From: Schlumberger Multiclient <environment@slb.com>
Sent: Friday, 12 March 2021 1:19 PM
To: [redacted]
Cc:
Subject: RE: [Ext] Reg 25A - Schlumberger Otway Basin 2DMC MSS [DLM=For-Official-Use-Only]
Attachments: Otway Mc2D_NOPSEMA_BIA_Clarification_09 March 2021.jpg; P19057 _SeaBird_MFO-PAM Final Report_Otway Basin_FINAL.pdf

Dear [redacted]

In relation to the Otway Basin 2D MC MSS End of operation of an Environment Plan assessment queries raised, please find our responses below in *blue*.

1) Information to demonstrate compliance with the limitation imposed on the activity:

[redacted]

2) Evidence to demonstrate compliance with control measures/commitments put in place to address NOPSEMA recommendation 2101-1

[redacted]

[redacted]

Please let us know if you require any further information or clarifications on these items.

Regards,

[redacted]

Schlumberger-Private

From [redacted]
Sent: Wednesday, March 10, 2021 11:59 AM
To: Schlumberger Multiclient <environment@slb.com>
[redacted]
Subject: RE: [Ext] Reg 25A - Schlumberger Otway Basin 2DMC MSS [DLM=For-Official-Use-Only]

For Official Use Only

Good morning [redacted]

Are you able to provide an update of this information request?

Kind regards,
[redacted]

[redacted] | Environment Officer
Assessment & Inspection - Seismic & Production Operations

National Offshore Petroleum Safety and Environmental Management Authority
[redacted] | W: nopsema.gov.au

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From: Schlumberger Multiclient <environment@slb.com>
Sent: Friday, 12 February 2021 4:25 PM
[redacted]
Subject: Re: [Ext] Reg 25A - Schlumberger Otway Basin 2DMC MSS [DLM=For-Official-Use-Only]

Dear [redacted]

Schlumberger Multiclient acknowledge receipt of your email and would like to inform you that we are currently looking into the information you have outlined below. We will endeavour to respond to you as soon as possible.

Regards,

[redacted]

From [redacted] >
Sent: Wednesday, February 10, 2021 9:08 AM
To: Schlumberger Multiclient
Cc: [redacted]
Subject: [Ext] Reg 25A - Schlumberger Otway Basin 2DMC MSS [DLM=For-Official-Use-Only]

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Dear [redacted]

As part of the Reg 25A (End of operation of an Environment Plan) assessment process, NOPSEMA seeks to confirm that all relevant obligations under an EP have been met [redacted]

1) Information to demonstrate compliance with the limitation imposed on the activity:

[redacted]

[redacted]

2) Evidence to demonstrate compliance with control measures/commitments put in place to address NOPSEMA recommendation 2101-1. The Schlumberger response to this recommendation was:

[redacted]

[redacted]

This should include information relating to:

- [redacted]

[redacted]

Please let me know if you need any clarification to assist with meeting this request.

Kind regards,

[redacted]

[redacted]
Assessment & Inspection - Seismic & Production Operations

National Offshore Petroleum Safety and Environmental Management Authority
[redacted] | **W:** nopsema.gov.au

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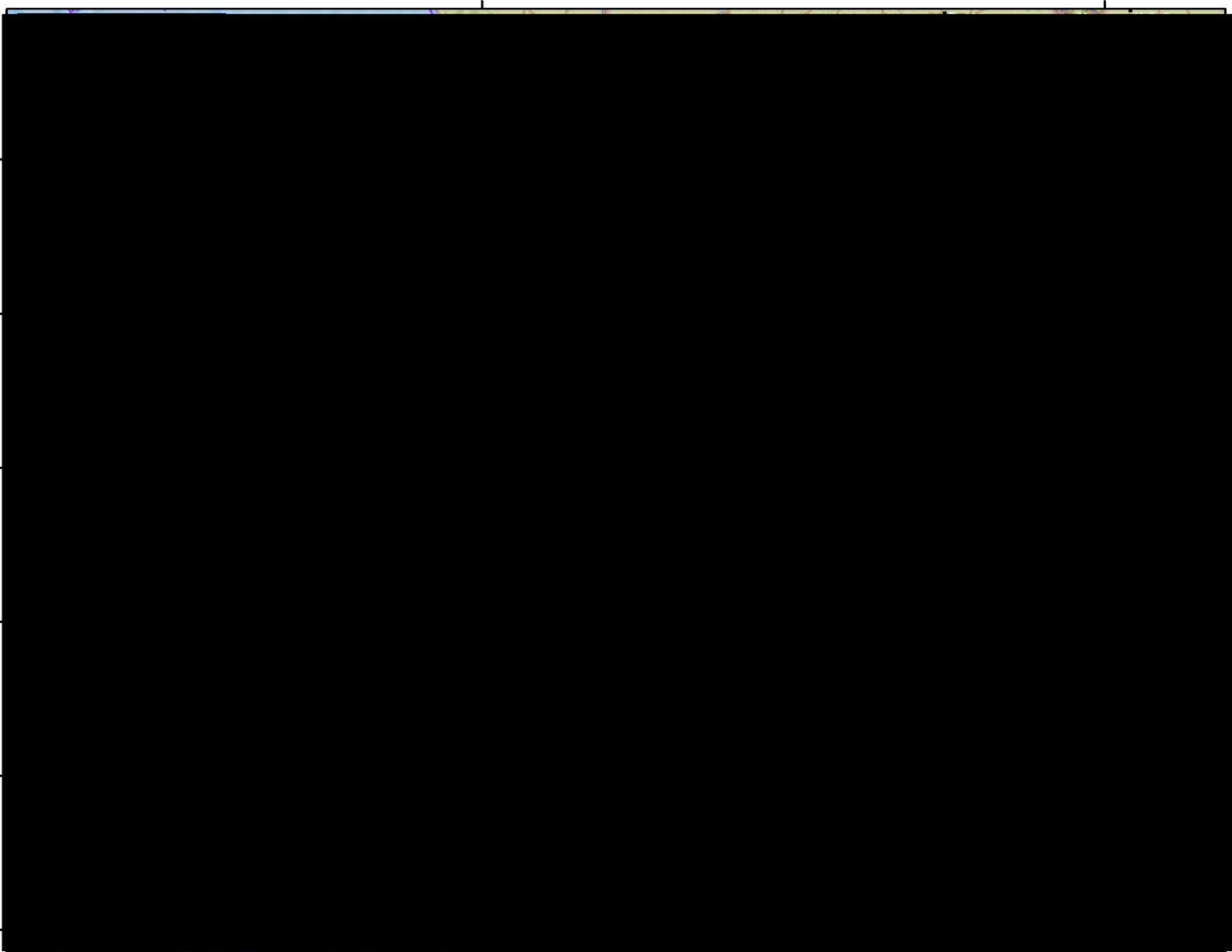

Marine Mammal Monitoring Report

SeaBird 2D Seismic Survey

Otway Basin, Australia

Client: SeaBird Exploration

Project: Otway Basin 2D Seismic Survey

Area: Australia

REPORT AUTHORISATION AND DISTRIBUTION

Marine Mammal Observers	[redacted]
Passive Acoustic Monitoring System Operatives	[redacted]
Compilation	[redacted]
Review	[redacted]

Authorisation

Revision Summary:

Title	Version	Date
Final	1	12/05/2020

Distribution:

[redacted]

SeaBird Exploration Norway AS
Cort Adelers gate 16,
P.O. Box 1302 Vika,
0112 Oslo,
Norway

SUMMARY

This report covers the Marine Mammal Observer (MMO) and Passive Acoustic Monitoring (PAM) mitigation undertaken during the 2D seismic survey on the MV *Nordic Explorer* conducted by SeaBird Exploration, on behalf of Schlumberger Australia Pty Ltd (SLB) from 15th January 2020 to 10th April 2020.

The Otway Basin is located off the coasts of Victoria, South Australia and Tasmania and covers an area of 5265 m^3 in water depths of between 50 – 5600 m. Seismic acquisition for this project was undertaken using the MV *Nordic Explorer,* supported by the chase vessel MV *No Limitation.*

The survey was performed in accordance with the "Otway Basin 2DMC Marine Seismic Survey Environmental Plan" developed by SLR Consulting Australia Pty Ltd for Schlumberger Australia Pty Ltd for this survey based on the "EPBC Act Policy Statement 2.1 - Interaction between offshore seismic exploration and whales: Industry guidelines" and subject to limitations listed by NOPSEMA in document A702829. There have also been subsequent MoC documents (SLB, January 2020).

This report details of the results of the marine mammal mitigation activity undertaken to ensure compliance with the conditions outlined in the consent document issued by NOPSEMA, with limitations therein (November 2019) and using the mitigation procedures outlined in the Environment Plan (EP) prepared by SLR Consulting Australia Pty Ltd for Schlumberger Pty Ltd (SLB).

- There were 87 survey days beginning on the 15th January 2020 and ending on the 10th April 2020. Marine mammal observation effort was carried out on 72 days during the survey.
- Cumulative MMO observation on the MV *Nordic Explorer* totalled 873 hours and 54 minutes and passive acoustic monitoring totalled 1332 hours and 14 minutes.
- Cumulative MMO observation on the MV *No Limitation* totalled 711 hours and 20 minutes and passive acoustic monitoring totalled 450 hours and 12 minutes.
- 60% of MMO observation effort took place while the source was active and 73% of PAM effort took place while the source was active.
- The total number of soft-starts was 124, of these 83 occurred during daylight/dawn and 41 were during the hours of dusk/darkness.
- All pre-start observations for marine mammals were performed in accordance with EP mitigation guidelines prior to all seismic source operations.
- There were no instances of non-compliance with the guidelines.
- There was a total of 94 visual sightings and 21 acoustic detections of marine mammals from Nordic Explorer.
- There were 33 mitigation actions initiated for marine mammals during the survey.
- For 14% of the survey period, weather conditions recorded during visual observations were considered good (i.e. glassy or slight sea state, low swell and good visibility) and 86% were considered poor.

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GLOSSARY

ALARP	As Low As Reasonably Practicable
BIA	Biologically Important Area
EEP	Environmental Execution Plan
EIA	Environmental Impact Assessment
EPBC	Environment Protection and Biodiversity Conservation Act
km	kilometre
m	metre
MMMT	Marine Mammal Mitigation Team
MMO	Marine Mammal Observer
MoC	Management of Change
NES	National Environmental Significance
NM	Nautical miles
NOPSEMA	The National Offshore Petroleum Safety and Environmental Management Authority
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
PAM(S)	Passive Acoustic Monitoring (System)
SLB	Schlumberger Australia Pty Limited

1. INTRODUCTION

1.1 Objective

The objective of the survey was to acquire 2D seismic data and run in accordance with the conditions outlined in the consent document issued by NOPSEMA, with limitations therein (November 2019) and using the mitigation procedures outlined in the Environment Plan prepared by SLR Consulting Australia Pty Ltd for Schlumberger Pty Ltd (SLB). The survey was conducted by SeaBird Exploration on behalf of SLB.

1.2 Marine Mammal Diversity in the Project Area

1.2.1 Cetaceans

Cetaceans are of particular interest during the planning stages of any seismic survey on account of the well-recognised potential for acoustic disturbance to these species. The EPBC Act Policy Statement 2.1, with which the Otway Basin 2DMC MSS will comply with, sets out different management procedures based on the likelihood of encountering during a survey. A thorough investigation of sighting and stranding data was conducted to assess which cetacean species were likely to be encountered in the Operational Area during the survey period. From this investigation it was concluded that the following species have a moderate to high likelihood of being present: ·

- Southern right whales (EPBC Act listing of endangered/migratory): Breed in coastal areas from May to October. The Operational Area overlaps with the southern right whale BIA which encompasses coastal areas used during migrations and the Warrnambool calving aggregation.
- Sei whales (EPBC Act listing of vulnerable/migratory): Forage in the Bonney Upwelling during summer and early autumn.
- Pygmy blue whales (EPBC Act listing of vulnerable/migratory): Forage for krill in the Bonney Upwelling from November to May (peak abundance in February). The Operational Area overlaps with the pygmy blue whale BIA which identifies critical foraging habitat for this species.
- Fin whales (EPBC Act listing of vulnerable/migratory): Forage in the Bonney Upwelling from November to May.
- Humpback whales (EPBC Act listing of vulnerable/migratory): Migrate southwards through the Operational Area during November – December.
- Sperm whales (EPBC Act listing of migratory): Have been recorded from all Australian waters, particularly in deep waters off the continental shelf. The Operational Area overlaps with the sperm whale BIA which identifies foraging habitat for this species.
- Beaked whales: High number of stranding records of Gray's, strap-toothed and Cuvier's beaked whales in the south-east Marine Region suggest regionally significant populations of these species may be found in the vicinity of the Operational Area. Prefer deep waters beyond the shelf edge.
- Long-finned pilot whales: High numbers of stranding records for the Victoria coast suggest a regionally significant population.
- Risso's dolphin: High numbers have stranded within the south-east Marine Region suggesting that regionally significant populations may be present.
- Common bottlenose dolphin: High numbers have stranded in the south-east Marine Region suggesting a regionally significant population. Summer breeding season.

Marine mammals likely to be found in the survey area and their seasonal variations can be found in Table 1.

Table 1 Marine mammals likely to be found in the Otway Basin 2D marine seismic survey area (SLR Environmental Plan, 2019)

Species	January	February	March	April	May	June	July	August	September	October	November	December
Baleen Whales												
Southern right whale												
Pygmy right whale												
Minke whale												
Sei whale												
Bryde's whale	Seasonality unknown											
Blue whale												
Fin whale												
Humpback whale				North							South	
Toothed Whales												
Sperm whale	Seasonality unknown											
Pygmy sperm	Seasonality unknown											
Common dolphin												
Long-finned pilot whale												
Short-finned pilot whale												
Risso's dolphin	Seasonality unknown											
Hourglass dolphin	Seasonality unknown											
Dusky dolphin	Seasonality unknown											
Southern right whale dolphin	Seasonality unknown											
Killer whale												
False killer whale												
Common bottlenose dolphin												
Indian Ocean bottlenose dolphin	Seasonality unknown											
Spectacled porpoise	Seasonality unknown											
Key:												
Breeding/calving			Peak breeding/calving									
Presence during migrations/movements			Resident population, or consistent presence of transients									
Feeding			Peak feeding									
Most likely time of presence with unspecified activity – most likely feeding												

1.2.2 Pinnipeds

Six species of pinniped (i.e. seals and sea lions) have been recorded in the south-east Marine Region and therefore had the potential to be present within the Operational Area: Australian sea lion, Sub-Antarctic fur seal, Antarctic fur seal, Australian fur seal, New Zealand fur seal and southern elephant seal (Commonwealth of Australia, 2015). Australian sea lions, Australian fur seals, and New Zealand fur seals were the most likely pinnipeds to occur in the Operational Area. An assessment of the likely timing of pinniped presence within the Operational Area was undertaken (Table 2).

Pinnipeds are less susceptible to acoustic damage from underwater noise; however, a BIA for Australian sea lions (EPBC Act listing of vulnerable) representing important foraging habitat overlaps with the north-west corner of the Operational Area.

Table 2 Timing of pinniped presence in operational area (SLR Environmental Plan, 2019)

Species	January	February	March	April	May	June	July	August	September	October	November	December
Pinnipeds												
Australian sea lion												
Sub-Antarctic fur seal	Seasonality unknown											
Antarctic fur seal												
Australian fur seal												
New Zealand fur seal												
Southern elephant seal	Seasonality unknown											
Key:												
Breeding/pupping				Peak breeding/pupping								
Presence during migrations/movements				Resident population								
Feeding				Peak feeding								
Most likely time of presence with unspecified activity – most likely feeding												

1.2.3 Turtles

Two species of marine turtles are present in the Operational Area (DoEE, 2018): the leatherback turtle (*Dermochelys coriacea*) and the loggerhead turtle (*Caretta careta*). Both species are migratory and have an EPBC Act listing status of endangered. Both species are managed under the 2017 Recovery Plan for Marine Turtles in Australia.

Leatherback turtles are the largest of all sea turtles, growing up to 1.6 m in carapace length. They occur in tropical and temperate waters in Australia and are regularly seen in southern Australian waters (Bone, 1998). The South-east Marine Region is an important feeding area for leatherback turtles and they generally feed in the open ocean on jellyfish and other soft-bodied invertebrates (Commonwealth of Australia, 2015). Breeding tends to occur in summer months, where these turtles migrate to warmer waters in Queensland or northern neighbouring countries. No nesting areas have been reported in southern Australian waters (DOEE, 2018). Leatherback turtles are listed as Endangered and Migratory under the EPBC Act.

A Conservation Advice was approved for leatherback turtles on 17 December 2008. Threats listed under this Conservation Advice of relevance to the Otway Basin 2DMC MSS include boat strike and ingestion of marine debris.

