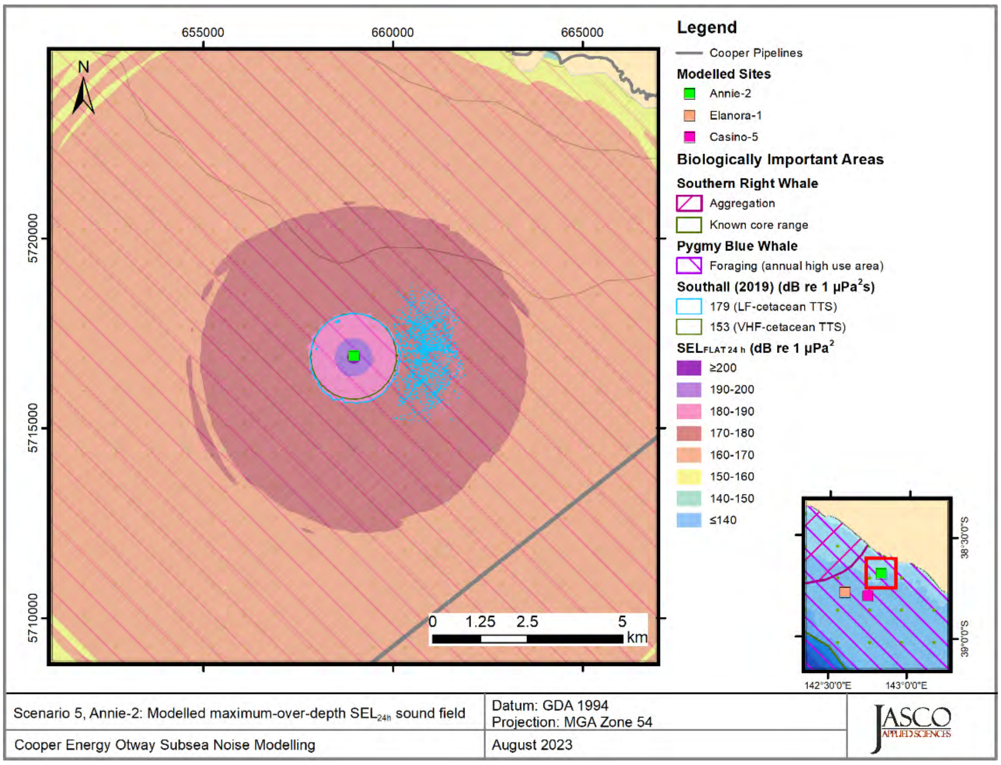

Figure 32. *Scenario 5, Drilling and standby OSV during resupply, Annie-2, accumulated SEL_{24h}*: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

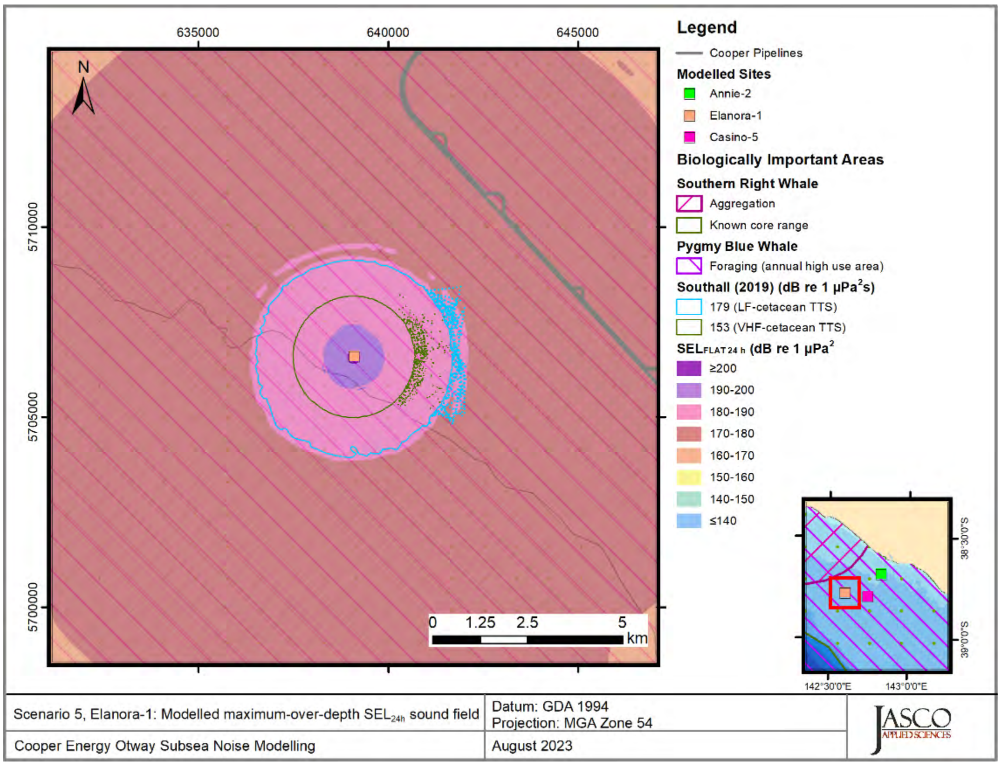

Figure 33. *Scenario 5, Drilling and standby OSV during resupply, Elanora-1, accumulated SEL_{24h}*: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

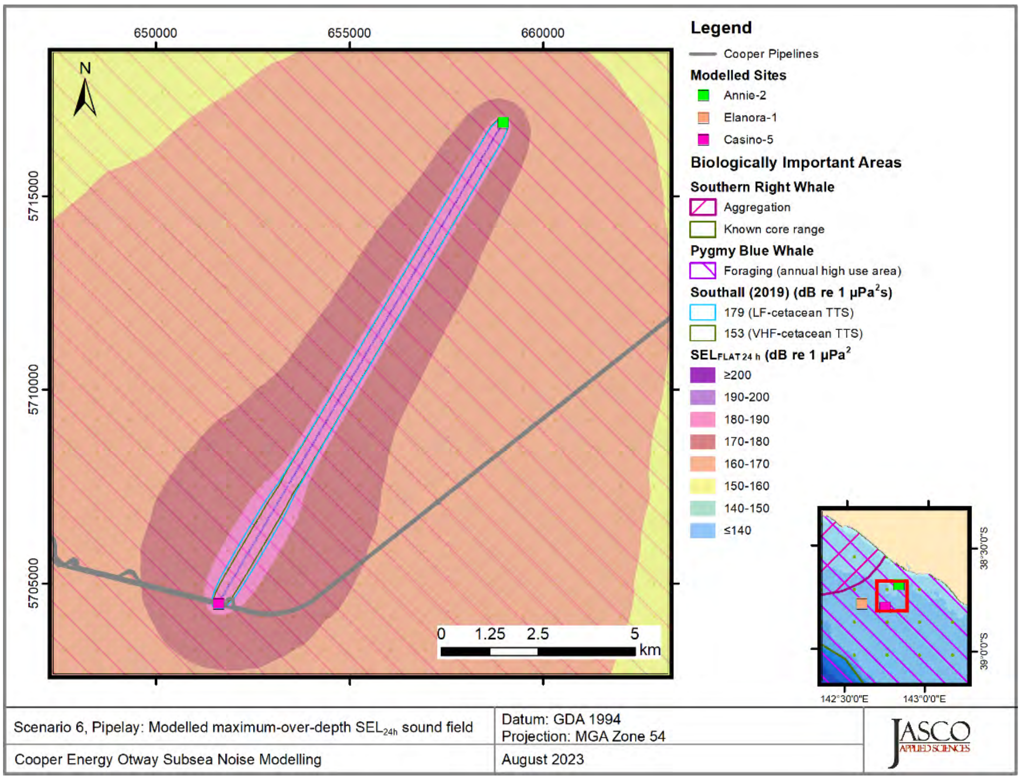

Figure 34. *Scenario 6, Pipeline/Umbilical installation*, Annie-2 & Casino-5*, accumulated* SEL_{24h}: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

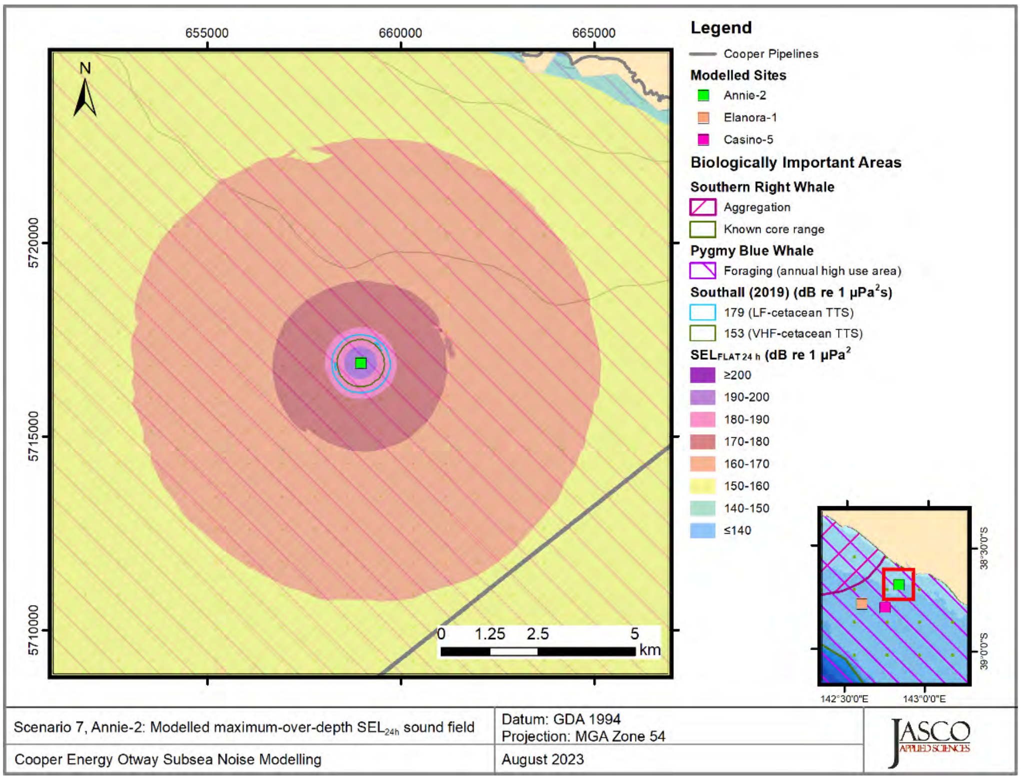

Figure 35. *Scenario 7, Installation, Annie-2, accumulated* SEL_{24h}: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

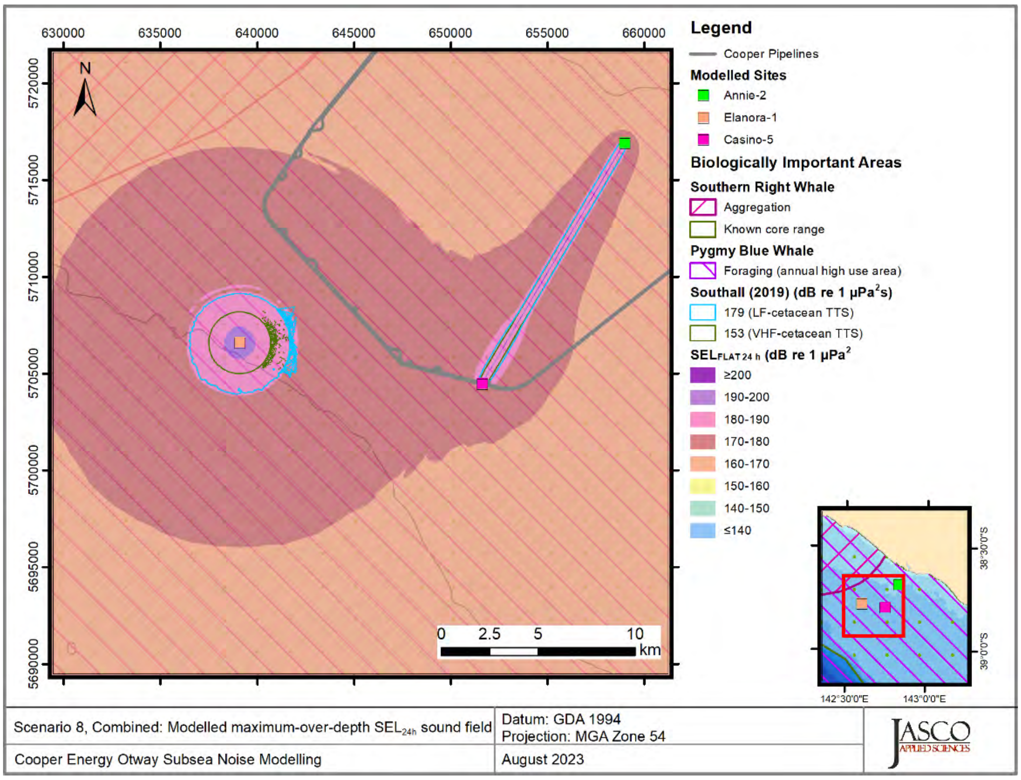

Figure 36. *Scenario 8, Drilling and standby OSV during resupply and pipelay, Elanora-1 and between Annie-2 and Casino-5, accumulated* SEL_{24h}: Sound level contour map showing weighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS in low and very-high-frequency cetaceans. Thresholds omitted here were not reached or not long enough to display graphically.

