Resource and Environmental Management Ltd

New Zealand Oil & Gas Devon Limited

Endurance 3D Seismic Survey

Marine Mammal Impact Assessment

3 December 2013

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List of Abbreviations

AEI	Areas of Ecological Importance
ACE	Annual Catch Entitlement
BPA	Benthic Protection Areas
CMA	Coastal Marine Area
Code of Conduct	2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations
COLREGS	International Regulations for the Prevention of Collisions at Sea 1972
DOC	Department of Conservation
EEZ	Exclusive Economic Zone
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
FMA	Fisheries Management Area
IAGC	International Association of Geophysical Contractors
IAPPC	International Air Pollution Prevention Certificate
IMO	International Maritime Organization
IOPPC	International Oil Pollution Prevention Certificate
ISPPC	International Sewage Pollution Prevention Certificate
IUCN	International Union for Conservation of Nature
Kts	Knots – (Nautical miles per hour)
LOA	Length Over All
MARPOL	International Convention for the Prevention of Pollution From Ships, 1973 as modified by the Protocol of 1978
MfE	Ministry for the Environment
MMIA	Marine Mammal Impact Assessment
MMO	Marine Mammal Observer
MMS	Marine Mammal Sanctuary
MNZ	Maritime New Zealand
MPI	Ministry for Primary Industries
MSL	MetOcean Solutions Limited
MSS	Marine Seismic Survey
NABIS	National Aquatic Biodiversity Information System
NIWA	National Institute of Water and Atmospheric Research
Nm	Nautical Mile
NZMEC	New Zealand Marine Environment Classification
NZP&M	New Zealand Petroleum and Minerals
NZOG	New Zealand Oil & Gas Devon Limited

PAM	Passive Acoustic Monitoring
PEPANZ	Petroleum Exploration and Production Association of New Zealand
PNA	Protected Natural Areas
PEP	Petroleum Exploration Permit
PMP	Petroleum Mining Permit
QMS	Quota Management System
REM	Resource and Environmental Management (Nelson) Limited
RMA	Resource Management Act 1991
RPS	RPS Consultancy, MMO contractor for this survey
SC	Southland Current
SEL	Sound Exposure Level
SOPEP	Shipboard Oil Pollution Emergency Plan
SRD	Self-Recovery Device
TACC	Total Allowable Commercial Catch
UNEP	United Nationals Environment Program
WC	Westland Current
WWF	Worldwide Fund for Nature

1 Executive Summary

The New Zealand Oil and Gas (NZOG) Endurance 3D Marine Seismic Survey is located within Petroleum Exploration Permit (PEP) 52717 due east of Oamaru. The aim of the survey is to obtain three dimensional seismic data for ~700 km^2 of survey lines in order to better assess the hydrocarbon potential suspected within the permit area. This survey will be 'tied' to the Galleon-1 well location via a single swath line.

The Endurance 3D survey is planned to commence on 15 December 2013 and is likely to run for 21 - 28 days depending on weather constraints and marine mammal delays. NZOG will use the *'Polarcus Alima'* to undertake this survey. The vessel will tow 12 streamers each measuring 8 km in length separated by 100m increments. The acoustic source of the proposed Endurance 3D MSS will consist of 2 x 3480 in^3 arrays located at 7.5 m water depth, which will be activated alternatively at an operating pressure of 2,000 psi. The airguns are typically fired so that the shotpoint interval is 18.75 m apart, and with the average boat speed of 4.5 kts, that relates to a shot every 8.1 seconds. Two support vessels will accompany the seismic ship to provide supplies and scout the area ahead of the survey vessel for obstructions.

The survey area encompasses the Waitaki Canyon which is expected to support high levels of biodiversity. Specific environmental sensitivities in the survey area include marine mammals, sea birds, fish species, benthic marine fauna and plankton. Of the marine mammals only five threatened species are anticipated to be present; killer whales and bottlenose dolphins are likely to occur within the survey area, and southern elephant seals, southern right whales, and NZ sea lions have a low probability of being encountered during the survey. This likelihood assessment is based on life history characteristics, behaviour and previous sighting records. New Zealand fur seals are classified as 'not threatened' by the Department of Conservation. This species is present in relatively high densities along the North Otago coast and it is predicted that significant numbers of seals could be seen during the survey. NZOG hold specific concerns about potential operational delays which may be incurred on account of the presence of this species.

Numerous sea bird species are likely to be present in the survey area, however northern royal albatross, caspian tern, sooty shearwater, little blue penguin and yellow-eyed penguin have a Department of Conservation threat listing and are known to breed on the Otago coast, so are of particular local importance. The most commonly caught commercial fish species in this area are barracouta, squid, red cod, spiny dogfish and silver warehou.

As part of this Marine Mammal Impact Assessment, a range of potential effects on the environment have been assessed in relation to: the physical presence of the seismic vessel/towed gear, the introduction of sound into the marine environment, the generation of solid and liquid waste in conjunction with the survey and support vessels, atmospheric emissions, potential gear loss, oil spills and vessels collisions. To address these potential effects NZOG will implement mitigation measures which aim to eliminate or minimise any negative environmental consequences.

The introduction of anthropogenic sound into the marine environment is considered to be the most significant potential impact from the Endurance 3D MSS. The primary mitigation tool to address this impact is the Department of Conservation's Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals (Code of Conduct). NZOG will strictly adhere to the recently approved 2013 Code of Conduct for the duration of the survey.

In accordance with operator best practice, NZOG will implement a number of mitigation measures over and above the Code of Conduct. These additional measures are deemed necessary on account of the survey area being within an 'Area of Ecological Importance'

and on account of sound transmission loss modelling results which on account of areas of shallow water, raised concerns about the level of protection afforded to marine mammals by the standard mitigation zones outlined in the Code of Conduct. The additional measures that will be undertaken by NZOG during the Endurance 3D survey are:

- The intention to necropsy any dead marine mammal that washes ashore between Otago Peninsula and Banks Peninsula both during the survey and for the 2 week period following survey completion;
- The extension of observation duties for the Marine Mammal Observers to cover the periods of transit as well as the time spent within the survey area;
- The provision of weekly reports to the Department of Conservation and the Environmental Protection Authority;
- The immediate notification to the Department of Conservation should high numbers of a species of concern be observed within the survey area;
- The participation of the Environmental Protection Authority in the briefing of Marine Mammal Observers at the survey outset;
- The intention for a support vessel to spend time assessing bathymetry in the NW buffer zone before the survey commences in order to identify any bathymetrical anomalies which are not illustrated on the charts and to refine boundaries of mitigation regimes;
- The intention to avoid acoustic source testing in waters < 100 m deep;
- The intention to minimise the run-in distance at the start of each survey line in the NW section of the buffer zone;
- The intention to approach survey lines which abut buffer zone water depths of <100m from a NW to SE direction in order to minimise sound input into shallow waters;
- The adoption of a 1.5 km mitigation zone in 'shallow' waters for all species of concern (i.e. not just those with calves as per standard requirements under the Code of Conduct), in an attempt to minimise behavioural impacts;
- The adoption of a 1.8 km mitigation zone at the Galleon-1 well site for all species of concern (i.e. not just those with calves as per standard requirements under the Code of Conduct), in an attempt to minimise behavioural impacts;
- The assurance that the tie-in line to the Galleon-1 well will be conducted in a NE to SW direction in order to provide animals in the distal part of this line ample opportunity to leave the area as sound levels increase during the vessels approach from deeper water;
- The ground truthing of received sound levels at the mitigation distances, with particular emphasis on fine scale results at shallow water depths (particularly along the tie-in line to the Galleon-1 well site);
- The immediate notification of the Department of Conservation of any ground-truthing results that indicate the mitigation zones are insufficient for providing protection to marine mammals from physiological or behavioural impacts.
- The intention to ensure 'in country' availability of a backup PAM system in the event that the primary system malfunctions and cannot resume monitoring.

Other potential environmental effects are largely addressed by the vessels adherence to the International Convention for the Prevention of Pollution From Ships 1978, the International Regulations for the Prevention of Collisions at Sea 1972 and by having a thorough ship-specific Environmental Management Plan and appropriate biosecurity clearance from the Ministry of Primary Industries.

In preparation for this survey, NZOG have consulted widely with a range of stakeholders and their concerns have been taken into account during the development of this MMIA. In all respects NZOG are committed to operate in a responsible environmental manner and the adoption of numerous mitigation measures over and above the Code of Conduct

are testimony to this commitment. In summary, the environmental effects associated with the Endurance MSS, when assessed in light of the proposed mitigation measures, are considered to be negligible or minor for virtually all operations, with moderate effects potentially occurring for those marine mammal species not considered to be species of concern and that approach the acoustic source during full capacity to within 200m. These moderate effects may cause temporary behavioural changes, but typically free-swimming animals avoid the immediate vicinity of the sound source, and the use of delayed starts and soft starts will minimise the occurrence of such effects which is indeed their intended purpose under the Code of Conduct.

2 Introduction

2.1 Background

Resource and Environmental Management Limited (REM) has been engaged by New Zealand Oil & Gas Devon Limited (NZOG) to prepare a Marine Mammal Impact Assessment (MMIA) for a Marine Seismic Survey (MSS), east of Oamaru in the Canterbury Basin. The survey area lies within Petroleum Exploration Permit (PEP) 52717, known as the Clipper Block, as shown in Figure 1 (hereafter the 'Survey Area'), while the larger Operational Area; which encompasses a 15 km buffer around the Survey Area provides for line turns, acoustic source testing and soft start initiation.

NZOG plan to undertake the Endurance 3D MSS to acquire 700 km^2 of seismic data over the Barque structure within the Survey Area. Within the PEP, NZOG have the right to undertake geological or geophysical surveying, exploration and appraisal drilling and testing of petroleum discoveries, however this MMIA is only in regards to a 3D MSS. The completion of this survey is a requirement under the terms of the work programme within the PEP.

The purpose of the MSS will be to obtain seismic data to assess the potential for hydrocarbons within the Survey Area and identify potential locations for exploration wells. A tie-in seismic survey line will also be undertaken from the Endurance seismic Survey Area out to a previously drilled well Galleon-1, which is shown in Figure 1. This tie-in survey will involve one swath of seismic acquisition. NZOG propose to undertake the MSS in mid-December 2013. It is anticipated that the Endurance MSS will take approximately between 21 and 28 days to complete, depending on weather conditions and marine mammal related delays.

The Exclusive Economic Zone (EEZ) and Continental Shelf (Environmental Effects-Permitted Activities) Act (EEZ Act) came into effect on 28 June 2013. Under the EEZ Act MSS are classified as permitted activities as long as they comply with the Code of Conduct.

NZOG have adopted and will adhere to the updated '2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations' (Code of Conduct) (DOC, 2013). The Code of Conduct came into effect on 29 November 2013, and was developed by the Department of Conservation (DOC) in consultation with a broad range of stakeholders.

This MMIA has been prepared in accordance with the Code of Conduct, and the guidelines set out in Appendix 1 therein, to assess the management of any potential environmental impacts of MSS operations in the Survey Area with the purpose being to:

1. Identify key environmental sensitivities in relation to the seismic programme;
2. Identify potential environmental impacts on marine species and the surrounding environment; and
3. Describe measures to avoid or minimise any adverse impacts to the surrounding environment and marine mammals.

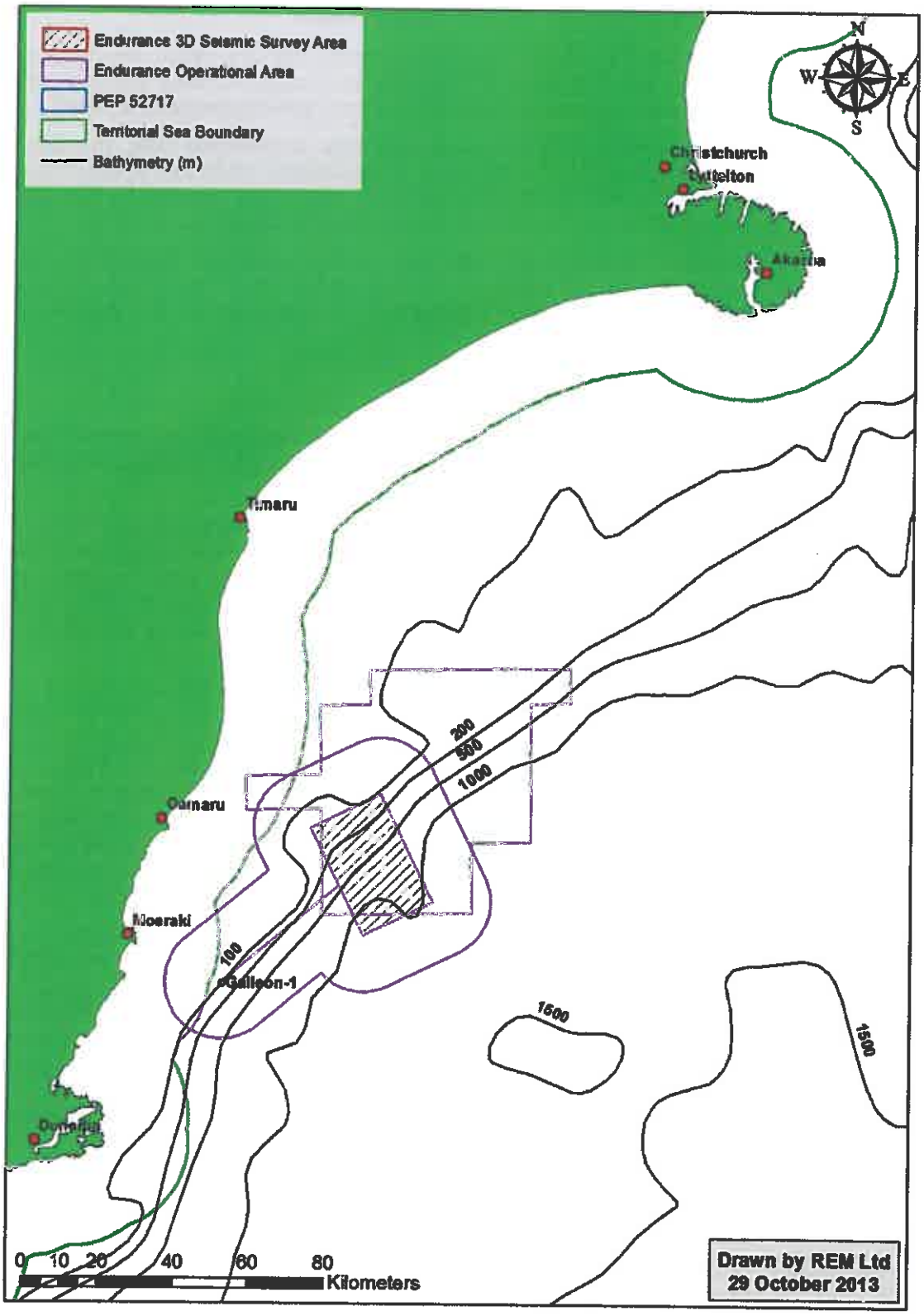

Figure 1: Location Map of the Endurance 3D Seismic Survey Area – the primary MSS polygon is defined by the red rectangle with diagonal hatching, while the swath tie-in line is marked with a clear red line out to the Galleon-1 well site.

2.2 Objectives and General Approach

This MMIA forms part of the overall planning process for the MSS, which is being conducted in accordance with the Code of Conduct, applicable NZ laws and regulations, international guidelines and procedures, and NZOG's own environmental standards.

Under the EEZ Act – *Permitted Activities* Regulations, compliance with the Code of Conduct, including the preparation of a MMIA, is a requirement when carrying out seismic operations within the EEZ. For the Endurance MSS, NZOG will operate to the specific requirements of a 'Level 1 Survey' as defined by the Code of Conduct.

This MMIA also conforms to the Craft Risk Management Standard (CRMS) for Vessel Biofouling, NZ Import Health Standard for Ballast Water from all Countries, Marine Mammals Protection Act 1978 and the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

2.3 Sources of Information

A review of existing data and literature from national and international sources was the basis for the description of the existing environment in Section 5. The following sources were used as a basis for the background information:

- Background biological information was obtained from numerous sources. The Ministry for Primary Industries (MPI); along with the National Aquatic Biodiversity Information System (NABIS) website which was used for part of the fisheries baseline information. Information on marine mammals, seabirds, and plankton was obtained from the DOC, NABIS, MPI, various referenced articles and the Worldwide Fund for Nature (WWF).

A full list of references can be found in Section 9.

2.4 Consultation

NZOG initiated consultation with key local stakeholders in September 2013 during the preparation of this MMIA. NZOG are committed to continual consultation through the MMIA and Endurance MSS process. Table 1 outlines key stakeholders who have been identified and consulted with, either in person, over the phone or by receiving an information sheet advising them of the Survey Area and further details of the MSS (Appendix 1).

Table 1: Endurance 3D MSS Stakeholders

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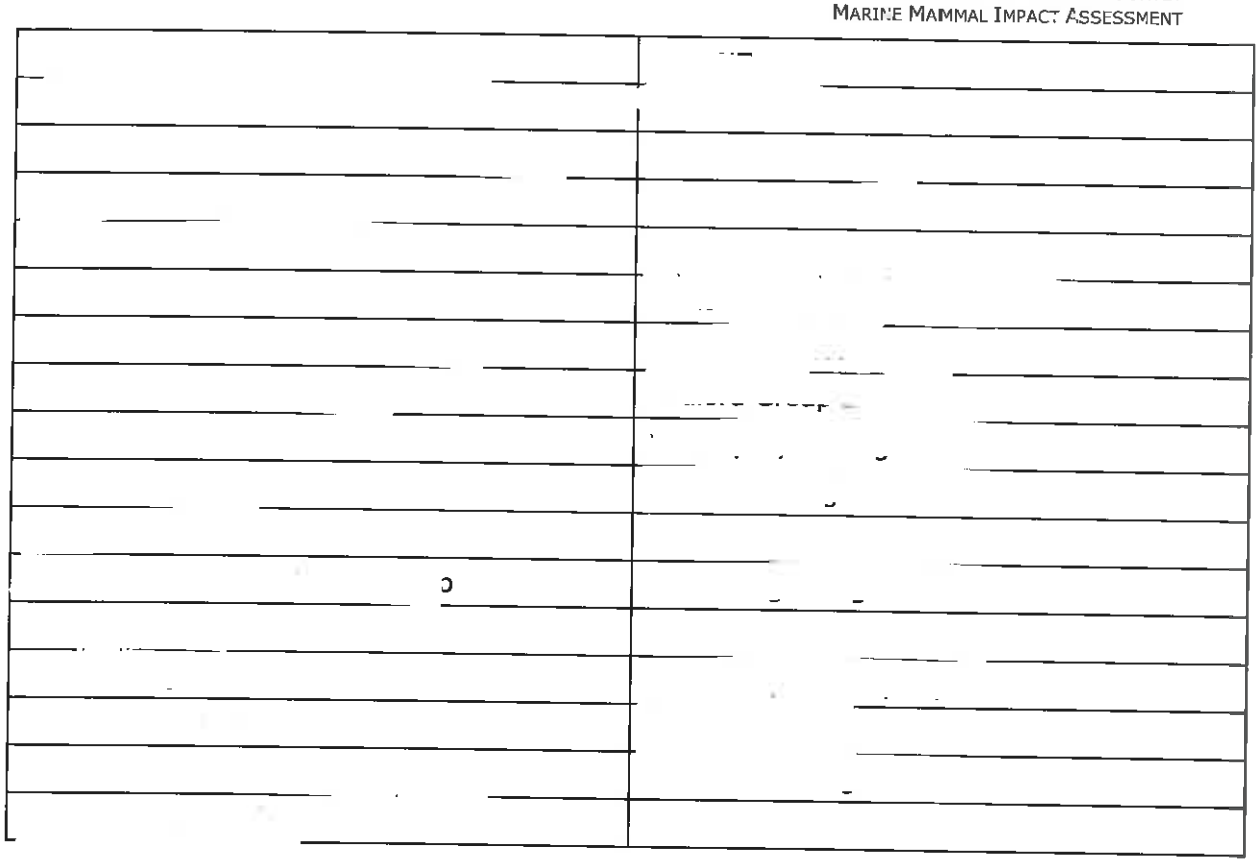

2.5 Limitations

Although information has been provided on the possible or likely fish, marine mammal and seabird species that might be found in the project area, survey information on species numbers or seasonal or long-term variations is inherently difficult to obtain, as pelagic communities are generally highly mobile and transient.

In accordance with the agreed scope of work, this MMIA was prepared on the basis of existing information that could be readily obtained from relevant online and local sources. The conclusions and recommendations are therefore based on available published data from the consulted sources and expert review of these and other data. Baseline field studies were not completed by REM as part of this work.

2.6 Research

Research on the effects of seismic survey operations on marine species is being undertaken globally. The Code of Conduct does not anticipate NZ operators to duplicate international research; however it does state that it is essential for research to be carried out specifically on NZ species, habitats and conditions. Operators undertaking seismic surveys in NZ should use every opportunity possible to address research on gaps.

At the conclusion of the Endurance MSS, the Code of Conduct requires NZOG to submit to DOC a Marine Mammal Observer (MMO) report including observational data from the survey. This can then be used for research by DOC or the scientific community to help build and expand on distributional and behavioural patterns of marine mammals around an operating seismic vessel.

A desktop research project is currently underway on the effects of seismic operations on NZ fur seals, and the results of this study may be taken into account in future management actions. Other than providing MMO data to DOC at the completion of this survey, no specific research actions are required.

In addition to the obligations under the Code of Conduct, NZOG intends to engage Massey University pathologists to perform necropsies on any dead marine mammals found ashore between Otago Peninsula and Banks Peninsula throughout the operational period of the Endurance MSS and for the 14 day period following survey completion. The intention of this is to look for any pathological changes which might link the cause of death to the seismic survey.

3 Policy, Legal, and Administrative Framework

3.1 National Legislation

New Zealand Petroleum & Minerals (NZP&M) manages the Crown's oil, gas, mineral and coal resources, known as the Crown Mineral Estate. NZP&M sits within the Ministry of Economic Development. NZP&M's role is to advise on policy, operational regulation and promote investment in the mineral estate.

National legislation applicable to the offshore oil & gas sector and relevant legislation in terms of environmental protection, maritime activities, biosecurity, industrial safety, and cultural and archaeological heritage is covered under a range of different legislation.

Variations do occur within the legal jurisdiction of the legislation, for example, the Resource Management (Marine Pollution) Regulations 1998 and the Biosecurity Act 1993 only apply within NZs territorial waters (12 Nm from the statutory baseline), the EEZ Act applies within the NZ EEZ, beyond 12 - 200 Nm from shore, whereas the Marine Mammals Protection Act 1978 applies to NZ's 'fisheries waters', including inshore waters, territorial waters, and the EEZ.