Loggerhead turtles generally occur in tropical, subtropical and warm temperate waters. They only rarely occur in the Bass Strait and southern Australian waters and as such, are unlikely to be present in the Operational Area. The carapace of this species grows to approximately 1 m and like leatherback turtles, loggerheads are carnivorous and breed during late spring and early summer in more northern waters.

1.3 Legislation

Australian marine seismic surveys, in 'offshore areas' – defined as those waters between the outer limit of coastal water (3 nautical miles (NM)) and the outer limit of the Continental Shelf (at least 200 NM) - are required to be assessed and authorised under the OPGGS Act (2006) and the associated Environment Regulations.

The OPGGS Act (2006) confers powers to the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) to regulate the health and safety, structural integrity and environmental management of petroleum exploration and development activities within Australia's offshore areas.

The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is the Australian Government's central piece of environmental legislation which provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places as matters of National Environmental Significance (NES). There are nine matters of NES to which the EPBC Act applies, the two listed below are of most concern to marine mammal mitigation, which are:

- Listed threatened species and ecological communities
- Listed migratory species

Under the EPBC Act, a number of whale species are listed as threatened and/or migratory species and are subsequently protected under the EPBC Act as matters of NES. In order to manage the interaction between offshore seismic exploration and whales, the EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales (EPBC Act Policy Statement 2.1) was developed. The aim of the EPBC Act Policy Statement 2.1 is to:

- Provide practical standards to minimise the risk of acoustic injury to whales in the vicinity of seismic survey operations
- Provide 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
- Provide guidance to both proponents of seismic surveys and operators conducting seismic surveys about their legal responsibilities under the EPBC Act

NOPSEMA accepted, subject to limitations, the Otway Basin 2D MC Marine Seismic Survey Environment Plan (the EP) submitted by Schlumberger Australia Pty Limited (the titleholder) for seismic survey activity in the Otway Basin (NOPSEMA document A702829, November 2019).

2. SURVEY METHODOLOGY

2.1 Survey Area

The project area was located between 12 and 200 NM offshore southern Australian coastlines, in the Otway Basin (Figure 1). Coordinates for the survey area can be found in Table 3.

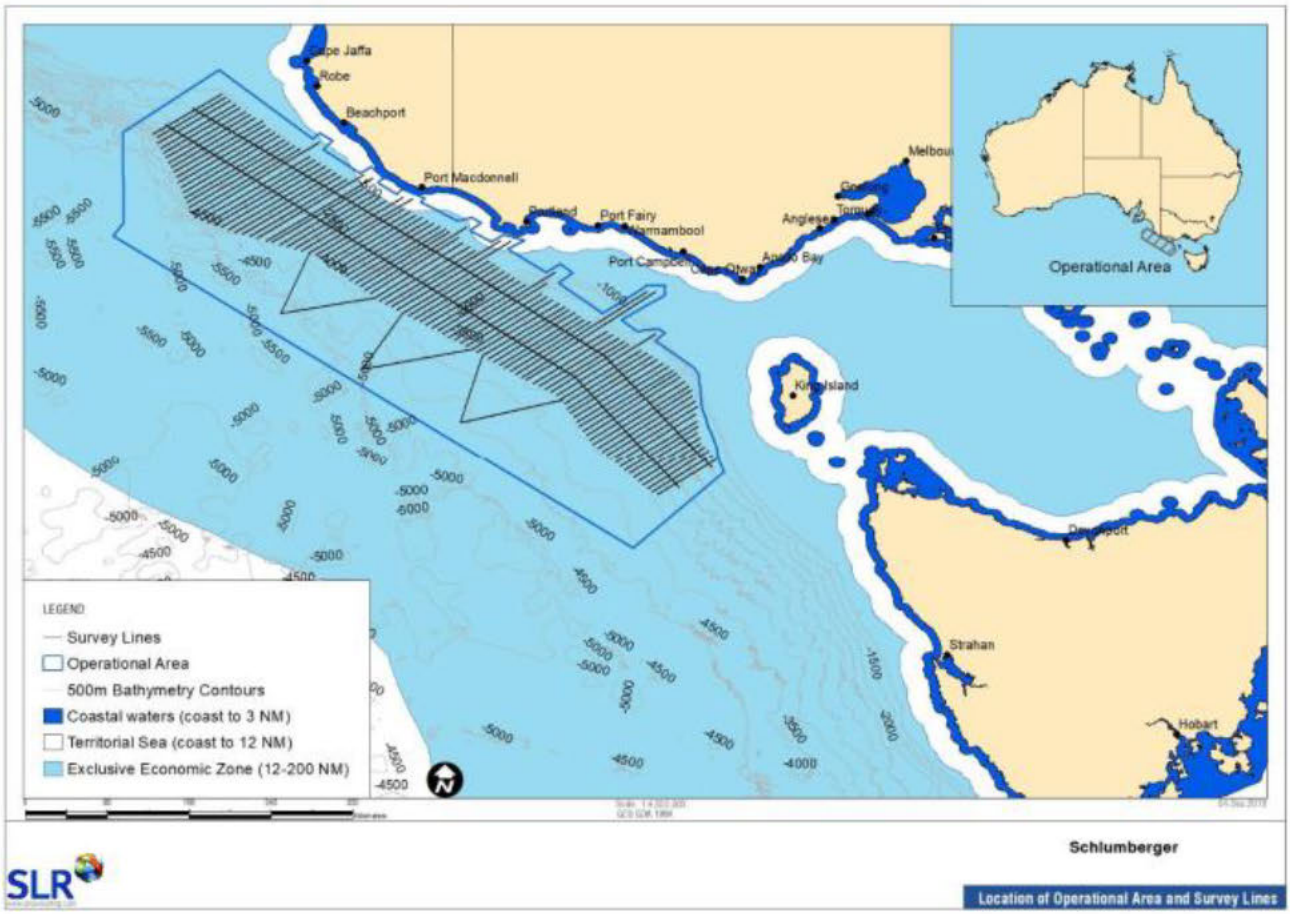

Figure 1 Map of the survey area

Table 3 Seismic survey area coordinates

Sail no	Longitude	Latitude	Sail no	Longitude	Latitude
1	139.80	-37.58	**27**	142.83	-38.92
2	139.92	-37.65	**28**	139.80	-37.58
3	139.83	-37.72	**29**	142.83	-39.00
4	140.15	-37.93	**30**	142.67	-39.09
5	140.25	-37.87	**31**	142.45	-39.21
6	140.36	-37.97	**32**	142.59	-39.32
7	140.31	-38.01	**33**	142.67	-39.30
8	140.47	-38.11	**34**	142.78	-39.30
9	140.53	-38.07	**35**	142.83	-39.33

Sail no	Longitude	Latitude	Sail no	Longitude	Latitude
10	140.72	-38.15	**36**	142.75	-39.40
11	140.68	-38.18	**37**	143.08	-39.63
12	141.01	-38.35	**38**	143.13	-39.69
13	141.14	-38.32	**39**	143.16	-40.00
14	141.22	-38.36	**40**	143.19	-40.07
15	141.12	-38.43	**41**	143.21	-40.15
16	141.31	-38.53	**42**	143.23	-40.19
17	141.42	-38.47	**43**	143.29	-40.32
18	141.60	-38.52	**44**	143.31	-40.46
19	141.45	-38.59	**45**	143.36	-40.57
20	141.79	-38.80	**46**	142.55	-41.23
21	141.91	-38.72	**47**	137.98	-38.48
22	142.02	-38.80	**48**	138.08	-38.37
23	141.90	-38.89	**49**	138.07	-37.57
24	142.28	-39.16	**50**	138.91	-37.02
25	142.58	-38.98	**51**	139.74	-37.63
26	142.68	-38.92	**52**	139.80	-37.58

Note: Coordinate projection is in WGS84.

2.2 Survey Vessels

Seismic acquisition was executed using the Bahamas registered MV *Nordic Explorer* (Figure 2). The vessel acquired the survey data using a seismic spread of one streamer of 10 km in length, a 3-array source configuration, with a north-east/south-west acquisition heading and strike lines intersecting from north-west/south-east. The survey vessel was accompanied by an Australian support vessel, MV *No Limitation* (Figure 3). Dedicated marine mammal monitoring was performed on board both vessels. Technical specifications for both vessels can be found in Table 4 & 5.

Figure 2 Seismic survey vessel MV *Nordic Explorer*

Table 4 MV *Nordic Explorer* specifications

MV *Nordic Explorer*	
Flag	Bahamas
Date of Build	1986
IMO	8517449
Overall Length	81.1 m
Breadth Moulded	16.5 m
Draft (Max.)	8.1 m
Gross Tonnage	3861
Main Engine	Wickman 12Wx28 3960kw
Maximum Speed	12 knts

Figure 3 Support vessel MV *No Limitation*

Table 5 MV *No Limitation* specifications

MV *No Limitation*	
Flag	Australia
Date of Build	2001
IMO	8517449
Overall Length	22.90 m
Breadth Moulded	5.40 m
Draft (Max.)	1.6 m
Gross Tonnage	15
Main Engine	Caterpillar 2xC18
Maximum Speed	23 knots

2.3 Survey Equipment

Details of the 2D equipment used to acquire data during the survey can be found in Table 6. Figure 4 shows the positioning of the streamers and source behind the vessel. The average speed of the vessel during seismic acquisition was 4.2 knots. The gun array configuration on the MV *Nordic Explorer* can be found in

Table 6 Survey equiment

SOURCE	
Source type	Teledyne Bigshot
Number of arrays (source)/sub-arrays	3
Number of source elements	30
Operation pressure (psi)	2000
Volume (per source) (in^3)	4470
Source depth (m)	8
Shot point interval (m)	25
STREAMER	
Streamer type	ION Digi streamer
Number of streamers	1
Streamer separation (m)	-
Streamer length (per streamer) (m)	10 km
Streamer depth (m)	15

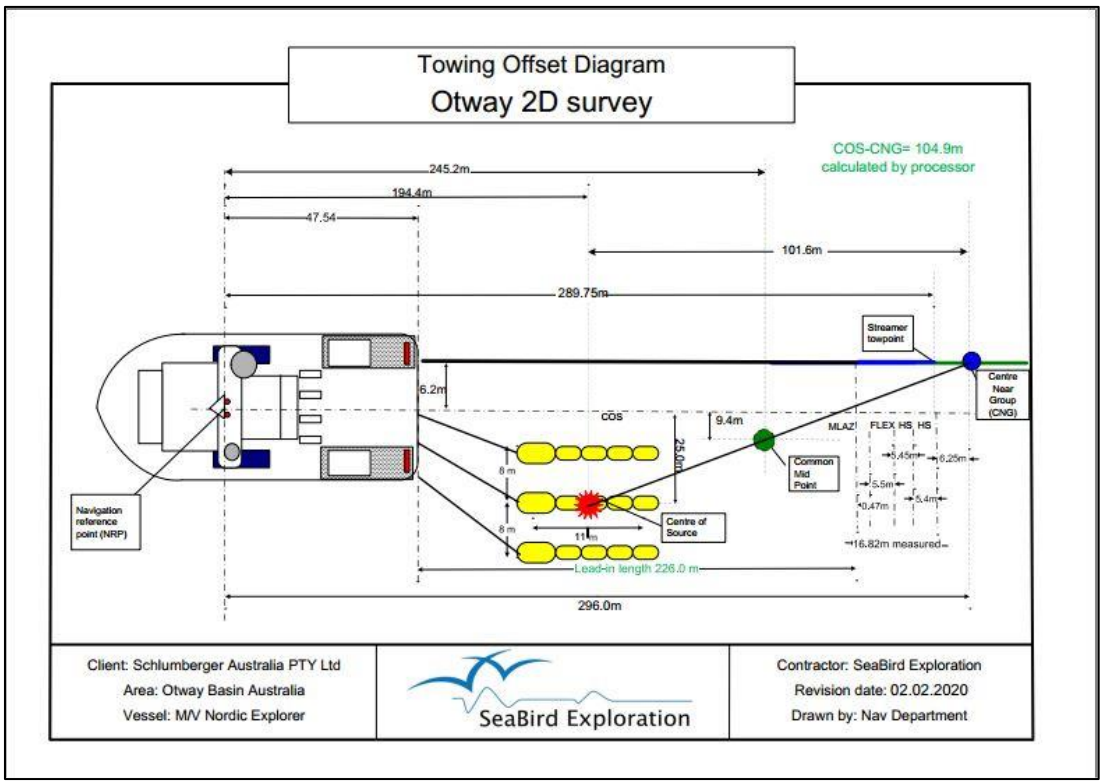

Figure 4 Source and streamer configuration and distances

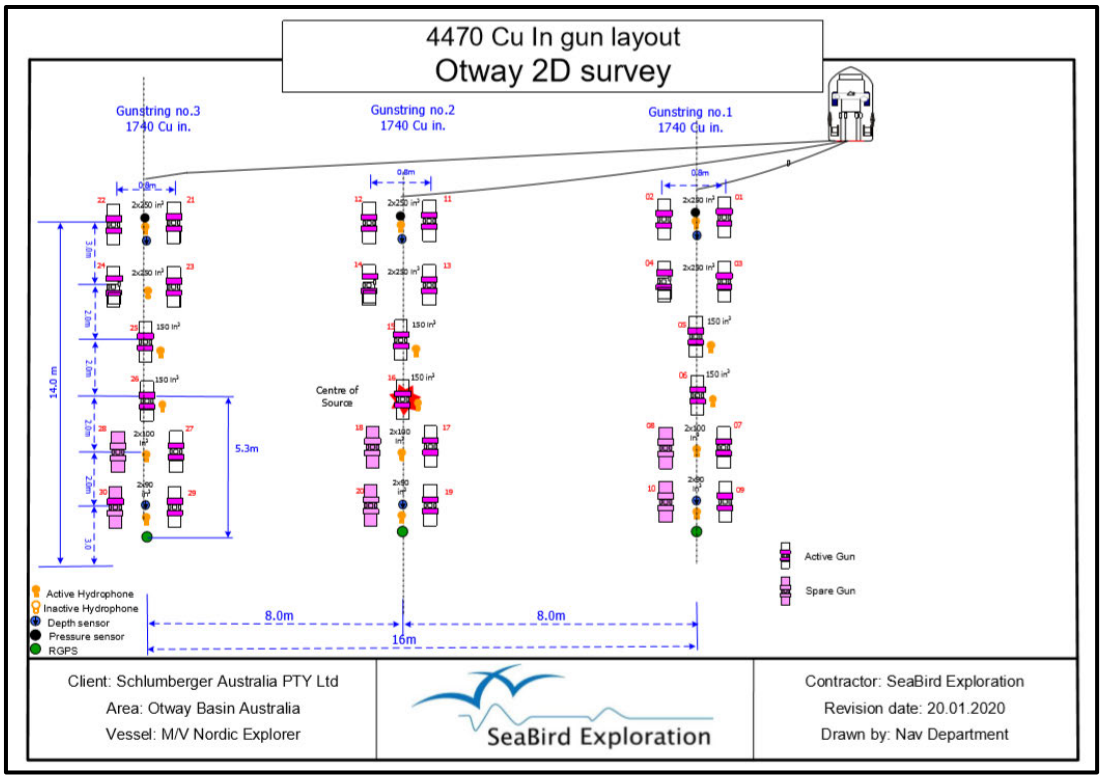

Figure 5 Gun array configuration

3. MARINE MAMMAL MONITORING METHODOLOGY

3.1 Mitigation Procedures

SLB took a conservative approach when developing the control measures to provide additional protection for whale species. The mitigation zones selected for shut-down procedures were much larger than the zones required by the regulations; and the larger mitigation zones were applied extensively across a range of bathymetry to avoid any confusion among the observers.

3.1.1 Control Measures

A 10 km buffer zone (red zone, Figure 6) was established around Biological Important Area (BIA) (yellow zone, Figure 6) where special control measures were applied in addition to control measures in the remainder of the Operational Area.