5. Discussion and Conclusion

The sound speed profile (Appendix B.1.2) was derived from data from the U.S. Naval Oceanographic Office's Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). The month of August was chosen based on an analysis of the temperature, salinity, and sound speed profiles extracted from this database. The final profile consisted of a combination of three representative profiles from within the modelled area to capture the propagation effects associated with shallow and deep-water areas.

The August sound speed profile was primarily upward refracting between the sea surface and 160 m water depth. The upward refracting section of the profile may result in energy being refracted away from the seabed and back into the water column, which can lead to large distances to isopleths compared to other months. The upward refracting sound speed profile has the potential trap frequencies above 93 Hz based on the thickness of the refracting layer (Jensen et al. 2011). These frequencies also correspond to the majority of the highest spectral levels for the considered sources detailed in Section 3.1, which can further enhance large distances to isopleths and criteria compared to other months.

Considering activity locations are situated on the continental shelf, variations in bathymetry were generally gradual within the modelled areas. Any variations in the bathymetry had a small effect on the predicted sound field footprints as manifested in the generally symmetric sound field footprints. However, the composition of the seabed used for modelling had a more substantial influence when comparing the threshold radii and sound field footprints between the Annie-2 and Elanora-1 areas. The presence of a thin veneer of un-consolidated coarse sand overlying semi-cemented carbonate rock at Elanora-1 led to a more reflective seabed and likely led to larger isopleths for low level thresholds than Annie-2. This is most evident for the marine mammal behavioural threshold of 120 dB re 1 µPa (SPL) for non-impulsive sound sources, where the Elanora-1 radii and areas are larger than Annie-2 radii and areas. However, the distribution of sand over cemented carbonate appears to be variable in the Otway Basin; (McPherson et al. 2021). Towards the Elanora-1 area, for simplicity, modelling has assumed a sand layer throughout the area. In reality, the sand layer may be present or absent depending on exact location and hence radii may be smaller than predicted. In general, the sediment cover along the continental shelf of the Otway region is minimal and non-uniform (James and Bone 2010).

The modelled scenarios generally considered activities at either Elanora-1 or Annie-2. The exception are, pipelay between Annie-2 and Casino-5 and the concurrent operations with drilling activities at Elanora-1 occurring at the same time as pipelay between Annie-2 and Casino-5 (Scenario 8). The concurrent operations scenario (Scenario 8) was considered to capture what may be a worst-case occurrence, with multiple simultaneous operations occurring. Figures 21–23 show the potential difference in the SPL contours when the pipelay may occur simultaneously but at different locations along the route with drilling activities at Elanora-1. These contours can be compared to Figure 15 for the same drilling activities at occurring only at Elanora-1. Whilst the total ensonified area and isopleth contours do increase when activities at Elanora-1 are considered with pipelay between Annie-2 and Casino-5, the resultant contours to isopleths like the behavioural response criteria of 120 dB re 1 µPa (SPL) do not significantly change. This is likely due to the activities at Elanora-1 occurring over a more reflective seabed, as discussed above, and containing louder sources than the pipelay activity. Within this modelled scenario activities at Elanora-1 are predicted to be the dominant contributor to the sound field. For PTS and TTS thresholds, for all considered hearing groups, Figure 36 show the result of the concurrent operations scenario. The additional energy that is included by considering both sets of operations simultaneously is not substantial enough to increase the size of contours such that they join. As such, for the considered concurrent scenario, the distances to PTS and TTS thresholds are approximately the same whether activities occur independently or simultaneously.

For the tables presented in Section 4.1, where a dash is used in place of a horizontal distance, these thresholds may or may not be reached. Due to the discretely sampled 20 m calculation grids of the modelled sound fields, distances to these levels could not be estimated for practicable computational purposes. It is likely that SPL isopleths could be reached at distances between the source and the modelled horizontal resolution (20 m); however, distances to injurious accumulated SEL thresholds may not be reached at any range greater than the source due the species-specific frequency weighing functions. Additionally, if close-to-source radii are comparable to the dimensions of the modelled vessel (MODU, AHTS, ISV or DSV) then they may only be reached within close proximity to a vessel, if at all.

The key results of this modelling study are summarised in Tables 15 and 16 below. These tables present the maximum distances to relevant criteria and/or thresholds. Table 15 summarises scenarios 1–7 and associated operations which may occur at Annie-2, Elanora-1, and pipelay between Annie-2 and Casino-5. Table 16 summarises potential concurrent drilling operations at Elanora-1 and pipelay operations between Annie-2 and Casino-5.

Table 15. Summary of maximum (R_{max}) horizontal distances (in km) to the behavioural response threshold, temporary threshold shift (TTS) and permanent threshold shift (PTS) for marine mammals. The maximum across scenarios 1–7 at Annie-2, Elanora-1, and pipelay between Annie-2 and Casino-5 are reported here.

Hearing group	Modelled distance to effect threshold (R_{max})					
	Behavioural response[a]	TTS[b]	PTS[b]	Behavioural response[a]	TTS[b]	PTS[b]
	Annie-2			Elanora-1		
Low-frequency (LF) cetaceans	7.87	3.03	0.31	21.7	5.23	0.32
High-frequency (HF) cetaceans		0.16	0.05		0.16	0.04
Very High-frequency (VHF) cetaceans		1.15	0.26		1.67	0.24
Otariid Seals		0.08	0.05		0.07	0.02

Noise exposure criteria: [a] NOAA (2019) and [b] Southall et al. (2019).

Table 16. Summary of maximum (R_{max}) horizontal distances (in km) to the behavioural response threshold, temporary threshold shift (TTS) and permanent threshold shift (PTS) for marine mammals. For the concurrent scenario (Scenario 8) with drilling at Elanora-1 and pipelay between Annie-2 and Casino-5

Hearing group	Modelled distance to effect threshold (R_{max})		
	Behavioural response[a]	TTS[b]	PTS[b]
	Concurrent		
Low-frequency (LF) cetaceans	30.7	3.38	0.15
High-frequency (HF) cetaceans		0.16	0.04
Very High-frequency (VHF) cetaceans		1.67	0.24
Otariid Seals		0.04	0.01

Noise exposure criteria: [a] NOAA (2019) and [b] Southall et al. (2019).
This scenario is a combination of Scenario 5 at Elanora-1 and Scenario 6 to represent concurrent operations.

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Appendix A. Acoustic Metrics

This section describes in detail the acoustic metrics, impact criteria, and frequency weighting relevant to the modelling study.

A.1. Pressure Related Acoustic Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 μPa. Because the perceived loudness of sound, especially pulsed sound such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate sound and its effects on marine life. Here we provide specific definitions of relevant metrics used in the accompanying report. Where possible, we follow International Organization for Standardization definitions and symbols for sound metrics (ANSI 2013, e.g., ISO 2017).

The sound pressure level (SPL or L_p; dB re 1 μPa) is the root-mean-square (rms) pressure level in a stated frequency band over a specified time window (T; s). It is important to note that SPL always refers to an rms pressure level and therefore not instantaneous pressure:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T g(t)\,p^2(t)\,dt/p_0^2\right)\text{ dB} \qquad \text{(A-1)}$$

where $g(t)$ is an optional time weighting function. In many cases, the start time of the integration is marched forward in small time steps to produce a time-varying SPL function.

The sound exposure level (SEL or L_E; dB re 1 μPa^2·s) is the time-integral of the squared acoustic pressure over a duration (T):

$$L_E = 10\log_{10}\left(\int_T p^2(t)\,dt/T_0p_0^2\right)\text{ dB} \qquad \text{(A-2)}$$

where T_0 is a reference time interval of 1 s. SEL continues to increase with time when non-zero pressure signals are present. It is a dose-type measurement, so the integration time applied must be carefully considered for its relevance to impact to the exposed recipients.

SEL can be calculated over a fixed duration, such as the time of a single event or a period with multiple acoustic events. When applied to pulsed sounds, SEL can be calculated by summing the SEL of the N individual pulses. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, the SEL can be computed by summing (in linear units) the SEL of the N individual events:

$$L_{E,N} = 10\log_{10}\left(\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}}\right)\text{ dB}. \qquad \text{(A-3)}$$

If applied, the frequency weighting of an acoustic event should be specified, as in the case of weighted SEL (e.g., $L_{E,LFC,24h}$; Appendix A.4). The use of fast, slow, or impulse exponential-time-averaging or other time-related characteristics should also be specified.

A.2. Decidecade Band Analysis

The distribution of a sound's power with frequency is described by the sound's spectrum. The sound spectrum can be split into a series of adjacent frequency bands. Splitting a spectrum into 1 Hz wide bands, called passbands, yields the power spectral density of the sound. This splitting of the spectrum into passbands of a constant width of 1 Hz, however, does not represent how animals perceive sound.

Because animals perceive exponential increases in frequency rather than linear increases, analysing a sound spectrum with passbands that increase exponentially in size better approximates real-world scenarios. In underwater acoustics, a spectrum is commonly split into decidecade bands, which are one tenth of a decade wide. A decidecade is sometimes referred to as a "1/3 octave" because one tenth of a decade is approximately equal to one third of an octave. Each decade represents a factor 10 in sound frequency. Each octave represents a factor 2 in sound frequency. The centre frequency of the ith band, $f_c(i)$, is defined as:

$$f_c(i) = 10^{\frac{i}{10}} \text{ kHz} \tag{A-4}$$

and the low (f_{lo}) and high (f_{hi}) frequency limits of the ith decade band are defined as:

$$f_{lo,i} = 10^{\frac{-1}{20}} f_c(i) \quad \text{and} \quad f_{hi,i} = 10^{\frac{1}{20}} f_c(i) \tag{A-5}$$

The decidecade bands become wider with increasing frequency, and on a logarithmic scale the bands appear equally spaced (Figure A-1). The acoustic modelling spans from band 10 ($f_c(10)$ = 10 Hz) to band 44 ($f_c(44)$ = 25 kHz).

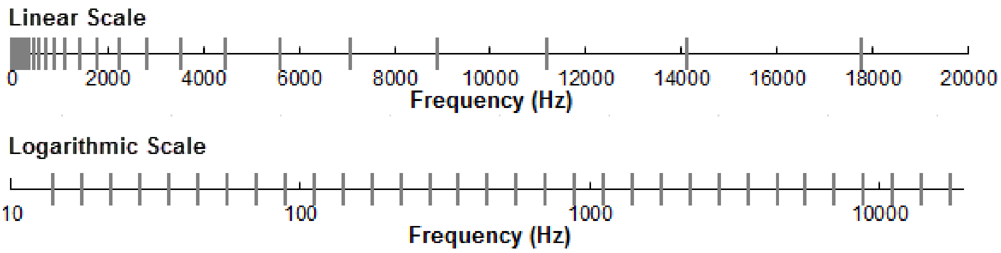


Figure A-1. Decidecade frequency bands (vertical lines) shown on a linear frequency scale and a logarithmic scale.

The sound pressure level in the ith band ($L_{p,i}$) is computed from the spectrum $S(f)$ between $f_{lo,i}$ and $f_{hi,i}$:

$$L_{p,i} = 10 \, log_{10} \int_{f_{lo,i}}^{f_{hi,i}} S(f) \, df \;\; \text{dB} \tag{A-6}$$

Summing the sound pressure level of all the bands yields the broadband sound pressure level:

$$\text{Broadband SPL} = 10 \log_{10} \sum_i 10^{\frac{L_{p,i}}{10}} \text{ dB} \tag{A-7}$$

Figure A-2 shows an example of how the decidecade band sound pressure levels compare to the sound pressure spectral density levels of an ambient sound signal. Because the decidecade bands are wider than 1 Hz, the decidecade band SPL is higher than the spectral levels at higher frequencies. Acoustic modelling of decidecade bands requires less computation time than 1 Hz bands and still resolves the frequency-dependence of the sound source and the propagation environment.