For the Endurance MSS, the relevant legislation which NZOG will comply with is the EEZ Act and the Code of Conduct.

3.2 Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act

The EEZ Act was came into force on 28 June 2013, when the first regulations (Permitted Activities) were promulgated. The EEZ Act is considered as landmark legislation as it establishes the first comprehensive environmental consenting regime for activities in NZ's EEZ and Continental Shelf.

The purpose of the EEZ Act is to manage and protect the natural resources of the EEZ whilst concurrently enabling use of resources on or within the seabed and sub-surface. Before the EEZ Act was passed there was a wide gap in domestic legislations for the EEZ; where NZ has historically not being able to assess and regulate the environmental effects of many activities in the EEZ and Continental Shelf.

The EEZ Act allows the Minister for the Environment to classify activities within the EEZ and Continental Shelf, depending on a number of considerations outlined in s33 of the EEZ Act. These considerations include; environmental effects of the activity, the importance of protecting rare and vulnerable ecosystems and the economic benefit to NZ of the activity. The classifications for activities within the EEZ Act are either:

- **Permitted** – the activity can be undertaken provided the operator meets the conditions specified within the regulations. Seismic surveys fall within this classification and the conditions state that the person undertaking the activity must comply with the Code of Conduct;
- **Non-notified discretionary** – (this classification is currently under discussion in September 2013 through a Supplementary Order Paper to the Marine Legislation Bill) – where activities can be undertaken if applicants obtain a marine consent from the EPA, who may grant or decline consent and place conditions on the consent. The consent application is not publically notified and has statutory timeframes adding up to 60 working days in which the Environmental Protection Authority (EPA) must assess the consent application;

- **Discretionary** – activities may be undertaken if applicants obtain a marine consent from the EPA. The consent application will be notified, submissions will be invited and hearings will be held if requested by any party, including submitters. The process has a statutory timeframe of 140 working days in which the EPA must assess the consent application; and
- **Prohibited** – the activity may not be undertaken.

For completeness the requirements of s39 of the EEZ Act – Impact Assessment have been considered when preparing this MMIA.

3.3 Crown Minerals (Permitting and Crown Land) Bill

The Crown Minerals (Permitting and Crown Land) Bill was introduced into Parliament at the end of September 2012. This bill is an omnibus Bill and amends the Crown Minerals Act 1991, the Conservation Act 1987, the Continental Shelf Act 1964, the Reserves Act 1977, and the Wildlife Act 1953. The purpose of the Bill is to promote prospecting for, exploration for, and mining of Crown owned minerals for the benefit of NZ.

Currently under the Crown Minerals Act a PEP allows an operator to identify petroleum deposits and evaluate the feasibility of mining any discoveries made. The duration of this permit is for up to five years, with an option for renewal of five years over a maximum of 50% of the original area, while an appraisal extension is also possible for up to four years. This also gives the operators the subsequent rights to apply for a petroleum mining permit (PMP).

3.4 2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations

In February 2006 a set of guidelines were established by DOC for 'minimising the acoustic disturbance to marine mammals from seismic survey operations' in conjunction with PEPANZ. These were then further developed in collaboration with a broad, representative range of domestic and international stakeholders which formed the Code of Conduct. The Code of Conduct was developed to establish a comprehensive and ambitious regime to manage the potential impacts of seismic survey activities. It was initially implemented as a voluntary regime, however, under the EEZ Act – *Permitted Activities*, seismic surveys must now comply with the Code of Conduct.

The development of the Code of Conduct shows how industry and government can work together towards the shared goal of growing the contribution that the oil and gas industry makes to NZ in an environmentally responsible way (PEPANZ Foreword in DOC, 2012). The Code of Conduct aims to minimise potential impacts while still providing for normal seismic operations to continue (PEPANZ Foreword in DOC, 2012).

Under the Code of Conduct, NZOG's Endurance MSS will fall under a Level 1 survey. A Level 1 survey is where the acoustic source used has a total combined operational capacity exceeding 427 cubic inches (in^3). This level features the most stringent requirements for marine mammal protection, and is the main focus of the Code of Conduct on which this MMIA is based.

The notification and requirements of the Code of Conduct have been adhered to and followed with the formulation of this MMIA. A letter was submitted to the Director-General of Conservation on 31 July 2013, informing of NZOGs proposed survey and preparation of a MMIA as per the requirements of the EEZ Act.

NZOG have contracted [redacted] provide MMO's and Passive Acoustic Monitoring (PAM) operators to oversee operations in relation to the Code of Conduct for the Endurance 3D MSS. Details of the PAM specifications are provided in Appendix 2.

3.4.1 Level 1 Seismic Survey Requirements

According to the 2013 Code of Conduct the following operational protocols must be adhered to.

A Level 1 survey requires at least two qualified MMOs and two qualified PAM operators onboard for the duration of the survey.

The minimum observer requirements for a Level 1 survey are that:

- The qualified observers will be dedicated in that their roles on the vessel are strictly for the detection and data collection of marine mammal sightings and instructing crew on their requirements when a marine mammal is detected within the relevant mitigation zone; and
- At all times while the acoustic source is in the water, at least one qualified MMO (during daylight hours) and one qualified PAM operator will maintain a watch for marine mammals.

Observations by qualified observers are also encouraged at all other times where practical and possible.

If the PAM system has malfunctioned or become damaged, operations may continue for 20 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM gear must be repaired to solve the problem, operations may continue for an additional 2 hours without PAM monitoring as long as all of the following conditions are met:

- It is daylight hours and the sea state is less than or equal to Beaufort 4;
- No marine mammals were detected solely by PAM in the relevant mitigation zones in the previous 2 hours;
- Two MMOs maintain watch at all times during operations when PAM is not operational;
- DOC is notified via email as soon as practicable with the time and location in which operations began without an active PAM system; and
- Operations with an active source, but without an active PAM system, do not exceed a cumulative total of 4 hours in any 24 hour period.

3.4.1.1 Pre-Start Observations

The normal requirements for pre-start observations are as follows:

A Level 1 acoustic source can only be activated if it is within the specified operational area and no marine mammals have been observed or detected in the relevant mitigation zones.

The Level 1 source cannot be activated during daylight hours unless:

- At least one qualified MMO has continuously made visual observations all around the source for the presence of marine mammals, from the bridge (or preferably an even higher vantage point) using both binoculars and the naked eye, and no marine mammals (other than fur seals) have been observed in the relevant mitigation zones for at least 30 minutes and no fur seals have been observed in the relevant mitigation zone for at least 10 minutes; and
- Passive acoustic monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation and no vocalising cetaceans have been detected in the relevant mitigation zones.

The source cannot be activated during night-time hours or poor sighting conditions (visibility of 1.5 km or less or in a sea state of greater than or equal to Beaufort 4) unless:

- Passive acoustic monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation; and
- The qualified observer has not detected vocalising cetaceans in the relevant mitigation zones.

In addition to the normal pre-start observation requirements outlined above, when arriving at a new location in the survey programme for the first time the initial acoustic source activation must not be undertaken at night or during poor sighting conditions unless either:

- MMOs have undertaken observations within 20 Nm of the planned start up position for at least the last two hours of good sighting conditions preceding proposed operations, and no marine mammals have been detected; or
- Where there have been less than 2 hours of good sighting conditions preceding proposed operations (within 20 Nm of the planned start up position), the source may be activated if:
  - PAM monitoring has been conducted for 2 hours immediately preceding proposed operations; and
  - Two MMOs have conducted visual monitoring in the 2 hours immediately preceding proposed operations; and
  - No Species of Concern have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 2 hours immediately preceding proposed operations; and
  - No fur seals have been sighted during visual monitoring in the relevant mitigation zone in the 10 minutes immediately preceding proposed operations; and
  - No other marine mammals have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 30 minutes immediately preceding proposed operations.

3.4.1.2 Delayed Starts & Shut-downs

If, during pre-start observations or while a Level 1 acoustic source is activated (which includes soft starts), a qualified observer detects at least one cetacean with a calf within 1.5 km of the source, start-up will be delayed or the source will be shut down and not be reactivated until:

- A qualified observer confirms the group has moved to a point that is more than 1.5 km from the source; or
- Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1.5 km of the source, and the mitigation zone remains clear.

If during pre-start observations or while a Level 1 acoustic source is activated (which includes soft starts), a qualified observer detects a Species of Concern within 1 km of the source, start-up will be delayed or the source will be shut down and not reactivated until:

- A qualified observer confirms the Species of Concern has moved to a point that is more than 1 km from the source; or
- Despite continuous observation, 30 minutes has elapsed since the last detection of a Species of Concern within 1 km of the source, and the mitigation zone remains clear.

If during pre-start observations prior to initiation of a Level 1 acoustic source soft start, a qualified observer detects a marine mammal within 200 m of the source; start-up will be delayed until:

- A qualified observer confirms the marine mammal has moved to a point that is more than 200 m from the source; or
- Despite continuous observation, 10 minutes has passed since the last detection of a New Zealand fur seal within 200 m of the source and 30 minutes has elapsed since the

last detection of any other marine mammal within 200 m of the source, and the mitigation zone remains clear.

If all mammals detected within the relevant mitigation zones are observed moving beyond the respective areas, there will be no further delays to initiation of soft start.

3.5 Marine Mammal Sanctuaries & Areas of Ecological Importance

In addition to the six gazetted Marine Mammal Sanctuaries (MMS) around NZ, the 2013 Code of Conduct identifies areas around NZ that are classified as Areas of Ecological Importance (AEI) for marine mammals based on information in the sightings and stranding's database. A map of these areas is shown in _2. The Endurance MSS is located ~120 km south southwest of the Banks Peninsula MMS and is within the AEI.

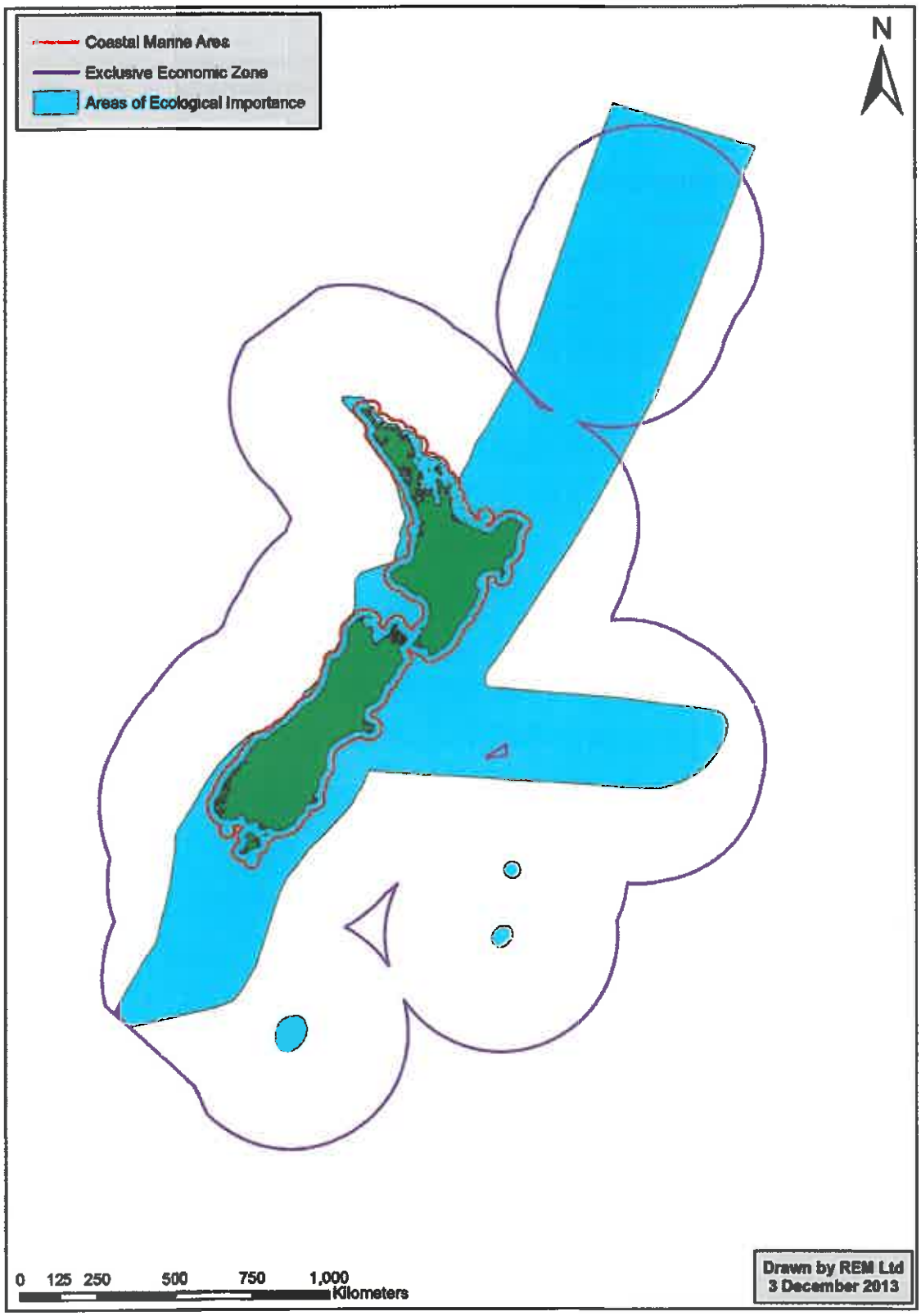

Figure 2: Areas of Ecological Importance as defined under the 2013 Code of Conduct

3.6 International Conventions and Regulations

The following international regulations and conventions will be adhered to and have formed part of the compilation of this MMIA.

International Regulations for the Prevention of Collisions at Sea (COLREGS) 1972

Also known informally as the nautical rules of the road, COLREGS specifies the conduct of vessels on the high seas, and provides a standard set of operational expectations and navigation procedures for maritime vessels. NZ ratified the convention in 1972. COLREGS 1972 is implemented in NZ under the Maritime Transport Act regime.

The International Convention for the Prevention of Pollution from Ships [MARPOL], 1973 as modified by the Protocol of 1978

MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978, and updated by amendments through the years. Specific provisions of relevance relate to the discharge of oily water from machinery spaces, sewage and garbage.

In 2011, the Marine Environment Protection Committee of the International Maritime Organisation (IMO) agreed to amend MARPOL Annex V (garbage management), making current rules and requirements far more restrictive. This new Annex came into force by tacit agreement on 1 January 2013 and will affect Marine Protection Rules Part 170: Prevention of Pollution by Garbage from ships. This rule will be amended to prohibit garbage discharges while also providing for exceptions in special circumstances.

There are some materials that are classified as garbage but are conditional on location of the vessel and whether processing has occurred. Food can be discharged from a vessel if the vessel is beyond 12 Nm from shore or beyond 3 Nm if the material is macerated.

As part of these new requirements, every ship over 100 gross tonnes or certified to carry more than 15 persons has to display placards and develop garbage management plans and log books (MNZ, 2012). These new garbage management plan requirements are in line with discharge management approaches already applied in NZ waters. Vessels may also need to evaluate cleaning agents in use on the ship to ensure they are either harmless to the marine environment otherwise they have to be contained and discharged ashore to an appropriate waste reception facility.

Garbage management plans will detail procedures for minimising, collecting, sorting, processing and disposing of all garbage and designate the crew responsible for garbage management. Garbage record books will be kept to enable operators and officials to audit all garbage discharges, with new garbage categories assigned so that the fate of each different waste type to be more transparent.

4 Project Description

4.1 Seismic Survey Method

Marine seismic surveys are used to identify geological features below the seafloor, by relying on the differing reflective properties of soundwaves to various subsurface rock strata. During a survey the energy source (airgun) which is towed behind the seismic vessel transmits a downward pulse of compressed air which travels through the water column and into the earth. At each point where different geological strata exist, different densities and velocity discontinuities cause a portion of the energy to be reflected back to the sea surface. The reflected soundwaves are picked up by a series of sensitive receivers called hydrophones. The hydrophones are located along the streamers which are also towed behind the vessel and transmit the electrical signals received to the mobile laboratory onboard the seismic vessel, where they are amplified, digitised and recorded for interpretation (E&P Forum/UNEP 1997). The seismic data profiles provide an 'image' of the rocks beneath the seafloor, commonly to depths of 10 km (McCauley *et al.*, 2000). The configuration of a marine seismic survey is illustrated in Figure 3. MSS use energy in the frequency range of 3 – 200 Hz, usually in the form of short-duration pulses.

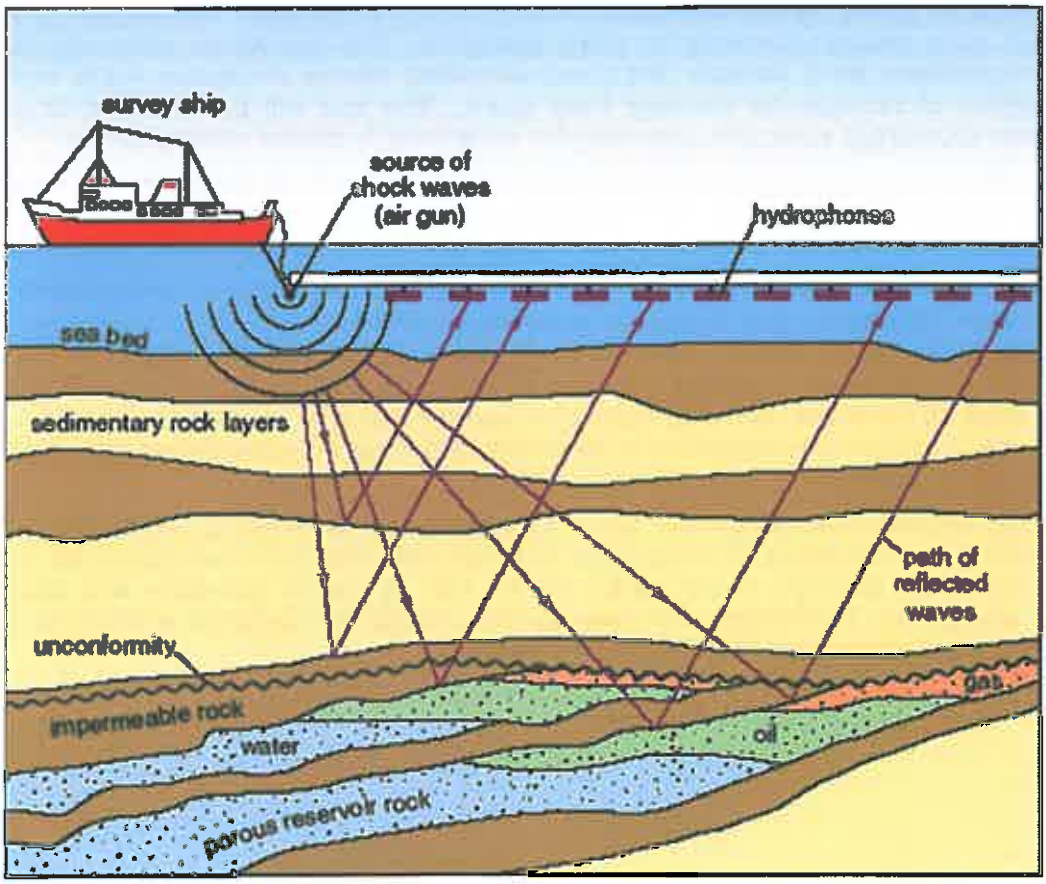

Figure 3: Schematic of an Operational Marine Seismic Survey

(Source: http://geomaticsolutions.com)

Airguns are operated either singly or in arrays of multiple guns. The acoustic source of the proposed Endurance MSS will consist of 2 x 3480 in^3 arrays located at 7.5 m water depth, which will be activated alternatively at an operating pressure of 2,000 psi. The airguns are typically fired so that the shotpoint interval is 18.75 m apart, and with the average boat speed of 4.5 kts, that relates to a shot every 8.1 seconds. Airgun arrays are designed to direct a high proportion of the energy vertically downwards. However, energy is also projected horizontally into the water, and can be detected at different distances from the source (depending on hydrographical conditions and level of background noise). With increasing distance from the source, pulses received from an airgun array decrease in amplitude. The pulses from the guns are broad band, with most energy concentrated in the 10 – 200 Hz frequency range, with lower levels in the 200 – 1000 Hz range. Depending upon how many guns are fired together, peak sound pressure levels one metre from the source range from 237 – 262 dB when measured relative to a reference pressure of one micropascal (re 1µPa/m).

The returning seismic signals are received by hydrophones which are carried in streamer cables. Streamers consist of tubular sections—containing the receiver phones—and electrical conductors, which carry the signals. The cable sections are connected together with electronic modules in which the signals from the hydrophones are digitised and put onto an optical carrier, which returns the signals to the recording system on-board the vessel. Streamer cables are neutrally buoyant, and may be solid or filled with electrical insulating fluid. Solid streamers will be used for the Endurance MSS and will be up to 8 km in length, with 12 streamers being towed by the vessel at any one time.

Solid streamers are now replacing fluid filled streamers for several reasons:

- Lower noise profiles of solid streamers contribute to higher quality seismic images and provide longer operational weather windows;
- Consistent buoyancy among the solid streamer sections reduces deployment time;
- Modern solid streamers are steerable, meaning improved control and fewer requirements for infill lines to be acquired. This means the vessel makes less passes over the survey area and introduces less cumulative source energy into the marine environment as a result;
- The Pipeline MSS which Todd Energy undertook in early 2013 in the South Taranaki Bight, utilising fluid streamers resulted in significant damage to the streamers from shark bites. Solid streamers are more durable and able to withstand shark bite damage; and
- Solid streamers require less frequent repairs, which extends in-water deployment time and reduces Health Safety & Environment (HSE) risk.

4.2 Background, Location and Timing

The Survey Area is located mostly within PEP 52717, while the Operational Area extends beyond PEP 52717 to the south (Figure 1). NZOG have been granted ingress by NZP&M under s42A which allows the survey to extend into the areas outside of PEP 52717. The Operational Area will be used for the line turns, acoustic source testing and soft start initiation, as defined in the Code of Conduct. A tie-in seismic survey line will also be undertaken from the Endurance seismic Survey Area to the previously drilled Galleon-1 well will involve one swath of seismic acquisition. NZOG are planning to undertake the Endurance MSS in mid-December 2013. Surveying will be conducted 24 hours per day, 7 days per week, subject to suitable weather conditions and marine mammal encounter protocols, and will take approximately 21 days to complete.

NZOG will conduct the seismic survey from the specialist seismic vessel , (Figure 4). The specifics of this vessel are outlined in more detail in Section 4.3.1.1 below. The survey will include two full time support vessels (, and) that will be in close proximity to the at all times.