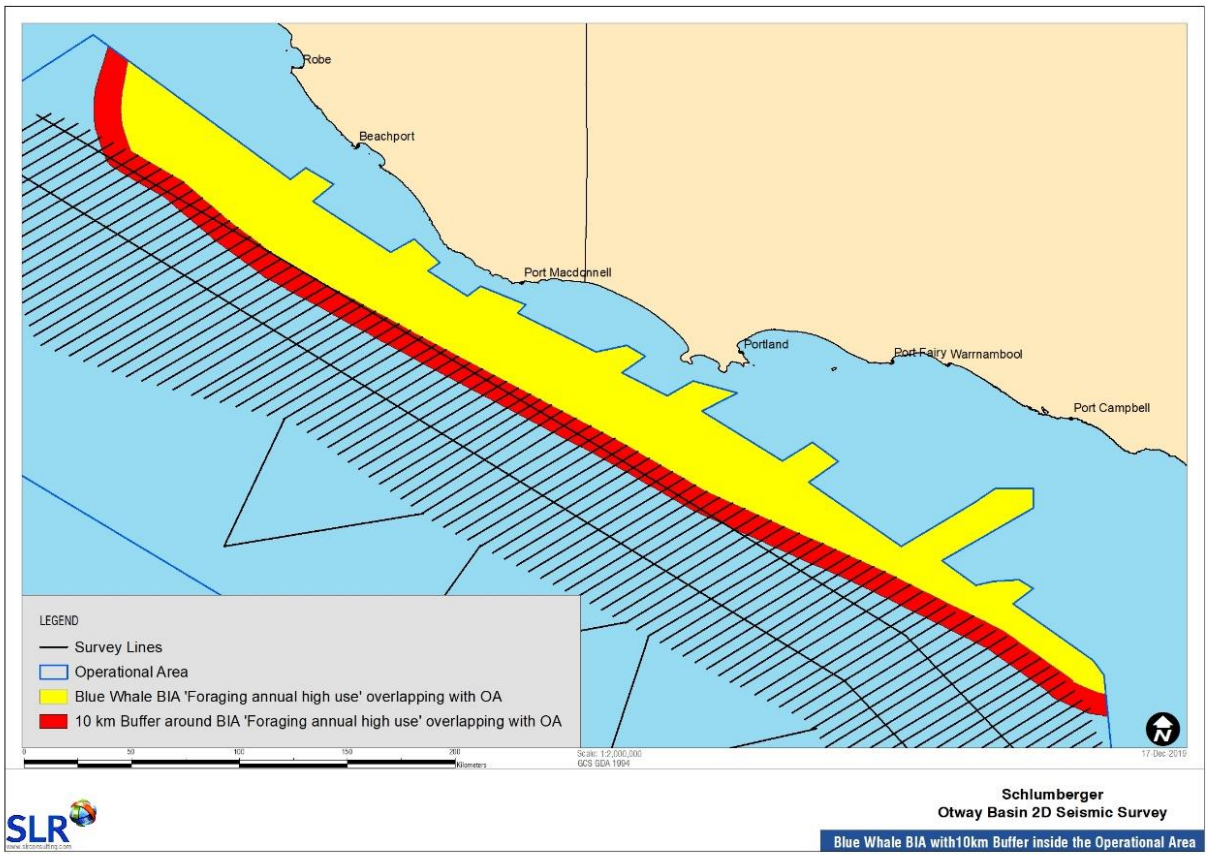

Figure 6 BIA and buffer zone control measures area

The following figures describe “Observation” and “Shut-down” zones inside the buffer zone (Figure 7) and outside the buffer zone (Figure 8). Within the BIA zone, no operations were allowed so no mitigation was required.

A 10 km Observation zone for pygmy blue whales and southern right whales required a shut-down if these species were detected. Within a 4 km zone, any whale species detected required a shut-down.

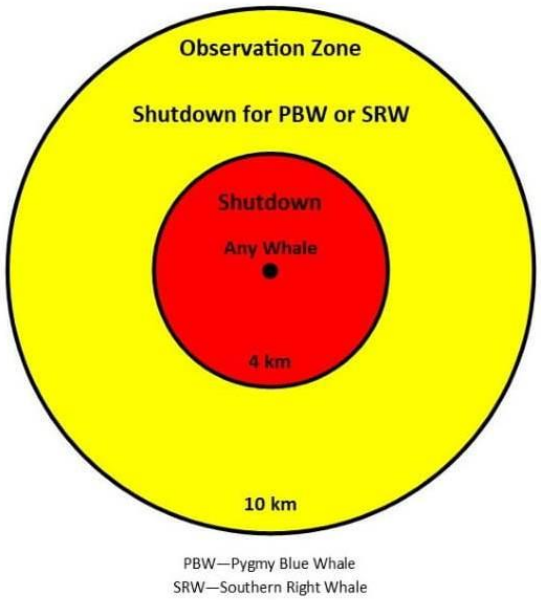

Figure 7 Inside the 10 km buffer zone

For operations outside of the buffer zone, the Observation zone was 3 km. If a pygmy blue whale or a southern right whale were detected in that zone, acquisition was shut-down. Within the 2 km zone, any whale species required a shut-down.

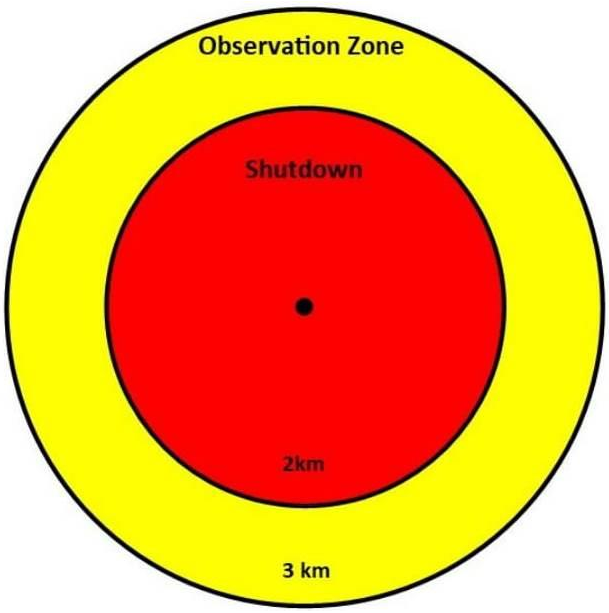

Figure 8 Outside the BIA and 10 km buffer zone

SLB have committed to a large number of control measures to reduce potential impacts from the Otway Basin 2DMC MSS to ALARP and an Acceptable Level. One of these control measures was the use of "turtle guards" on the streamer tail buoy (Figure 9)

Figure 9 Tail buoy with turtle guard

The following flow charts (Figures 10-13) outline the mitigation and operational procedures for acquisition inside the buffer zone and for standard operations outside of the buffer zone, detailing the differences for PAM not validated and for if PAM validation was achieved. No source activity was permitted inside the BIA under any circumstances.

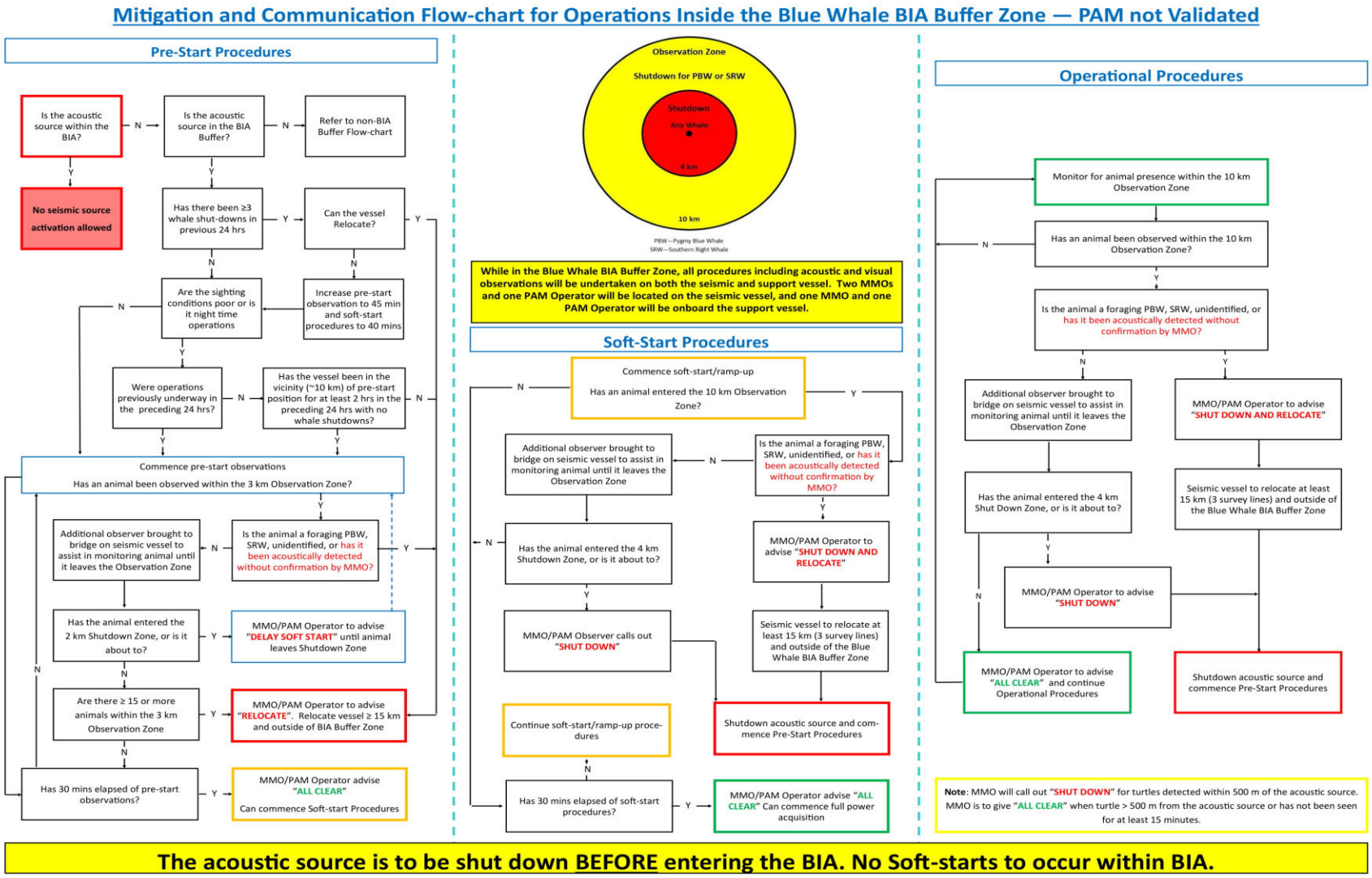

Figure 10 Mitigation flow-chart for inside the BIA buffer zone with PAM not validated

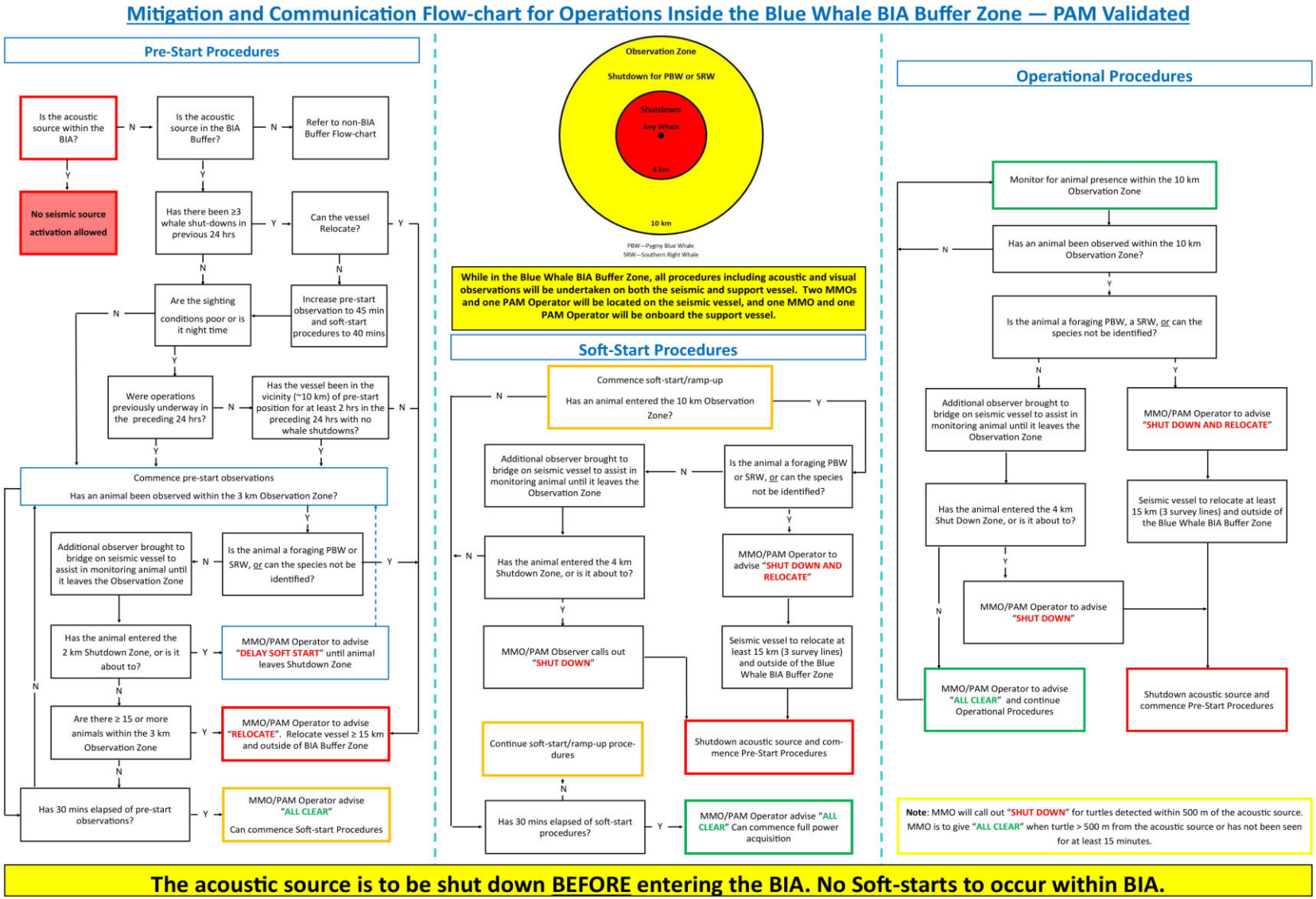

Figure 11 Mitigation flow-chart for inside the BIA buffer zone with PAM validated

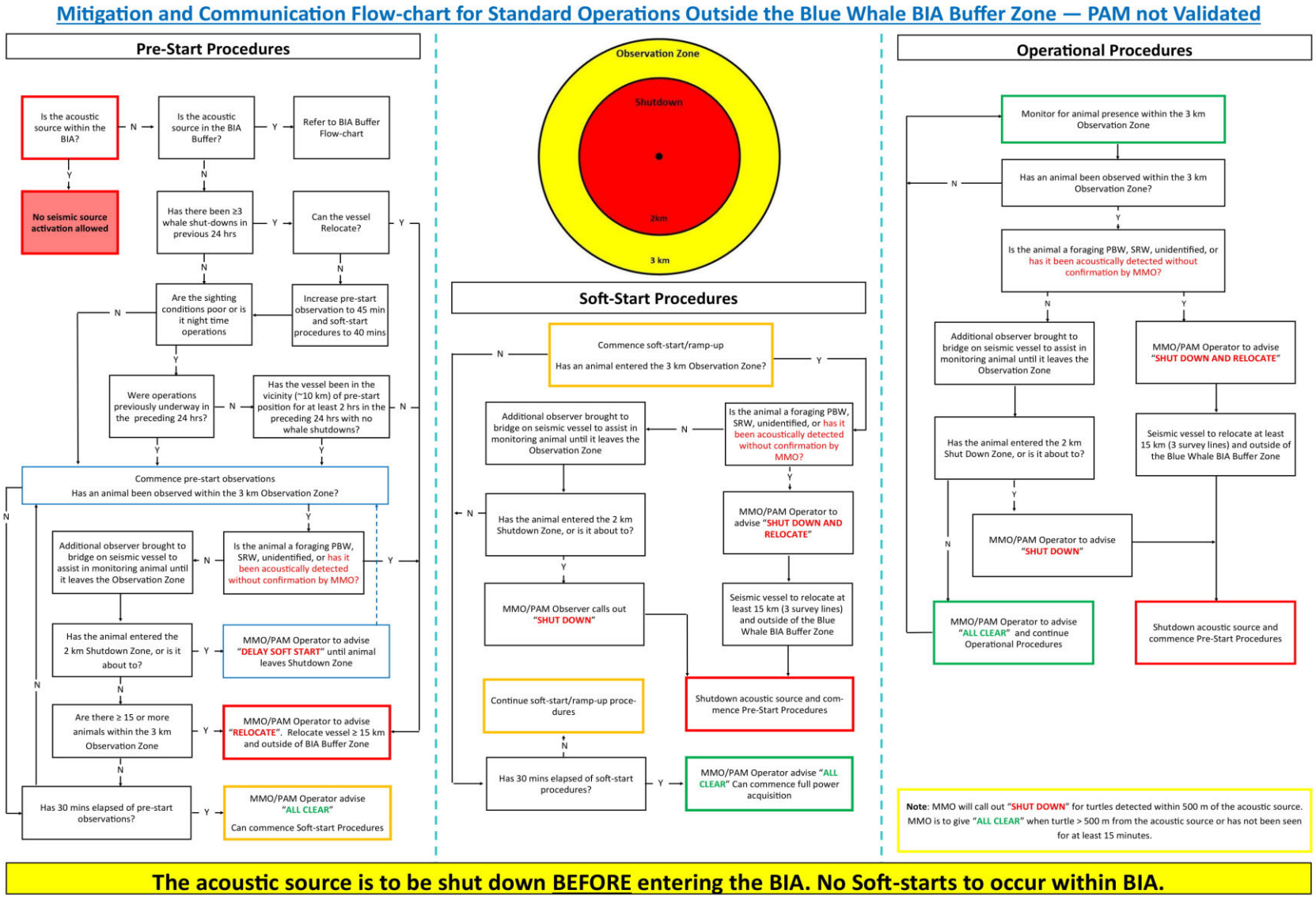

Figure 12 Mitigation flow-chart for outside the BIA buffer zone with PAM not validated