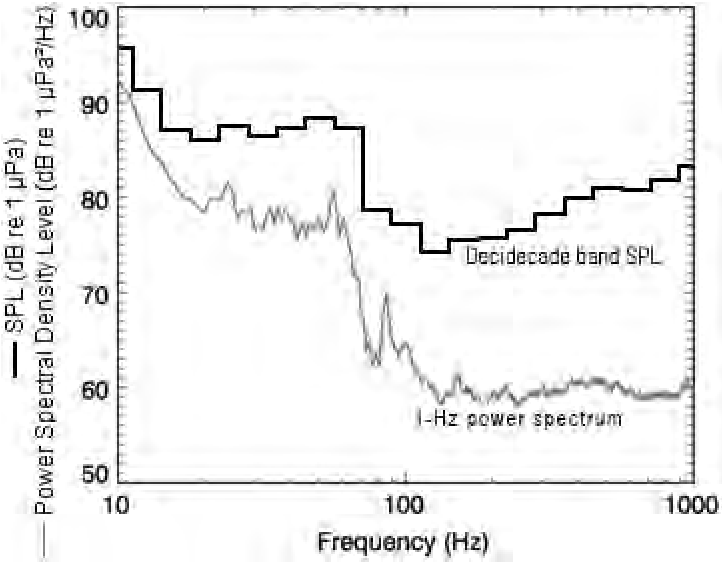


Figure A-2. Sound pressure spectral density levels and the corresponding decidecade band sound pressure levels of example ambient noise shown on a logarithmic frequency scale.Because the decidecade bands are wider with increasing frequency, the decidecade band SPL is higher than the power spectrum.

A.3. Marine Mammal Noise Effect Criteria

It has been long recognised that marine mammals can be adversely affected by underwater anthropogenic noise. For example, Payne and Webb (1971) suggest that communication distances of fin whales are reduced by shipping sounds. Subsequently, similar concerns arose regarding effects of other underwater noise sources and the possibility that impulsive sources—primarily airguns used in seismic surveys—could cause auditory injury. This led to a series of workshops held in the late 1990s, conducted to address acoustic mitigation requirements for seismic surveys and other underwater noise sources (NMFS 1998, ONR 1998, Nedwell and Turnpenny 1998, HESS 1999, Ellison and Stein 1999). In the years since these early workshops, a variety of thresholds have been proposed for auditory injury, impairment, and disturbance. The following sections summarise the recent development of thresholds; however, this field remains an active research topic.

A.3.1. Injury and Hearing Sensitivity Changes

In recognition of shortcomings of the SPL-only based auditory injury criteria, in 2005 NMFS sponsored the Noise Criteria Group to review literature on marine mammal hearing to propose new noise exposure criteria. Some members of this expert group published a landmark paper (Southall et al. 2007) that suggested assessment methods similar to those applied for humans. The resulting recommendations introduced dual auditory injury criteria for impulsive sounds that included peak pressure level thresholds and SEL24h thresholds, where the subscripted 24h refers to the accumulation period for calculating SEL. The peak pressure level criterion is not frequency weighted whereas SEL24h is frequency weighted according to one of four marine mammal species hearing groups: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively) and Pinnipeds in Water (PINN). These weighting functions are referred to as M-weighting filters (analogous to the A-weighting filter for humans; see Appendix A.4). The SEL24h thresholds were obtained by extrapolating measurements of onset levels of Temporary Threshold Shift (TTS) in belugas by the amount of TTS required to produce Permanent Threshold Shift (PTS) in chinchillas. The Southall et al. (2007) recommendations do not specify an exchange rate, which suggests that the thresholds are the same regardless of the duration of exposure (i.e., it implies a 3 dB exchange rate).

Wood et al. (2012) refined Southall et al.'s (2007) thresholds, suggesting lower PTS and TTS values for LF and HF cetaceans while retaining the filter shapes. Their revised thresholds were based on TTS-onset levels in harbour porpoises from Lucke et al. (2009), which led to a revised impulsive sound PTS threshold for HF cetaceans of 179 dB re 1 µPa^2·s. Because there were no data available for baleen whales, Wood et al. (2012) based their recommendations for LF cetaceans on results obtained from MF cetacean studies. In particular they referenced the Finneran and Schlundt (2010) research, which found mid-frequency cetaceans are more sensitive to non-impulsive sound exposure than Southall et al. (2007) assumed. Wood et al. (2012) thus recommended a more conservative TTS-onset level for LF cetaceans of 192 dB re 1 µPa^2·s.

As of present, a definitive approach is still not apparent. There is consensus in the research community that an SEL-based method is preferable, either separately or in addition to an SPL-based approach to assess the potential for injuries. In August 2016, after substantial public and expert input into three draft versions and based largely on the above-mentioned literature (NOAA 2013, 2015, 2016), NMFS finalised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing (NMFS 2016). The guidance describes auditory injury criteria with new thresholds and frequency weighting functions for the five hearing groups described by Finneran and Jenkins (2012). The latest revision to this work was published in 2018 (NMFS 2018a). Southall et al. (2019) revisited the interim criteria published in 2007. All noise exposure criteria in NMFS (2018a) and Southall et al. (2019) are identical (for impulsive and non-impulsive sounds); however, the mid-frequency cetaceans from NMFS (2018a) are classified as high-frequency cetaceans in Southall et al. (2019), and high-frequency cetaceans from NMFS (2018a) are classified as very-high-frequency cetaceans in Southall et al. (2019).

A.3.2. Behavioural Response

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioural reactions. However, it is recognised that the context in which the sound is received affects the nature and extent of responses to a stimulus(Southall et al. 2007, Ellison and Frankel 2012, Southall et al. 2016).

NMFS currently uses step function (all-or-none) threshold of 120 dB re 1 µPa SPL (unweighted) for non-impulsive sounds to assess and regulate noise-induced behavioural impacts on marine mammals (NOAA 2019). The 120 dB re 1 µPa threshold is associated with continuous sources and was derived based on studies examining behavioural responses to drilling and dredging (NOAA 2018b), referring to Malme et al. (1983), Malme et al. (1984), and Malme et al. (1986), which were considered in Southall et al. (2007). Malme et al. (1986) found that playback of drillship noise did not produce clear evidence of disturbance or avoidance for levels below 110 dB re 1 µPa (SPL), possible avoidance occurred for exposure levels approaching 119 dB re 1 µPa. Malme et al. (1984) determined that measurable reactions usually consisted of rather subtle short-term changes in speed and/or heading of the whale(s) under observation. It has been shown that both received level and proximity of the sound source is a contributing factor in eliciting behavioural reactions in humpback whales (Dunlop et al. 2017, Dunlop et al. 2018).

A.4. Marine Mammal Frequency Weighting

The potential for noise to affect animals depends on how well the animals can hear it. Noises are less likely to disturb or injure an animal if they are at frequencies that the animal cannot hear well. An exception occurs when the sound pressure is so high that it can physically injure an animal by non-auditory means (i.e., barotrauma). For sound levels below such extremes, the importance of sound components at particular frequencies can be scaled by frequency weighting relevant to an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007).

A.4.1. Marine Mammal Frequency Weighting Functions

In 2015, a US Navy technical report by Finneran (2015) recommended new auditory weighting functions. The overall shape of the auditory weighting functions is similar to human A-weighting functions, which follows the sensitivity of the human ear at low sound levels. The new frequency-weighting function is expressed as:

$$G(f) = K + 10\log_{10}\left[\left(\frac{(f/f_{lo})^{2a}}{\left[1+(f/f_{lo})^2\right]^a\left[1+(f/f_{hi})^2\right]^b}\right)\right] \quad \text{(A-8)}$$

Finneran (2015) proposed five functional hearing groups for marine mammals in water: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively), phocid pinnipeds, and otariid pinnipeds. The parameters for these frequency-weighting functions were further modified the following year (Finneran 2016) and were adopted in NOAA's technical guidance that assesses acoustic impacts on marine mammals (NMFS 2018a), and in the latest guidance by Southall (2019). The updates did not affect the content related to either the definitions of frequency-weighting functions or the threshold values, however, the terminology for mid- and high-frequency cetaceans was changed to high- and very high-frequency cetaceans. Table A-1 lists the frequency-weighting parameters for each hearing group relevant to this assessment, and Figure A-3 shows the resulting frequency-weighting curves.

Table A-1. Parameters for the auditory weighting functions used in this project as recommended by Southall et al. (2019).

Hearing group	a	b	flo (Hz)	fhi (kHz)	K (dB)
Low-frequency cetaceans (baleen whales)	1.0	2	200	19,000	0.13
High-frequency cetaceans (most dolphins, plus sperm, beaked, and bottlenose whales)	1.6	2	8,800	110,000	1.20
Very-high-frequency cetaceans (true porpoises, *Kogia*, river dolphins, *Cephalorhynchus* spp., *Lagenorhynchus cruciger* and *L. australis*)	1.8	2	12,000	140,000	1.36
Otariid Seals in water	2.0	2	940	25,000	0.64

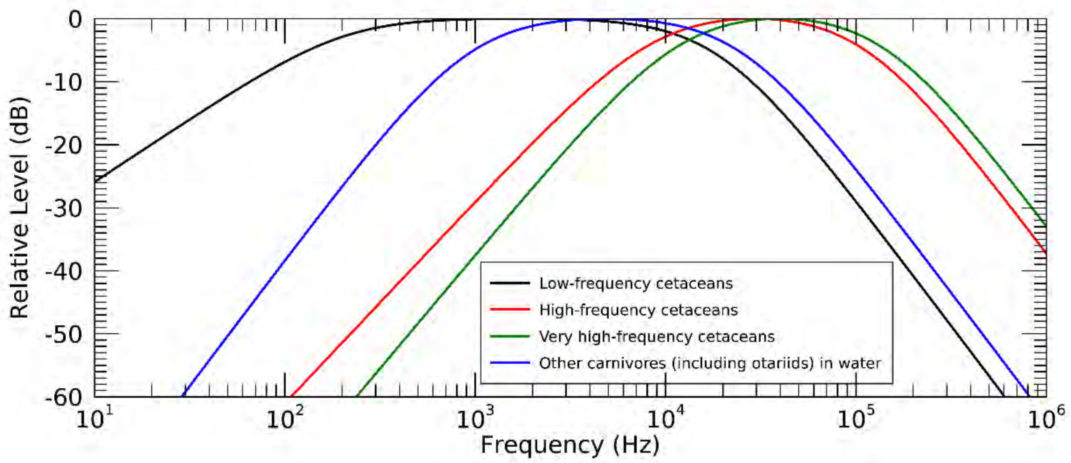


Figure A-3. Auditory weighting functions for functional marine mammal hearing groups used in this project as recommended by Southall et al. (2019).

Appendix B. Methods and Parameters

B.1. Environmental Parameters

B.1.1. Bathymetry

Bathymetry throughout the modelled area was extracted from the Australian Bathymetry and Topography Grid, a 9 arc-second grid rendered for Australian waters (Whiteway 2009). Bathymetry data were re-gridded and combined onto a Map Grid of Australia (MGA) coordinate projection (Zone 54) with a regular grid spacing of 250 × 250 m (Figure B-1).