4.3 Navigation and Survey Safety

NZOG are dedicated to ensuring the safety of all crew involved in the Endurance MSS and that of other vessels in the vicinity of the survey vessel. As such, it is important that other vessels are aware of the planned movements of the survey vessel. Other vessels must also not pass too close to the stern of the survey vessel such that there is the potential to cut the streamer cables.

Consultation has been undertaken by NZOG and REM notifying all known users of the Survey Area for the upcoming Endurance MSS and the likely configuration of towed gear. Commercial and other vessels will be notified of the Endurance MSS prior to the survey commencing and the will also display the appropriate lights and day shapes in accordance with International Maritime Law. A Notice to Mariners was issued on 28 November 2013 to alert other maritime users to the Endurance MSS. The support vessel will also be utilised to notify small fishing boats that do not have a radio or are potentially unaware of the seismic operations and location of the streamers. Navigation and collision avoidance will be conducted in accordance with the relevant Maritime Rules and COLREGS 1972.

4.3.1 MSS Elements

The MSS is to be conducted by the vessel towing 12 solid streamers, 100 m apart with a total length of up to 8,000 m at a maximum depth of up to 7.5 m (+/- 1 m) below the surface.

Both the and support vessel will comply with MARPOL and the relevant Marine Protection Rules in having current International Oil Pollution Prevention Certificates (IOPPCs), International Sewage Pollution Prevention Certificates (ISPPCs) and International Air Pollution Prevention Certificates (IAPPCs).

The main elements of the seismic survey are:

- *Mobilisation of the vessels to the Survey Area*: NZOG intends to undertake mobilisation from Wellington. A crew change will be required during the MSS. Refuelling of the is required every two weeks so the is likely to require bunkering. Except in the event of an emergency, the seismic vessel will be accompanied by a support vessel for the duration of the MSS;
- *Deployment of the towed equipment*: typically, the uses prevailing wind and currents to assist in the deployment of the towed equipment. It is likely that the gear will be left deployed although no acoustic sources will be emitted while travelling to the Endurance Survey Area; and
- *Data acquisition*: during data acquisition, the will follow predetermined survey lines that may be subject to change depending on prevailing current and wind conditions.

Figure 4: Seismic Vessel -

(Source i)

4.3.1.1 Vessel and Seismic Specifications

Further detailed specifications for the Endurance MSS and the are provided in Table 2 and Table 3 respectively, while details of the seismic array are provided in Table 4.

Table 2: Endurance MSS General Specifications

Date of commencement	15 December 2013
Duration of survey	20 - 28 days
Type of survey	3D Seismic
Name of seismic vessel	
Number of hydrophone streamers	12

Table 3: Seismic Vessel Technical Information

Vessel General	
Name	
Owner	
Operator	
Propulsion	Diesel electric
Fuel Capacity	1925 m^3 gas-oil

Vessel General	
Dimensions and Capacities	
Vessel Length	92.0 m
Beam	21.0 m
Max Draft	7.5 m
Gross Tonnage	7894 t
Net Tonnage	2231 t
Cruising speed	12.0 knots
Accommodation (Total capacity)	60
Fresh Water Capacity	1 x 10 m^3/24hrs
Fresh Water Maker Production	Alfa-Laval
Ballast	2120 m^3 (2170 t)
Machinery	
Main Engine or Electric Prop Motors	Wartsila 4 x 9L20 +2 x 9L26, MCR rating 2850ekW at 1000rpm

Table 4: Seismic Specifications

Streamers	
Streamer (Manufacturer and type)	Sercel Sentinel solid streamers
Streamer Length	8000 m
Streamer Control Device (Manufacturer and type)	Input/Output (Digicourse) 5011 (Depth) Digifin (Lateral Control)
Energy Systems	
Manufacturer and Type	Bolt Air Guns
Source	3480 cubic inches
Source Depth	6 m
Nominal Source Pressure	2000 psi
Pressure Release	SeaMap GunLink 4000

4.4 Analysis of Alternatives

4.4.1 Introduction

This section of the MMIA outlines alternatives that were considered by NZOG as part of the commissioning of the Endurance MSS. All of the components of the Endurance MSS were selected with a focus on obtaining the best information of the hydrocarbon potential in the Canterbury Basin while avoiding adverse impacts on the environment to the fullest extent practicable.

4.4.2 Sound Source

A variety of seismic sources are available for marine applications, including Water Guns (20-1500 Hz), Air Gun (100 – 1500 Hz), Sparkers (50-4000 Hz), Boomers (300-3000 Hz), and Chirp Systems (500 Hz – 12kHz, 207 kHz, 4-24 kHz, 3.5 kHz, and 200 kHz). The greatest resolution of near surface structure is generally obtained from the higher frequency sources such as the Chirp systems, while the lower frequencies characterise structure at depth. For example, Chirp systems image only metres to tens of metres below the seafloor, whereas Air Guns image several kilometres below the sea floor.

NZOG have opted for Bolt Air Guns as they are the most appropriate source to meet the geophysical objectives in the Canterbury Basin while minimising the potential acoustic disturbance to the local environment. A dual sound source will be used where each source has two sub arrays, located at 7.5 m depth and approximately 450 m back from the

In summary, in order to fulfil the data acquisition objectives there is no alternative to the chosen sound source.

4.4.3 Airgun Barrel Volumes

As stated above the full capacity of the gun array is 3480 in^3 while the operating pressure is 2,000 psi. In the case of dropouts the gun array may operate at slightly lower capacity for a short period. This capacity and operating pressure is what the sound loss transmission modelling for the Endurance MSS was based on (Section 6.3.2.1).

4.4.4 Timing of the Survey

The commencement date of the survey is 15 December 2013. The timing for the proposed MSS has considered: 1) vessel availability, 2) operating in an Area of Ecological Importance during a period when numbers of migrating great whales are likely to be low, 3) when weather is predicted to be settled in order to minimise weather-induced vessel down-time.

4.4.5 Do Nothing Option

In order to progress investigations into the petroleum potential of PEP 52717 within the Canterbury Basin and to fulfil Work Programme commitments agreed with NZP&M; 3D seismic data acquisition is required to provide information for further petroleum exploration. Consequently, there is no 'do-nothing' option.

5 Existing Environment

5.1 Physical Environment

5.1.1 Climate

New Zealand's climate is complex and varies from warm subtropical in the far north to cool temperate in the far south.

The climate of the north Dunedin coastline is characterised by cool coastal breezes, and here there is an absence of shelter from the unsettled weather that moves over the sea from the south. Hot north-westerly conditions in summer can occasionally bring high temperatures, however summer daytime temperatures range from 16°C to 23°C, occasionally rising above 30°C. Winters are cold with infrequent snowfall and frequent frost. Typically, winter daytime maximum temperatures range from 8°C to 12°C (NIWA, 2013). Table 5 outlines the mean monthly weather parameters at Dunedin based on historical average weather conditions.

Table 5: Mean Monthly Weather Parameters at Dunedin, Indicative for Survey Area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	42	47	47	57	30	37	44	38	32	44	41	72
Humidity (%)	71	74	76	80	81	83	82	80	73	72	70	74
Temperature – average daytime (°C)	22	21	19	16	14	11	11	12	15	16	19	20
Temperature – average night time (°C)	8	8	6	4	2	-1	-1	0	2	3	6	8
Wind speed average (kts)	7	7	6	6	5	6	5	6	7	7	8	8
Wind speed – max (kts)	29	35	30	32	31	30	28	31	34	36	35	26

(Source: Weather2, 2013)

5.1.2 Geological Setting

The Canterbury Basin formed as an intraplate rift during the Cretaceous period. Subsidence was accompanied by marine transgression, and was followed by further thermal subsidence in the Neogene to recent times when an active plate boundary developed at the western margin. The Canterbury Basin Cretaceous and Cenozoic sequence outcrops in the foothills of the Southern Alps, extending down beneath the gravels of the Canterbury Plains, and is present over a large offshore area; providing a total area of 330,000 km^2. The northern margin of the Canterbury Basin is bound by the Chatham Rise, while the eastern margin is poorly defined. The Canterbury Basin has many similarities to the productive Taranaki Basin, where it has a viable source rock in the Cretaceous and suitable reservoir and seal rocks at several stratigraphic intervals. The deepest parts of the Canterbury Basin lie offshore from Timaru and Oamaru in the Clipper sub-basin, where a thickness of over 6,000 m of sediment has accumulated.

Exploration in the Canterbury Basin first began in the 1920s; where eight onshore wells between 1920 – 2008 and five offshore wells from 1970 – 2006 have now been drilled (oil and gas fields shown in Figure 5). Numerous marine 2D and 3D seismic surveys

have been undertaken in the Canterbury Basin, and the Endurance 3D MSS will help gather more sub-surface information and tie in to the previously drilled well Galleon-1.

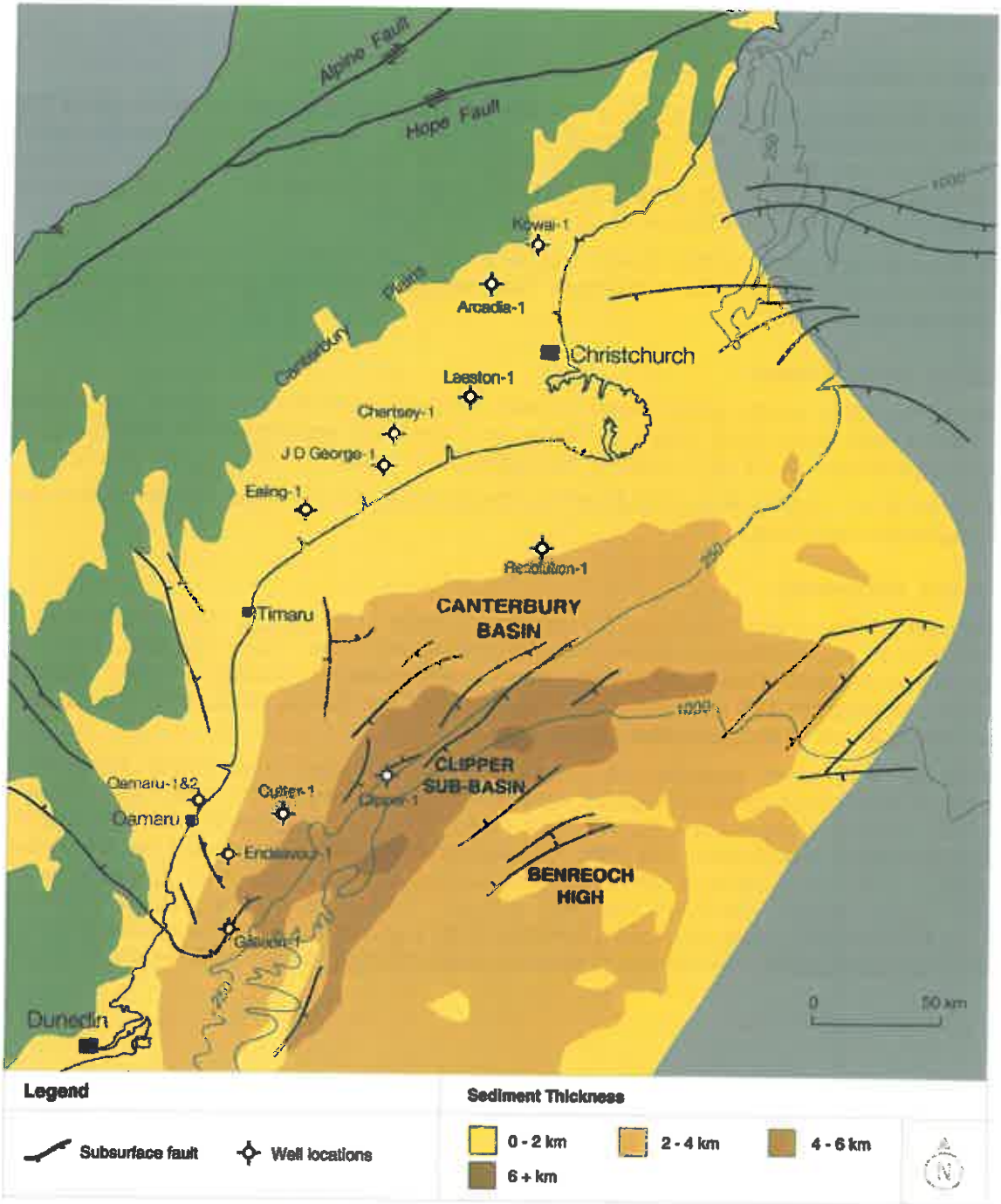

Figure 5: Canterbury Basin Map

(Source: NZ Petroleum & Minerals, 2013)

5.1.3 Oceanography

Circulation in the Canterbury Basin is mainly influenced by tide, wind, bathymetry and currents.

5.1.3.1 Wave Height

In the Gorman *et al.* (2005) study of the Great South Basin, modelling showed that high-energy waves from the west predominate, with wave heights at their lowest in summer (December/January), while the annual maximum occurs in May, with a secondary maximum in October. The Great South Basin model is considered to be relevant to the Canterbury Basin in the absence of any other data source.

In open waters close to the South Island, winds are predominantly westerly, but the distribution of wave directions becomes more weighted towards the southwest quadrant (Gorman *et al.*, 2005).

5.1.3.2 Wind Climate

Strong westerly winds predominate in the southern part of NZ. Along the Dunedin coastline the wind fields begin to show an increasing occurrence of southwest and northeast winds, partly as a result of the topographic influence of the South Island.

Gorman *et al.*, (2005) showed that off the Otago coastline, the least windy months occur in December and June.

5.1.3.3 Bathymetry

The bathymetry of the Endurance Survey Area is shown in Figure 6. The seabed gradient slopes in a southeastern direction through the Survey Area, where it drops down very quickly at the shelf break. The survey area encompasses the Waitaki Canyon. The water depth ranges from 119 m in the northwest corner of the Survey Area, and extends down to over 1,000 m in the southeast corner.

Typically submarine canyons are considered to represent biodiversity hotspots on account of the high levels of organic enrichment in these zones (De Leo, 2012). Flow on effects from this organic terrestrial input often lead to an increased diversity and high abundances of macrofauna. To date little research has been conducted on the Waitaki Canyon and the habitat it provides and species assemblages that it supports, but bathymetry studies conclude that the Waitaki Canyon is the largest of the South Canterbury/North Otago Canyons (Forsythe 2001) and it therefore is assumed to have regional significance with regards to primary productivity and species diversity.

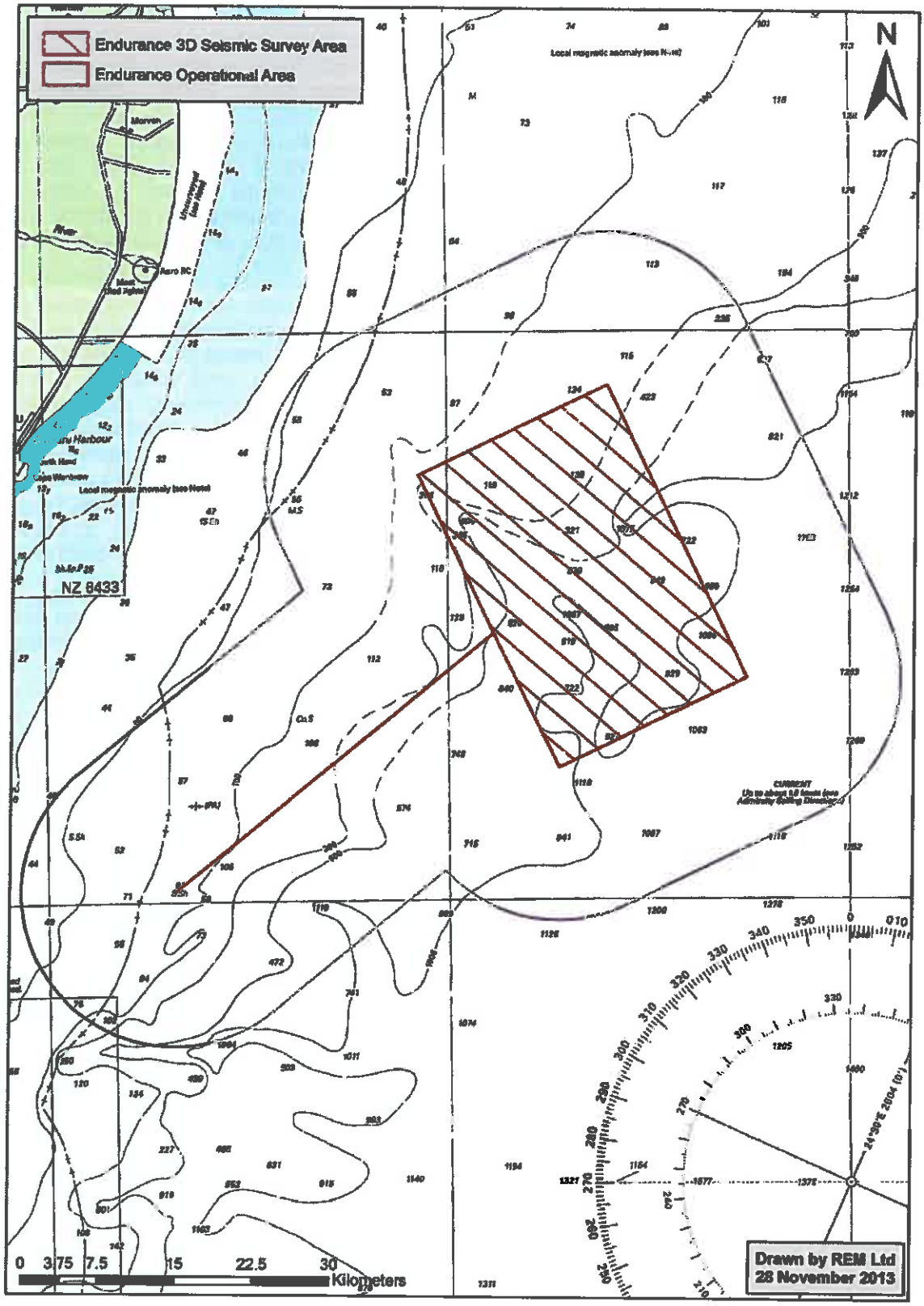

Figure 6: Bathymetry of the Endurance Survey Area

5.1.3.4 Currents

New Zealand sits in the generally eastward flowing southern branch of the South Pacific subtropical gyre which is driven by winds; the southeast Trade winds to the north and the Roaring Forty westerly winds to the south (Gorman *et al.*, 2005). These winds initiate an anti-clockwise circulation, which is then modified by the Coriolis Effect. In the Tasman Sea, westerly winds and the eastward currents force warm water against the South Island. This water body splits to form the Westland Current (WC) and the Southland Current (SC) (Figure 7). The SC travels anticlockwise around the bottom of NZ and north along the Otago-Canterbury coast. Near Banks Peninsula most of the SC is diverted east by the Chatham Rise. The remaining current flow continues north to mix with water from the Cook Strait.

The SC is associated with the Southland Front which is a stable, narrow front separating a band of relatively warm, salty subtropical water on the continental shelf from cold, fresh subantarctic water offshore to the east (Sutton, 2003). Along the southeast coast of NZ, the front follows the continental shelf break to the north, until turning east along the crest of the Chatham Rise. The SC plays a key role in determining oceanographic conditions off the South Island's SE coast. Here a narrow band of subtropical water maintains inshore water temperatures c.2°C warmer than those offshore of the Southland Front (Sutton, 2003). Currents in the SC can reach as high as 90 cm/s, and are mostly unidirectional (Gorman *et al.*, 2005). Sharp bathymetric features have a strong influence on the position of the Southland Front (Smith et al. in press), and higher levels of chlorophyll a concentrations within the SC give rise to increased productivity levels in this zone (Murphy et al 2001).

The current regime around NZ is dominated by three main processes; wind-driven flows, low frequency flows and tidal currents. The net flows are a combination of all three of these processes, and can be further influenced by bathymetric effects.

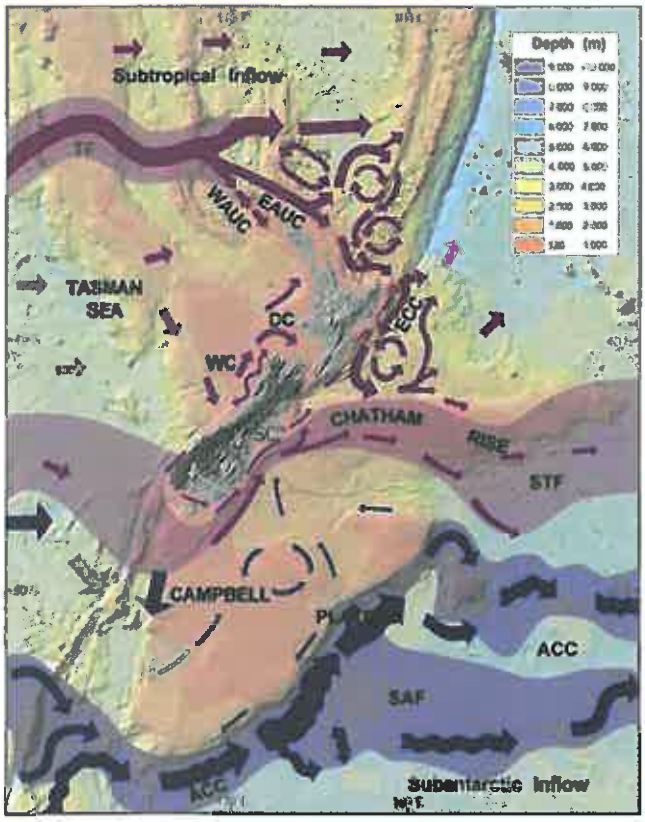

Figure 7: Ocean Circulation around New Zealand

(Source: The Encyclopaedia of New Zealand)

5.1.3.5 Sediments and Seafloor

The Canterbury basin is composed of prograding sediment drifts formed in the Neogene geological period, which overlay limestone formed in the Paleogene geological period (Al-Hadab, 2012). The prograding sediment accumulation of Neogene sediment supply is due to the high rates from the uplifting Southern Alps and a stable geostrophic oceanic current (Fulthorpe *et al.*, 2011).

The Canterbury basin contains 5 km or more of Cretaceous-Cenozoic sediment overlaying the basement rock. Large amounts of clastic sediments were deposited into the Canterbury Basin during the Jurassic period in a convergent margin setting. During the mid-Cretaceous, normal faulting was responsible for creating the main basin architecture, with greatest subsidence in the Clipper sub-basin. Widespread faulting in the Canterbury basin created smaller grabens, where terrestrial conglomerate, sandstone, siltstone, carbonaceous mudstone and coals were deposited into these grabens. Previous drilling activities in the Canterbury Basin region on the upper continental slope have found the sediment layers to be composed of silty clays, silty sands and sandy silts down to a depth of about 500 m below the sea floor.