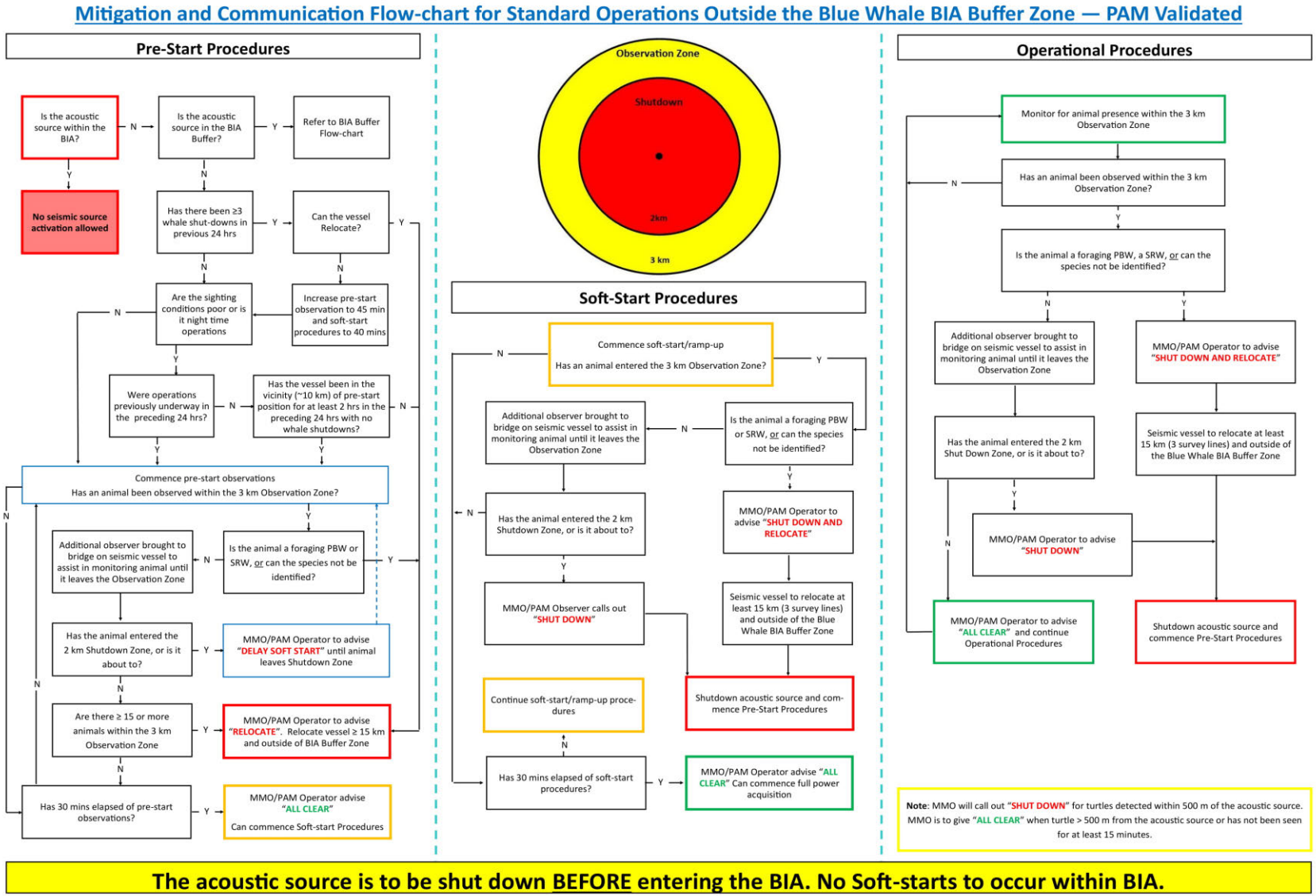

Figure 13 Mitigation flow-chart for outside the BIA buffer zone with PAM validated

3.1.2 PAM Validation

PAM equipment was installed on both the MV *Nordic Explorer* and the MV *No Limitation*, with validation being considered acceptable from either vessel. Mitigation measures were different prior to and after the validation process. Validation consisted of cross-referencing acoustic detections of marine mammals against visual observations of the same animal(s). The estimates for distances between the two observational methods could not differ by more than 20%. The purpose of this validation process was to determine distance errors (if any) in PAM detections.

3.1.3 BIA 10 km Buffer zone – Additional Control Measures

Additional control measures for the BIA 10 km buffer zone consisted of:

- Extended Shut-down Zone: 4 km horizontal radius from the acoustic source for all whales, and a 10 km Shut-down Zone for blue whales and southern right whales.
- Two experienced MMOs were required on the bridge of the survey vessel during daylight hours whilst the seismic source was active in the BIA 10 km buffer zone. This was to maximise visual coverage and increase the potential for observing whales that may have entered the relative Shut-down Zones.
- An experienced MMO was required on the support vessel to provide additional observations during daylight hours.
- A PAM system and an experienced PAM Operator were required on board the support vessel to provide both visual and acoustic monitoring, enabling 24-hour detection method capabilities.
- The support vessel was to be positioned 10 km ahead (when moving towards the BIA) or aft (when moving away from the BIA) of seismic vessel whilst the seismic source was active in the BIA 10 km buffer zone.
- The support vessel was to maintain a 10 km buffer ahead or aft of the source vessel all the way up to the BIA boundary, resulting in the support vessel being extended to nearly 10 km inside the BIA boundary.
- If a blue whale or southern right whale were detected (visually or acoustically) from the support vessel, the acoustic source would be shut-down.
- The MMO and PAM Operator on board the support vessel, and operations of support vessel, were to be undertaken in accordance with the Operational Plan.
- No seismic operations were permitted to occur in the BIA.
- Data acquisition was permitted in the 10 km buffer zone during November-April if the support vessel (with MMO/PAM monitoring) was 10 km ahead/behind the seismic vessel.
- No seismic operations were permitted to occur during May to October (inclusive) within 85 km of the southern right whale calving and aggregation BIA, as gestating females and young calves could be present during this period.

3.1.4. Adaptive Management

Adaptive management changes to the survey were required and the details of these can be found below:

- If foraging blue whales were observed, all relevant sighting data was to be recorded (i.e. location and number).
- SLB would implement adaptive management measures if:
    - >15 whales were present in the observation zone during pre-start observation
    - Higher than anticipated observations result in >3 shut-downs within a 24-hour period

- If PAM was not validated, any detection of a blue whale at night would trigger a shut-down.

- If >3 whales were present in the observation zone during pre-start observation, the vessel would relocate to >15 km away and be outside of the BIA buffer zone.
- If a high number of detections or >3 shut-downs initiated in a 24-hour period, seismic vessel to relocate to >15 km away, outside of the BIA buffer zone, and follow these additional start-up procedures:
    - Pre-start visual observations increased to 45 minutes
    - Soft-start procedures increased to 40 minutes
    - If operating outside 10 km buffer zone at the time, observation zone increased to 4 km
    - Vessel would not relocate to original area until at least 24 hours had passed

- If a southern right whale mother and calf pair were observed at any time, the seismic source would shut-down immediately. Soft-start would only commence once whales had not been observed for at least one hour or at were at least 10 km away.
- If high numbers of whale detections resulted in three or more shut-downs in a 24-hour period, the seismic vessel would relocate to another survey line at least 15 km away (three survey lines away), that was outside of the blue whale BIA 10 km buffer zone (if the observations were within the BIA), and follow the additional start-up procedures and increased observation zone below:
    - The pre-start up visual observations would be increased to 45 minutes
    - The soft-start procedures will be increased to 40 minutes
    - If the seismic vessel was operating outside of the BIA buffer zone at the time, the observation zone would be increased to 4 km. If the seismic vessel was within the BIA buffer zone, the 4 km Shut-down Zone is in place for other whales and a 10 km observation/Shut-down zone would be implemented for blue whales and southern right whales; and the seismic vessel would not relocate back to the original area where the three or more shut-downs occurred until at least 24 hours had passed

- If more than 15 whales were present in the observation zone during the pre-start observation period, but not close enough to prevent soft-start procedures commencing (i.e. within the shut-down zone), the seismic vessel would relocate to another area (>15 km away that is outside of the blue whale BIA and 10 km buffer zone if the observations were within the BIA).
- If a southern right whale mother and calf pair were observed in any part of the Operational Area, the seismic source would immediately be shut-down. Pre-start observations and soft-start procedures would not commence until the whales had not been observed for at least one hour, or until they were at least 10 km away.

3.1.5. Support Vessel – MV No Limitation

The MV *No Limitation* had one MMO and one PAM Operator on board during the entire survey period. Prior sections, including PAM, acquisition inside the buffer zone and BIA and adaptive management operations in sections 3.1.1 to 3.1.4 apply to all support vessel operations.

Continuous communications via VHF radio between the MMO's on board the MV *Nordic Explorer* and the MMO/PAM Operator on board the MV *No Limitation* on agreed frequencies was paramount, as was coordination of sightings and vessel positioning between OOW on both vessels. Protocols were established before departure from Portland for mobilization. The MMO was on the bridge of the support vessel during daylight hours, especially during the run-in, soft-start and acquisition phases of all lines and when in proximity of the buffer zone and BIA.

A trained and experienced PAM Operator was on board the support vessel to provide observational coverage during night-time and low visibility when adaptive management measures were required and, in the BIA, or 10 km buffer zone.

3.1.6. Marine Mammal Mitigation Measures

A summary of the mitigation measures for this survey can be found in Table 7. These were followed by the team on board the MV *Nordic Explorer* as well as the team on board the support vessel MV *No Limitation*.

Table 7 Mitigation measures summary

SUMMARY	
Mitigation zone size	Varies (see 3.1.1 & 3.1.2)
Pre-start observation period	30 minutes
Soft-start length	30 minutes
Soft-start delays	Delay for marine mammals and turtles inside 500 m zone or designated zone appropriate to whale species
Shut-down during production	Shut-down for marine mammals and turtles, depending on species and area of the survey – guidelines vary between BIA buffer zone and all other areas (see 3.1.1 & 3.1.2)
Resuming production	Soft-start and production should only recommence if the animal has been observed to move outside the shut-down area or 30 minutes passed since the last sighting
Species covered	All marine mammals and turtles
No. of MMO & PAM Op.	3 x MMOs & 2 x PAM Op (NE); 1 x MMO & 1 x PAM Op (NL)
Special requirements	For Pygmy Blue Whales & Southern Right Whales (see 3.1.1 & 3.1.2)

3.2 Marine Mammal Mitigation Team (MMMT)

The Marine Mammal Mitigation Team consisted of five trained and dedicated MMO and PAM Operators on board the MV *Nordic Explorer* and two trained and dedicated MMO and PAM Operators on board the support vessel MV *No Limitation* throughout the survey (Table 8).

The role of the team was to detect marine mammals and sea turtles as part of the mitigation procedures and to advise a delay/stop in the activity if any of these animals were detected within the designated mitigation zone. This is to reduce the potential for deliberate injury to occur and ensure the survey complies with the relevant consent conditions.

Table 8 MMOs and PAM Operators on board the MV *Nordic Explorer* and MV *No Limitation*

OBSERVER	POSITION	PERIOD ONBOARD
[redacted]	[redacted]	12/01/2020 -12/02/2020
[redacted]	[redacted]	12/01/2020 -12/02/2020
[redacted]	[redacted]	12/01/2020 -12/02/2020
[redacted]	[redacted]	12/01/2020 -12/02/2020
[redacted]	[redacted]	12-01/2020 - 11/03/2020
[redacted]	[redacted]	12-01/2020 - 11/03/2020
[redacted]	[redacted]	12-01/2020 - 11/03/2020
[redacted]	[redacted]	12/02/2020 -15/04/2020
[redacted]	[redacted]	12/02/2020 - 11/03/2020
[redacted]	[redacted]	12/02/2020 -15/04/2020
[redacted]	[redacted]	12/02/2020 -15/04/2020
[redacted]	[redacted]	11/03/2020-15/04/2020
[redacted]	[redacted]	11/03/2020-15/04/2020
[redacted]	[redacted]	11/03/2020-15/04/2020
[redacted]	[redacted]	11/03/2020-15/04/2020

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

3.3 Visual Monitoring

During survey operations the MMOs carried out dedicated watches for marine mammals and marine turtles during daylight hours. Further watches were also conducted when the survey equipment was not operational.

The MMOs monitored the area with the naked eye and 7 x 50 binoculars, checking for visual cues such as seabirds, splashes, blows and sea surface disturbances. When marine fauna was observed, the distance and bearing to the animals were recorded along with the species, time, position as well as some environmental conditions. Species identification was aided when possible by photographic records of sightings, taken using digital SLR cameras. Species identification was also confirmed by reference to a field guide (Shirihai & Jarrett, 2006).

Observations were carried out mainly from the bridge, with very limited occasions from the elevated deck, 140 m away from the centre of the mitigation zones. The elevated deck provided a clear 360-degree view of the mitigation zones, but its use was heavily restricted due to weather conditions.

Distances to sightings were estimated using reticle binoculars, range sticks and by reference to known distances, such as seismic gear and other vessels. Communication with the instrument room and the MMOs was maintained by handheld radio. The seismic observers in the instrument room kept the MMOs informed of all planned seismic activities and whenever there was a change in source activity.

3.4 Acoustic Monitoring

PAM is the process in which an array of hydrophones, acquisition unit and sound processing software are used in conjunction with a trained PAM Operator to detect marine mammal vocalisations. Analysis of vocalisation Time Differences of Arrival (TDOA), to each hydrophone allows two-dimensional localisation of vocalisations, providing a sound source bearing in relation to the hydrophone array. Knowledge of vocalisation intensity and sound propagation properties allow estimation of distance, whilst analysis of vocalisation characteristics can be used to deduce marine mammal species.

On the MV *Nordic Explorer*, PAM was conducted throughout the survey with 24-hour coverage. The PAM Operator monitored for marine mammals aurally using Sennheiser HD 215 headphones, listening to the lower audible frequencies, and visually observed PAMGuard on two computer screens. Modules included a whistle detector, spectrograms and a click detector for broadband and high frequency clicks. The high frequency vocalizations inaudible to humans may only be visually observed on the high frequency click detector. A visible display of the low-mid frequency vocalizations was monitored on the low-mid frequency spectrogram. A map module was used to track the vocalizations in order to localize marine mammals and determine an approximate range to the vessel, where possible. The map also provided a live feed of the vessel's location. A sound recorder was used to document the vocalizations and provide an opportunity for further analysis.

PAM effort data, including date, time, position, water depth, source activity and vessel speed were recorded within a JNCC Excel spreadsheet, reporting every hour (where possible) and during any instances in which source activity was altered. Positive marine mammal detections and associated vocalisation characteristics, species identification, range and bearing, alongside all aforementioned details, were also recorded within the same forms. Marine mammal detection audio was recorded and PAMGuard screenshots extracted to allow further analysis.

The PAM system was manufactured by Seiche Measurements Ltd. and comprised of a six-channel heavy tow array with integrated depth sensor, towed hydrophone array cable, deck cable, acquisition unit and integrated computer. To ensure 100% functional redundancy, the system also included additional hydrophone array cables, another deck cable and one acquisition unit with integrated computer.

The array section consisted of two 'LF' channels (H1, H2: 10 Hz - 24 kHz), two 'MF' channels (H3, H4: 200 Hz - 200 kHz), two 'HF' channels (H5, H6: 2 kHz - 200 kHz), and an array depth sensor (Figure 14 & Table 9). These elements were mounted in a 20 m cable terminated with a Seiche 36-pin connector. A 10 m drogue rope was also attached to the end of the array cable to reduce 'whipping' and promote a flat tow through the water column.