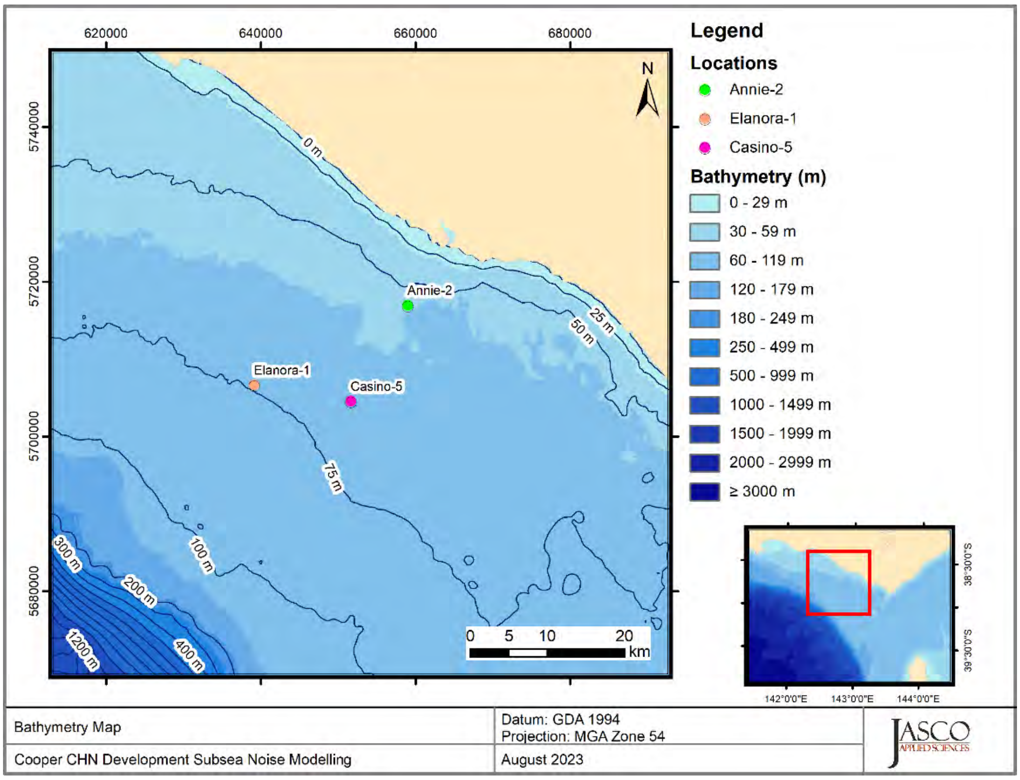


Figure B-1. Bathymetry in the modelled area.

B.1.2. Sound Speed Profile

The sound speed profile in the area was derived from temperature and salinity profiles from the U.S. Naval Oceanographic Office’s Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). GDEM provides an ocean climatology of temperature and salinity for the world’s oceans on a latitude-longitude grid with 0.25° resolution, with a temporal resolution of one month, based on global historical observations from the U.S. Navy’s Master Oceanographic Observational Data Set (MOODS). The climatology profiles include 78 fixed depth points to a maximum depth of 6800 m (where the ocean is that deep). The GDEM temperature-salinity profiles were converted to sound speed profiles according to Coppens (1981).

Mean monthly sound speed profiles were derived from the GDEM profiles at distances less than 40 km around the modelled site. The August sound speed profile is expected to be most favourable to longer-range sound propagation across the entire year which was determined by modelling a reduced number of transects for every month and comparing the ranges to thresholds. As such, August was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds. Figure B-2 shows the resulting profile, which was used as input to the sound propagation modelling.

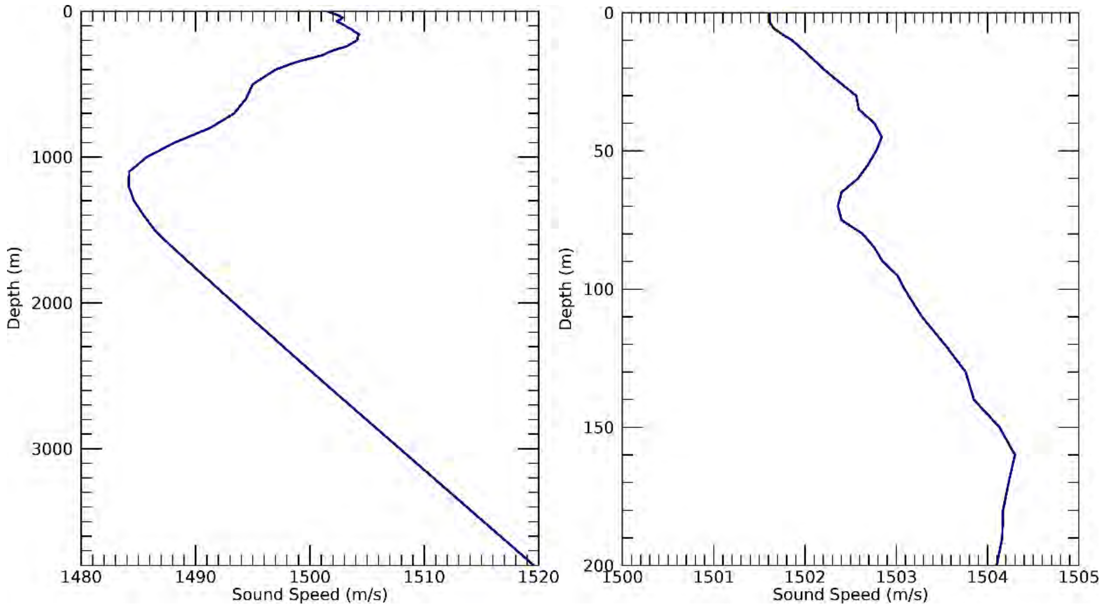


Figure B-2. The modelling sound speed profile corresponding to August: full profile (left) and top 200 m (right) Profiles are calculated from temperature and salinity profiles from Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009).

B.1.3. Geoacoustics

The propagation model used in this study consider a single geoacoustic profile for each well site area. Similar to previous modelling studies in the region (Wood and McPherson 2018, Koessler et al. 2020, Matthews et al. 2020, McPherson et al. 2021), two seabed types were considered for modelling. Both seabed profiles are indicative of seabed environments located on the continental shelf of the Otway region and are consistent with larger scale geological data and interpretations of the Australian continental shelf environment (James and Bone 2010).

The geoacoustic profiles Elanora-1, Casino-5 and Annie-2 well sites were generated using lithographic descriptions from the geotechnical and geophysical reports supplied by the client and considering previous underwater acoustic modelling and measurement studies (Koessler et al. 2020, Matthews et al. 2020, McPherson et al. 2021). Within the vicinity of Annie-2 the seabed is likely to consist of a well-cemented calcarenite caprock over a semi-cemented calcarenite. Near the Elanora-1 and Casino-5 locations, the seabed is likely to consist of a thin layer of coarse sand overlying a similar calcarenite structure. This sand layer may not be consistently present. In all cases, the calcarenite layering likely extended to many hundreds of metres below the seafloor.

Table B-1 and Table B-2 present the geoacoustic profiles used modelled sites in each respective development area.

Table B-1. Geoacoustic profile for Annie-2 associated modelled sites.

Depth below seafloor (m)	Material	Density (g/cm^3)	P-wave speed (m/s)	P-wave attenuation (dB/λ)	S-wave speed (m/s)	S-wave attenuation (dB/λ)
0-1	Well-cemented carbonate caprock	2.7	2600	0.5	1200	0.5
1-20	Increasingly cemented calcarenite	2.2	2000	0.30	900	0.27
20-40		2.3	2120	0.34	960	0.31
40-60		2.4	2240	0.38	1020	0.36
60-80		2.5	2360	0.42	1080	0.41
80-10		2.6	2480	0.46	1140	0.45
>100	Well-cemented calcarenite	2.7	2600	0.50	1200	0.50

Table B-2. Geoacoustic profile for Elanora-1 and Casino-5 associated modelled sites.

Depth below seafloor (m)	Material	Density (g/cm^3)	P-wave speed (m/s)	P-wave attenuation (dB/λ)	S-wave speed (m/s)	S-wave attenuation (dB/λ)
0-1.5	Coarse carbonate sand	2.0	1800	0.85	300	3.68
1.5-2.5	Well-cemented carbonate caprock	2.7	2600	0.50	1200	0.50
2.5-22.5	Increasingly cemented calcarenite	2.2	2000	0.3	900	0.27
22.5-42.5		2.3	2120	0.34	960	0.31
42.5-62.5		2.4	2240	0.38	1020	0.36
62.5-82.5		2.5	2360	0.42	1080	0.41
82.5-102.5		2.6	2480	0.46	1140	0.45
>102.5	Well-cemented calcarenite	2.7	2600	0.50	1200	0.50

B.2. Estimated Vessel Source Levels

At the time of this study, the Platform Support Vessel (ISV) and Dive Support Vessel (DSV) to be used in the project were unconfirmed and a generic source level was proposed. Similar to the approach detailed Connell et al. (2021) in different vessels were identified as either potential ISV or RDSV vessels, therefore the source level and spectrum used to represent any of these four vessels was based on the nominal specifications for all indicated vessels, due to similarity in dimensions and total installed power ratings. This nominal vessel has an 89.2 m overall length, 20 m breadth, and 7.6 m maximum draft.

A main propulsion system is this generic vessel comprised of the following specifications.

Two stern propellers with

- 3.2 m propeller diameter,
- 165 rpm nominal propeller speed,

- 2,200 kW maximum continuous power input, and
- Typical DP operation at 26% MRC.

Additional thruster modules active during DP operations may include bow tunnel thrusters and a bow azimuth thruster. The two bow tunnel thrusters for the generic vessel were comprised of:

- 2.0 m propeller diameter,
- 318 rpm nominal propeller speed,
- 1,000 kW maximum continuous power input, and
- Typical DP operation at 17% MRC.

The bow azimuth thruster generic vessel was comprised of:

- 1.65 m propeller diameter,
- 373 rpm nominal propeller speed,
- 830 kW maximum continuous power input, and
- Typical DP operation at 21% MRC

Estimates of the acoustic source levels were based on the parameters of the propulsion system together with the method descripted in Appendix B.2.1, and the percent of Maximum Continuous Rating (MCR) for the vessel operating at during typical DP operations, as provided by the potential vessel operators.

B.2.1. Thruster Source Level Estimation

A vessel equipped with propellers/thrusters has two primary sources of sound that propagate from the unit: the machinery and the propellers. For thrusters operating in the heavily loaded conditions, the acoustic energy generated by the cavitation processes on the propeller blades dominates (Leggat et al. 1981). The sound power from the propellers is proportional to the number of blades, the propeller diameter, and the propeller tip speed.

Based on an analysis of acoustic data, Ross (1976) provided the following formula for the sound levels from a vessel's propeller, operating in calm, open ocean conditions:

$$L_{100} = 155 + 60\log(u/25) + 10\log(B/4)\,, \tag{B-1}$$

where L_{100} is the spectrum level at 100 Hz, u is the propeller tip speed (m/s), and B is the number of propeller blades. Equation B-1 gives the total energy produced by the propeller cavitation at frequencies between 100 Hz and 10 kHz. This equation is valid for a propeller tip speed between 15 and 50 m/s. The spectrum is assumed to be flat below 100 Hz. Its level is assumed to fall off at a rate of −6 dB per octave above 100 Hz (Figure B-3).

Another method of predicting the source level of a propeller was suggested by Brown (1977). For propellers operating in heavily loaded conditions, the formula for the sound spectrum level is:

$$\mathrm{SL}_B = 163 + 40\log D + 30\log N + 10\log B + 20\log f + 10\log(A_c/A_D)\,, \tag{B-2}$$

where D is the propeller diameter (m), N is the propeller revolution rate per second, B is the number of blades, A_C is the area of the blades covered by cavitation, and A_D is the total propeller disc area. Similar to Ross's approach, the spectrum below 100 Hz is assumed to be flat. The tests with a naval propeller operating at off-design heavily loaded conditions showed that Equation B-2 should be used with a value of $(A_c/A_D) = 1$ (Leggat et al. 1981).

The combined source level for multiple thrusters operating together can be estimated using the formula:

$$\mathrm{SL_{total}} = 10\log_{10}\sum_i 10^{\frac{SL_i}{10}}, \tag{B-3}$$

where $\mathrm{SL}_{1,\ldots,N}$ are the source levels of individual thrusters. If the vessel is equipped with the same type of thrusters, the combined source level can be estimated using the formula:

$$\mathrm{SL}_N = \mathrm{SL} + 10\log N \tag{B-4}$$

where N is the total number of thrusters of the same type.