5.2 Biological Environment

5.2.1 New Zealand Marine Environmental Classification

MfE, MPI and DOC commissioned NIWA to develop an environmental classification covering NZ's Territorial Sea and EEZ, known as the New Zealand Marine Environment Classification (NZMEC). The classifications provide spatial frameworks for structured and systematic management by subdividing the geographic domain into units having similar environmental and biological character (NZMEC, 2005).

Physical and biological factors (depth, solar radiation, sea surface temperatures (SST), orbital velocity (waves), tidal current, sediment type, seabed slope and seabed curvature) have been used to classify and map marine areas that have a similar environmental character. This then allows the marine environments' around NZ to be mapped at different levels of detail, depending on which environmental groups are selected.

The Endurance Survey Area falls within marine environment classification groups 63, 169, and 190 representing the moderately shallow to deeper waters on the continental shelf (Figure 8), while the Operational Area extends into classification groups 47, 170 and 178. The classification groups the Endurance Survey Area and Operational Area encounters is explained below (NZMEC, 2005).

- **Class 47:** occurs extensively in deep waters (mean = 2998 m) where average chlorophyll-*a* concentrations are moderately low. Characteristic fish species include smooth oreo, Baxter's lantern dogfish, the rattail *Macrourus carinatus*, Johnson's cod and orange roughy.
- **Class 63:** occupies waters of a moderate depth (mean = 754 m) on the continental shelf and includes much of the Chatham Rise. It experiences moderate annual solar radiation, winter SST and chlorophyll-*a* concentrations. Common fish species within this area include orange roughy, Johnson's cod, Baxter's lantern dogfish, hoki, smooth oreo and javelin fish. The most commonly represented benthic invertebrate families are Carditidae, Pectinidae, Dentallidae, Veneridae, Cardiidae, Serpulidae and Limidae.
- **Class 169:** occupies shallow waters (mean = 66 m) and is extensive on the east of the South Island. It experiences low to moderate orbital velocities, moderately low annual solar radiation and wintertime SST. Moderate tidal currents are present with high average concentrations of chlorophyll-*a*. Some of the most commonly occurring fish species are barracouta, spiny dogfish, hapuku, red gurnard, ling and sea perch, while arrow squid are also taken frequently in trawls. The most commonly

represented benthic invertebrate families are Veneridae, Terebratellidae, Mactridae, Pectinidae, Cardiidae, Amphiuridae, Nuculidae, Balanidae and Carditidae.

- **Class 170:** is extensive in moderately shallow waters (mean = 129 m) on the continental shelf. Annual solar radiation and wintertime SST are both moderately low, as is the annual amplitude of SST. Tidal currents are moderate and average concentrations of chlorophyll-*a* reach moderate levels. Some of the most commonly occurring fish species are barracouta, spiny dogfish, hapuku and ling, while arrow squid are taken with very high frequency in trawls. The most commonly represented benthic invertebrate families are Terebratellidae, Serpulidae, Veneridae, Pectinidae, Temnopleuridae, Carditidae Cardiidae, Glycymerididae, Spatangidae and Limidae.
- **Class 190:** occurs in waters of moderate depth (mean = 321 m) along the Southland Coast. It experiences moderately low mean radiation and wintertime SST, and high gradients of SST, with high average concentrations of chlorophyll-*a*. Some of the most commonly occurring fish species are spiny dogfish, barracouta, ling, hapuku, hoki and sea perch. Arrow squid are also frequently taken in trawls.

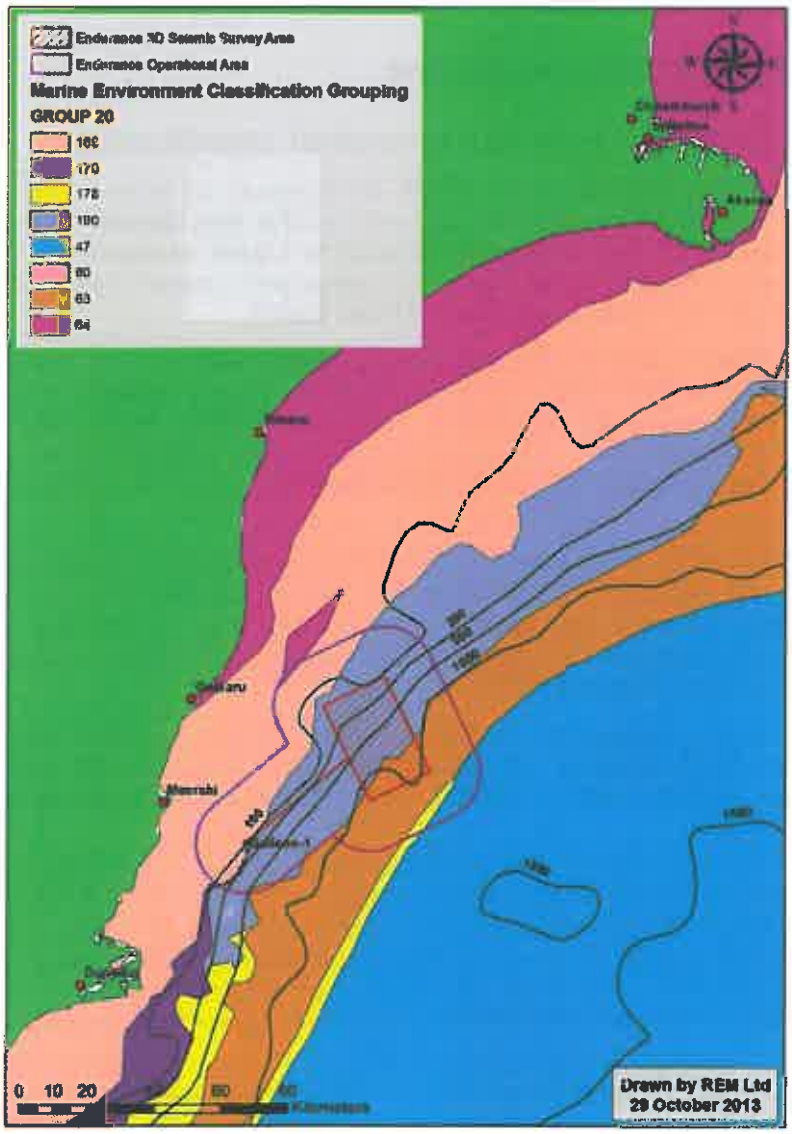

Figure 8: The NZMEC at the 20-Class Level.

Along the southern coast of NZ on the continental shelf and slope, silty-sand substrates are present between 30 – 50 m and are dominated by polychaetes, bivalves and whelks. At intermediate depths up to 200 m, sandy-mud substrates host polychaetes, bivalves and amphipods, while between 200 – 250 m sand substrates are home to bryozoans and polychaetes. Deeper sandy-mud substrates from 500 to 1,000 m have been shown to be occupied by tanaids and ophiuroids.

5.2.2 Regional Coastal Environment

The rocks that outcrop along Dunedin's coast represent the major stages of geological history; while offshore, the sea floor shelves for about 30 km before plunging steeply, marking Otago's ancient coastline when the sea level was lower.

About 20 – 30 km offshore, the warm and salty SC intrudes on the 'normal' cool and less saline sub-Antarctic surface water. Nearshore coastal water is extremely variable and strongly influenced by runoff and river levels. The north Otago coastline experiences the most coastal erosion in the region, while river mouths are subject to flood-related shifting.

Within the NZ Marine Fisheries Waters (EEZ and Territorial Sea) over 16,000 marine species have been identified. The sections below are a summary of the marine communities found within and surrounding the Survey Area.

Inshore and to the south of the Survey Area, there are two main urban areas, Oamaru and Dunedin although small fishing and holiday communities are interspersed between.

There is a wide range of coastal habitats inshore of the Survey Area, consisting of open coastline, estuaries, wetlands, beaches and rocky shores, all of which provide important feeding and breeding habitats for seabirds and marine mammals.

Along the South Canterbury coastline to the north of the Survey Area there is also a wide range of different habitats present; consisting of steep gravel beaches, alluvial cliffs, large river mouths and deltas, coastal lagoons, sandy beaches and coastal reefs.

5.2.3 Plankton

The productivity of NZ waters is due to its location in the Pacific, undersea landscape, ocean currents and climate. Warm subtropical surface waters along the North Island and west coast of the South Island meet colder sub-Antarctic surface waters which surround the rest of the South Island and offshore islands to the south and east (MPI, 2013a). From this, nutrient rich waters from the south mix with the warmer northern waters to create the Subtropical Front, which circles the Southern Hemisphere and create ideal conditions for plankton and the animals that feed on them (MPI, 2013a).

Plankton is a drifting organism (animals, plants or bacteria) that inhabits the pelagic zone of oceans or seas around the world. They are the primary producers of the ocean and provide a crucial source of food for fish and baleen cetaceans. Plankton travel with the ocean currents, and although some plankton can move vertically within the water column their horizontal distribution is primarily determined by the surrounding currents. Plankton abundance and distribution are strongly dependent on factors such as ambient nutrient concentrations, the physical state of the water column, and the abundance of other plankton.

Plankton can be divided into three broad functional groups:

- Bacterioplankton – bacteria which play an important role in nutrient cycles in the water column;
- Phytoplankton - microscopic plants that form the base of the marine food chain by capturing energy from the sun and nutrients in the water through photosynthesis. They help sustain almost all life in the ocean; and being primary producers they create organic compounds from CO_2 dissolved in the water; and

- Zooplankton – small protists or metazoans (e.g. crustaceans and other animals) that feed on the phytoplankton. Zooplankton also includes the larval stages of larger animals such as fish and crustaceans.

5.2.4 Fish Species

To the north and south of the Survey Area, the Chatham Rise and Subantarctic fishing grounds provide 60% of NZ's fish catch (MPI, 2013a). Most of which comes from the areas near the subtropical front, and includes the main hoki, hake, ling, silver warehou, squid, orange roughy and deep sea (oreo) dory fisheries. However, most of these fisheries are in deep water and not within the Survey Area.

On the Canterbury shelf, research trawls have shown that the survey catches are dominated by spiny dogfish, barracouta and red cod, which accounted for 60 – 80% of the fish biomass, mainly between depths of 100 – 200 m. These three species produce most of Canterbury's commercial fish catches along the Canterbury shelf.

A fisheries assessment was prepared by MPI (see Section 5.3.3), which showed that barracouta, squid, red cod, spiny dogfish and silver warehou are the most commonly caught commercial species within the Survey Area.

Inshore of the Survey Area rocky reef systems with kelp forests and clear waters which is interspersed by a coastline and shallow shelf of sandy mud that extends some distance offshore. These narrow shelf areas that connect the rocky and sandy-mud areas are rich in biodiversity and are often used as fish nursery areas and migratory pathways (MPI, 2013b).

5.2.5 Threatened Marine Species

The NZ threat classification system was developed for species according to their risk of extinction and used criteria developed specifically for NZ conditions. The list was first released in October 2002, and then updated again in January 2007 (Townsend *et al.*, 2007) and then a cycle for 2008-2011 which was published in independent peer-reviewed scientific journals.

New Zealand has 444 threatened marine species under the NZ threat classification system list; this list includes 38 species of seaweeds (Hitchmough *et al.*, 2005), 33 of marine invertebrates (Freeman *et al.*, 2010), and 36 of NZs 109 species of seabirds (Miskelly *et al.*, 2008). There are 82 species of marine fish listed as being in gradual decline, sparse or range restricted; but there is no comprehensive dataset on the occurrence or distribution of these species within the Canterbury basin. Additionally, 8 of NZs 56 species of marine mammals are also threatened (Hitchmough *et al.*, 2005, Baker *et al.*, 2010).

Great White sharks and basking sharks are at risk of extinction and are classified as being in gradual decline. Great white sharks occur throughout the southern waters of NZ and are now fully protected in NZ waters under the Wildlife Act 1953 and are further protected on the high seas under the Fisheries Act where NZ flagged vessels are prohibited from taking these sharks beyond the 200 Nm EEZ. Other protected marine species in NZ waters include the whale shark, oceanic whitetip shark, deepwater nurse shark, manta ray and spiny-tailed devil ray.

5.2.6 Marine Mammals

New Zealand waters support a diverse community of marine mammals. There are forty-one species of cetaceans (whales and dolphins) and nine species of pinnipeds (seals and sea lions) known to inhabit NZ waters (Suisted & Neale, 2004). The NABIS database (MPI, 2013d) uses mammal sightings, strandings, literature reviews and DOC data to provide accounts of marine mammal distributions within the NZ EEZ. Using information contained in NABIS and recent DOC stranding and sighting data, a list of marine

mammals which may be present in the Endurance MSS operational area has been compiled (Table 6).

Marine mammal datasets used here contain opportunistic presence-only data, and it is important to recognise that observer effort is not consistent across space and time.

Table 6: Marine Mammals which have been recorded in or around the Survey Area

	Baleen whales	**NZ Threat Status**
†Ψ	Humpback whale (*Megaptera novaeangliae*)	Migrant
Ψ	Blue whale (*Balaenoptera musculus and B. musculus brevicauda*)	Migrant
†	Fin whale (*Balaenoptera physalus*)	Migrant
†Ψ‡	Minke whale (*Balaenoptera acutorostrata & B. bonaerensis*)	Not Threatened
Ψ	Sei whale (*Balaenoptera borealis*)	Migrant
†Ψ	Southern Right whale (*Eubalaena australis*)	Nationally Endangered
†	Pygmy right whale (Caperea marginata)	Data Deficient
	Toothed whales	
†Ψ‡	Beaked whales (11 species identified in NZ waters)	Data Deficient
†Ψ‡	Sperm whale (*Physeter macrocephalus*)	Not Threatened
†Ψ	Common dolphin (*Delphinus delphis*)	Not Threatened
†Ψ‡	Killer whale (*Orcinus orca*)	Nationally Critical
†Ψ‡	Bottlenose dolphin(*Tursiops truncates*)	Nationally Endangered
†Ψ‡	Long-finned Pilot whale (*Globicephala macrorhynchus*)	Not Threatened
†Ψ‡	Short-finned Pilot whales (*Globicephala macrorpynchus*)	Migrant
†Ψ‡	Hector's dolphin (*Cephalorhynchus hectori*)	Nationally Endangered
†Ψ‡	Dusky dolphin (*Lagenorhynchus obscurus*)	Not Threatened
‡	False killer whales (*Pseudorca crassidens*)	Not Threatened
†‡	Striped dolphin (*Stenella sp*)	Vagrant
†‡	Pygmy sperm whale (*Kogia Breviceps*)	Data Deficient
†‡	Southern right whale dolphin (*Lissodelphis peronii*)	Data Deficient
†	Hourglass dolphin (*Lagenorhynchus cruciger*)	Data Deficient
‡	Spectacled porpoise (*Phocena dioptrica*)	Vagrant
	Pinnipeds	
Ψ	NZ sea lion *(Phocarctos hookeri)*	Nationally Critical
Ψ	Ψ NZ fur seal (*Arctocephalus forsteri*)	Not Threatened
Ψ	Ψ Southern elephant seal (*Mirounga leonina*)	Nationally Critical

† Canterbury stranding record, ‡ Otago stranding record, Ψ sighting record

Eight marine mammal species have been identified within NZ waters that have been included in the NZ Threat Classification List (Baker *et al.*, 2010) as either *nationally critical, nationally endangered* or *range restricted* (Table 7). Of these species, two (killer whale, and bottlenose dolphin) are likely to occur within the Survey Area, and for four there is a low probability that they will be present (southern elephant seal, southern right whale, Hector's dolphin and NZ sea lion)—based on their life history characteristics, behaviour and/or previous sighting records.

Table 7: Marine Mammal Species Listed on the NZ Threat Classification List (DOC, 2009, Baker *et al.*, 2010)

Common and scientific name	NZ threat classification	Biology	Local distribution	Likely to occur within Survey Area
Bryde's whale *(Balaenoptera edeni)*	Nationally critical	Generally a coastal species but does live in the open ocean. Bryde's whales prefer temperate waters and are observed off the NZ coast generally north of the Bay of Plenty. This species of whale is believed to rarely venture beyond 40 degrees south.	Unlikely to occur in the Survey Area due to preference for warmer waters.	×
Killer whale *(Orcinus orca)*	Nationally critical	Feeds on a variety of animals which include other marine mammals and fish species. They are believed to breed throughout the year and appear to migrate based on the availability of prey.	Largely unknown but tend to travel according to the availability of food. Killer whales are widely found in all oceans of the world although more dominant in cooler waters. Likely to occur in the Survey Area.	✓
Maui's dolphin *(Cephalorhynchus hectori maui)*	Nationally critical	World's smallest dolphin and found in inshore waters on the west coast of the North Island. Considered a subspecies of Hector's dolphin	Generally live close to shore (within 4 nautical miles). Only found in the North Island. Unlikely to occur in the Survey Area.	×
Southern elephant seal *(Mirounga leonina)*	Nationally critical	They are the largest species of seal and feed on squid, cuttlefish and large fish. Generally only comes ashore in spring/summer on offshore islands and some mainland areas to breed and moult; otherwise lives mostly at sea. They have an inflatable proboscis (snout) which is most present in adult males which is meant to increase the bull elephant seals roar.	Primary range includes the Antipodes, Campbell, Auckland, Snares Islands and the surrounding Southern Ocean. Occasionally they are found on the mainland from Stewart Island to the Bay of Islands. Low probability that they will be present in the Survey Area.	✓ (low)
Southern right whale *(Eubalaena australis)*	Nationally endangered	Present both offshore and inshore and their diet consist of krill, particularly copepods. Mate and calve during winter months in sheltered sub Antarctic harbours such as Auckland Islands and Campbell Island. Are baleen feeders and often travel well out to sea during feeding season; but they give birth in coastal areas (American Cetacean Society, 2010).	Likely to occur as a transient species in the Survey Area.	✓ (low)
Hector's dolphin *(Cephalorhynchus hectori)*	Nationally endangered	One of the smallest dolphin species (less than 1.5m long). Generally live inshore although have been sighted up to 18 Nm from the coast. Little known about migratory, reproductive, or feeding habits.	Patchily distributed around the South Island coast. On east coast live between Banks Peninsula and Te Waewae Bay and Porpoise Bay in the south. Not likely to occur in the main survey polygon due to their affinity for shallow inshore waters, but there is a possibility that they will be encountered in the Galleon-1 section of the MSS.	✓ (low)
NZ sea lion *(Phocarctos hookeri)*	Nationally critical	Feeds on fish, invertebrates, and occasionally birds or other seals. Breeding occurs in summer months with pupping occurring in December/January with the pups being weaned in July/August.	Known to forage along continental shelf breaks with primary range including the Auckland, Campbell, and Snares Islands. Small breeding colony recently established on the Otago Peninsula with low numbers of individuals seen in the Moeraki/Oamaru vicinity. Low probability that they will be present in the Survey Area.	✓ (low)
Bottlenose dolphin *(Tursiops truncatus)*	Nationally endangered	Are found worldwide in temperate and tropical waters, generally north of 45 degrees south. Population density appears to be higher near shore. Resident bottlenose dolphins are found off the east coast of the North Island, the northern tip of the South Island, and in Doubtful Sound.	Possibly observed in the Survey Area.	✓

5.2.6.1 Whale migration patterns around New Zealand

Each spring most of the large whales living in the Southern Hemisphere undertake extensive migrations: from the Pacific Islands to the Antarctic Ocean to feed, and returning each Autumn-Winter back to warmer waters for the breeding season (May – July) (DOC, 2007).

Figure 9 shows the distribution and migratory patterns of humpback, sperm, Bryde's and southern right whales around NZ. The northwards migration routes are well known, however there is a paucity of data for the return migration routes.

Figure 9: Whale Distribution in NZ Waters

(Source: Te Ara, 2013)

5.2.6.2 Humpback Whale

In the summer months humpbacks feed in Antarctic waters, while in the winter months they migrate north to tropical or sub-tropical waters, particularly around Tonga (Shirihai, 2002) for mating and calving. Both females and males are sexually mature at around five years old. Whaling in the southern hemisphere has reduced the population from

~120,000 animals to just 15,000; however the population is now believed to be recovering (Suisted & Neale, 2004).

The winter migration north occurs between May and December, whereby this species travels up the east coast of the South Island, through Cook Strait before continuing up the west coast of the North Island. The southern migration in spring is along the west coast of the South Island. These migration periods do not overlap with the Endurance MSS and therefore it is unlikely that this species will be encountered.

Both northern and southern migrations are characterised by a gradual increase in the numbers of whales passing through NZ waters, with the highest number of whales observed during the middle of the season. Lactating females and yearlings are often seen early in the season, followed by immature whales, then mature males and females, with pregnant females being the last cohort to travel (Gibbs & Childerhouse, 2000).

5.2.6.3 Blue Whale

Blue whales are the largest living animals, with adults reaching lengths of 33 m (Croll *et al.*, 2005). They are long-lived, slow reproducing animals and it is estimated that fewer than 2,000 blue whales are present in the southern hemisphere. During summer they are typically found at feeding grounds in the Antarctic, and in winter they are present in equatorial waters.

Blue whales have the highest prey demands of any predator where they consume up to two tonnes per day (Rice, 1978). Therefore, the presence of prey in large aggregations is important and drives their fine scale distribution at the feeding grounds.

There are two subspecies of blue whales in the Southern Hemisphere; Antarctic blue whales and pygmy blue whales which are difficult to distinguish between. Both of these species have been sighted off the Otago coast.

5.2.6.4 Minke Whale

There are two species of minke whale: the northern minke (*Balaenoptera acutorostrata*) and the southern minke whale (*Balaenoptera bonaerensis*). The northern minke is confined to the northern hemisphere. However, a sub-species - the dwarf minke, is found in NZ. Both the southern minke and the dwarf minke have been observed around the NZ coast (including off the east coast of the South Island), but are reported to be most common south of NZ, in Antarctic and subantarctic waters.

5.2.6.5 Sei Whale

Sei whales are a medium sized baleen whale with an average length of 15 - 18 m. They are a fast swimming whale and have been recorded at speeds up to 50 km/h. In February/March the Sei whales migrate south to Antarctica feeding grounds and then return home to NZ waters between the South Island and Chatham Islands to calve. Sei whales have been sighted off the Otago coast.

5.2.6.6 Southern Right Whale

The southern right whale can grow up to 18 m l and lack a dorsal fin. Their upper and lower jaw is highly curved, with their upper jaw often covered by 'callosities' (hardened patches of skin) that mainly occur around the facial area. Southern right whales are slow moving, swimming at no more than 9 km/h, making them vulnerable to ship-strikes.