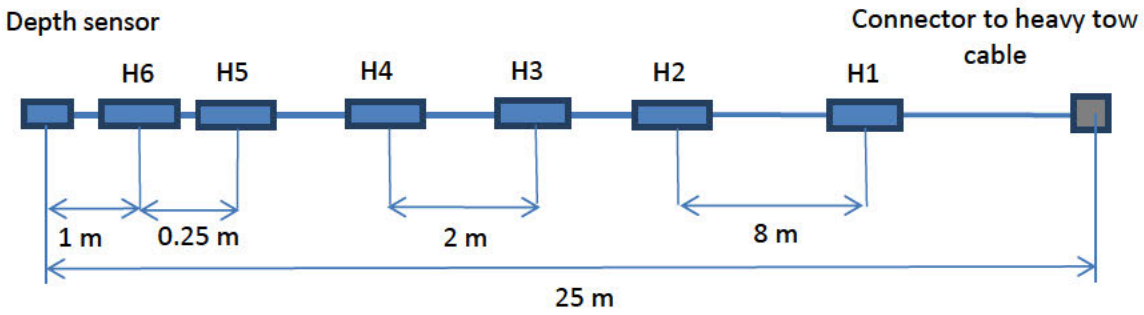

Figure 14 Six-channel hydrophone array schematic highlighting technical specifications

Table 9 Six-channel hydrophone array technical specifications

Hydrophone elements		
H1 – Low frequency	10 Hz to 24 kHz (-3 dB points)	+25 dB preamplifier gain
H2 – Low frequency	10 Hz to 24 kHz (-3 dB points)	+25 dB preamplifier gain
H3 – Broadband	200 Hz to 200 kHz (-3 dB points)	+40 dB preamplifier gain
H4 – Broadband	200 Hz to 200 kHz (-3 dB points)	+40 dB preamplifier gain
H5 – Standard	2 kHz to 200 kHz (-3 dB points)	+40 dB preamplifier gain
H6 – Standard	2 kHz to 200 kHz (-3 dB points)	+40 dB preamplifier gain

The 25 m six-channel hydrophone array is towed on a re-enforced 230 m heavy duty tow cable (Figure 15). The array cable connects to the heavy tow cable via a 36-pin connector.

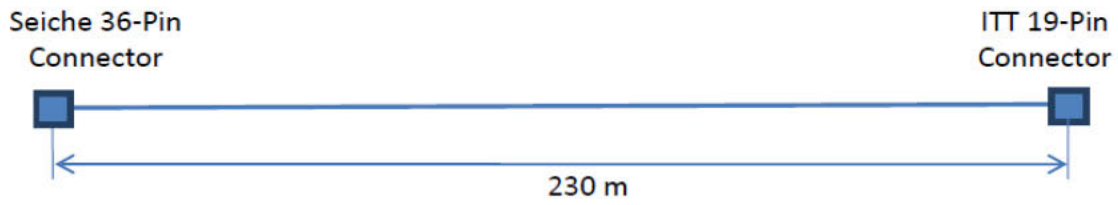

Figure 15 230 m heavy-duty tow cable

Broadband Channel sensitivity at the output of the pre-amplifier was typically -201 dB re: 1 V/µPa to 166 dB re: 1 V/µPa. Key technical specifications for the tow cable can be found within Table 10.

Table 10 Array tow cable technical specification

Length (m)	230 m
Diameter	17mm over cable, 32 mm over mouldings
Rear connector	Seiche 36-pin, 45 mm diameter over connectors
Front connector	ITT 19-pin, 65 mm diameter over connectors
Weight (kg)	100 kg
Min. bend radius	330 mm (dynamic), 165 mm (static)

The deck cable comprised of a 17 mm high tensile electrical cable of 100 m in length. Full technical specifications for the deck cable can be found within Table 11.

Table 11 Deck cable technical specification

Length (m)	100 m
Cable diameter (mm)	14 mm
Connectors	ITT 19 pin (1 x male & 1 x female)
Connector diameter (mm)	64 mm
Weight (kg)	30 kg

The PAM acquisition unit was within an 8U 19-inch rack housing container and comprised of an array power, interface and signal processing unit ("Buffer Box") with an internal card for sampling high frequency (HF) sound; external sound card ("Fireface 800") for digitally sampling low frequency (LF) sound; integrated rack mounted PC ("PAMGuard PC") and the Fireface 800 controller software; JTS remote headset unit ("JTS Unit") for listening to the LF output from the Fireface 800 via a base station transmitter and belt-mounted receiver and external inputs of GPS and vessel heading.

3.4.1 Pam System Set-up MV Nordic Explorer

A pre-laid Seiche deck cable (SM.4736) on the MV *Nordic Explorer* connected the PAM tow cable to the PAM acquisition unit at the PAM station. The PAM station was set up in the instrument room (Figure 16), adjacent to the navigator and observers work-stations. This allowed for excellent communication throughout the project.

The computer ran PAMGuard software version 1.15.11 Core (www.pamgard.org). The system was configured to monitor for low, medium and high frequency sounds. An additional spectrogram was added to detect baleen whale vocalisations below 100 Hz.

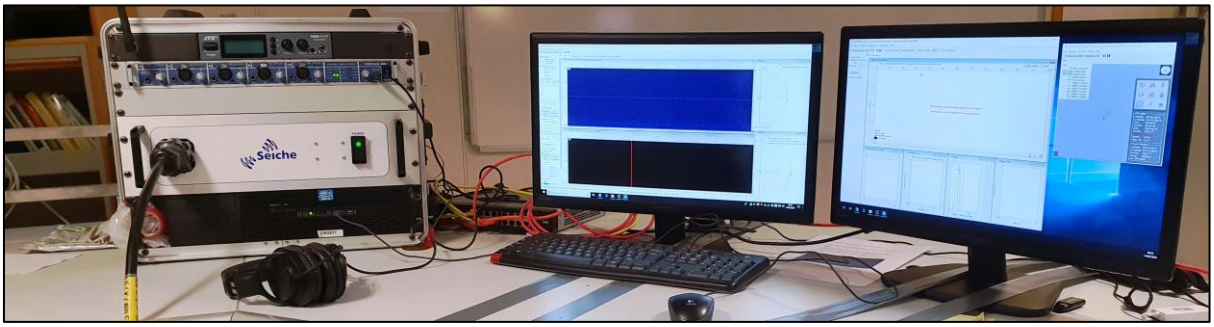

Figure 16 PAM station set-up on board the MV *Nordic Explorer*

3.4.2 Pam System Set-up MV No Limitation

The same type of system as on the MV *Nordic Explorer* was utilised on the MV *No Limitation*. The main system was set-up at a small desk within the wheelhouse (Figure 17). The deck cable ran from the stern of the vessel to the PAM station, entering the wheelhouse through a window.

Figure 17 PAM station set-up on board the MV *No Limitation*

3.4.3 Pam Cable Deployment MV Nordic Explorer

The cable was deployed from a large winch at the stern of the vessel on the starboard side (Figure 18).

Figure 18 PAM deployment on board the MV *Nordic Explorer*

Deployment History

Deployment 1 **15/01/2020 - 16/01/2020** **100 m Astern** **Weighted 10 kg**

For deployment 1, 2 & 3 the cable was weighted with 10 kg of chain 2 meters before hydrophone 1, see Figure 19. It was noted that the background noise from the propeller was quite high for this deployment. We were aware that low frequency noise may mask blue whale vocalisations.

Figure 19 PAM cable weighting arrangement for deployment 1, 2 & 3

Deployment 2 **16/01/2020 - 20/01/2020** **150 m Astern** **Weighted 10 kg**

To reduce background noise, the cable was deployed a further 50 m to 150 m. Background noise was improved; however, it was a concern having the cable deployed underneath the gun array.

Deployment 3 **20/01/2020 - 28/01/2020** **200 m Astern** **Weighted 10 kg**

The cable was deployed 200 m astern; it was felt the entanglement risk was now low as the cable terminated beyond the gun array. Background noise from the ship's propeller was excellent during good or moderate weather conditions. However, when seas were rough the cable would occasionally contact the streamer.

Loss of Cable

On 28/01/2020 at approximately 01:00 local time, during rough seas and a large swell, the cable seemingly wrapped around the streamer. After consultation with the gun mechanic and observer teams, it was decided to take the streamer and the PAM cable in at the same time. When the cable was about half-way in, it was noticed that after a few wraps on the streamer it led over to where the guns were. At that moment a 3-meter swell brought tension on the cable, and it snapped.

Deployment 4 **28/01/2020 – Project End** **125 m Astern** **Weighted 22 kg**

It was decided to weight the replacement cable closer to the stern, and along the cable at intervals (see Figure 20). Hoping that this would cause the cable to run deeper, and well below any possible entanglement spots, and the worst of the ship's propeller noise. As a precautionary measure it was decided to deploy the tow cable out to 125 m, allowing termination before the seismic source. Background noise levels for this deployment were moderate.

Figure 20 Pam cable weighting arrangement for deployment 4

Figure 21 PAM cable being deployed from the stern

Cable Entanglement

The PAM cable was retrieved and deployed on a number of occasions over the course of the second trip mostly due to poor weather conditions but on the 1st of March at 08:58 the cable had to be retrieved because it got tangled on the streamer lead in (Figure 22).

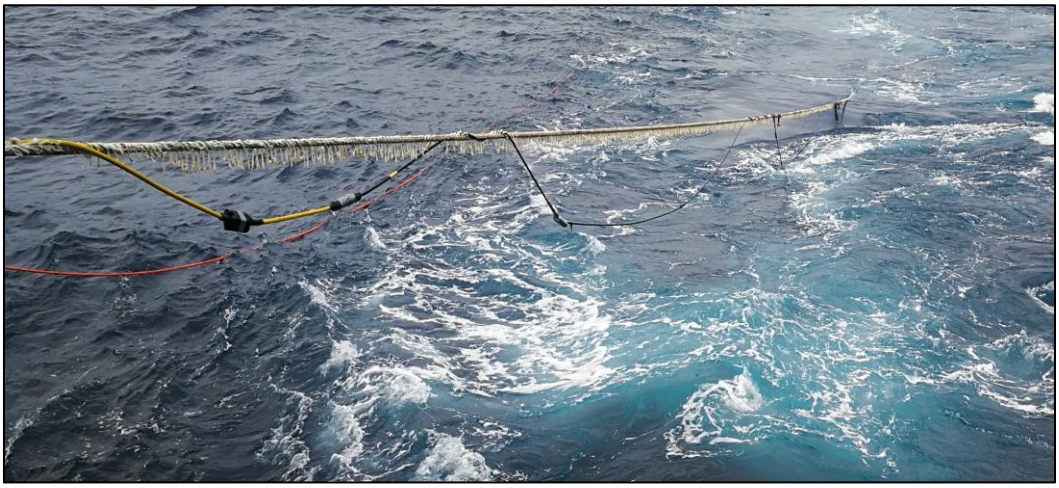

Figure 22 PAM cable tangled on the streamer lead in

Deployment 5 01/03/2020 – Project End 130 m Astern Weighted 36 kg

After the entanglement incident, the PAM Operators decided to weight the cable closer to the stern, with 36 kg of lead bars (14 kg more than previously added). This was to enable the cable to run deeper, well below any possible entanglement spots. As a precautionary measure it was decided to deploy the tow cable out to 130 m, allowing termination before the seismic source. Background noise levels for this deployment were moderate.

3.4.4 Pam Cable Deployment MV No Limitation

The tow cable was deployed and recovered from an electronic winch at the stern of the vessel, on the back deck (Figure 23). When not in use, the tow cable would be retrieved, which occurred on a daily basis. Prior to recovery, the deck cable was disconnected from the tow cable and both connectors were covered to avoid damage from weather conditions.

Figure 23 PAM deployment on board the MV *No Limitation*

3.5 Data Collection and Recording Forms

The MMO/PAM Operators compiled data throughout the survey into three main datasheets: effort, operations, and sightings/acoustic detections. For details of the data recorded on each form, please refer to Appendix A (MV *Nordic Explorer*) and Appendix B (MV *No Limitation*). For further explanation of the data entry please refer to Using Marine Mammal Forms (Appendix C).

Cumulative totals and statistics of the data were compiled throughout the survey. Daily reports on visual and acoustic monitoring effort were submitted along with any sightings, including marine wildlife activity to the client representatives, client, party chief and project manager.

All sighting/dectection data were tabulated and summarised. Where possible, photographs were taken of sightings to allow for analysis after the sighting was made to help obtain correct identification and to estimate group size.

3.6 Communication

There was a pre-survey start up meeting to confirm the marine mammal mitigation requirements and further meetings on board the vessel between the client, seismic observers and the MMMT to agree on mitigation procedures.

All communication followed the agreed protocol. Notice for commencement of the pre-start observation was given to the MMO/PAM Operator by UHF radio at least 60 minutes before any source operation. All soft-starts and tests were cleared with the MMO or/and PAM Operator prior to source activation. In the case of a mitigation action, the MMO and/or PAM Operator communicated with the observers directly and would advise all parties of actions required. In March 2020, a document was created and distributed throughout all departments to inform the appropriate people of the correct communication procedures (Figure 24; Table 12).

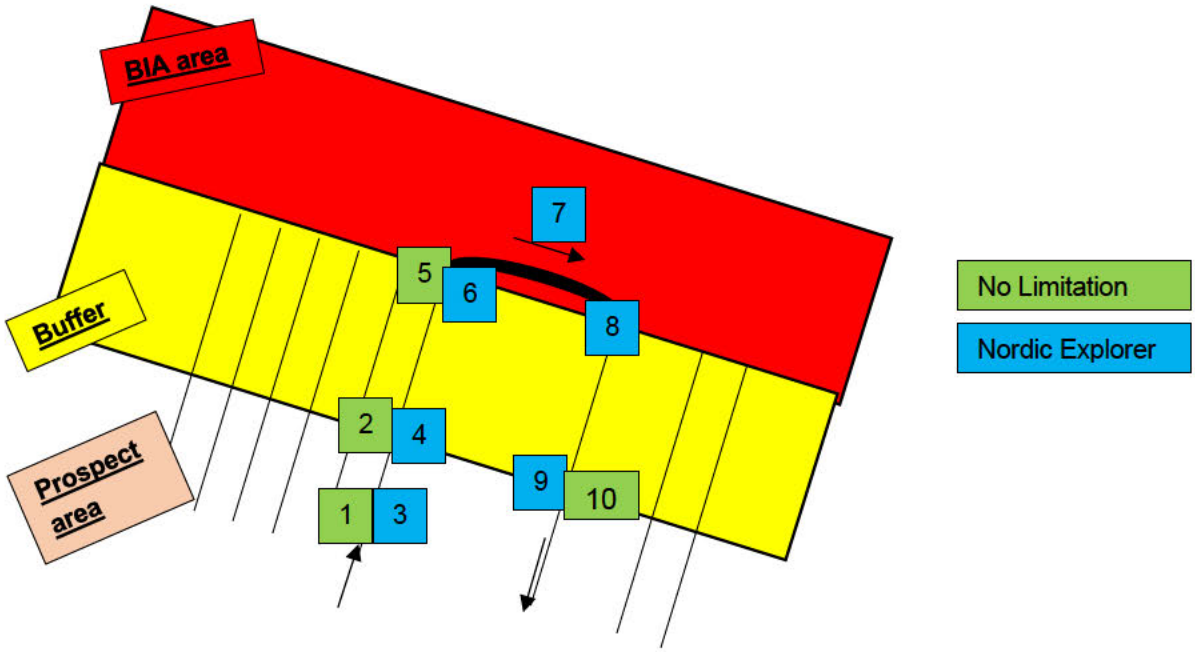

Figure 24 Communication diagram

Table 12 Communication table (linked to Figure 24 diagram)

Map	To do	Vessel	Time	Action	Coming from
1	Call NL to advise	*No Limitation*	30 min before	Entering buffer zone	Prospect area
2	Call NL to log	*No Limitation*	On time	In buffer zone	Prospect area
3	Advise MMOs	*Nordic Explorer*	30 min before	Entering buffer zone	Prospect area
4	Log and MMOs	*Nordic Explorer*	On time	In buffer zone	Prospect area
5	Call NL to log	*No Limitation*	On time	In BIA area	Buffer zone
6	Call NL to log	*Nordic Explorer*	On time	In BIA area	Buffer zone
6	Call NL to advise	*No Limitation*	On time	Go to stand-by position	Buffer zone

Map	To do	Vessel	Time	Action	Coming from
6	Log and MMOs	*Nordic Explorer*	On time	In BIA area	Buffer zone
7	Advise MMOs pre-start observation	*Nordic Explorer*	1 hour before	Exiting BIA area	Within BIA area
8	Log and MMOs	*Nordic Explorer*	On time	Out BIA area-back in buffer zone	BIA area
9	Log and MMOs	*Nordic Explorer*	On time	Out buffer zone	Buffer zone
9	Call NL to advise	*No Limitation*	On time	Recover PAM. Go ahead of NE	Buffer zone
10	Call NL to log	*No Limitation*	On time	Out buffer zone	Buffer zone

4. RESULTS

4.1 Operations Summary

The seismic survey was carried out from 15th January 2020 to 10th April 2020. Crew changes took place on 12th February 2020 and 11th March 2020.

There were no incidents of production suspension/stop action due to a lack of visual or acoustic pre-start monitoring. During the hours of darkness or when sighting conditions were poor, pre-start monitoring was carried out acoustically using the PAM system. On all other occasions, pre-start monitoring was conducted both visually and acoustically. There were 33 delays/shut-downs due to marine mammals in the mitigation zone. A full summary of operations and marine mammal mitigation can be found in Table 13.