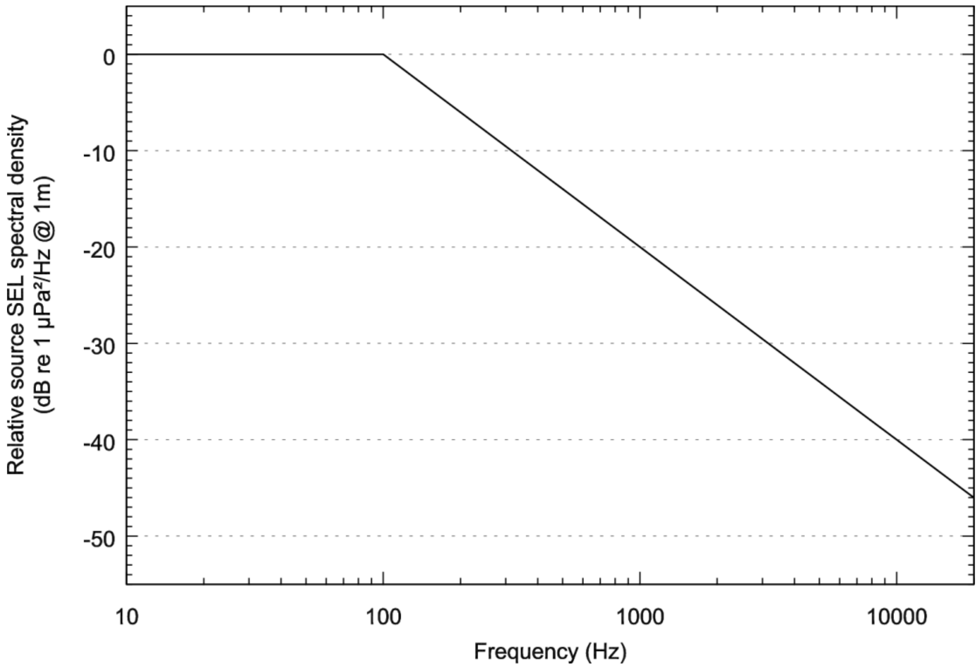


Figure B-3. Estimated sound spectrum from cavitating propeller (Leggat et al. 1981).

B.2.2. Estimating Sound Field from Moving Vessels

During vessel transit, new sound energy is constantly being introduced to the environment. The noise footprint for the transiting vessels considered in this report were estimated by modelling the 1-s SEL for the vessel at one location, and by translating and summing these footprints along the vessel transit routes. The vessel locations along the tracks were spaced uniformly, with an approximate step of $\Delta s \approx 100$ m.

The SEL sound field at any given point along the path is dependent upon the duration of exposure, which with a fixed footprint spacing depends upon the speed of the vessel during each segment of the transit. The 1-s SEL footprint at each vessel location (i) were therefore scales based on the speed of the vessel following:

$$\mathrm{SEL}_i = \mathrm{SEL}_{1s} + 10\log_{10}\left(\frac{\Delta s}{v}\right). \tag{B-5}$$

where v represents the vessel speed in m/s.

The present method acceptably reflects large-scale sound propagation features, primarily dependent on water depth, which dominate the cumulative field and is thus considered to provide a meaningful estimate of the SEL_{24h} field.

B.3. Sound Propagation Models

B.3.1. Propagation Loss

The propagation of sound through the environment was modelled by predicting the acoustic propagation loss—a measure, in decibels, of the decrease in sound level between a source and a receiver some distance away. Geometric spreading of acoustic waves is the predominant way by which propagation loss occurs. Propagation loss also happens when the sound is absorbed and scattered by the seawater, and absorbed scattered, and reflected at the water surface and within the seabed. Propagation loss depends on the acoustic properties of the ocean and seabed; its value changes with frequency.

If the acoustic energy source level (ESL), expressed in dB re 1 $\mu Pa^2 \cdot s\ m^2$, and propagation loss (PL), in units of dB, at a given frequency are known, then the received level (RL) at a receiver location can be calculated in dB re 1 $\mu Pa^2 \cdot s$ by:

$$\mathrm{RL} = \mathrm{SL} - \mathrm{PL}. \qquad \text{(B-6)}$$

B.3.2. MONM-BELLHOP

Long-range sound fields were computed using JASCO's Marine Operations Noise Model (MONM). While other models may be more accurate for steep-angle propagation in high-shear environment, MONM is well suited for effective longer-range estimation. This model computes sound propagation at frequencies of 10 Hz to 1.6 kHz via a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995). MONM computes sound propagation at frequencies > 1.6 kHz via the BELLHOP Gaussian beam acoustic ray-trace model (Porter and Liu 1994).

The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). MONM accounts for the additional reflection loss at the seabed, which results from partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modelled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

MONM computes acoustic fields in three dimensions by modelling propagation loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as N×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ number of planes (Figure B-4).

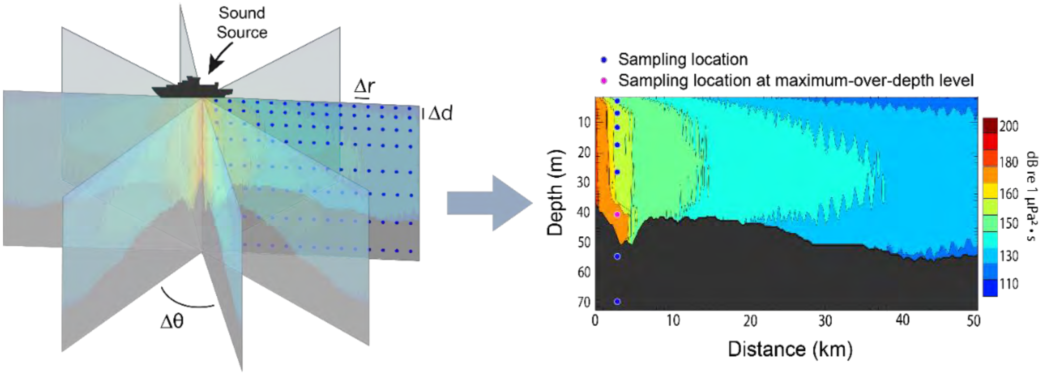


Figure B-4. The N×2-D and maximum-over-depth modelling approach used by MONM.

MONM treats frequency dependence by computing acoustic propagation loss at the centre frequencies of decidecade bands. Sufficiently many decidecade frequency-bands, starting at 10 Hz, are modelled to include most of the acoustic energy emitted by the source. At each centre frequency, the propagation loss is modelled within each of the N vertical planes as a function of depth and range from the source. The decidecade received per-second SEL are computed by subtracting the band propagation loss values from the directional source level in that frequency band. Composite broadband received per-second SEL are then computed by summing the received decidecade levels.

The received 1-s SEL sound field within each vertical radial plane is sampled at various ranges from the source, generally with a fixed radial step size. At each sampling range along the surface, the sound field is sampled at various depths, with the step size between samples increasing with depth below the surface. The step sizes are chosen to provide increased coverage near the depth of the source and at depths of interest in terms of the sound speed profile. For areas with deep water, sampling is not performed at depths beyond those reachable by marine mammals. The received per-second SEL at a surface sampling location is taken as the maximum value that occurs over all samples within the water column, i.e., the maximum-over-depth received per-second SEL. These maximum-over-depth per-second SEL are presented as colour contours around the source.

B.3.3. Wavenumber Integration Model

VSTACK computes propagation loss versus depth and range for arbitrarily layered, range-independent acoustic environments using the wavenumber integration approach to solve the exact (range-independent) acoustic wave equation. This model is valid over the full angular range of the wave equation and can fully account for the elasto-acoustic properties of the sub-bottom. Wavenumber integration methods are extensively used in the field of underwater acoustics and seismology where they are often referred to as reflectivity methods or discrete wavenumber methods. VSTACK computes sound propagation in arbitrarily stratified water and seabed layers by decomposing the outgoing field into a continuum of outward-propagating plane cylindrical waves. Seabed reflectivity in the model is dependent on the seabed layer properties: compressional and shear wave speeds, attenuation coefficients, and layer densities. Additionally, VSTACK assumes range-invariant bathymetry with a horizontally stratified medium (i.e., a range-independent environment) which is azimuthally symmetric about the source. Typically, VSTACK is best suited to modelling the sound field near the source; however, it can also be used in conjunction with MONM to account for additional bottom loss in high shear speed seabeds as described in Section B.3.4.

B.3.4. Limestone Seabed Propagation Loss

For sites where the seabed geoacoustic model consisted of bare calcarenite, an additional broadband correction was applied to the propagation loss results from MONM to better account for the additional propagation loss associated with a limestone (calcarenite) seabed (Duncan et al. 2009). The accuracy of the broadband calculated propagation loss for the South-eastern continental shelf of Australia depends significantly upon the frequency content of the radiating sound source together with thickness of any overlying layers of unconsolidated sediment (e.g. sand) on top of calcarenite likely to occur within the region.

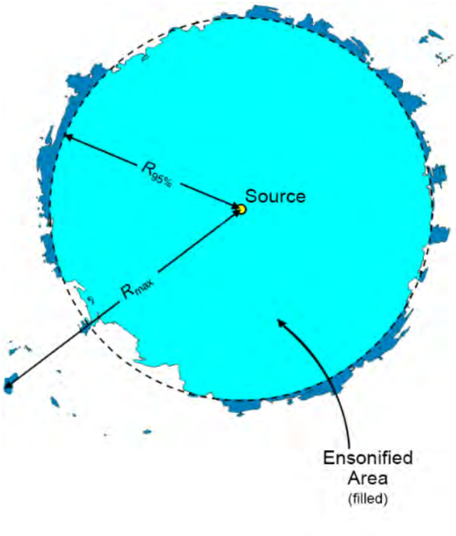
In general, the thinner the sand layer, the greater the overall propagation loss. When comparing SPL data McPherson et al. (2021), higher rates of propagation loss were observed and were attributed to, an absorptive carbonate (calcarenite) seabed. In this study, comparisons were conducted using JASCO's Marine Operations Noise Model (MONM), a wide-angle parabolic equation model which applies the BELLHOP Gaussian beam acoustic ray-trace model at higher frequencies, and JASCO's wavenumber integration model (VSTACK, Appendix B.3.3) which can fully account for the elasto-acoustic properties of the sub-bottom.

To account for the additional propagation loss associated with a cemented calcarenite seabed, an additional broadband correction was applied to the propagation loss results from MONM to account for the higher rates of loss when the full for the elasto-acoustic properties of the sub-bottom are consider. The differences between the broadband SPL from MONM and VSTACK were extracted at the same modelled ranges and depths that corresponded range independent predictions. The 90th percentile of the resultant dB differences in 250 m range bins were selected to generate a correction function for each individual site/source to be modelled. The conversion functions were applied after the propagation loss calculation from MONM but before summing decidecade band levels, gridding, and radii calculations for each modelled site in each modelled scenario considered.

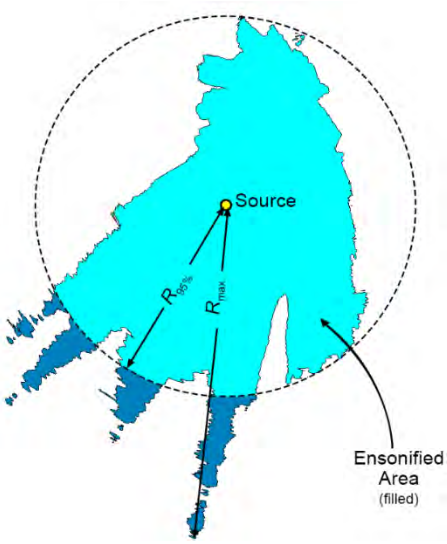
B.4. Estimating Range to Thresholds Levels

Sound level contours were calculated based on the underwater sound fields predicted by the propagation models, sampled by taking the maximum value over all modelled depths above the sea floor for each location in the modelled region. The predicted distances to specific levels were computed from these contours. Two distances relative to the source are reported for each sound level: 1) R_{max}, the maximum range to the given sound level over all azimuths, and 2) $R_{95\%}$, the range to the given sound level after the 5% farthest points were excluded (see examples in Figure B-5).

The $R_{95\%}$ is used because sound field footprints are often irregular in shape. In some cases, a sound level contour might have small protrusions or anomalous isolated fringes. This is demonstrated in the image in Figure B-5(a). In cases such as this, where relatively few points are excluded in any given direction, R_{max} can misrepresent the area of the region exposed to such effects, and $R_{95\%}$ is considered more representative. In strongly asymmetric cases such as shown in Figure B-5(b), on the other hand, $R_{95\%}$ neglects to account for significant protrusions in the footprint. In such cases R_{max} might better represent the region of effect in specific directions. Cases such as this are usually associated with bathymetric features affecting propagation. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the non-uniformity of the acoustic environment.



(a)



(b)

Figure B-5. Sample areas ensonified to an arbitrary sound level with R_{max} and $R_{95\%}$ ranges shown for two different scenarios. (a) Largely symmetric sound level contour with small protrusions. (b) Strongly asymmetric sound level contour with long protrusions. Light blue indicates the ensonified areas bounded by $R_{95\%}$; darker blue indicates the areas outside this boundary which determine R_{max}.

B.5. Model Validation Information

Predictions from JASCO's propagation models (MONM, FWRAM, and VSTACK) have been validated against experimental data from a number of underwater acoustic measurement programs conducted by JASCO globally, including the United States and Canadian Artic, Canadian and southern United States waters, Greenland, Russia and Australia (e.g. Hannay and Racca 2005, Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b, Matthews and MacGillivray 2013, Martin et al. 2015, Racca et al. 2015, Martin et al. 2017a, Martin et al. 2017b, Warner et al. 2017, MacGillivray 2018, McPherson et al. 2018, McPherson and Martin 2018, Quijano et al. 2018).