Southern right whales are the only baleen whales known to breed in NZ waters. Calving occurs in coastal waters during winter months while in summer they migrate to the Southern Ocean (sub-Antarctic Auckland and Campbell Islands) to feed. This species is classified as Nationally Endangered, due mainly to their reduced population size (whaling accounted for a reduction from c. 17,000 animals to just 908 today; Carroll *et al.*, 2011, Suisted & Neale 2004). Recent genetic findings from DOC have shown that southern

right whales around mainland NZ are part of the subantarctic population, which is believed to be undergoing a range expansion (DOC, 2013a).

When southern right whales are either on their breeding grounds or migration paths they are frequently found in sheltered coastal waters. Historical whaling records suggest that summer feeding grounds are present off the Chatham Rise (Patenaude, 2003), although most sightings of southern right whales in recent years around the New Zealand mainland have occurred during the winter months. There is a low probability that this species will be encountered during the Endurance survey.

5.2.6.7 Beaked Whale

There are many species of beaked whales, each of which is believed to have a low population, and each of which are typically deep water species. Beaked whales are typically elusive at sea so very few sightings of live animals have been reported. For some species, stranding data is the only indication of their presence in NZ waters (WWF, 2013b). Beaked whales are most commonly found in small groups in cool, temperate waters, with a preference for deep ocean waters or continental slope habitats. Several species appear to be largely restricted to southern NZ waters (WWF, 2013b), which suggests these whales do not undertake an annual migration.

It is possible that beaked whales could be present in the Endurance Operational Area, however to date the Canterbury Basin has not been identified as an important habitat.

5.2.6.8 Sperm Whale

Sperm whales, pygmy sperm whales and dwarf sperm whales are globally distributed and have all been recorded in NZ waters. Within NZ waters, sperm whales are the largest of the toothed whales; males can reach 18 m in length with females typically 2/3rds this length.

Sperm whales feed on squid and fish and live in open ocean environments or areas on the seaward edge of the continental shelf in the vicinity of deep productive canyons (WWF, 2013a). Sperm whales rely heavily on acoustic senses for navigation and communication.

Kaikoura is home to the main resident population of sperm whales in New Zealand; however groups of non-resident sperm whales are not uncommon elsewhere. In any one season there are around 85 sperm whales (mostly male) utilising habitat around Kaikoura (Richter *et al.*, 1996). Off Kaikoura, whale distribution is strongly related to bathymetry. This is particularly the case in summer, when almost all sightings are made Kaikoura Canyon waters deeper than 1,000 m (Richter *et al.*, 1996).

Under the International Union of Conservation of Nature (IUCN) they are currently listed as vulnerable. It is possible that sperm whales will be observed during the upcoming Endurance seismic survey.

The Pygmy sperm whale is a small whale which is difficult to observe at sea on account of their timid behaviour, lack of a visible blow, and their low profile in the water. Pygmy sperm whales are present in the stranding record for both Otago and Canterbury, indicating that they could be present in and around the survey area.

5.2.6.9 Hector's Dolphins

Hector's dolphins are endemic to NZ and grow to 1.2 – 1.5 m in length making them one of the smallest cetaceans in the world. They have a patchy distribution around the entire South Island. Three geographically distinct groups are present 1) on the West Coast between Farewell Spit and Haast (c. 5,400 dolphins), 2) on the east coast with highest densities around Banks Peninsula (c. 2,600 dolphins); and 3) on the south coast of South Island (c. 90 dolphins) (MPI 2013e).

Since the 1970s their numbers have declined from an estimated 29,000 to around 8,000 today. They are classified as 'nationally endangered' by DOC. However, their numbers have increased within the Banks Peninsula MMS and they are routinely reported in and around the Marlborough Sounds.

Set nets used in coastal waters are believed to be responsible for 75% of the known Hector's dolphin's deaths but many more may go unreported (MPI, 2013e and Project Jonah, 2013). Hector's dolphins prefer shallow, coastal waters with water depths of less than 100 m, therefore they are not likely to occur in the main Survey Area, but there is a possibility that they could be present in the vicinity of the Galleon-1 well site. If any observations of this species are made DOC will be notified via the weekly MMO reports.

5.2.6.10Common Dolphin

Common dolphins are easily recognisable by their pattern of colours; from purplish-black to dark grey on top to white and creamy tan on the underside. This species is relatively coastal and is found throughout NZ waters. A study was conducted in the Bay of Islands by Constantine & Baker (1997) which showed that the mean water depth of sightings for common dolphins was 80 m and ranged from 6 to 141 m. Although they are the most abundant dolphin in the world, globally they are in decline.

They feed on a variety of prey which includes surface schooling fish (anchovies) and small mid-water fish (jack mackerel) and squid (Meynier *et al.*, 2008). Killer whales are the principal predators of common dolphins. Common dolphins grow up to 1.7 – 2.4 m in length. Although common dolphins generally prefer coastal waters, they could be observed within the Survey Area.

5.2.6.11 Bottlenose Dolphin

Bottlenose dolphins are among the largest dolphins, ranging from 2.4 – 4 m in length. Bottlenose dolphins are widely distributed through the world in cold temperate and tropical seas, with NZ representing their southernmost range.

There are three main coastal populations of bottlenose dolphins in NZ; c. 450 live along the northeast coast of Northland, c. 60 live in Fiordland and there is another population present from the Marlborough Sounds to Westport. These populations are genetically distinct, indicating little or no gene flow between the populations (Baker *et al.*, 2010). There is a sub population of offshore bottlenose dolphins that tend to travel more widely and in larger groups. The offshore bottlenose dolphins could be encountered in the Endurance Survey Area.

In the latest threat classification assessment, bottlenose dolphins were moved from 'Range Restricted' to 'Nationally Endangered' based on new evidence of low abundance and concern over potential decline in two well described populations.

5.2.6.12 Dusky Dolphin

Dusky dolphins are found in coastal waters in the Southern Hemisphere; they are slightly smaller than common dolphins growing to 2 m in length. They prefer cool, upwelling waters and mainly live in inshore waters but can be found out to the outer continental shelf. Within NZ they are most abundant from East Cape down to Kaikoura and are the second most numerous species of dolphin in NZ. The NZ population of dusky dolphins is believed to be in the order of 12,000 to 20,000 individuals and they are not regarded as threatened (Markowitz *et al.*, 2004). During late spring and summer it has been shown that dusky dolphins will spend the mornings inshore resting and socialising then by late afternoon move between 6 and 15 km offshore to feed. Dusky dolphins will generally spend more time in deeper water in winter.

Dusky dolphins consume a variety of pelagic fish and squid species as part of their diet and often feed in very large groups.

5.2.6.13 Killer Whale

Killer whales are classified as a 'nationally critical' threatened species in NZ waters (Suisted & Neale, 2004), they are the largest living members of the dolphin family with males growing up to 8 m. Within NZ waters there are believed to be two killer whale populations; one inshore and one offshore. These whales are commonly seen inshore during the summer fur seal breeding season. The closet fur seal breeding location to the survey area is at Moeraki (Lalas 2008), which perhaps increases the chances of killer whales being present in the southern sector of the survey area. The entire NZ killer whale population is small (mean = 119 ± 24 SE) with a wide ranging distribution around both North and South Islands (Visser, 2000). It is likely that this species will be encountered during the Endurance MSS.

5.2.6.14 Pilot Whale

Two species of pilot whales exist in NZ waters; long-finned pilot whales and short-finned pilot whales. Short-finned pilot whales prefer warmer waters but their ranges do overlap. Both species are listed as data deficient by the IUCN.

Pilot whales are sexually dimorphic with males being larger than females. Pilot whales prefer coastal waters along the continental shelf breaks and in areas of sharp topographic relief (WWF, 2013c). Long finned pilot whales are migratory and prefer colder waters where they feed on fish and squid.

Pilot whales are notorious for mass strandings. Strandings of pilot whales have been recorded for most coastlines of NZ, where peaks in standing events seem to occur during spring and summer months (O'Callaghan, 2001).

Pilot whales are likely to be observed in the Survey Area as they have been observed commonly off the east coast of South Island and are also present in the stranding record from both Otago and Canterbury.

5.2.6.15New Zealand fur seal

The NZ fur seal is the most common seal in NZ waters and are found throughout the country. Conservative population estimates are believed to be in the order of 50,000 to 60,000.

They can hold their breath for a very long time enabling very deep dives to feed on fish (small mid water fish, conger eels, barracouta, jack mackerel and hoki), squid and octopus; which is further aided by the adaptation of being able to slow their heart rate down to about one-tenth of its normal rate to help conserve oxygen (WWF, 2013d). Fur seals are known to travel up to 200 km offshore to feed.

The closet fur seal breeding location to the survey area is at Moeraki (Lalas 2008). It is highly likely that this species will be encountered frequently throughout the survey area. Fur seals forage over the continental shelf break with coincides with the proposed survey area.

5.2.6.16New Zealand sea lion

The New Zealand sea lion is New Zealand's only endemic pinniped. The population stronghold for this species is based at the Auckland Islands where over 70% of breeding occurs, with virtually all the remainder occurring at Campbell Island (Robertson and Chilvers 2011). A few pups are born annually at both Stewart Island and on the mainland Otago coast (McConkey et al. 2002). On the Otago coast the majority of individuals occur on Otago Peninsula and in the Catlins, however low numbers of solitary individuals do frequent beaches at Moeraki, Shag Point, and occasionally areas of coast as far north as Oamaru (J. Fyfe, DOC Otago pers comm.).

The foraging range of New Zealand sea lions on the Otago Peninsula has been documented for females only in a study that used satellite telemetry to investigate

foraging behaviour (Auge et al 2011). Here the foraging behaviour of 14 females of varying ages (2 – 14 years old). The results indicated that the majority (68%) of foraging trips were in the coastal zone (<3 km from shore), most other foraging trips (30%) were on the continental shelf (<200 m water depth) with only two of the study individuals utilising oceanic water (>200 m water depth) for foraging.

The low numbers of sea lions seen in the Endurance survey area and the relatively inshore foraging behaviour indicate that the likelihood of sea lions sightings during the survey is relatively low.

5.2.6.17 Elephant seals

Southern elephant seals are occasional visitors to the New Zealand mainland, but are more frequently encountered in the New Zealand subantarctic. This species has been awarded a conservation status of nationally critical by the New Zealand Department of Conservation (Baker et al. 2011) on account of population estimates of fewer than 250 mature individuals in New Zealand.

In recent years a few seals per year are typically reported in North Otago where it is believed that the Waitaki Canyon is a potential foraging ground for this species (J. Fyfe, DOC Otago pers comm.). No formal investigations into elephant seal habitat use is available for the Endurance survey area, however this species could potentially be present during the proposed survey.

5.2.7 Marine Reptiles

There are seven species of marine reptiles known to occur off the coast of NZ: the loggerhead turtle (*Caretta caretta)*, the green turtle (*Chelonia mydas)*, the hawksbill turtle (*Eretmochelys imbricate)*, the olive Ridley turtle (*Lepidochelys olivacea)*, the leatherback turtle (*Dermochelys coriacea*) the yellow-bellied sea snake (*Pelamis platurus)*, and the banded sea snake (*Laticauda colubrine)*. Apart from the leatherback sea turtle, marine reptiles are generally found in warm temperate waters and as a result most of NZ's marine reptiles are found off the northeast coast of the North Island in the warmer water (WWF, 2013e).

Observations records from the DOC database show the southernmost sighting of a loggerhead turtle is at Banks Peninsula, while the leatherback turtle have been observed as far south as the North Otago coastline and the Ridley turtle has been observed at the Catlin's and Stewart Island (DOC, 2013b). A study undertaken by McCauley *et al.*, (2000) exposed captive sea turtles to an approaching single air gun. The results indicated that the turtles displayed a general alarm response at an estimated 2 km range from an operating seismic vessel with avoidance behaviour estimated at 1 km.

It is highly unlikely that marine turtles will be encountered during the Endurance MSS.

5.2.8 Seabirds

Due to the diversity of seabirds in NZ waters, NZ is often considered to be the seabird capital of the world. There are 86 species of sea birds found in the marine waters off NZ which include albatrosses, cormorants and shags, fulmars, petrels, prions, shearwaters, terns, gulls, penguins, and skuas (DOC, 2013c). The greatest variety of albatrosses and petrels in the world are found within NZ waters, with NZ considered as an important breeding ground.

Information on seabirds within the Canterbury basin was obtained from DOC records and the NABIS database. Species identified that could possibly be in the Endurance Survey Area include:

- Albatross, including the wandering, southern royal, northern royal, light-mantled sooty, antipodean, Campbell, Gibson's, grey headed, Chatham, pacific and white capped;

- Mollymawks, including the Salvin's, Black-browed and Buller's;
- Shearwaters, such as short-tailed, little, Buller's, flesh-footed, sooty, Hutton's, common-diving, and fluttering;
- Petrels, including black, common diving, grey, grey-faced, Kermadec white-faced storm, northern giant, Westland, New Zealand storm, Giant (Nelly), blue, Cape, Mottled, and white-chinned;
- Terns, including Caspian, white, and the white-fronted;
- Penguins including eastern rockhopper, white-flippered, yellow-eyed, and Blue; and
- Other seabirds such as south polar skua, black-backed gull, red-billed gull, black-billed gull, cape pigeon, fairy Prion, Stewart Island shags, spotted shags, fulmar prion and Australasian gannet.

Many of these species breed on coastal headlands and islands off the NZ coastline, while some will use the Endurance Survey Area as foraging habitat.

Sea birds that feed by plunge diving (i.e. Australasian Gannet) or that rest on the sea surface and dive for food (i.e. sooty shearwater) have the potential to be affected by underwater noise from seismic surveys. Potential impacts of seismic pulses to seabirds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey.

Diving seabirds are all highly mobile and are likely to flee from approaching sound sources. The potential for physiological impact of seismic noise on diving bird species is considered to be of high intensity but would be limited to the survey area, specifically in close to the sound source and the survey duration (short term).

Avoidance behaviour of the birds potentially affected would only last for as long as the seismic survey continues while the behavioural impact of seismic noise on non-diving seabirds is considered to be *negligible*.

5.2.8.1 Breeding Colonies

There are five species of birds that have known breeding colonies in the surrounding areas of the Survey Area. These species are shown in (Figure 10) and are listed below, with their DOC threat classifications:

- Northern royal albatross – endangered;
- Caspian Tern – nationally vulnerable;
- Sooty shearwater – near threatened;
- Little blue penguin – declining; and
- Yellow-eyed penguin - endangered.

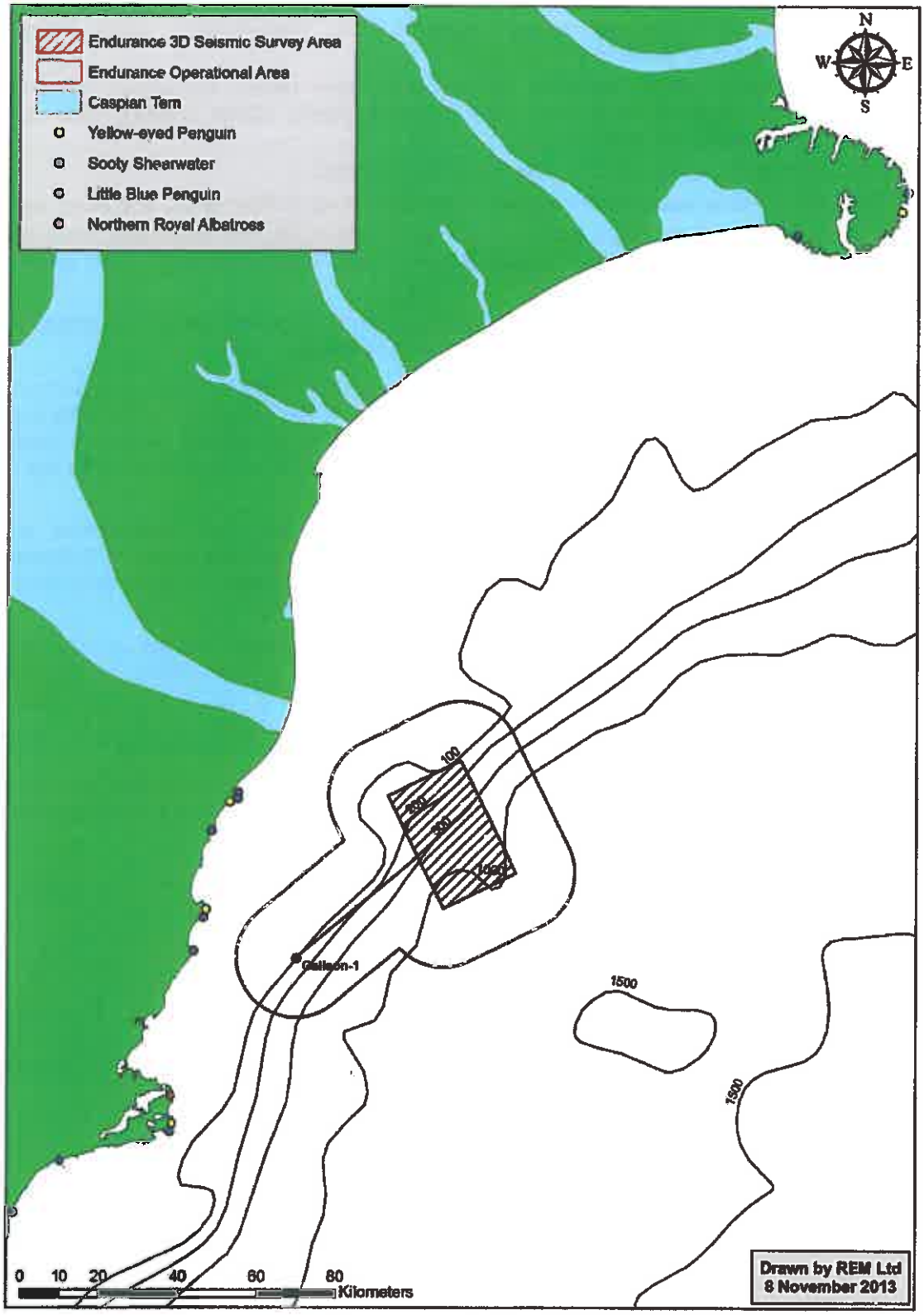

Figure 10: Breeding Colonies of Seabirds in Areas Surrounding the Endurance Survey Area

5.2.8.2 Blue Penguins

The little blue penguin (*Eudyptula minor*), which weighs ~1 kg and is ~40 cm in length is found around NZ's three main islands. There are two colonies of blue penguins located on the foreshore at Oamaru, with ~1,000 penguins at one site and ~800 at the other. The colonies are managed as part of a commercial tourism venture, however only one colony receives visitors.

Blue penguins mainly eat sprats, a small schooling inshore fish. When they are foraging for food at sea they feed within the top 10 m of water and can dive on average up to 800 times per day, and for approximately 20 – 30 seconds at a time. Swimming rates can be up to 8 km per hour and during the breeding season can cover on average 50 km in a day.

Blue penguins are habitual, there life cycle is well known as is the timing of their activities throughout the year. Twenty minutes after sunset the penguins arrive from sea and start to walk up the beach. Blue penguins do not migrate; they stay in the same site as where they were born and can therefore not be trans-located, with dogs, cats and ferrets being their biggest predators. The blue penguins nest in burrows, caves, rock crevices and under bushes and trees. The breeding season varies but usually begins somewhere from late June to September, where typically two eggs are laid, three days apart. During October through to December, the chicks have hatched and both parents return from sea daily to feed their chicks. At eight weeks of age the chicks are fully grown and fledge the nest and go to sea for 6 – 12 months. During the 2012 – 2013 breeding season which began in late July, there was 172 breeding pairs, with 484 eggs laid, of which 383 hatched and 367 fledged the nest.

The Blue Penguin Trust was engaged with during consultation and they are happy to keep an eye out for any changes that may occur within the behaviour of the penguins, given they are habitual. Studies have been undertaken on the colony, where penguins have been tracked via GPS which has shown them to range up to 15 – 20 km offshore. The movements of blue penguins off the Oamaru coastline are shown below in Figure 11.

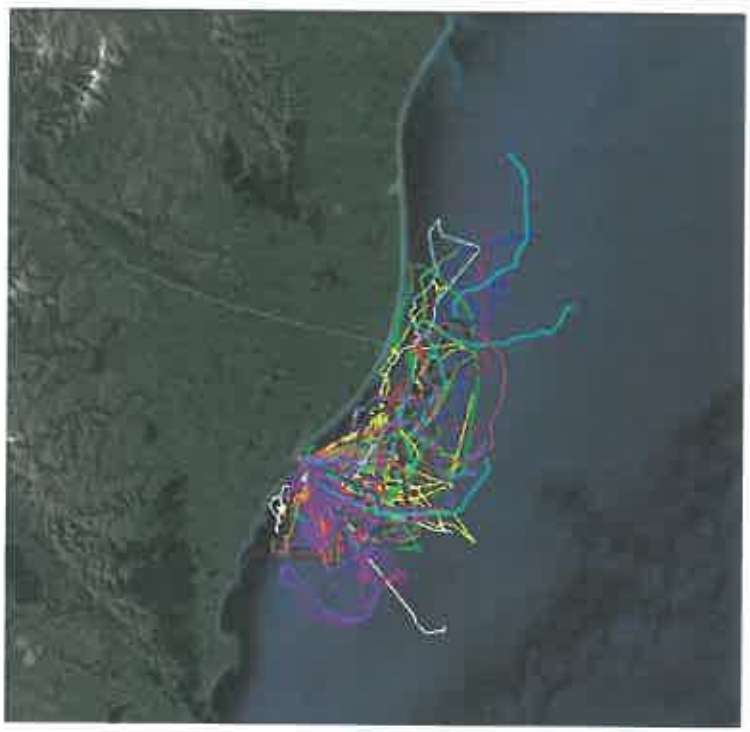

Figure 11: Blue Penguin Tracks from Oamaru Penguin Colony

5.2.8.3 Yellow eyed penguin

The yellow eyed penguin (*Megadyptes antipodes*) is endemic to New Zealand and breeds along the South Island's south-eastern coastline, on Stewart Island and on the subantarctic Auckland and Campbell Islands. Yellow eyed penguins primarily feed on benthic fish (Moore and Wakelin 1997) and penguins based at Oamaru exhibit nearly exclusive bottom-feeding strategies (Mattern et al. 2007). The daily foraging trips of Oamaru penguins between 2003 and 2005 ranged from 12 - 20 kilometres offshore with the average dive depth being approx. 25 m (max. dive depth logged = 38 m) (Mattern et al 2007).

The survey area lies beyond the 200 m depth contour off Oamaru, so there is little chance that yellow-eyed penguins will be in the immediate vicinity of the MSS. There is some potential for an overlap with yellow-eyed penguin foraging distribution in the 15km buffer zone in the southern sector of the survey area. Yellow eyed penguin nesting sites in the vicinity of the survey area were provided by Mel Young, DOC – Coastal Otago District Office, and are listed in Table 8.