Table 13 Operation and marine mammal mitigation summary

MV *Nordic Explorer*	
Total visual monitoring (hrs:min)	873:54
Total acoustic monitoring (hrs:min)	1332:14
Total monitoring (hrs:min)	2206:08
Total visual effort whilst seismic source was inactive (hrs:min)	351:06
Total PAM effort whilst seismic source was inactive (hrs:min)	359:32
Total visual effort whilst seismic source was active (hrs:min)	552:48
Total PAM effort whilst seismic source was active (hrs:min)	972:42
Total gun activity (hrs/min)	1162:08
Total no. of survey lines (incl. re-runs)	114
Total time data acquisition (hrs/min)	944:53
Total no. of source tests	21
Total no. of source tests followed by a line	1
Total time source tests (hrs/min)	08:17
Total soft-start to SOL (hrs/min)	64:01
Total no. of soft-starts	124
Total no. of soft-starts during dawn/day	83
Total no. of soft-starts during dusk/night	41
Minimum soft-start time (hrs/min)	00:02*
Maximum soft-start time (hrs/min)	00:31
No. of only visual pre-start observation periods	0
No. of only acoustic pre-start observation periods	50
No. of joint pre-start observation periods	85
Total visual pre-start observation (hrs/min)	52:49
Total acoustic pre-start observation (hrs/min)	86:02
Total visual & acoustic pre-start observation (hrs/min)	138:51
No. of cetacean sightings	82
No. of acoustic detections	21
No. of turtle sightings	0
No. of pinniped sightings	12

MV *Nordic Explorer*	
No. of mitigation actions initiated	33
No. of incidences of non-compliance	0
MV *No Limitation*	
Total visual monitoring (hrs:min)	711:20
Total acoustic monitoring (hrs:min)	450:12
Total monitoring (hrs:min)	1161:32
No. of cetacean sightings	70
No. of acoustic detections	47
No. of turtle sightings	0
No. of pinniped sightings	6

*Short soft-start time for a gun test

Details of when the vessel entered and exited the BIA 10 km buffer zone can be found in Appendix D.

4.2 Marine Mammal Monitoring Effort and PAM Validation

MV *Nordic Explorer*:
During the survey, a total of 2206 hours and 08 minutes of dedicated marine mammal watches were carried, of these 873 hours and 54 minutes were MMO effort and 1332 hours and 14 minutes were PAM Operator effort. Of the total monitoring effort, 1495 hours and 30 minutes were completed whilst the guns were active (full power, soft-starts, tests, reduced power), and 710 hours and 38 minutes whilst the guns were silent.

MV *No Limitation*:
During the survey, a total of 1161 hours and 32 minutes of dedicated marine mammal watches were carried, of these 711 hours and 20 minutes were MMO effort and 450 hours and 12 minutes were PAM Operator effort.

PAM validation:
The first validation occurred on the MV *No Limitation* on the 1st of March 2020 at 12:26 LT. A Sperm whale was visually and acoustically detected by Lead MMO Gary Nicol and PAM Operator Raquel Soley. Distance estimations were 930 m and 1100 m respectively, which resulted in a 15% estimate difference.

The second validation occurred on the MV *Nordic Explorer* on the 14th of March 2020 at 19:49 LT. A Sperm whale was visually and acoustically detected by Lead MMO Sara Sánchez-Quiñones, MMOs Isabel Córdoba and Heather Fowle, and PAM Operator Raquel Soley. Distance estimations were 800 m and 879 m respectively, which consisted in a 9% estimate difference.

Full reports on both PAM validations can be found in Appendix E.

4.3 Weather Conditions

As environmental conditions heavily influence the likelihood of observing marine mammals, several weather-related variables were recorded during MMO watches. These variables and the percentage of time spent observing during different

states are illustrated below. Weather conditions were not recorded at times when the visual monitoring was suspended due to poor sighting conditions. Therefore, the following summary relates to periods when visual monitoring was conducted.

Weather conditions were good for 14% of monitoring time (i.e. glassy or slight sea state, swell less than 2 m and visibility greater than 5 km). The sea state (Figure 25) was predominantly slight during visual monitoring (43%) and the swell height (Figure 26) predominantly medium (2-4 m) (59%).

Wind speed between Beaufort Force 1 and 8 were recorded (Figure 27), with the most dominant wind speed being Force 4 (32%). Beaufort force 4 or less (conditions best suited for visually detecting marine mammals) was recorded 51% of the time. Wind direction (Figure 28) was predominantly from the south (26%).

Visibility (Figure 29) was good (>5 km) for 89%, no sun glare (Figure 30) for 47%, and strong sun glare present for 27% of watches.

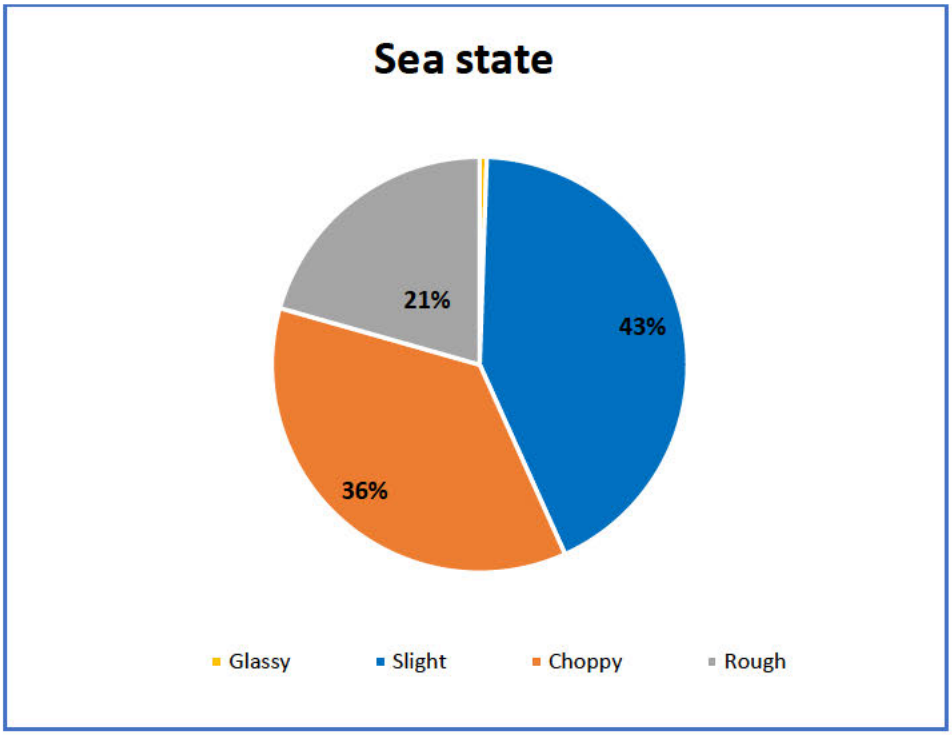

Figure 25 Sea state recorded during dedicated marine mammal monitoring

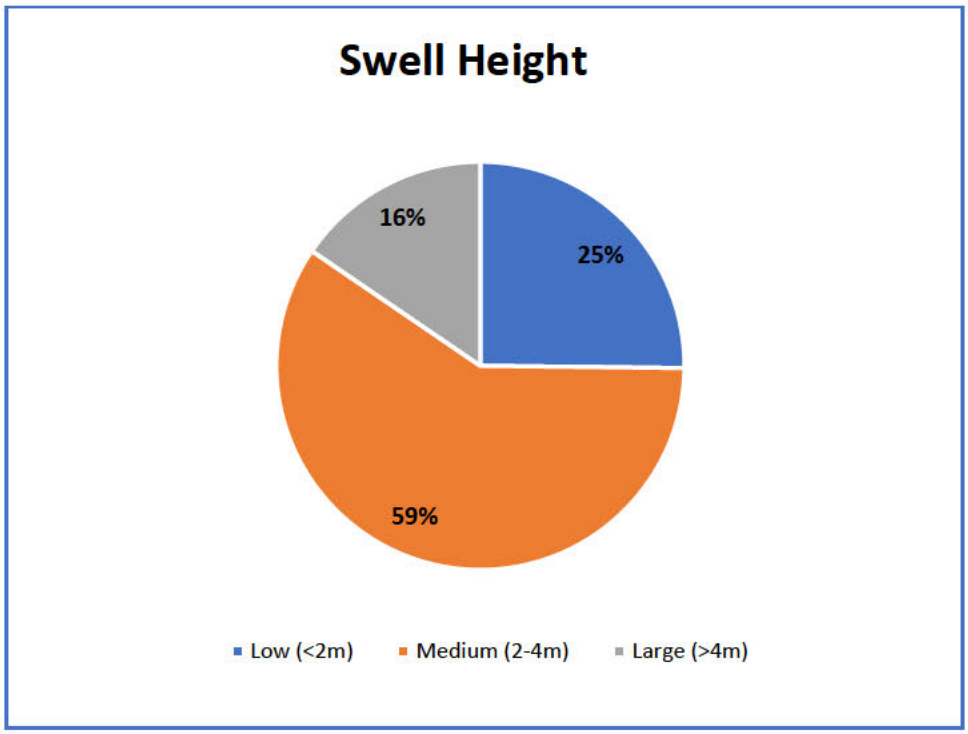

Figure 26 Swell height recorded during dedicated marine mammal monitoring

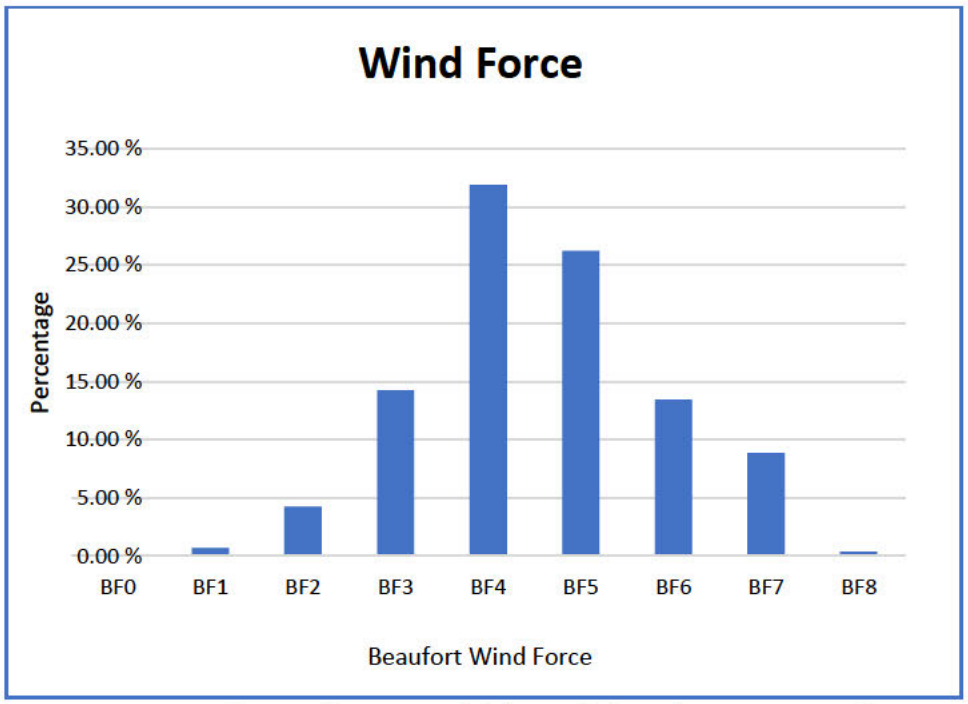

Figure 27 Beaufort wind force recorded during dedicated marine mammal monitoring

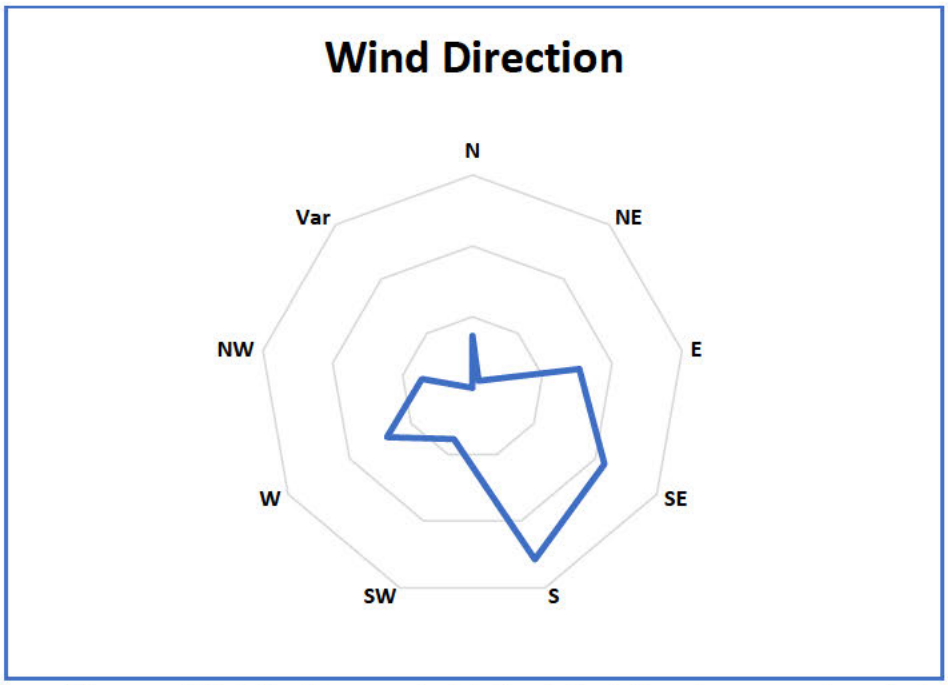

Figure 28 Wind direction recorded during dedicated marine mammal monitoring

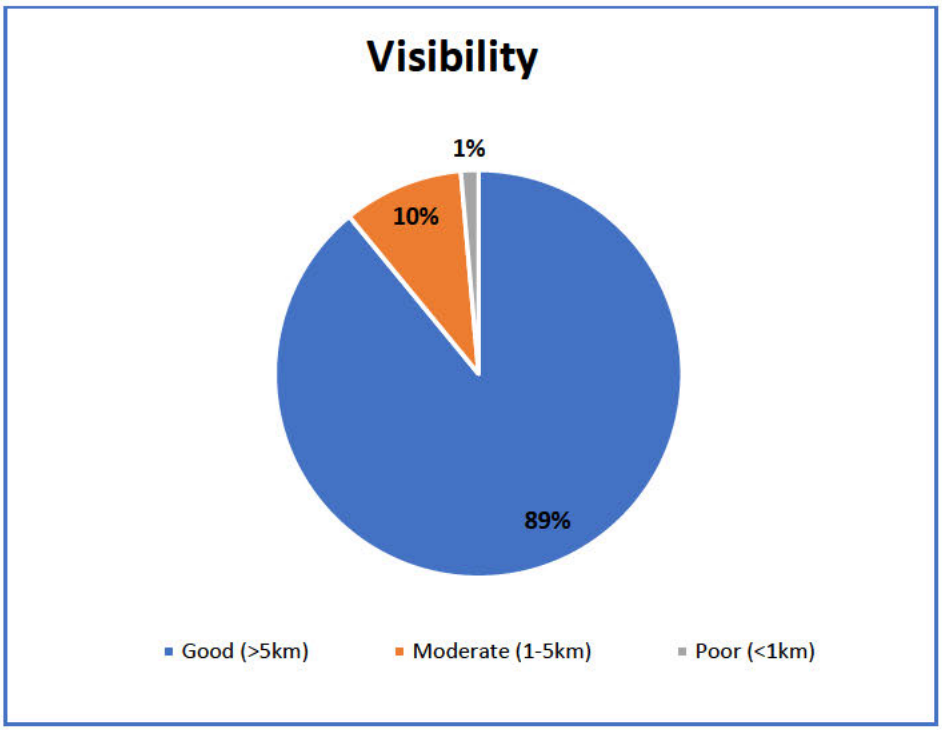

Figure 29 Visibility recorded during dedicated marine mammal monitoring

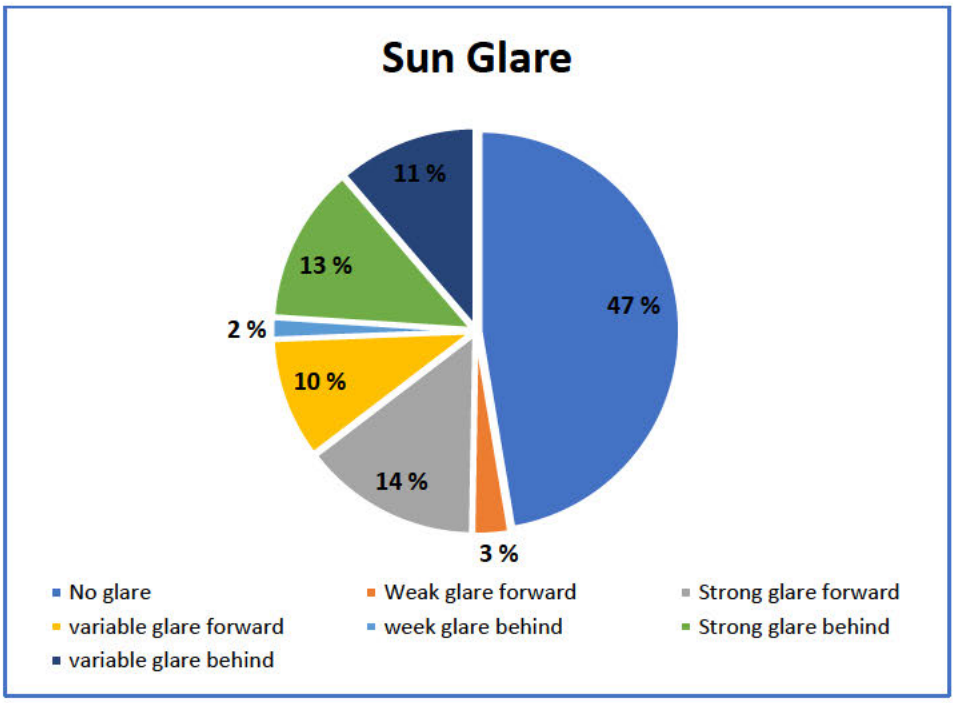

Figure 30 Sunglare recorded during visual monitoring for marine mammals

4.4 *Marine Mammal Sightings*

During the survey period there were 94 visual sightings of marine mammals from the MV *Nordic Explorer* and 76 from the MV *No Limitation*; summaries of these can be found in Table 14 and 15, respectively. A distribution map of sightings from the MV *Nordic Explorer* can be found in Figure 31. Photographs of sightings can be found in Appendix F.