In addition, JASCO has conducted measurement programs associated with a significant number of anthropogenic activities that have included internal validation of the modelling (including McCrodan et al. 2011, Austin and Warner 2012, McPherson and Warner 2012, Austin and Bailey 2013, Austin et al. 2013, Zykov and MacDonnell 2013, Austin 2014, Austin et al. 2015, Austin and Li 2016, Martin and Popper 2016, Austin et al. 2018, Beach Energy Limited 2020).

Appendix 5. GHG Modelling

Cooper Energy

Otway Offshore Project Proposal

GHG Inventory Technical Note

ASSIGNMENT P200203-S01
DOCUMENT P-200203-S01-A-REPT-001

XODUS

Perth

Level 1
1 William Street . Perth
WA 6000 . Australia

T +61 (0)86555 5600
E matthew.holding@xodusgroup.com

www.xodusgroup.com

REVISIONS & APPROVALS

REV	DATE	DESCRIPTION	ISSUED	CHECKED	APPROVED	CLIENT
I09	04/12/2024	Issued for information	FC	MH	MH	COE
I08	01/10/2024	Issued for information	FC	MH	MH	COE
I07	25/06/2024	Issued for information	FC	MH	MH	COE
I06	12/06/2024	Issued for information	FC	MH	MH	COE
I05	03/05/2024	Issued for information	FC	MH	MH	COE
I04	24/04/2024	Issued for information	FC	MH	MH	COE
I03	06/02/2024	Issued for information	FC	MH	MH	COE
I02	14/12/2023	Issued for information	FC	MH	MH	COE
I01	10/11/2023	Issued for information	FC	MH	MH	COE
A01	19/10/2023	Issued for Review	FC	MH	MH	COE
R01	29/08/2023	Issued for Review	FC	KS	MH	COE

CONTENTS

1 INTRODUCTION

1.1 Background

Cooper Energy's existing Otway Casino-Henry-Netherby (CHN) development (known as the 'existing CHN facilities') consist of the Casino, Henry and Netherby gas fields along with associated subsea infrastructure. Hydrocarbons from these fields are produced via four subsea wells and transported to shore via the CHN pipeline and processed at the shore-based Athena Gas Plant (AGP) situated ~6 km from Port Campbell.

Cooper Energy proposes extending the gas supply to the AGP by developing additional gas fields and tying them into the existing CHN facilities – the East Coast Gas Supply Project.

The East Coast Gas Supply Project will include up to 15 wells within eight potential gas development opportunities in Commonwealth waters which are either:

- a confirmed resource (Annie and Henry-3), or
- prospective resources (Pecten East, Elanora, Heera, Juliet, Nestor, and Isabella).

1.2 Aim and Objectives

This technical note presents the greenhouse gas (GHG) emissions inventory to identify and quantify GHG emissions for the East Coast Gas Supply Project for the purpose of environmental impact assessment in the Offshore Project Proposal (OPP) required under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* and Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 [OPGGS(E)R].

This includes direct and indirect GHG emissions associated with the East Coast Gas Supply Project.

Emissions have been estimated based on a scenario where all fields within the scope of the OPP are developed, and multiple fields are brought online simultaneously. It should be noted that this is considered conservative, and that production and emissions profiles will be refined as field development plans are matured.

2 DEFINITIONS AND BOUNDARY OF ASSESSMENT

As illustrated in Table 2-1, GHG emissions from the existing CHN facilities served as the baseline for the emissions estimation. The baseline has also included CHN and AGP decommissioning.

This technical report addresses and categorises GHG emissions into the following groups:

- Direct GHG emissions: Direct GHG emissions are created as a direct result of the East Coast Gas Supply Project activities within Commonwealth jurisdiction, including Surveys, Drilling, Installation and Commissioning, Operations (inclusive of Inspection, Maintenance and Repair (IMR)), and Decommissioning. These emissions originate from support activities - mobile offshore drilling unit (MODU), vessels, and remotely operated vehicle (ROV) / autonomous underwater vehicle (AUV)[1] within Commonwealth waters, including flaring.
- Indirect GHG emissions: Key sources of emissions in this category include:
    - Fuel gas
    - Flaring and Venting
    - Diesel for transport and stationary energy
    - Purchased goods and transportation, limited to the major items listed below:
        - Cement
        - Corrosion-resistant alloy (CRA)
        - Carbon steel
        - Flowlines
        - Umbilicals
        - Manifolds
        - Others (skids, hot-tap tie-in structure, protection pressure structure, pig launcher/receiver, and subsea trees)
    - Waste generated, including:
        - Solid steel waste
        - Flowline disposal
        - Umbilicals disposal
        - Mattresses disposal
        - Liquids (hazardous waste) disposal
    - Fugitive emissions
    - Other emissions including vessels within State jurisdiction and employee commuting (inclusive of helicopters)
    - Purchased electricity.
- Downstream indirect GHG emissions: Downstream indirect GHG emissions are associated with the product transmission and distribution to customers, and final combustion or use of gas and condensate products by customers.

[1] *No additional emissions from the ROV/AUV as they are powered by the vessels used.*

NB: The direct emissions do not equate to scope 1 emissions (i.e., emissions under operational control of the organisation) under the *National Greenhouse and Energy Reporting Act 2007*, as the:

- Direct emissions in this inventory includes relevant Support Operations both within and outside of Copper Energy's operational control.
- Scope 1 emissions associated with the transport and processing of hydrocarbons outside of Commonwealth Waters are considered indirect emissions in this inventory.

The indicative duration of each phase of the East Coast Gas Supply Project is as documented in the Description of Activity chapter of the OPP. The first stage of the East Coast Gas Supply Project is likely to be ready for development in 2025. There will likely be some small activities (e.g., mobilisation of drilling rig) in late 2024, but these activities will cause minimal impact on the annual GHG emissions profile and will not affect the final emissions figure. The Operations phase is forecast to end in approximately 2045 and Decommissioning phase by approximately 2049.

The following emissions sources/activities have been excluded from the GHG emissions assessment:

- Any expenses or activities related to Gippsland basin as these are not relevant to the East Coast Gas Supply Project.
- Processing of sold products and end-of-life treatment of sold products. These are not applicable due to the assumption that all products will be combusted (refer to Section 3.2).
- Emissions from the Cooper Energy offices have not been apportioned from the baseline as these emissions are not material.

Table 2-1: Boundary of assessment and emissions sources (with Baseline being the emissions from the existing CHN facilities).

DIRECT GHG EMISSIONS SOURCES					INDIRECT GHG EMISSIONS SOURCES ‡	DOWNSTREAM INDIRECT GHG EMISSIONS SOURCES ‡
The East Coast Gas Supply Project						
Survey	**Drilling**	**Installation and Commissioning**	**Operations**	**Decommissioning**	• Fuel gas usage • Flaring and venting • Diesel usage • Fugitives • Purchased goods and transportation • Purchased electricity Other (vessels including ROV/AUV‡*, liquid fuel, waste generated, and employee commuting)	• Combustion of products • Fugitive emissions from natural gas transmission and distribution • Condensate transportation
Vessels†	• MODU • Flaring • Vessels† • ROV/AUV†*	• Vessels† • ROV/AUV†*	• Vessels (IMR)† • ROV/AUV (IMR)†* • Flaring (well intervention)	• MODU • Flaring • Vessels† • ROV/AUV†		
Baseline: The Existing CHN Facilities						
-	-	-	-	-	• Fuel gas usage • Flaring and venting • Diesel usage • Fugitives • Purchased goods and transportation • Purchased electricity • Other (vessels including ROV/AUV‡*, liquid fuel, waste generated, leased assets, employee commuting, business travel, CHN and AGP decommissioning)	• Combustion of products • Fugitive emissions from natural gas transmission and distribution • Condensate transportation

† Within Commonwealth jurisdiction

‡ Within State jurisdiction

** No additional emissions from the ROV/AUV as they are powered by the vessels used.*

3 METHODOLOGY

3.1 Emissions Calculations

Support activities (MODU and vessels), fuel gas, and stationary energy

For these emissions sources, GHG emissions were calculated using Equation (1).

GHG Emissions [CH_4, CO_2, N_2O] (t CO_2-e) = Activity x Emissions Factor ... Equation (1)

Activities were based on the information provided by Cooper Energy's data sets, including existing inventories and data from previous campaigns. The amounts of fuel use required for the support activities were estimated from Xodus' database. Emissions factors were sourced from the National Greenhouse and Energy Reporting (NGER) (Measurement) Determination 2008 (NGER Determination) (Clean Energy Regulator, 2023).

Unprocessed natural gas emissions factor from the NGER Determination was used for the fuel gas usage. Diesel oil emissions factor was used for the MODU, vessels, and stationary energy, whilst kerosene emissions factor was used for the helicopters. Marine gas oil (MGO) may be used, however, diesel was used as a conservative emissions estimate.

Flaring and Venting

GHG emissions for flaring during Drilling were calculated using Method 1 under Section 3.44 of the NGER Determination. Operational flaring and venting emissions due to gas processing were provided by Cooper Energy. Flaring may also occur due to well intervention activities and has been allowed for.

Purchased goods and transportation

Equation (1) was used to compute GHG emissions from purchased goods and transportation. For the types of purchased goods considered in Section 2, Xodus' rigid material estimation tool was used along with the emissions factors from the Inventory of Carbon and Energy (ICE Database) (Circular Ecology, 2023).

For goods transportation by sea, South Australia and Argentina were used as the departure ports for transporting cement and Oil Country Tubular Goods (OCTG), respectively. Emissions from sea transportation were estimated based on the vessel fuel consumption rate from Xodus database using diesel oil emissions factor from the NGER Determination. Emissions from land transportation were estimated based on the diesel fuel emissions factor for heavy-goods vehicle (HGV) sourced from the UK Government Conversion Factors (UK Government, 2023), with an assumed travel distance of 120 km and a carrying capacity of 40 t.

Waste generated

Equation (1) was used to compute GHG emissions from waste generated. For the types of waste considered in Section 2, the following emissions factors were used:

- Transportation and disposals of solid steel, flowline, umbilicals and mattresses: 0.0203 t CO_2-e/t ('Structural Steel' in Waste Reduction Model (WARM) tool Version 15) (US EPA, 2016)
- Transportation and treatment of hazardous waste: 0.0018 t CO_2-e/USD ('Hazardous Waste Treatment and Disposal' in Supply Chain GHG Emission Factor v1.2) (US EPA, 2023).

Employee commuting

Helicopter was categorised as Employee Commuting. Equation (1) was used for emissions estimation. Kerosene emissions factor was used for the helicopters.

Equation (2) was used to estimate the GHG emissions from employee commuting by road. An emissions factor of 0.035 t CO_2-e/employee-day was used which was based on a case study on commuting for within 50 km and pro-rated to 100 km, one-way (Leao, 2013).

GHG Emissions (t CO_2-e) = No. of Employees x Working Days x Emissions Factor ... Equation (2)

Electricity usage

Indirect GHG emissions due to the consumption of an energy commodity were provided by Cooper Energy based on the emissions factors in the NGER Determination.

Downstream product transportation and use

Sales gas will be piped to end users from AGP to Cooper Energy's customers in Victoria and South Australia. Condensate product will be trucked to the Viva refinery in Geelong. The resulting fugitive emissions from pipeline transmission were calculated using Method 1 in Section 3.76 of the NGER Determination and the emissions from condensate transport were calculated using Method 1 in Section 2.41 of the NGER Determination.

To estimate the emissions from product use, the production forecast profiles for the sales gas and condensate provided by COE were used (Section 4.1.5 of the OPP). For conservatism, all products were assumed to be combusted, Equation (3) was used to calculate the emissions from the combustion of gas and condensate products with the emission factors sourced from the NGER Determination.

GHG Emissions [CH_4, CO_2, N_2O] (t CO_2-e) = Product Type x Emissions Factor ... Equation (3),

Fugitives

Fugitive emissions resulted from gas processing at AGP were provided by Cooper Energy which were estimated using the methodologies in the NGER Determination.