Table 8: Yellow-eyed penguin nest records

Location	Number of nests
Barracouta Bay	26
Katiki Point	31
Bushy Beach	6
Bobbys Head	4
Katiki Beach	1
Waianakarua	1

5.2.9 Deep Sea Corals

A rich and diverse range of corals are recorded in NZ waters from the intertidal region out to depths of c. 5,000 m (Consalvey *et al.*, 2006). Many species are long lived and corals belong to the phylum Cnidaria of which there are four main classes: the Anthozoa, Hydrozoa, Cubozoa and Scyphozoa. Corals exist either as individuals or in colonies, and form external skeletons which provide habitat for other organisms.

The NABIS database indicates that black corals are distributed off the east coast of the South Island, mainly along the Chatham rise out to the Chatham Islands, with a small finger of coral that extends down to the northern part of the Endurance Survey Area (Figure 12) (MPI, 2013d). Within NZ waters there have been 58 species of black coral species identified, and although their depth and geographical distributions have not been analysed in detail, it appears most tend to live in deep water on seamounts or other hard substrate in depths ranging from 200 to 1,000 m deep. Black Coral within NZ's EEZ is protected under the Wildlife Act 1953.

There is limited published literature on the potential impacts of airgun noise emissions on sessile, benthic marine organisms, including hard and soft corals. It has been speculated that sound emissions from airguns could remove polyps from the calcium carbonate skeleton or that vibrations from pressure pulses propagating through the skeleton could damage polyps, but neither have been reported thus far in the literature. Woodside Energy Ltd conducted a 3D MSS around Scott Reef in Western Australia in deep water in 2007 where a pre and post seismic survey field experiment was conducted. Results of the post survey data did not reveal any detectable effects of airgun noise emissions on coral species (Woodside, 2007).

Most corals have a pelagic or planktonic phase in their lifecycle and mortality of plankton has been observed at close range (within 5 m) of the source of the seismic shot (DIR,

2007). However, the effects of seismic surveys on the planktonic phase of corals are considered to be *negligible* given the size of the planktonic populations and their high natural mortality rates resulting from stochastic events.

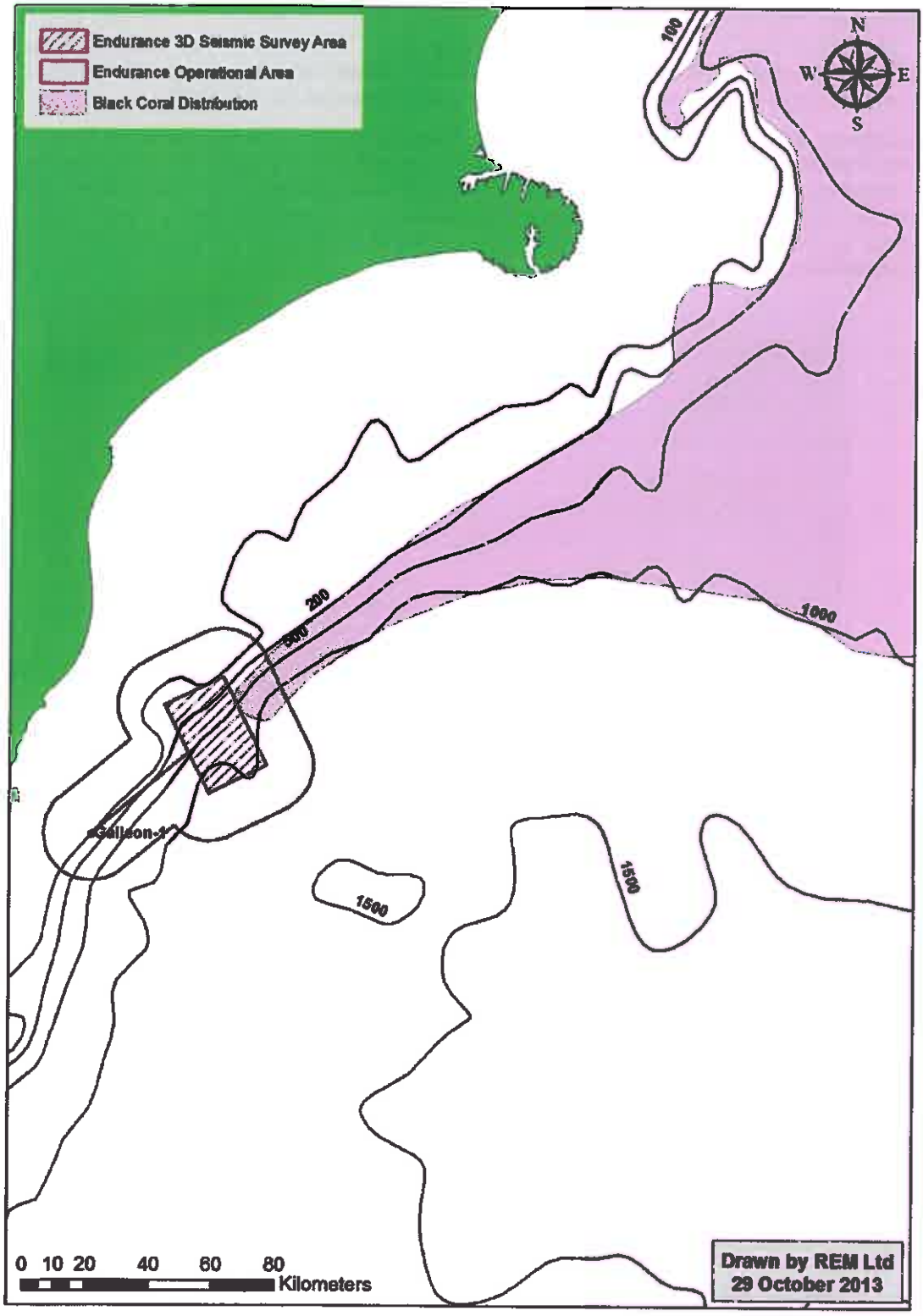

Figure 12: Black Coral Distribution Surrounding the Survey Area

5.2.10 Protected Natural Areas in the Vicinity of the Survey Area

Protected Natural Area's (PNA) are locations which receive protection due to their recognised natural ecological values, and are put in place for biodiversity conservation.

The closest PNA to the Survey Area is the Pohatu Marine Reserve at Flea Bay which is on the southeast side of Banks Peninsula (Figure 13). The reserve has a diverse range of habitats providing a rich intertidal and shallow subtidal environment, abundance of fish life and during summer a number of Hector's dolphins and NZ fur seals.

The Survey Area is located ~120 km south-southwest from the southern boundary of the Banks Peninsula MMS, which extends from the mouth of the Rakaia River to the mouth of the Waipara River and was established in 1998 for the protection of the Hector's dolphins from bycatch in set nets. The MMS offshore boundary extends from mean high water springs to the 12 Nm territorial sea limit, giving a total area of 413,000 hectares and covers 389 km of coastline.

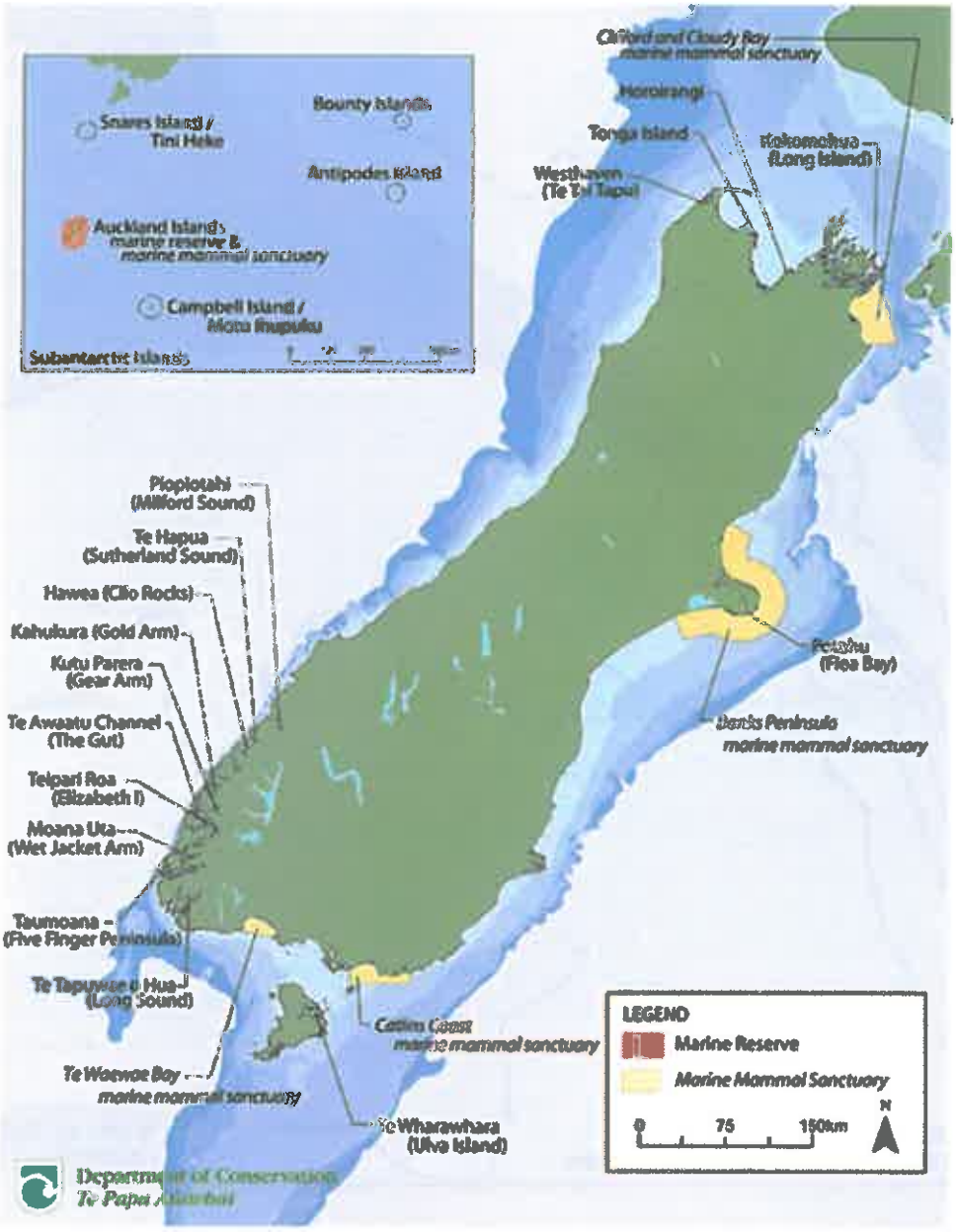

Figure 13: South Island Marine Reserves and Marine Mammal Sanctuaries

5.2.11 Benthic Protection Areas

In November 2007, 17 Benthic Protection Areas (BPA) were established by the Government, closing areas within NZ's EEZ to bottom trawling and shellfish dredging. These BPAs were introduced to protect the seabed habitat of 1.2 million square kilometres of seabed – approximately 32% of the EEZ. No BPAs are located in the vicinity of the Survey Area with the nearest BPA located on the Mid Chatham Rise, northeast of the Survey Area (Figure 14).

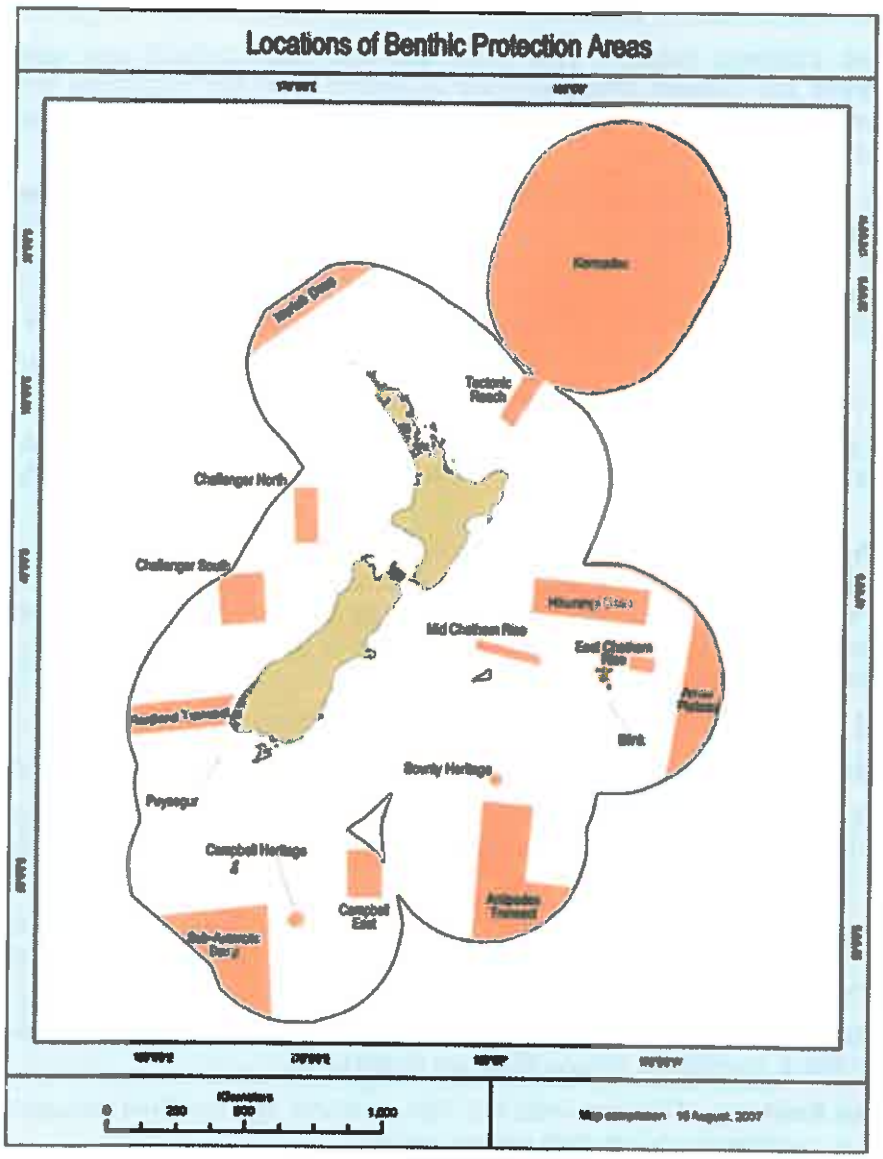

Figure 14: Benthic Protected Areas

(Source: MPI, 2013f)

5.2.12 Otago Areas of Significant Conservation Value

Within the Otago Regional Coastal Plan (2001) there are a number of areas within the coastal marine area which have significant conservation values and are protected due to having regional, national or international importance in terms of their ecological and scenic values as well as including those areas that have spiritual or cultural significance. The Otago Regional Council has policies in place to protect these areas from any adverse effects of use or development. Some of these areas and their outstanding coastal values,

relevant to the Endurance Survey Area are listed below and identified in Figure 15, while all of the areas can be found in the Otago Regional Coastal Plan. The Endurance Survey Area is located well offshore from these significant areas, but they have been discussed here for completeness.

Papanui Inlet – This inlet has Kai Tahu cultural and spiritual values. The estuary provides important habitat for birds such as the eastern bar-tailed godwit and white-faced heron, while providing an important nursery habitat for flatfish. A significant population of cockles also is present.

Otakou and Taiaroa Head – This area has Kai Tahu cultural and spiritual values. Estuarine areas are present which provide a wading area for migratory birds, while the intertidal flats provide for significant cockle habitat. There are also many eel grass beds within this area.

Aramoana – This area has Kai Tahu cultural and spiritual values. The estuarine area includes a large area of saltmarsh and sand which is used by wading and migratory birds, such as the Siberian wader and the Caspian tern. A wide variety of species are present within this area which also provides a breeding nursery for endemic fish species. The sandy beaches of Aramoana are also used as a haul out area by the Hookers sea lion.

Purakanui Inlet – This area has Kai Tahu cultural and spiritual values present. There are a wide range of estuarine values present within this area.

Orokonui Inlet – This area has Kai Tahu cultural and spiritual values present. Important estuarine values are present here which include feeding grounds for wetland birds.

Blueskin Bay – This area has Kai Tahu cultural and spiritual values present. The estuarine area is important and provides important feeding areas for wetland birds and a nursery for flatfish. The tidal flats are classified as an extremely well defined landform of international significance, while the inlet provides a significant habitat for a number of shellfish, especially cockles.

Puketeraki – This area has Kai Tahu cultural and spiritual values present.

Karitane Headland – This area has Kai Tahu cultural and spiritual values present.

Waikouaiti River – This area has Kai Tahu cultural and spiritual values present. The estuary is important and is important for coastal birds such as the eastern bar-tailed godwit and oystercatchers.

Hawksbury Inlet – This area has Kai Tahu cultural and spiritual values present. The estuary is a number of important values which include a habitat for a large number of wading birds and water fowl.

Pleasant River Estuary – This area has Kai Tahu cultural and spiritual values present. The estuary has a number of values that are important.

Stony Creek Estuary - This area has Kai Tahu cultural and spiritual values present. The estuary has a number of values that are important.

Shag Point & Shag River Estuary – This area has Kai Tahu cultural and spiritual values present. There is an extensive subtidal reef system present with a rich kelp bed. Mudstone wave cut platforms are present which contain fossils and spherical boulders (Katiki concretions). The estuary is important and provides large mudflats for feeding birds which are roosting or stopping over. The area is also important as a whitebait spawning area and as a habitat for lamprey. New Zealand (Hooker's) sea-lions and elephant seals occasionally use the spit to haul out.

Moeraki Peninsula – This area has Kai Tahu cultural and spiritual values present. The coastal rocky platforms of subcalcic augite at Tawhiroroko Point are considered

internationally significant, while the golden coloured gravel beaches are nationally important.

Moeraki Beach – This area has Kai Tahu cultural and spiritual values present. The spherical mudstone boulders, which can take millions of years to form, are an internationally important landform.

Figure 15: Areas of Significant Conservation Value as defined in the Otago Regional Coastal Plan and DOC Area of Ecological Importance

5.2.13 Canterbury Areas of Significant Conservation Value

Within the Environment Canterbury Coastal Plan (2012) there are a number of areas within the coastal marine area which have significant conservation values and are protected due to having regional, national or international importance in terms of their ecological and scenic values. Environment Canterbury has policies in place to protect these areas from any adverse effects of use or development. Some of these areas and their outstanding coastal values, relevant to the Endurance Survey Area are listed below and identified in Figure 16, while all of the areas can be found in the Environment Canterbury Coastal Plan. The areas of significant conservation value listed below are all defined as being important due to: Maori cultural values, protected areas, wetland estuaries and coastal lagoons, presence of marine mammals and birds, ecosystems, flora and fauna habitats, scenic sites, historic places and coastal landforms and associated processes. The Endurance Survey Area is located well offshore and to the south of these significant areas, but they have been discussed here for completeness.

- Waitaki River Mouth;
- Wainono to Waihai River Mouth;
- Washdyke (Waitarakao) coastline;
- Opihi River Mouth and Lagoons;
- Orari River Mouth and Lagoons;
- Ashburton River/Hakatere Mouth;
- Rakaia River Mouth;
- Coopers Lagoon/Muriwai coastline; and
- Kaitorete Spit.

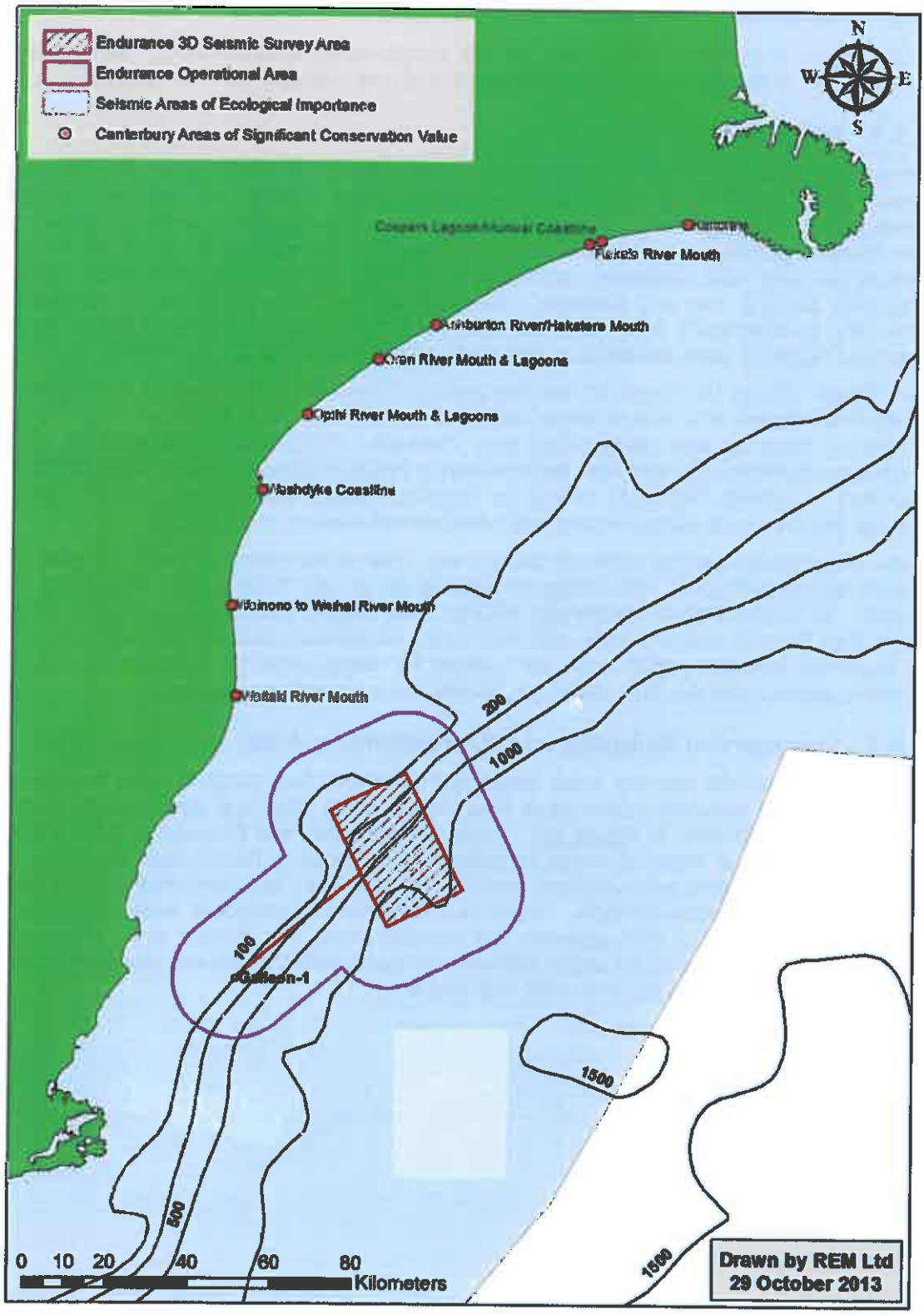

Figure 16: Areas of Significant Conservation Value as defined in the Environment Canterbury Coastal Plan and DOC Area of Ecological Importance

5.3 Anthropogenic Environment

This section focuses on the users of the surrounding environments; with particular emphasis on shipping, commercial fishing, oil and gas industry, tourism and research.