Table 14 Summary of marine mammal sightings (MV *Nordic Explorer*)

Species	Number of sightings	Number of animals
Blue whale	41	79
Sperm whale	18	32
Unidentified whale	5	8
Pilot whale	3	62
Short-beaked common dolphin	10	125
Bottlenose dolphin	2	15
Unidentified dolphin	3	41
Australian Fur seal	5	5
Australian Sea Lion	1	1
Unidentified pinniped	6	6
Total	**94**	**374**

Table 15 Summary of marine mammal sightings (MV *No Limitation*)

Species	Number of sightings	Number of animals
Blue whale	17	22
Sperm whale	5	17
Dwarf minke whale	1	1
Southern right whale	1	2
Unidentified whale	13	15
Unidentified beaked whale	1	1
Pilot whale	1	30
Short-beaked common dolphin	25	370
Bottlenose dolphin	1	10
Unidentified dolphin	5	14
Australian Fur seal	1	1
Unidentified pinniped	5	5
Total	**76**	**488**

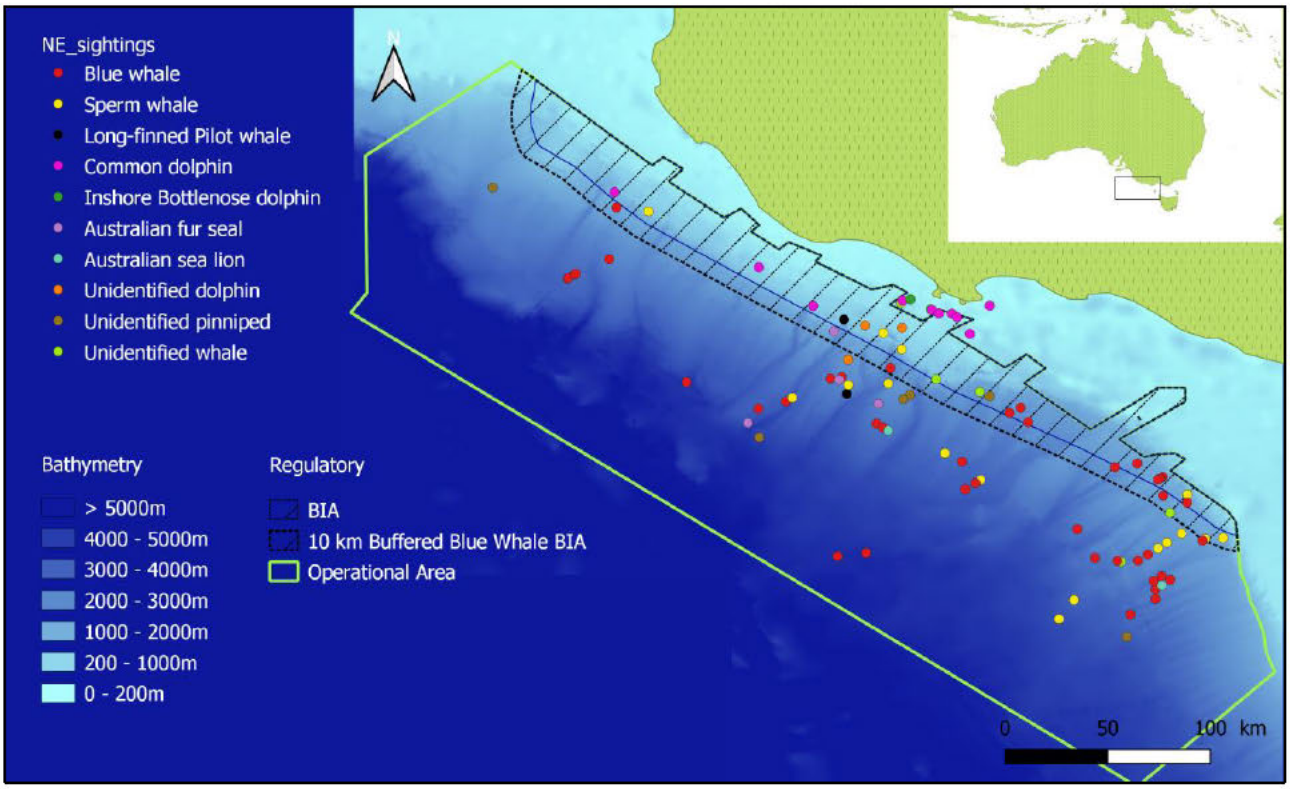

Figure 31 Distirubtion map of sightings

4.5 Marine Mammal Acoustic Detection

During the survey period there were 21 acoustic detections of marine mammals from the MV *Nordic Explorer* and 47 from the MV *No Limitation*; summaries of these can be found in Table 16 and 17, respectively. A distribution map of acoustic detections from the MV *Nordic Explorer* can be found in Figure 32. Screenshots of detections can be found in Appendix G.

Table 16 Summary of acoustic detections (MV *Nordic Explorer*)

Species	Number of sightings
Sperm whale	5
Pilot whale	2
Short-beaked common dolphin	2
Bottlenose dolphin	1
Unidentified delphinid	11
Total	**21**

Table 17 Summary of acoustic detections (MV *No Limitation*)

Species	Number of sightings
Sperm whale	18
Pilot whale	1
Short-beaked common dolphin	8
Bottlenose dolphin	
Unidentified delphinid	13
Unidentified odontocete	7
Total	47

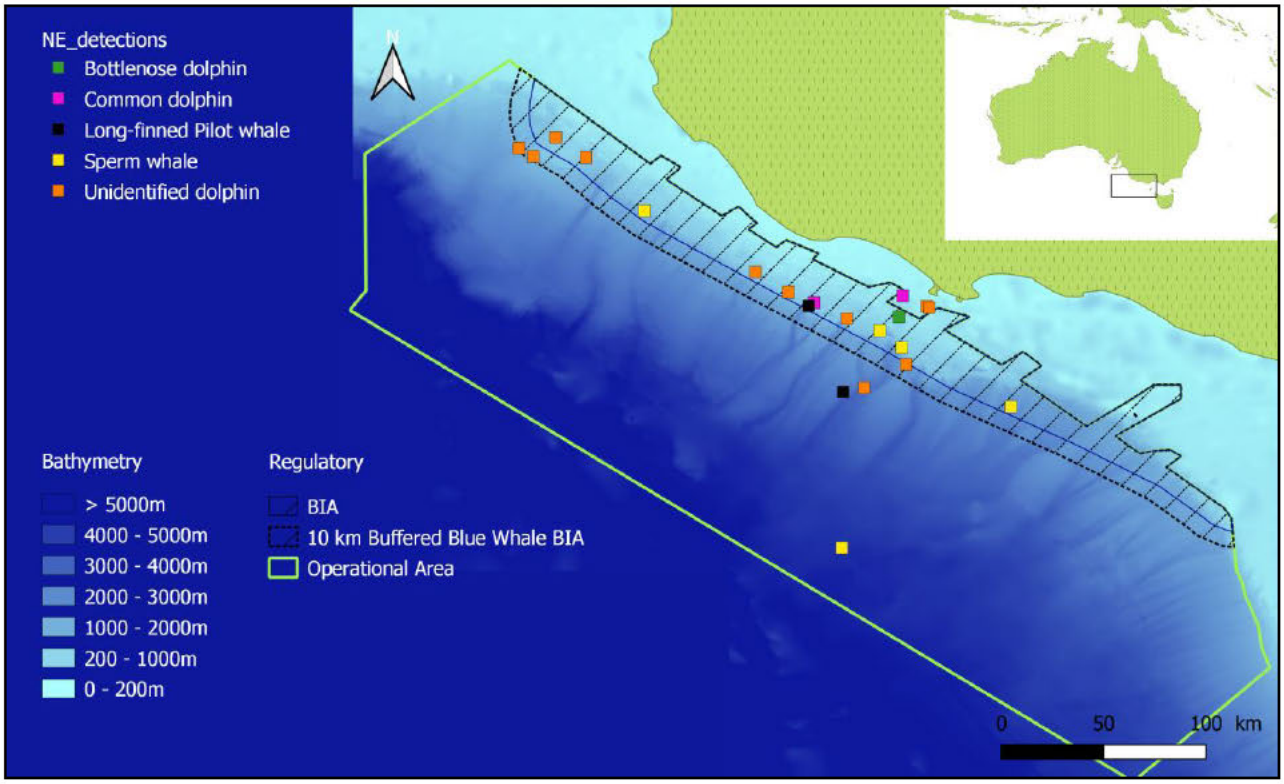

Figure 32 Distirubtion map of detections

4.6 *Mitigation Incidences*

There were 33 incidents where mitigation actions occurred, which are tabulated below (Table 18).

Table 18 Incidents of mitigation actions for marine mammals

Date	Line Sequence	Sighting No.	Species	Guns Stopped	Mitigation Actions Taken
26/01/2020	OB2D-0049P1-005	16	Blue whale	11:58	Shut-down
26/01/2020	OB2D-0049P2-006	18	Blue whale	18:34	Shut-down
29/01/2020	OB2D-0048P2-013	25	Sperm whale	10:56	Shut-down
01/02/2020	OB2D-0040P1-019	29 / 30	Pilot whale / common dolphin	N/A	19-minute delay to soft-start
07/02/2020	OB2D-1002P1-030	33	Blue whale	12.09	Shut-down
24/02/2020	OB2D-0091P1-047	35	Blue whale	16:17	Shut-down
25/02/2020	OB2D-0090P1-049	37	Blue whale	07:30	Shut-down
25/02/2020	OB2D-0090P2-050	38	Australian sea lion	N/A	37minute delay to soft-start
01/03/2020	OB2D-0089P1-051	40	Blue whale	7:24	Shut-down

Date	Line Sequence	Sighting No.	Species	Guns Stopped	Mitigation Actions Taken
01/03/2020	OB2D-0088P1-052	44	Blue whale	15:20	Shut-down
03/03/2020	OB2D-0086P1-055	46	Sperm whale	12:18	Shut-down
03/03/2020	OB2D-0086P2-056	47	Blue whale	15:12	Shut-down
03/03/2020	OB2D-0086P3-057	48	Blue whale	16:38	Shut-down and relocation
03/03/2020	OB2D-0083P1-058	51	Blue whale	19:35	Shut-down
04/03/2020	OB2D-0083P2-060	53	Blue whale	16:26	Shut-down during soft-start
04/03/2020	OB2D-0083P2-060	54	Unidentified whale	N/A	Delay to soft-start
14/03/2020	Gun Test	62	Blue whale	N/A	Delay to soft-start
15/03/2020	OB2D-0068P2-072	63	Sperm whale	18:01	Shut-down
15/03/2020	OB2D-0068P3-073	64	Blue whale	N/A	Delay to soft-start
16/03/2020	OB2D-0063P1-075	68	Blue whale	N/A	Delay to soft-start
18/03/2020	OB2D-0063P1-079	72	Unidentified pinniped	15:54	Shut-down
18/03/2020	OB2D-0063P2-080	73	Unidentified pinniped	N/A	Delay to soft-start
19/03/2020	OB2D-00104P2-082	74	Blue whale	N/A	Shut-down during soft-start
20/03/2020	OB2D-00104P2-082	75	Blue whale	15:07	Shut-down
20/03/2020	OB2D-00104P3-083	517	Unidentified delphinid	21:51	Shut-down
20/03/2020	OB2D-00104P4-084	518	Unidentified delphinid	23:11	Shut-down
23/03/2020	OB2D-0008P1-090	76	Unidentified pinniped	9:11	Guns paused for 4 mins
27/03/2020	OB2D-0022P1-097	79	Blue whale	9:12	Shut-down
31/03/2020	OB2D-0105P1-104	84	Blue whale	15:33	Shut-down
01/04/2020	OB2D-0105P2-105	85	Blue whale	13:12	Shut-down
08/04/2020	OB2D-0081P1-107	88	Blue whale	6:59	Shut-down
08/04/2020	OB2D-0079P1-108	90 / 91	Blue whale / blue whale	N/A	Delay to soft-start and relocation
08/04/2020	OB2D-0079P1-108	93	Blue whale	16:30	Shut-down
09/04/2020	OB2D-0075P1-111	76 (NL)	Blue whale	12:56	Shut-down during soft-start

Full details of mitigation actions initiated on the MV *Nordic Explorer*:

Sighting 016 26/01/2020

Shortly before midday, MV *No Limitation* reported sightings of blue whales, astern of them and ahead of *Nordic Explorer*. At 11:56 LT, blue whale blows were sighted by MMOs on-board MV *Nordic Explorer*. Multiple blows were seen, as the animals slowly travelled towards the MV *Nordic Explorer*, heading in the opposing direction to the vessel. Four Blue Whales were counted. The whales entered the 3000 m mitigation zone at 11:58 LT and the source was shut-down. The whales passed along the starboard beam of the vessel, with the closest distance being 1500 m, at 12:20 LT. The animals left the mitigation zone at 12:48 LT and were last spotted at 13:26 LT, well astern of the vessel. The PAM equipment also detected these animals.

Sighting 018 26/01/2020

At around 18:00 LT, the team on the MV *No Limitation* reported the presence of blue whales, at a distance of 50 m from their vessel. They confirmed a mother and a calf. At 18:12 LT, MMOs on-board the MV *Nordic Explorer* sighted blue whale blows, directly ahead and approaching the vessel. At 18:34, the whales were sighted within the 3000 m mitigation zone, resulting in a shut-down. The whales passed along the starboard side of the vessel, with the closest distance being 800 m, at 18:40 LT. MMOs on-board MV *Nordic Explorer* confirmed 4 whales: 2 adults and 2 calves. The animals passed behind the vessel and were last spotted outside the mitigation zone, at a distance of over 4000 m, at 19:02 LT. Due to the presence of calves, it was agreed that MV *Nordic Explorer* would travel 15 km away from the last known blue whale location, before restarting the seismic source.

Sighting 025 29/01/2020

At 10:53 LT, a sperm whale was spotted approximately 2500 m off the port side of the MV *Nordic Explorer*. Multiple blows were observed as the whale travelled in a southerly direction, towards the vessel. At 10:56 LT the whale was seen inside the exclusion zone, at a distance of 1800 m from the seismic source. The vessel was acquiring data and a shut-down was implemented. At 11:01 LT the whale was seen leaving the mitigation zone and last sighted at 11:13 LT.

Sighting 029/030 01/02/2020

At 09:38 LT, a mixed group of long-finned pilot whales and common dolphins were sighted, 1000 m from the port bow of the MV *Nordic Explorer*. The animals were approaching the vessel and entered the mitigation zone at 09:39 LT. The pilot whales continued travelling in a north-westerly direction, whereas the dolphins headed north-east. The pilot whales and dolphins got to within 250 m and 100 m of the seismic source, respectively. The group were seen leaving the mitigation zone at 09:49 and were last spotted at 09:56 LT. The sighting was during pre-start observation and soft-start was delayed by 19 minutes, as a result.