3.2 Assumptions and Information

The following assumptions have been made when creating the GHG emissions inventory for the East Coast Gas Supply Project:

Direct GHG emissions:

- Duration of Drilling: 60 days/well, with five campaigns.
- Duration of Installation and Commissioning: 30 days/well.
- Duration of Decommissioning – P&A and retrieval and surveys, taken as 30 days/well, with two campaigns.
- Duration of Survey: 7 days/well.
- Flaring during the Drilling phase taken as 60 MMscfd/well (~1 day) with no venting.
- Flaring during IMR (well interventions) taken as 18 MMscf/well intervention activity.
- Flaring during the Decommissioning phase taken as 30% of that during the Drilling phase.
- Additional time for unexpected delays and extreme weather events taken as 30% of the expected durations.
- Support vessels return to port every 3 days during the Drilling phase, and 28 days for other phases.
- Bunkering vessels travel every 20 days for large vessels, and work for 24 hours/vessel.
- Sea transit time taken as 10 knots (except cargo ships at 12 knots).
- Immaterial fugitive emissions resulted from mud gas degassing (less than 100 t CO_2-e).

Indirect GHG emissions:

- The emissions from product use have been based on the forecast volume of sales gas and condensate.
- The average energy content factors of gas and condensate taken as 37.2 MJ/m^3 and 46.5 GJ/t respectively.
- The purchased goods included in the GHG inventory considered only the major items – cement, CRA, carbon steel, flowline, umbilicals, skids, manifolds, hot tap tie-in structure, protection pressure structure, pig launcher and subsea trees.
- For goods transportation, sea freight distances of approximately 400 nm (South Australia) and 6990 nm (Argentina) were assumed for transporting cement and OCTG, respectively. Land transportation was also included with an assumed travel distance of 120 km in rigid average-laden HGVs (>17 t), and a carrying capacity of 40 t per HGV.
- For the Operations phase, emissions from the purchased goods and transportation, solid waste and wastewaters generated, and diesel used were pro-rata to the percentage of products from the East Coast Gas Supply Project from the data given by Cooper Energy, based on the baseline.
- For estimating the fugitive emissions from natural gas transmission and distribution, an assumption of 1000 km transmission pipeline length was used, which was based on an average distance from AGP to Cooper Energy's customers in Victoria and South Australia.
- Condensate product will be trucked to the Viva refinery in Geelong (~180 km from AGP) and the trucking frequencies were pro-rata to the basis year of 2022. Fuel consumption taken as 202.6026 L/100 km (CoA, n.d.).
- Emissions from structural steel waste and hazardous waste generated were pro-rata to the number of wells, based on the decommissioning estimate study (Cooper Energy, 2022).
- Emissions from employee commuting considered for fly-in-fly-out (FIFO) workers were based on 3:3 basis (except for once per year during the Operations phase), and included automobile travels up to 100 km.

Table 3-1 shows the input information used for creating a GHG inventory for the East Coast Gas Supply Project. Where options or a range of values exist, the options/values decided by Cooper Energy, or the most conservative values have been used.

Table 3-1: Model inputs for the East Coast Gas Supply Project over the project life (2025~2049).

GENERAL INFORMATION					
Number of wells:	15				
Plant operation days/year:	342				
IMR campaign:	1/year				
Inspections:	6 h/well/year (structural), 2 days/year (pipeline), 28 days/year (survey)				
DEVELOPMENT AND OPERATIONS INFORMATION					
For Direct Emissions Estimation:					
Phase:	Survey	Drilling	Installation and Commissioning	Operations	Decommissioning
Duration (cumulative days):	105	900	450	27,740	900
Flaring of gas:	-	60 MMscf/well	-	18 MMscf/well intervention	18 MMscf/well
Helicopter frequency:	-	8/week	8/week	-	8/week
Barges/supply frequency:	-	-	-	2/week	-
Vessel requirement*:	• Survey • Diver support	• MODU • AHTS • Supply Inspection: • Supply • ROV/AUV	• Survey • ROV/AUV • Installation and reel-lay • Heavy lift/diver support • Supply	• Supply • IMR Inspection: • Supply • ROV/AUV • Installation • Diver support	• MODU • AHTS • ROV/AUV • Supply • Survey • Installation • Diver support
For Indirect Emissions Estimation:					
Fuel gas (PJ):	-	-	-	12	-
Diesel/Liquid fuel (m^3):	-	1920	-	154	
Operational flaring and venting (t CO_2-e):	-	-	-	377,632	-
Fugitives (t CO_2-e):				147,730	
Maximum POB:	80	200	200	80	150
FIFO of POB:	-	3:3	3:3	-	3:3
Purchased goods:					

GENERAL INFORMATION					
Cement (t):	-	2448	4,800	-	180
CRA (t):	-	936	-	-	-
Carbon steel (t):	-	3744	9,855	-	-
Flowline (km):	-	-	23	-	-
Umbilicals (km):	-	-	52.73	-	-
Manifolds:	-	-	5	-	-
Skids:	-	-	5	-	-
Others (hot-tap tie-in, pressure protection structures, subsea trees, pig launcher/receiver):	-	-	23	-	-
Waste generated:					
Structural steel waste (t):	-	-	-	-	60,510
Hazardous waste disposal (USD):	-	-	-	-	1,567,125

*Vessels transiting within Commonwealth and State jurisdictions considered as direct and indirect emissions respectively.

Table 3-2 shows the indicative project timings, as well as the selected year(s) for the GHG model. Note that these timings are only indicative and used for generating annual emissions profiles. Varying these timings will not significantly impact the GHG emissions estimates.

Table 3-2: Selected year(s) for GHG model input for annual emissions estimate.

	INDICATIVE PROJECT TIMINGS				SELECTED FOR GHG MODEL		
	Development timing	First gas timing	End production timing	P&A and Decommissioning timing	Development year	Production year	P&A and Decommissioning year
Baseline: CHN	-	-	2029~2032	2029~2037	-	~2030	2035~2036
Annie	2025~2027	2025~2027	2030~2033	2030~2038	2025	2025~2032	2035
Juliet	2025~2027	2025~2027	2030~2033	2030~2038	2025	2025~2032	2035
Nestor	2025~2027	2026~2028	2031~2034	2031~2039	2026	2026~2031	2034
Elanora	2029~2031	2030~2033	2038~2042	2038~2047	2029	2030~2039	2042~2043
Henry	2029~2031	2030~2033	2038~2042	2038~2047	2029	2030~2042	2045
Isabella	2029~2031	2030~2033	2038~2042	2038~2047	2029	2030~2042	2044
Pecten East	2031~2033	2032~2036	2040~2044	2040~2049	2031	2032~2044	2048
Heera	2031~2033	2032~2036	2040~2044	2040~2049	2031	2032~2044	2046~2047

4 RESULTS

4.1 Direct GHG Emissions

The direct GHG emissions for the East Coast Gas Supply Project are estimated to be 1,000 kt CO_2-e over the project life. Figure 4-1(a) shows the emissions generated during each project lifecycle stage and embeds the support operations associated with each stage. Figure 4-1(b) extracts the associated support operations from each life cycle stage and presents these emissions as its own stage alongside the non-vessel related activities. Surveying is not presented in Figure 4-1(b) as all emissions relate to vessel operation.

As presented in Figure 4-1(b), approximately 895 kt CO_2-e or around 89% of the direct GHG emissions are attributed to support operations (i.e., use of vessels and MODU), and approximately 105 kt CO_2-e or around 11% attributable to Well Construction, Operations and Decommissioning.

The emissions values are considered to be a conservatism estimate. In addition, maximum duration of the activities as well as a weather contingency of 30% have been used in the inventory.

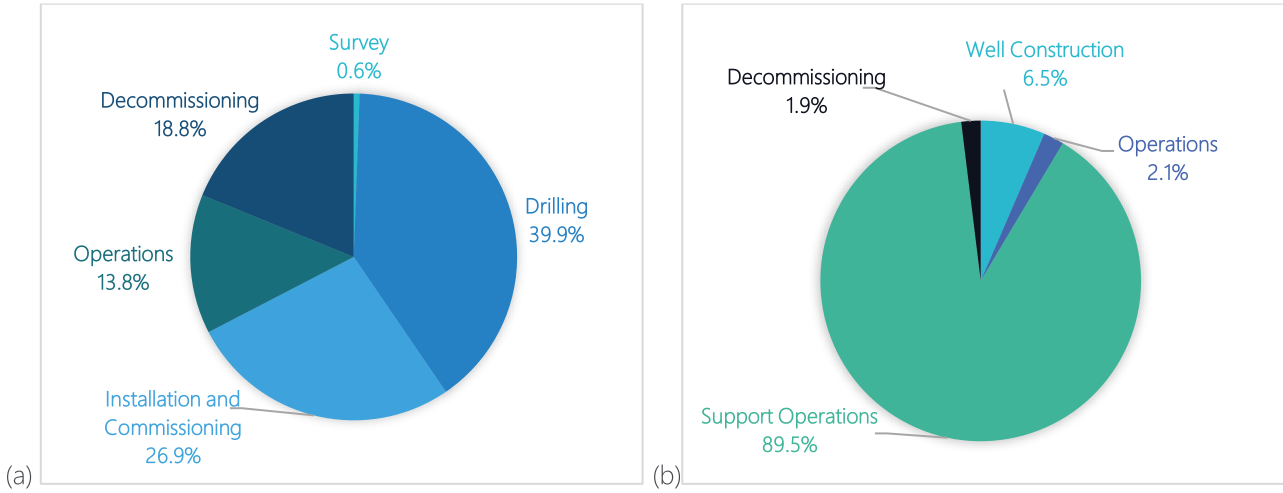


Figure 4-1: (a) Direct GHG emissions generated during each project lifecycle stage (with support operations embedded in each stage), (b) Direct GHG emissions breakdown into Well Construction, Operations, Decommissioning and Support Operations.

The indicative annual direct GHG emissions for the East Coast Gas Supply Project are presented in Figure 4-2. The maximum (peak) and average annual emissions are estimated to be approximately 198 kt CO_2-e/year and 40 kt CO_2-e/year, respectively.

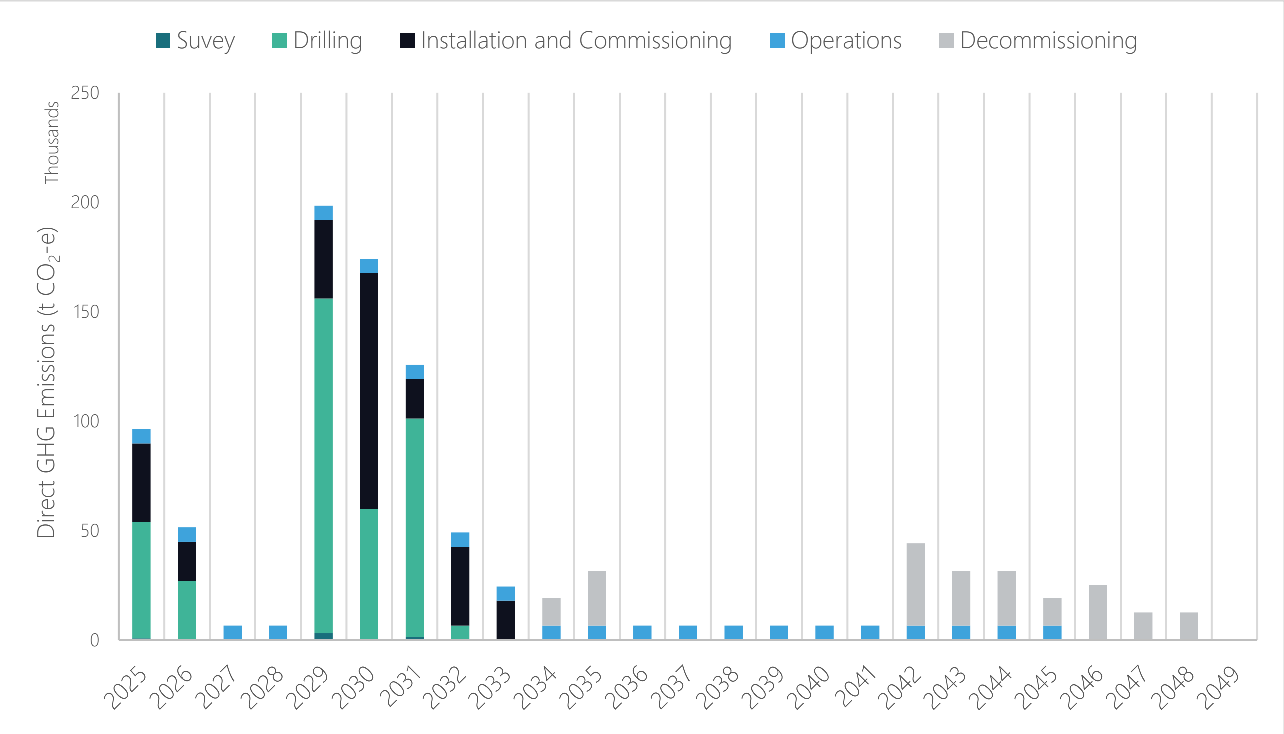


Figure 4-2: Annual direct GHG emissions by project lifecycle stage (all stages are inclusive of support operations).