5.3.1 Ports and Harbours

NZ has thirteen major commercial ports and harbours, of which there are three main types; major ports, river ports and breakwater ports. Ports are not only important gateways for freight, transport and trading both nationally and internationally but they can have a general conservation value due to the abundance of eelgrass, mudflats, mangroves and salt marshes, providing extensive habitats for a diverse range of migratory birdlife, fish and shellfish. Many of the harbours within NZ have numerous arms and embayment's which may be used for swimming, boating or fishing. Local iwi also hold harbours and estuaries as areas of particular significance to them.

Port Otago Ltd, to the south of the Endurance Survey Area is based at Port Chalmers; which first started NZs export trade with the successful arrival of frozen meat to Great Britain in 1882 on the refrigerated ship *Dunedin*. Port Otago has wharves at Port Chalmers, Dunedin city and the Ravensbourne fertiliser peer, located between Dunedin and Port Chalmers. The port caters for logging, containers, fishing industry and cold storage for the meat, dairy, fishing and horticultural exports in the region.

Prime Port Timaru to the north of the Survey Area is the most centrally located South Island port providing all tide access to vessels up to 261 m in length with drafts up to 10.6m. In 2003, Port of Tauranga, NZ's busiest export port bought a 50 % stake of Prime Port Timaru, providing the port and South Canterbury community with a direct link to Tauranga and the world. The port caters for cargo services (containers, breakbulk handling service and dry bulk cargoes), fishing industry and liner vessels.

5.3.2 Commercial Shipping and Precautionary Area

Shipping vessels will use the most direct path between two ports for the movement of goods. General shipping routes have been provided by MNZ and direct routes between NZ ports are illustrated in Figure 17. It can be seen that the Endurance Survey Area is beyond any coastal shipping route between Port Chalmers, Timaru and Lyttelton. The Port Chalmers, Timaru and Lyttelton harbour masters have been informed of the MSS as part of the consultation process. There are no dedicated shipping lanes between Port Chalmers and Lyttelton, it is generally the shortest route that is used or in consideration of the weather conditions, so under abidance of the COLREGS and the issuance of Notice to Mariners there will be no issue with the operation.

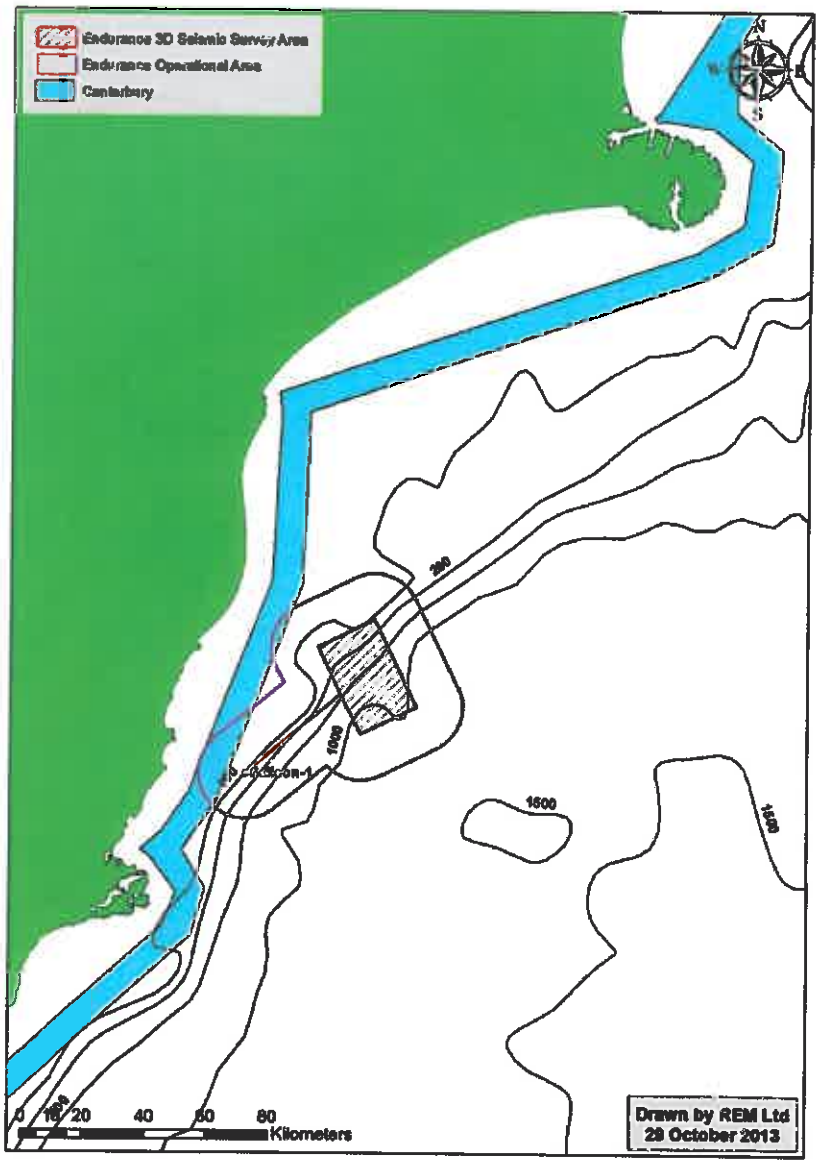

Figure 17: General Shipping Routes to each Port in the Vicinity of the Survey Area as Provided by MNZ

5.3.3 Commercial Fishing

Fishing within NZ waters can be split into three categories: commercial fishing; recreational fishing; and traditional or customary fishing as practiced by Maori.

NZ waters have been split into 10 Fisheries Management Areas (FMA), as seen in Figure 18 in order to better manage the Quota Management System (QMS) by MPI. The QMS is the primary fisheries management tool to provide for commercial utilisation of the fisheries resource while ensuring sustainability. There are 96 species within the QMS which have an Annual Catch Entitlement (ACE) which takes into account the commercial catch from the previous season, along with the recreational and customary catch. The ACE is used to determine the Total Available Commercial Catch (TACC) each year which is split among the companies that own the quota.

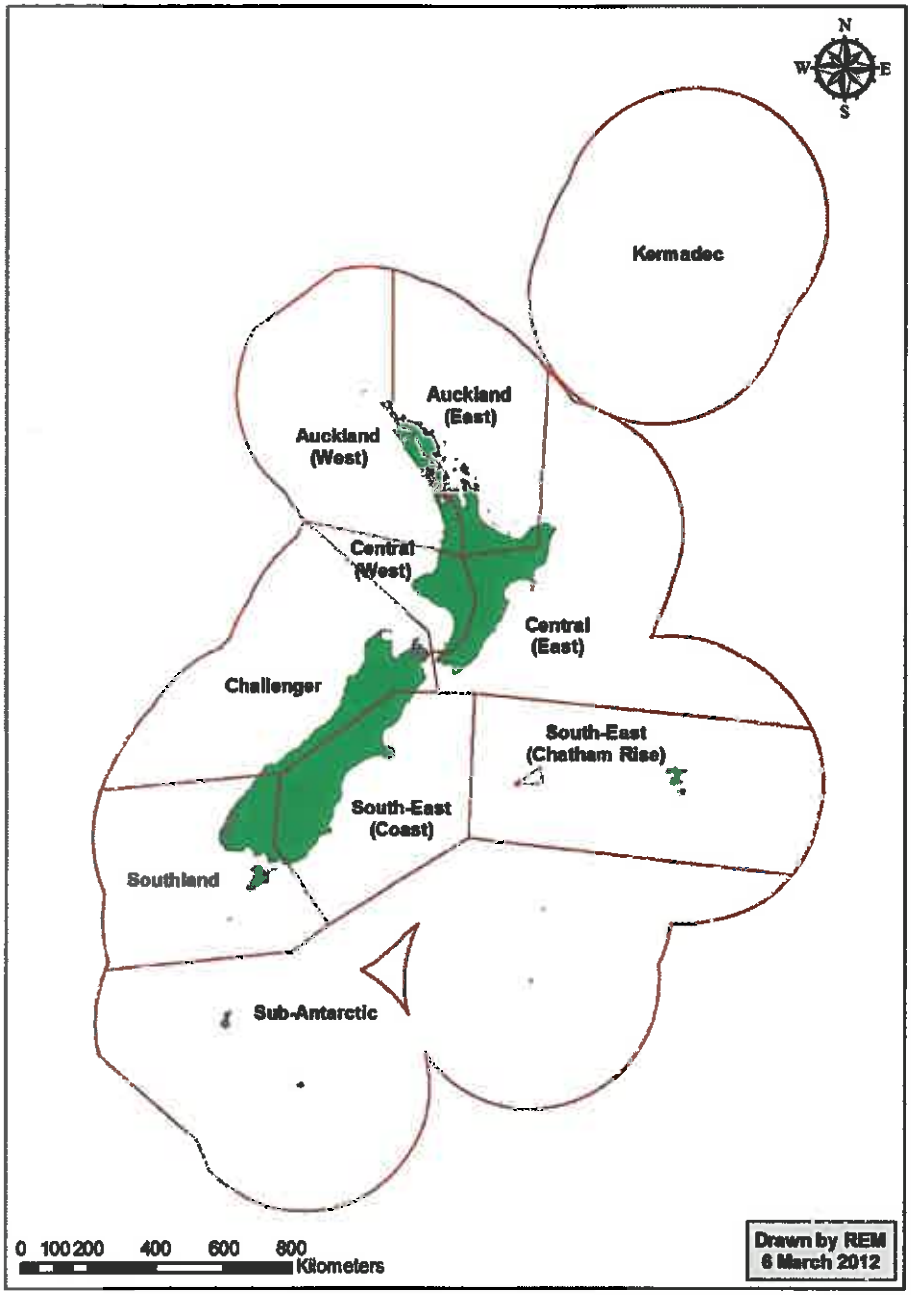

Figure 18: Fisheries Management Areas

Commercial fishing activities are the most intensely monitored fishing activities within NZ. The calculated asset value of NZs commercial fish resource in 2009 was $4.017 billion which is a 47% increase from 1996 (Statistics, 2013). The top 20 species of fish contributed 91% of the value of NZ's commercial fish resource, with hoki contributing 20% alone.

MPI undertook a fisheries assessment for the stretch of coast within the Endurance Operational Area from 1 October 2007 to 30 September 2012. The assessment area is shown in Figure 19.

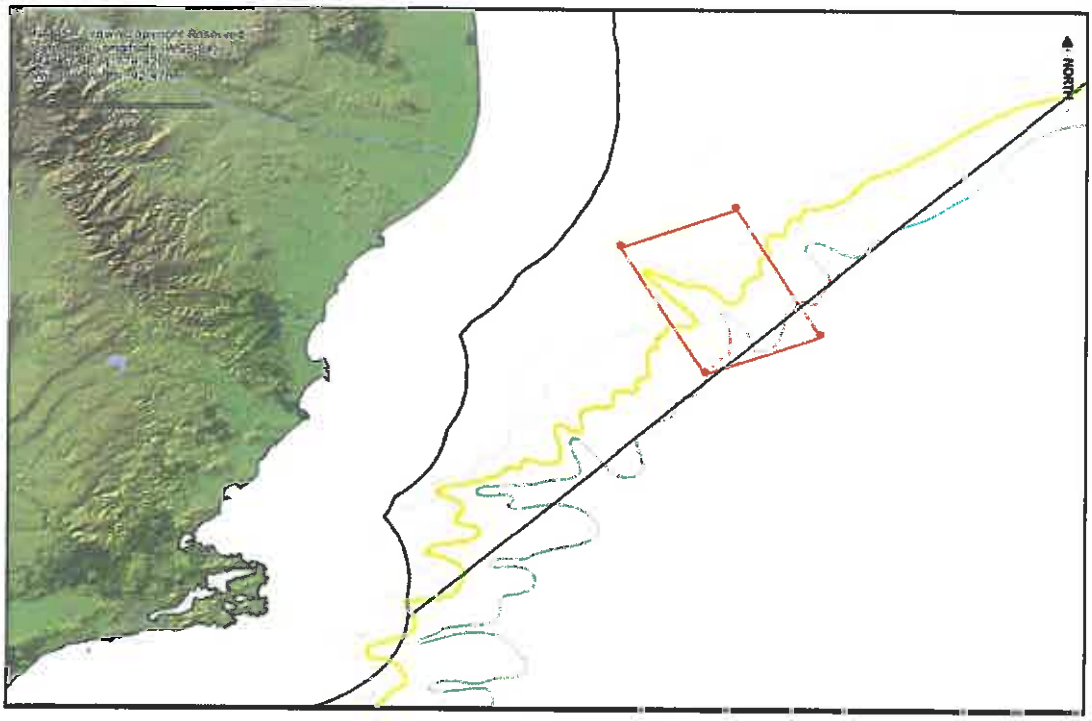

Figure 19: Location of Operational Area (red box) with 500 m depth contour highlighted in yellow. Territorial sea boundary and the area where Trawl Vessels >46 m are Prohibited from Operating

(Source: MPI)

Five years' worth of fishing data was used in this assessment (2007/08 to 2011/12) from completed catch effort returns from commercial fishers. Data was included in the assessment if the fishing event started, ended or passed through the Operational Area, which resulted in 1,097 fishing events.

The highest concentration of fishing effort within the Endurance Operational Area is in the northwest corner, which aligns with the edge of the continental shelf break, while the southeast portion of the assessed area is in very deep water and is also restricted to trawlers longer than 46 m operating within this coastal buffer (Figure 20). The fishing methods utilised within the Operational Area are: trawl, bottom longline, squid jig and set net.

Trawling is the most commonly used fishing method in the Operational Area and accounts for 87% of the fishing effort, which has been shown to peak in effort during January/March, while the least amount of fishing is between July – November, (Figure 21). Squid is the species most targeted, where 36% of fishing events are targeting squid although 50% of all fish caught within the Operational Area is barracouta, and squid only makes up 21%.

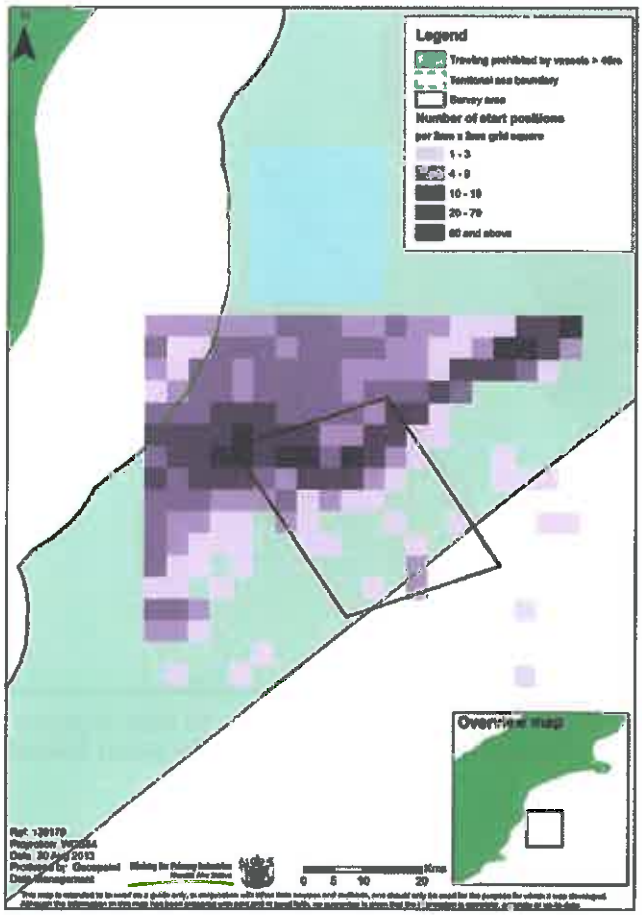

Figure 20: Endurance Operational Area with Commercial Fishing Effort

(Source: MPI)

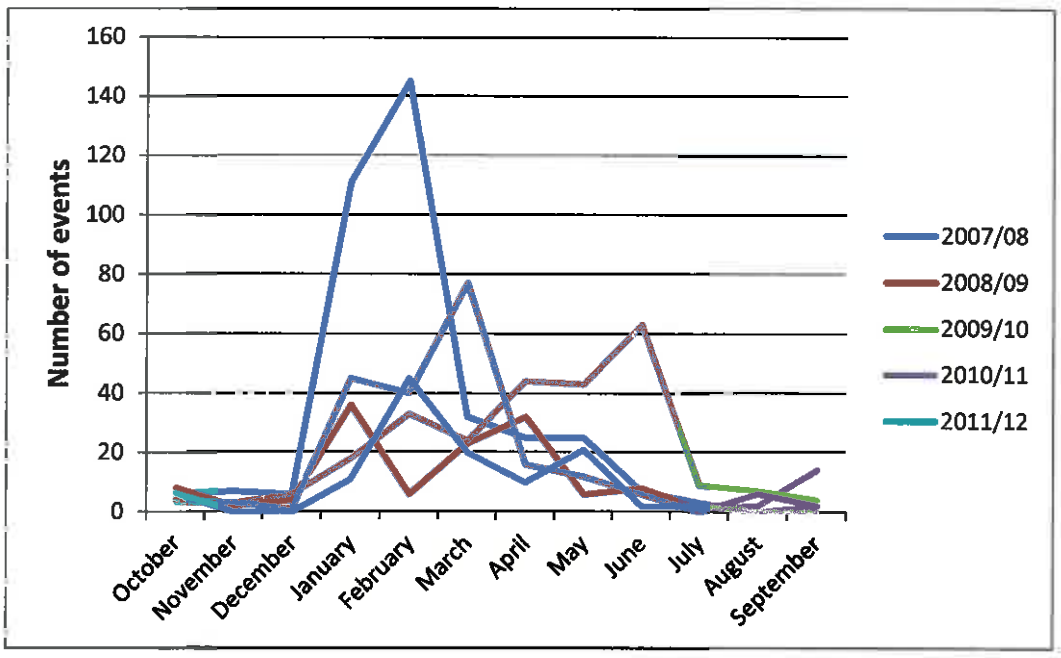

Figure 21: Number of Trawl Events by Month in the Endurance Operational Area for the 2007/08 – 2011/12 Fishing Years

Consultation has been undertaken with the fishers identified who have fished within the Endurance Operational Area between 2007 – 2012 to brief them of the timing of the Endurance MSS and the array of gear likely to be behind the . Further information will be provided to these companies including contact details of the vessel. A Notice to Mariners will also be issued and will be broadcast over maritime radio, notifying the Survey Area and the slow moving vessel undertaking the Endurance MSS.

The will apply all the appropriate navigational lighting and day-shapes to abide with the International COLREGS and a Notice to Mariners will be issued as well as notice over Maritime Radio. Likewise, if all vessels in the area are abiding to the International COLREGS there should be no close calls or damage of any fishing gear, or the array.

Most of the fishing undertaken in the Survey Area is trawling so the fishing gear is towed behind the boat and will not interfere with the array of streamers behind the boat.

5.3.4 Recreational Fishing

The North Otago coastline inshore of the Survey Area has a number of rocky reef systems which are popular with fishers and divers based from a far afield as Dunedin and Christchurch. The most popular species targeted includes rock lobster, paua, blue cod and trumpeter, while there are also important cockle fisheries around some of the estuaries.

5.3.5 Customary Fishing and Cultural Environment

The stretch of coast inshore of the Survey Area is home to a number of Runanga (Figure 22) who each have coastal areas that are of high cultural importance to them for collecting marine resources and protection of spiritual values. Fishing and the gathering of kaimoana was, and remains today, a fundamental part of being Maori and living along the coastline, as Maori hold a very strong relationship with the sea. For coastal hapu, kaimoana is vital to sustain the mauri (life force) of tangata whenua.

The southeast region of the South Island covers the traditional landing places of the Uruaokapuarangi, Arai-te-Uru and Takitimu waka hundreds of years ago. The descendants of these early settlers value being able to provide fish and shellfish to feed whanau (family) and manuhiri (guests). Iwi value a number of marine species very highly, and for the souther region includes blue cod, flatfish, small sharks, sea urchin (kina), scallops, mussels, paua, and cockles (MPI, 2013c).

Traditional management governing fishing practices within an area of significance to tangata whenua can be undertaken using the Fisheries (Kaimoana Customary Fishing) Regulations 1998. Customary rights provided for under these regulations allow tangata whenua to establish management areas (mataitai reserves) where they can create bylaws to oversee fishing within these designated reserves and to create management plans for their overall area of interest. Mataitai comprise of traditional fishing grounds established for the purpose of recognising and providing for customary management practices and food gathering.

If tangata whenua choose not to utilise the kaimoana customary fishing regulations they can still exercise their customary right through issue of a customary fishing permit under the Fisheries (Amateur Fishing) Regulations 1986. Under the Fisheries Act 1996 and Kaimoana Customary Fishing Regulations 1998, a Taiapure is a local management tool established within an area that has customarily been of special significance to an iwi or hapu as a source of food or for spiritual or cultural reasons.

Figure 22 shows approximate Runanga locations inshore of the Survey Area, while Figure 23 shows the coastal area where a Mataitai and Taiapure are in place.