Sighting 033 07/02/2020

At 12:09 LT, blue whale blows were sighted 1200 m off the starboard bow. The whales were approaching the vessel; however, sighting conditions were challenging due to rough seas and moderate visibility. Four animals were observed; three of which passed the starboard beam, with a closest distance of 600 m from the seismic source, at 12:14 LT. The fourth whale turned and headed back away from the starboard bow. The last sighting was at 12:24 and the whales were not reacquired. The seismic source was active and a shut-down was implemented at 12:09 LT. 11 km of production was lost during this time.

Sighting 035 24/02/2020

At 16:17 LT, two blue whales were sighted 2000 m from the vessel, at a bearing of 250°. The seismic source was shut-down immediately. The whales were observed slow travelling and deep diving with fluke exposed. The blows observed were tall

and straight. The whales were last observed in the mitigation zone at 16:50, with the last observation being at 17:08 LT, over 7000 m away. Pre-start observation began at 16:55 and a soft-start commenced at 17:26 to continue the line.

Sighting 037 25/02/2020

At 07:30 LT, a blue whale was sighted 1800 m away from the vessel, at a bearing of 255°. The seismic source was shut-down immediately. The whale was observed slow travelling and was last seen at 07:52 LT exiting the area. Direct soft-start could not be conducted as a sea lion entered the area and a delay of soft-start had to be applied (see sighting 038).

Sighting 038 25/02/2020

At 07:45 LT, an Australian sea lion was sighted 600 m away from the vessel, at a bearing of 240°. The seismic source was inactive due to a shut-down for a blue whale (sighting 037). At 07:55 LT, the animal entered the 500 m mitigation zone, and was observed approaching the seismic source. A delay to soft-start was implemented. The animal was last seen at 08:28 LT.

Sighting 040 01/03/2020

At 07:24 LT, two different blue whale blows were sighted approximately 2500 m off the starboard side of the vessel, at a bearing of 180°. The whales were travelling away from the vessel and were last observed at 07:36 LT. A shut-down was implemented for this sighting.

Sighting 044 01/03/2020

At 15:19 LT, four blue whale blows (one of a juvenile) were sighted approximately 4000 m off the starboard side of the vessel, at a bearing of 240°. The whales were travelling in pairs, but were considered as a single group due to their close proximity. The whales were travelling in the opposite direction to the vessel and were last observed at 15:51 LT. A shut-down was implemented for this sighting.

Sighting 046 03/03/2020

At 12:01 LT two sperm whales were sighted approximately 3500 m off the bow of the vessel, at a bearing of 170°. The whales were travelling in a south-easterly direction and at 12:09 LT one of the animals undertook a dive, showing the tail flukes. At 12:18 LT the whales were spotted inside the mitigation zone at a distance of 1800 m from the seismic source. A shut-down was implemented. At 12:25 LT the whales were last observed, outside the mitigation zone, at a distance of 4000 m, and travelling away from the vessel. The soft-start was implemented at 12:40 LT.

Sighting 047 03/03/2020

At 15:12 LT three blue whales were sighted approximately 1200 m off the starboard side of the vessel, at a bearing of 240°. The vessel was acquiring data and a shut-down was implemented. The closest approach was at 15:17 LT when the whales ware observed approximately 1000 m of the source. The whales were travelling in a north-easterly direction. At 15:27 LT the whales were observed leaving the mitigation zone and a soft-start commenced at 15:41 LT.

Sighting 048 03/03/2020

At 16:38 LT, a blue whale was sighted approximately 1500 m off the port bow, at a bearing of 150°. The vessel was acquiring data and a shut-down was implemented. At 16:40 LT, the whale was observed approximately 1000 m off the port beam travelling in a north-easterly direction. At 16:55 LT, the whale was last seen at a distance of 5000 m from the seismic source. The vessel relocated to an area 15 km away and followed start-up procedures.

Sighting 051 **03/03/2020**

At 18:36 LT, a blue whale was sighted approximately 2700 m off the starboard side of the vessel, at a bearing of 200°. The sighting was during soft-start and a shut-down was implemented. The closest approach was at 19:41 LT when the whale was observed approximately 1800 m from the seismic source. The whale was travelling in a westerly direction. At 19:47 LT the whale left the mitigation zone and a soft-start was implemented at 20:18 LT.

Sighting 053 **04/03/2020**

At 16:26 LT in the buffer zone, tall blows of a blue whale were sighted approximately 5500 m off the starboard bow, at a bearing of 210°. The last observation of the whale was at 17:16 LT. The sighting was during soft-start and a shut-down was implemented at 16:26. Soft-start recommenced at 18:02 LT, following a 96 minute loss to production time.

Sighting 054 **04/03/2020**

At 17:30 LT in the buffer zone, dispersed blows of an unidentified whale were sighted approximately 3500 m off the starboard side of the vessel, at a bearing of 250°. The whale was last observed at 17:31 LT. The sighting was during the pre-start observation period, resulting in an 8 minute delay to soft-start.

Sighting 063 **15/03/2020**

At 18:01 LT, a sperm whale was sighted approximately 1750 m off the starboard side of the vessel, at a bearing of 345°. A shut-down was implemented. The whale was last observed at 18:22 LT.

Sighting 064 **15/03/2020**

At 18:26 LT, the tall blows of two blue whales, an adult and a juvenile, were sighted approximately 2500 m off the bow of the vessel, at a bearing of 240°. At 19:46 LT, the whales were observed leaving the mitigation area. A delay to the soft-start was required. The soft-start was initiated once the whales were observed outside of the mitigation area.

Sighting 067 **16/03/2020**

At 13:30 LT, the tall blows of two blue whales were sighted approximately 4500 m off the bow of the vessel, at a bearing of 240°. The whales were last observed at 13:48 LT. A delay to the soft-start was required.

Sighting 068 **16/03/2020**

At 14:22 LT, the tall blows of two blue whales were sighted approximately 3500 m off the bow of the vessel, at a bearing of 200°. The whales were possibly an adult with a juvenile and were exhibiting potential feeding behaviour (shallow dives). The whales were last observed at 15:52 LT. A delay to the soft-start was required.

Sighting 072 **18/03/2020**

At 15:54 LT, a fur seal or sea lion was observed resting at the surface approximately 200 m off the port side of the vessel, at a bearing of 135°. The animal was last observed at 15:59 LT, travelling away from the approaching vessel. A shut-down was required.

Sighting 073 **18/03/2020**

At 16:29 LT, a fur seal or sea lion was observed resting at the surface approximately 400 m off the starboard side of the vessel, at a bearing of 330°. The animal was last observed at 16:34 LT. A delay to the soft-start was required.

Sighting 074 **19/03/2020**

At 15:45 LT, the tall blow of a blue whale was observed approximately 1929 m off the bow of the vessel, at a bearing of 225°. Following five blows the whale undertook a dove for around 5-10 minutes. This occurred several times and was last observed at 17:28 LT. The sighting was during soft-start and a shut-down was implemented.

Sighting 075 **20/03/2020**

At 15:07 LT, the tall blow of a blue whale was observed approximately 2700 m off the starboard side of the vessel, at a bearing of 330°. The whale was last observed at 16:21 LT. A shut-down was implemented.

Detection 517 **20/03/2020**

At 21:45, the tonal sweeps (6 – 22 kHz) of an unidentified delphinid species was detected on PAM. The animals were determined to be within 500 m of the seismic source and a shut-down was implemented. The last detection was at 21:55. A pre-start observation was carried out before production resumed.

Detection 518 **20/03/2020**

At 23:11, the tonal upsweeps and buzzes (6 – 22 kHz) of an unidentified delphinid species was detected on PAM. The animals were determined to be within 500 m of the seismic source and a shut-down was implemented. The animals were last detected at 23:13.

Sighting 076 **23/03/2020**

At 09:11 LT, a fur seal or sea lion was observed resting at the surface approximately 250 m off the starboard side of the vessel, at a bearing of 315°. The animal was last observed at 09:15 LT. A power down was required.

Sighting 079 **27/03/2020**

At 09:10 LT, the tall blows of two blue whales were sighted approximately 2400 m off the port side of the vessel, at a bearing of 320°. The whales were travelling slowly away from the vessel. The whales were last observed at 10:07 LT. A shut-down was required.

Sighting 84 **31/03/2020**

At 15:32 LT, the tall blow of a blue whale was sighted at approximately 2600 m off the starboard front quarter of the vessel, at a bearing of 200°. After 14 minutes, a smaller blow was observed at approximately 1000 m off the port front quarter of the vessel. The sighting was of one adult and one juvenile. The whales were last seen at 16:19 outside of the mitigation area at approximately 3800 m. A shut-down was required.

Sighting 85 **01/04/2020**

At 13:12 LT, the tall blow of a blue whale was sighted at approximately 2400 m off the starboard front quarter of the vessel at a bearing of 150°. The whale was travelling parallel to the vessel, in the opposite direction, and at 13:42 LT, following a few blows, the tail flukes were observed, indicating a deep water. A shut-down was required for this sighting.

Sighting 88 **08/04/2020**

At 06:59 LT, the tall blow of a blue whale was sighted at approximately 1900 m from the bow of the vessel, at a bearing of 60°. A shut-down was implemented and production did not resume due to being in the BIA area. The whale was last observed at 07:25 LT.

Sighting 90 **08/04/2020**

At 09:25 LT, the tall blow of a blue whale was sighted at approximately 2000 m from the bow of the vessel, at a bearing of 210°. The whale was travelling in a north-easterly direction parallel to the vessel, in the opposite direction. The whale was last observed at 09:52 LT, at a distance of 4500 m. A delay to the soft-start was required.

Sighting 91 **08/04/2020**

At 09:29 LT, the tall blows of two blue whales were sighted at approximately 1700 m from the starboard bow, at a bearing of 250°. The whales were travelling parallel to the vessel, in the opposite direction. The whale was last observed at 10:28 LT, at a distance of approximately 7000 meters. A delay to the soft-start was required and the vessel relocated 15 km away, due to the presence of more than three whales having been spotted in the same area.

Sighting 93 **08/04/2020**

At 16:30 LT, the tall blows of two blue whales were sighted at approximately 1500 m at the starboard aft quarter of the vessel, at a bearing of 345°. The whales were travelling perpendicular to the stern of the vessel and were last observed at 17:03 LT. A shut-down was required and production resumed at 18:05 LT.

4.7 Mitigation Compliance

There were no non-compliance events during the survey.

4.8 Other sightings of interest

Thirteen seabird species were recorded during the survey (Table 19). Photographs of birds can be found in Appendix H. All species had been previously recorded in the area and identification was confirmed by reference to an Australian bird field guide (Menkhorst *et al.*, 2017).

Table 19 Bird species observed in the survey area

Common Name	Scientific Name
Southern royal albatross	*Diomedea epomophora*
Black-browed albatross	*Thalassarche melanophris*
New Zealand wandering albatross	*Diomedea antipodensis*
Shy Albatross	*Thalassarche cauta*
Sooty albatross	*Phoebetria fusca*
Buller albatross	*Thalassarche bulleri*
Giant petrel	*Macronectes spp*
White-chinned petrel	*Procellaria aequinoctialis*
White headed petrel	*Pterodroma lessonii*

Common Name	Scientific Name
Australasian gannet	*Morus serrator*
Crested tern	*Thalasseus bergii*
Prions	*Pachyptila spp.*
Little penguin	*Eudyptula minor*

5. DISCUSSION

5.1 Visual monitoring and acoustic detections

The sightings and detections encountered during the survey were consistent with what was expected in the project area. The majority of the sightings were of blue whales, thought to be pygmy blue whales (*Balaenoptera musculus brevicauda*), which aggregate (November - May) to feed on krill in the Australian Great South regional upwelling system of the Australian Great South (Gill *et al*, 2011), and more specifically to this survey, the Bonney Upwelling. As expected, some of the sightings were of several individuals in the same area/day, indicating potential patched swarms of the blue whales' prey. Despite the inadequate visibility conditions (high winds and medium to high swell) experienced during the majority of the survey, the tall blows of the blue whales were still visible, being also an explanation of the higher rates of sightings. The distribution of blue whale sightings was greater in the lower half of the operation area; however, this could have been a result of being in those areas in the months leading up to the peak blue whale season for the area. The level of blue whale sightings experienced outside of the BIA should be considered when planning for future seismic surveys in the area.

The constant noise of the vessel along with the fact that blue whales and other baleen whales vocalize less often in feeding areas (Oleson *et al.* 2007), might be the potential reasons why there were no baleen whale detections on PAM. This is a major concern for mitigating these animals, especially in an area known as an important feeding ground for blue whales. While blue whales were the main species visually detected during the day, the lower likelihood of their acoustic detection through the night made mitigation ineffective during periods of darkness and/or bad visibility conditions.

On the MV *Nordic Explorer*, sperm whales were the second most detected species during the survey, both visually (after blue whales) and acoustically (after delphinid spp.). Numerous cross-shelf canyons are found throughout the area, creating important foraging areas for sperm whales (Gill *et al.* 2015), as most of the detections indicate. The high acoustic detection rate of sperm whales might indicate that, unlike blue whales, sperm whales are more detectable on PAM due to the higher frequency range of their vocalisations, which are not masked by ambient noise.

There was numerous pinniped (seals and sea lions) species sighted during the survey, with all the sightings of fur seals and/or Australian sea lions. Even though pinnipeds do not rely on underwater communication/echolocation as strongly as the cetacean species, they still use the noise properties of the sea water to avoid predators, for social communication and navigation. The inconsistency with the mitigation protocols throughout the survey related to pinnipeds (along with dolphins and turtles), making mitigation more unreliable and challenging as protocols were being changed rapidly, even towards the end of the survey. Mitigation protocols might require modifications during the early operational stages of a survey, as circumstances (weather, distribution of animals, etc.) might change. However, these changes should be consistent with environmental requirements and made clear and concise to all parties concerned, in order to achieve high-quality mitigation and protection for marine fauna.

Visual observations from the support vessel, MV *No Limitation*, were extremely limited in times of poor weather conditions. With the vessel being small in size and conditions being poor 86% of the time during the survey, it was not conducive to effective marine mammal monitoring, particularly when the vessel was in the trough of a wave and poor conditions rendered the best vantage point (fly deck) unsafe.

5.2 Probability of marine mammal detections

Many potential species of concern will not be detected using PAM equipment because they do not produce vocalisations or vocalise infrequently. Cetacean species may not vocalise all the time and may pass close to a PAM system and remain undetected. A limited ability to detect baleen whale vocalisations can be achieved using standard PAM equipment settings for mitigation purposes (Todd *et al.*, 2015). As PAM gear is conventionally deployed astern of the large seismic vessel, the proximity to continuous low frequency engine and propeller noise (together with water noise and the low frequency sound emitted by the airgun sound source) masks the low frequency biological signals. Consequently, PAM detection of some vocalisations is rendered virtually impossible using the currently available Passive Acoustic Monitoring systems.

In cases where baleen whales are detected, the nature of these long-travelling vocalisations makes the corresponding range and bearing problematic to determine with the current equipment. Therefore, a PAM operator may be unable to say, with a certain level of reliability, whether an animal is inside a safety zone. Moreover, species that vocalise at high frequencies may not be detectable beyond short distances (Todd *et al.*, 2015). The vocal repertoires of many marine mammal species are also poorly described or unknown.

Many marine mammal vocalisations, particularly the echolocation click trains produced by odontocetes, are directional in nature and not easily detected by PAM equipment whenever an animal faces away from the hydrophone (Todd *et al.*, 2015). For example, bow-riding dolphins are often undetected by PAM systems which are deployed astern. The vocalisation frequencies of blue whales are between 10 and 40 Hz (Cummings & Thompson, 1971; Richardson *et al*, 1995) and the vessel engine frequencies are in a similar range starting from 11.0 Hz, indicating that blue whale vocalisations could have been masked by the vessel engine noise thereby giving false negative results.

5.3 Recommendations

For a survey with weather conditions such as those found in the Otway Basin, a much larger vessel would be far more suitable. This is not only from the perspective of effectively monitoring for marine mammals, particularly when in sensitive areas for marine fauna, but also from a health and safety point of view for the MMO and PAM Operators working on board.

When deploying PAM from a vessel, attempts should always be made to position the hydrophone cable in such a way that noise interference from the vessel's engines is minimised. Considering additional/alternative mitigation measures for night-time operations would be beneficial for future projects.

6. CONCLUSIONS

Mitigation measures on seismic surveys are widely used as a protection for sensitive marine species while allowing industrial activities. The mitigation plan on the 2D Otway basin followed the EP agreed by NOPSEMA and all parties was conservative in comparison to other international regulation bodies. Nevertheless, the surveyed area is a critical feeding habitat for endangered blue whale species (as well as other baleen whales), which very seldom vocalize in the feeding grounds. This fact and the constant low frequency sounds made by the source vessel, highly affects the detection probability for baleen whales in comparison with other cetacean species. No baleen whale sounds were detected for the entire period on both vessels, while the majority of visual sightings involved blue whales. Additional mitigation procedures should be considered for future surveys to compensate for the lack of detection probability of baleen whales, especially during night-time.

7. REFERENCES

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APPENDICES