4.2 Indirect GHG Emissions

The indirect GHG emissions, excluding downstream indirect GHG emissions, are estimated to be 1,581 kt CO_2-e over the project life. As summarised in Figure 4-3, the emissions sources are fuel gas (40.0%), flaring and venting (23.9%), purchased electricity (14.1%), purchase goods and transportation (11.3%), fugitive emissions (9.4%), and others (1.3%).

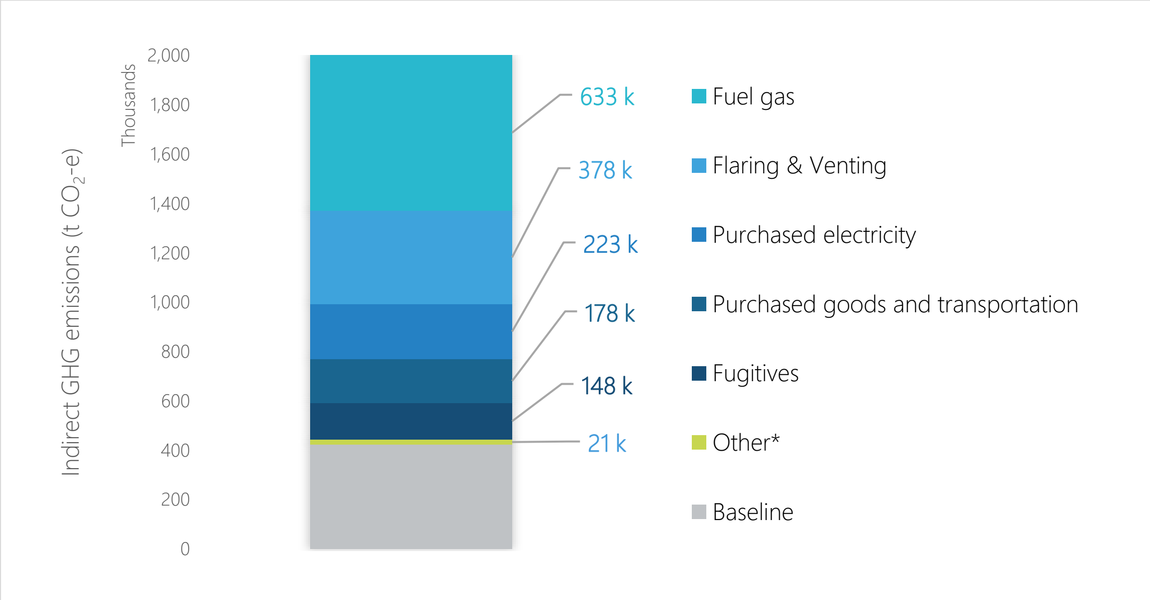


Figure 4-3: Indirect GHG emissions breakdown by emissions source
*(*Other indicates vessels within State jurisdiction, liquid fuel, waste generated, and employee commuting).*

Figure 4-4 presents the indicative scope 1 annual emissions for onshore (AGP) gas processing throughout the project life.

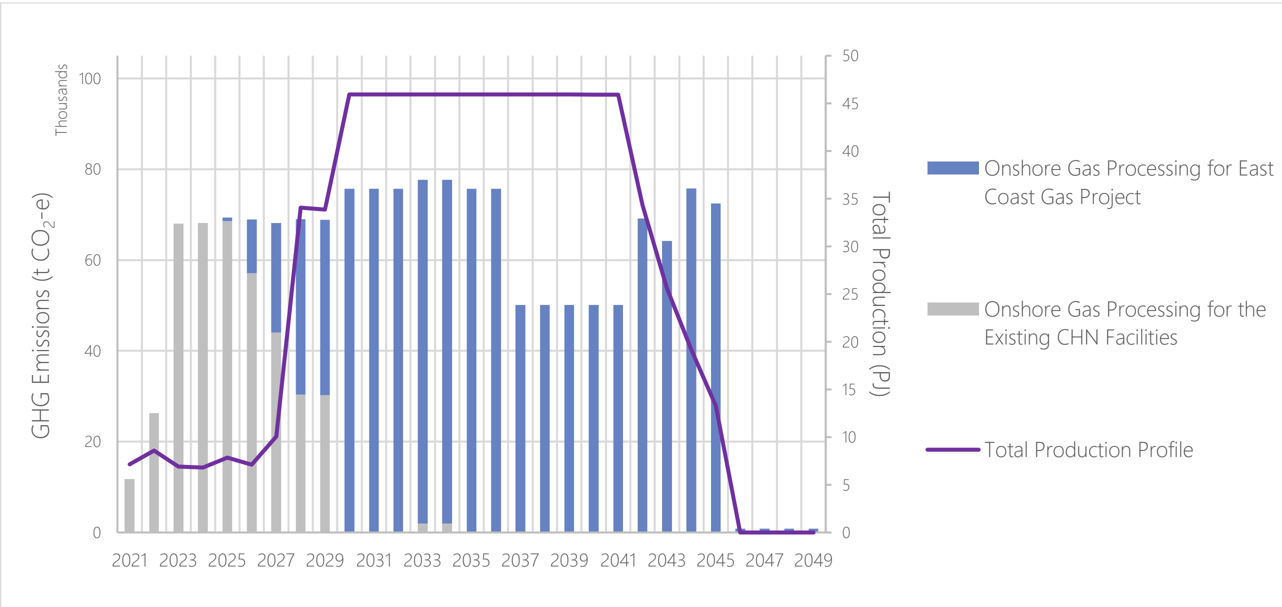


Figure 4-4: Annual scope 1 emissions profile for onshore (AGP) gas processing.

4.3 Downstream Indirect GHG Emissions

The downstream indirect GHG emissions are estimated to be 38,561 kt CO_2-e over the project life. As summarised in Table 4-1, the downstream indirect emissions include 6.5% of emissions from the downstream transportation and distribution and 93.5% of emissions from the combustion of products.

Table 4-1: Downstream indirect GHG emissions breakdown.

	CATEGORY	EAST COAST GAS SUPPLY PROJECT		BASELINE	TOTAL
		t CO_2-e	%	t CO_2-e	t CO_2-e
1	Downstream transportation and distribution	2,513,000	6.5	135,000	2,648,000
	Fugitive emissions from natural gas transmission and distribution	2,513,000	6.5	135,000	2,648,000
	Condensate transportation	<400	<0.5	<100	<500
2	Combustion of products	36,048,000	93.5	1,930,000	37,978,000
	Combustion of gas product	35,914,000	93.1	1,919,000	37,833,000
	Combustion of condensate product	134,000	0.4	11,000	145,000
	Total Downstream Indirect GHG Emissions (t CO_2-e)	38,561,000	-	2,065,000	40,626,000

4.4 Total GHG Emissions

Table 4-2 summarises the total direct and indirect GHG emissions for the East Coast Gas Supply Project. The direct emissions for the East Coast Gas Supply Project are estimated to be 1,000 kt CO_2-e over the project life, and the indirect emissions and downstream indirect emissions are estimated to be 1,581 and 38,561 kt CO_2-e, respectively.

Table 4-2: Total GHG emissions for the East Coast Gas Supply Project.

	CATEGORY	EAST COAST GAS SUPPLY PROJECT		BASELINE	TOTAL
		t CO_2-e	%	t CO_2-e	t CO_2-e
1	Direct GHG emissions	1,000,000	2.4	0	1,000,000
2	Indirect GHG emissions	1,581,000	3.9	422,000	2,003,000
3	Downstream indirect GHG emissions	38,561,000	93.7	2,065,000	40,626,000
	Total GHG Emissions (t CO_2-e)	41,142,000	-	2,487,000	43,629,000

Figure 4-5 shows the indicative annual total GHG emissions for the East Coast Gas Supply Project over the project life, broken down to the emissions category. The maximum and average annual emissions (inclusive of the baseline) are estimated to be approximately 2,840 kt CO_2-e/year and 1,745 kt CO_2-e/year, respectively. The associated emissions intensity based on a representative production year (2035) is estimated to be 58 t CO_2-e/TJ.

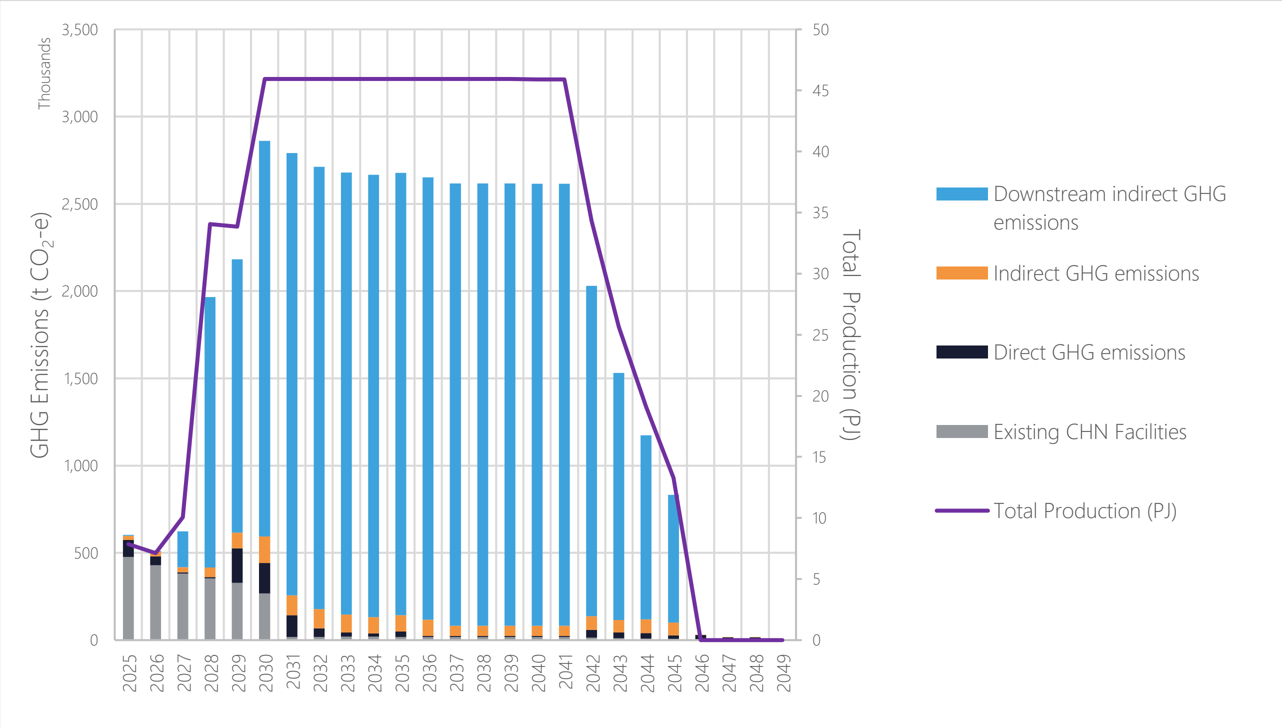


Figure 4-5: Annual total GHG emissions breakdown by category and production profile forecast.

5 CONCLUSIONS

This technical report presents the GHG emissions inventory for the East Coast Gas Supply Project. The GHG assessment has been conducted to derive the direct, indirect and downstream indirect emissions with the following key points:

- Direct GHG emissions are estimated to be approximately 1,000 kt CO_2-e over the project life (2025~2049). These consist of 89% emissions from the support operations (MODU, vessels), and 11% emissions from Well Construction, Operations, and Decommissioning.

- Indirect GHG emissions for the East Coast Gas Supply Project is estimated to be 1,581 kt CO_2-e over the project life. These consist of fuel gas (40.0%), flaring and venting (23.9%), purchased electricity (14.1%), purchase goods and transportation (11.3%), fugitive emissions (9.4%), and others (1.3%).

- Downstream indirect GHG emissions are estimated to be approximately 38,561 kt CO_2-e over the project life, consisting of 6.5% and 93.5% of the emissions from downstream transportation and distribution and combustion of products respectively.

- Based on a representative production year, the emissions intensity is estimated to be 58 t CO_2-e/TJ (inclusive of the baseline).

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