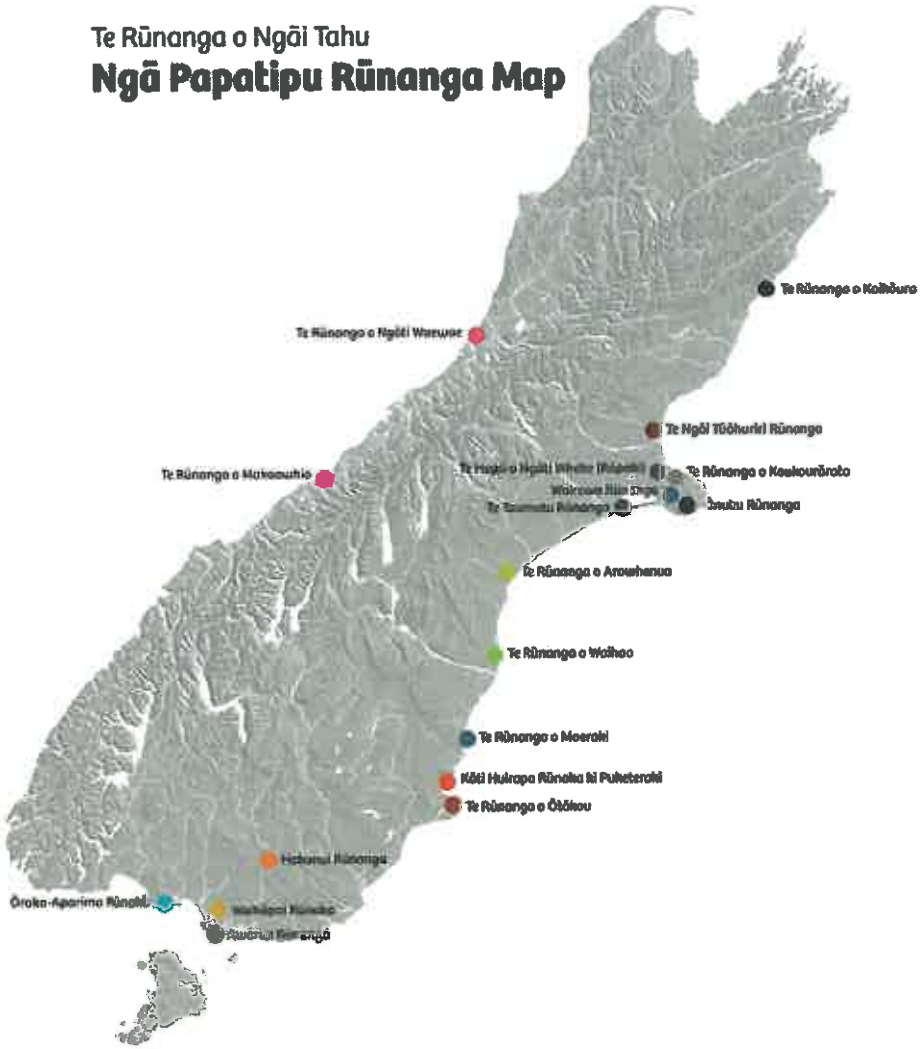

Figure 22: South Island Runanga Map

Source: http://ngaitahu.iwi.nz/te-runanga-o-ngai-tahu/papatipu-runanga/

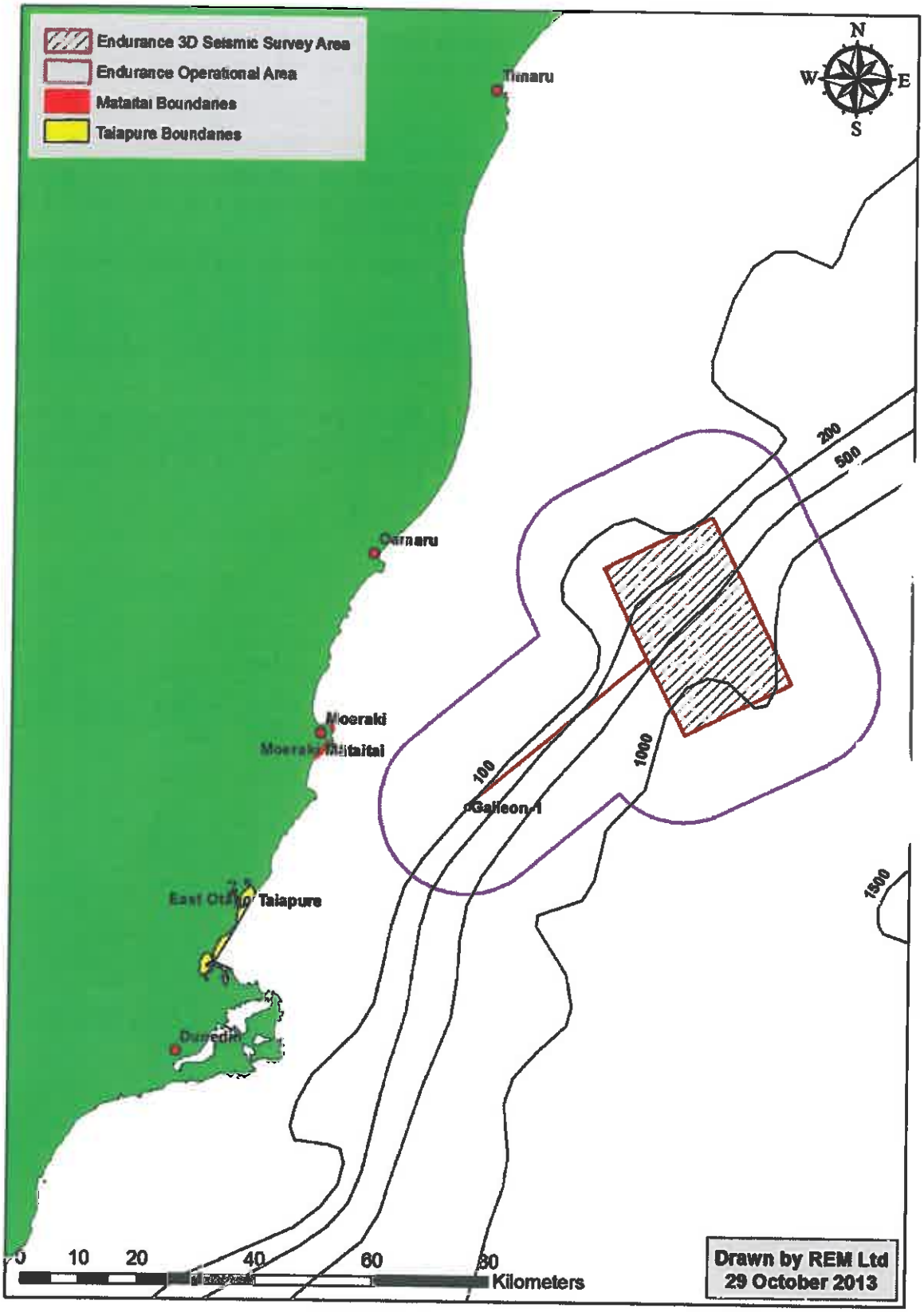

Figure 23: Culturally Important Areas

5.3.6 Tourism Industry

Various tourism companies operate on land or near the coastline in the Canterbury basin region. However, on-water based tourism is not a large industry around the Endurance Survey Area due to the distance offshore.

5.3.7 Other Uses

No specific information is available on other users of the ocean near or within the Endurance Survey Area; however, maritime shipping, recreation and navy vessels have the potential to traverse the Survey Area during the MSS.

There are no known shipwrecks or sites of heritage significance within the Survey Area.

5.3.8 Research

Various organisations conduct research within or near the Survey Area, especially Otago University.

The Endurance MSS will also contribute to the knowledge of marine mammals and mega fauna in the area as dedicated MMO's will be on board for the duration of the survey and their reports will be lodged with the Department of Conservation at the completion of the survey.

6 Potential Environmental Effects and Mitigation Measures

6.1 Introduction and Methodology

This chapter considers all planned and unplanned activities and their likely environmental impacts. The main steps used in the assessment can be summarised as follows:

- Identification of the Endurance MSS activities that could result in potential environmental effects;
- Identification of the key potential environmental sensitivities;
- Description of each identified potential environmental effect, including the factors which NZOG will undertake to control and mitigate each potential effect; and
- Determining the significance of the potential environmental effects identified, taking into account the proposed control and mitigation measures. This assessment considers the likelihood and magnitude of the potential impact including its geographical scale (site, local and region) and its duration.

Environmental effects have been classified into the five categories (Table 9).

Table 9: Categories of Potential Environmental Effects to Marine Mammals and the Environment

Negligible Effect
There are no significant effects predicted to occur to the environment, or the impact is of small enough magnitude that it does not require further consideration. No recovery period is required.
Minor Effect
The negative environmental effect disappears within one hour after cessation of activity. No further management measures are required for the return to the original situation or behaviour. Marine mammals are not exposed to sound levels greater than 171dB re 1 $\mu Pa^2.s$.
Moderate Effect
The environmental effect occurs at a level which requires a short period of recovery time following cessation of the activity. For marine mammals this impact is likely to occur when exposed to sound levels between 171 – 186 dB re 1 $\mu Pa^2.s$. Temporary behavioural changes could occur, but no additional management measures are required to return to the original situation.
Severe Effect
The environmental effect occurs at a level which requires up to 24 hours of recovery time following cessation of the activity. For marine mammals this impact is likely to occur when exposed to sound levels greater than 186 dB re 1 $\mu Pa^2.s$ (e.g. Temporary Threshold Shift)
Critical Effect
There is a permanent loss of environmental conditions or tissue injury to marine mammals. For marine mammals this impact is likely to occur when exposed to sound levels between 218 - 230 dB re 1 $\mu Pa^2.s$ (e.g. Permanent Threshold Shift or injury). There is no recovery from this type of impact.

6.2 Sources of Effects

The first step of the assessment process is to identify potential sources of environmental effects. These sources can vary from accidental events, such as accidental discharges, to routine operations in relation to the MSS, including the source sound or the physical presence of the vessels.

Table 10 outlines the planned and unplanned activities of the MSS that have the potential to result in environmental effects. The following sections outline the potential effects of these activities, and the mechanisms NZOG proposes to mitigate these effects.

Table 10: MSS Activities and Potential Environmental Effects

Planned Activities
Physical presence of the seismic survey vessel, streamer and support vessel • Interference with local fishing activities and damage to fishing equipment; • Interaction or interference with marine traffic; • Interference and/or damage to marine archaeology, cultural heritage, or submarine infrastructure; • Indirect effects, such as changes in the abundance or behaviour of fish species targeted by established fisheries; • Change in marine bird behaviour; • Introduction of marine pests; and • Interaction or interference with marine mammals.
Source sound and transmission • Sound transmission loss modelling; • Physiological effects on marine fauna from exposure to sound or associated pressure effects; • Behaviour disturbance leading to behavioural changes or displacement; • Disruption to feeding, mating, breeding or nursery activities of marine organisms; • Interference with the use of acoustic communication signals, or naturally-produced cues used by marine animals; and • Indirect effects, such as changes in the abundance or behaviour of prey.
Solid and liquid wastes generated on the vessels • Generation of sewage and greywater; • Generation of galley waste and garbage; and • Generation of oily waters.
Fuel consumption and Atmospheric emissions
Unplanned Activities
Streamer cable break and cable content release
Fuel/Oil spill from vessels
Vessel collision or sinking

6.3 Impacts of Planned Activities and Proposed Mitigation Measures

6.3.1 Physical Presence of the Seismic Survey Vessel, Streamers, and Support Vessels

The physical presence of the seismic survey vessel and associated equipment, along with the support vessels, has the potential to interfere with activities and the local social environment within the Endurance Survey Area, in particular:

- Interference with local fishing activities (commercial and recreational) and damage to fishing equipment;
- Interaction or interference with marine traffic;
- Interference and/or damage to marine archaeology, cultural heritage, or submarine infrastructure;
- Indirect effects, such as changes in the abundance or behaviour of fish species targeted by established fisheries;
- Change in marine bird behaviour;
- Introduction of marine pests; and
- Interaction or interference with marine mammals.

6.3.1.1 Interference with local fishing activity and damage to fishing equipment

Disturbance to the offshore fishing activities could occur due to the physical presence of the seismic vessel and potential exclusion of fishing vessels or equipment from areas of direct seismic surveying activity (up to about 10 km behind the survey vessel). The presence of the vessel and associated equipment and craft (streamers, support vessel, etc.) could cause temporary loss or reduction of access to fishing grounds, temporary displacement of fish stocks; and/or reduced efficiency of fishing equipment.

The fishers who use the Endurance Survey Area for their fishing activities have been notified of the Endurance MSS taking place, and will be provided with vessel contact details closer to the survey period. The trawlers are a mobile method of fishing so no gear is deployed for any period of time, and the s observing the radar at all times for any approaching vessels.

At the end of each streamer, tail buoys will mark the end of the array which will also have radar reflectors and lights fitted (Figure 24).

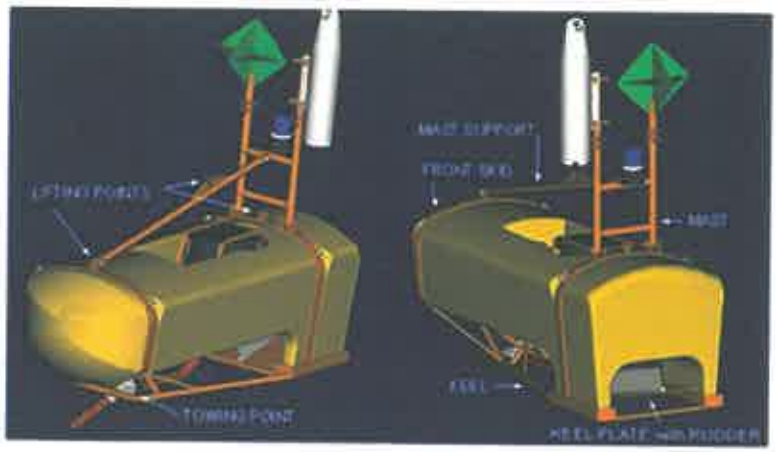

Figure 24: An example of Tail Buoys that will be on the End of Each Streamer Making the End of the Array Visible

NZOG proposes the following measures to ensure the impacts of the Endurance MSS are minimised as far as practicable:

- Operating 24 hours a day, 7 days a week (weather permitting) to minimise the overall duration of the survey (21-28 days);
- Compliance with the COLREGS, in terms of obligatory appropriate radio, lights, day shapes, good navigational practices and seamanship;
- The presence of a support vessel at all times during the proposed seismic survey to help ensure that other users of the sea are aware of the presence of the trailing underwater streamers behind the seismic vessel;
- Commercial fishers will be notified of the Survey Area and provided with the ontact details;
- Fishing and boating clubs will be notified of the operating areas;
- A Notice to Mariners has been issued and a vigilant watch will be maintained throughout survey activities. Both English and signal code protocols will be employed to allow multi-lingual communication streams; and
- Tail buoys will be trailing marking the end of the array.

With the mitigation measures in place and the relatively small survey area the effects from the Endurance MSS on the fishing activities is believed to be ***negligible***.

6.3.1.2 Interaction or interference with marine traffic

Adherence to the COLREGS makes the use of warning signals obligatory, including those announcing restricted manoeuvrability or presence of underwater non-visible structures, such as fishing equipment or streamers. These measures would mitigate any potential risks of collision. The support vessel will also act as a warning vessel to any ship in the vicinity of the Survey Area which will ensure the potential risks of collision are minimised as far as practicable. The potential for disturbance to commercial vessels or private vessels will be ***negligible***.

6.3.1.3 Interference with and/or damage to marine archaeology, cultural heritage or submarine infrastructure

The survey equipment involved in the Endurance MSS will not come into contact with the seabed, the coast, or other features on the sea floor. Most of the areas of cultural importance are on the shallow reefs and coastline inshore of the Endurance Survey Area. These features would only be impacted should there be a rupture of the vessels fuel tank; however with the mitigation measures in place as discussed through this document, this will not occur. Therefore, it is considered that the potential interference with and/or damage to marine archaeology, cultural heritage or submarine infrastructure is ***negligible***.

6.3.1.4 Indirect effects, such as changes in the abundance or behaviour of fish species targeted by established fisheries

Overseas reports and studies have noted that seismic data acquisition can alter the behavioural patterns of certain fish species, causing them to dive deep and away from the sound source or tightening up of their school structure (McCauley *et al.*, 2000). However, this effect is generally noted for shallow waters in areas of hard bottom.

The operation will be undertaken 24 hours a day, 7 days a week (weather permitting) to minimise the overall duration of the MSS. As the Endurance MSS will only run for a short duration (21-28 days), any potential effect in the Survey Area on fish species is considered to be ***minor*** in relation to the fish species targeted.

6.3.1.5 Change in marine bird behaviour

There is the potential, either positive or negative, for sea birds to interact with the seismic vessel and/or the support vessel. A positive interaction would include the vessels providing loafing or perching opportunities that would not otherwise be available to birds on the open ocean, and this is known to occur on slow moving vessels. However, negative interactions would include injury to birds through a collision with the ships or becoming entangled in the vessels' rigging.

Research has shown that artificial lighting can cause disorientation in seabirds, mainly fledglings and novice flyers, particularly when it occurs near shore (Telfer *et al.*, 1987). The mechanisms through which seabirds are attracted to artificially lit vessels are poorly understood. Seabirds are thought to navigate by starlight over the ocean, and in some cases artificial lights may interfere with their ability to navigate by stars (Black, 2005; Guynup, 2003). There is also a chance that fish and other forager species are attracted to lights which would then in turn attract seabirds due to the foraging opportunities around the vessels (Black, 2005).

Collisions during the day would be unlikely as most seabirds are agile flyers with keen eyesight, and would be able to avoid collisions with the vessels. However, the risk would be greater at night as they may become disoriented or unable to identify the rigging in flight.

However, various factors, including the short duration of the Endurance MSS and the fact the vessels will be in constant motion, reduces the potential for long term interference with seabird navigation.

It is likely that the vessels would provide resting opportunities for birds on railings, antennas, or other similar structures. Therefore, it is considered that the proposed Endurance MSS would have ***negligible*** adverse impacts on seabirds.

6.3.1.6 Introduction of marine pests

The primary mechanisms that have the potential to cause the inadvertent introduction and spread of marine pest species to NZ waters are ballast water discharges, sea chests and hull fouling.

Pursuant to Section 22 of the Biosecurity Act 1993, MPI issued the *Import Health Standard for Importing Ballast Water from all Countries* in June 2005. This standard was developed to limit the potential for the introduction and spread of marine pests into NZ territorial seas. This standard applies to ballast water loaded within the territorial waters of a county other than NZ, and intended for discharge in NZ waters.

MPI also issued the *Draft CRMS for Vessel Biofouling* in accordance with Section 22 of the Biosecurity Act 1993. This standard specifies the requirements to be met for the effective management of risks associated with biofouling on the submerged parts of vessels arriving in NZ from international waters. This requires any vessel arriving into NZ to be 'clean' which is defined as no visible aquatic organisms on the hull, including niche areas (propellers, rudder shafts, bow thrusters, sea chests and dry-docking support strips), except as a slime layer.

The CRMS for biofouling is expected to come into force in 2017, to allow vessels enough time to make any required changes to their current hull management regimes. These requirements will be voluntary until 2017, but MPI will be actively encouraging vessels to improve hull management and become compliant as early as practical.

No vessel involved in the proposed Endurance MSS will discharge any ballast water within the NZ territorial sea. Even if discharges were to occur, the , has a ballast water treatment system to the level of international best practice. Therefore, the potential to introduce marine pests as a result of ballast water discharges during the proposed Endurance MSS is ***negligible***.

Commercial seismic survey vessels have their hulls cleaned regularly, and are treated with antifouling paints to prevent the establishment and growth of fouling communities. This means that the presence of fouling communities and any pest species is usually much less on commercial seismic survey vessels than on smaller or non-commercial vessels.

The was last slipped in October 2013 and was treated with antifouling paint, essentially ensuring there is no risk of any invasive species on the vessels hull. As required by the Biosecurity Act 1993, the *Polarcus Alima* will seek biosecurity clearance from MPI before entering NZ waters.

The support vessel was last slipped in April 2012 and was treated with antifouling paint, essentially ensuring there is no risk of any invasive species on the vessels hull. As required by the Biosecurity Act 1993, the will seek biosecurity clearance from MPI before entering NZ waters.

The support vesse is based in NZ and poses no risks associated with ballast water and hull fouling.

In summary, the potential to introduce marine pests as a result of hull biofouling during the proposed MSS is ***negligible***.

6.3.1.7 Interaction or interference of the seismic vessel with marine mammals

As outlined in Table 6, six threatened marine mammals may be present in part of or in close proximity to the Survey Area during the proposed Endurance MSS. There is a high likelihood that killer whales (nationally critical) and bottlenose dolphins (nationally endangered) will be encountered in the survey area. Although it is possible that southern right whales (nationally endangered), Hector's dolphins (nationally endangered), southern elephant seals (nationally critical) and NZ sea lions (nationally critical) will be present in the vicinity, these species are less likely to be encountered.

Interaction or collision with a vessel, or entanglement in the streamer cables, may disrupt the behaviour of the individual or group of marine mammals. In the case of ship strike or entanglement, lethal or sub-lethal injuries may be caused. In a report by Jensen & Silber (2003) they found there were 11 whale species confirmed as victims of ship strike globally, of which seven could potentially be present within the Survey Area (killer, minke, sei, southern right, sperm, humpback and blue whales). Should a strike occur, vessel-type is a factor in the likelihood of mortality. Vessels of the type involved in the MSS (described as *research* by Jensen & Silber (2003)) result in approximately 0.75 % of strikes globally. The will be conducting the survey at 4.5 kts, which is a slow safe speed and well below the mean speed (18.6 kts) which has resulted in ship strikes.

In order to further reduce the probability of interaction with marine mammals the Endurance MSS vessels will operate in accordance with the Code of Conduct and a number of additional mitigation measures as outlined in Section 6.5.

These mitigation measures will also reduce the impacts associated with potential disruptions to natural acoustic use of marine mammals (e.g. communication, navigating and foraging). As a result of these mitigation measures in place, it is believed that the impacts on marine mammals as a result of this survey would be ***minor***.

6.3.2 Source Sound Emissions

The source of sound used for seismic data acquisition is generated using arrays of air guns, that produce sound at about 250-270 dB at frequencies generally lower than 1 KHz (usually lower than 600 Hz) and directed downwards towards the sea floor.

The low-frequency signals created during MSS events propagate efficiently in the water, with little loss due to attenuation (i.e. due to absorption and scattering). Within a few

metres of an airgun array, in deeper waters, spherical spreading loss (the reduction in intensity caused by the spreading of waves into an ever increasing space) results in a loss of around 6 dB per doubling of distance. However, attenuation depends on propagation conditions. In good propagation conditions, the signal may be above the background level for more than 100 km; in poor propagation conditions it may reach background level within a few tens of kilometres (McCauley, 1994).

Sound waves travel until they meet an object or they are dissipated by normal decay of the signal. Nevertheless, the intensity of sound waves decays exponentially, and although low level signals travel for long distances, the higher amplitude waves lose much of their energy very close to the airgun source. Typically, most emitted energy is low frequency, between 0.01 to 0.3 kHz, but pulses also contain some higher frequency energy up to 0.5 to 1 kHz. However, the latter components are weak when compared to the low frequency emissions (Richardson *et al.*, 1995). The low frequency component of the sound spectrum attenuates slowly, but high frequency sound attenuates rapidly to levels similar to those produced from natural sources. The rate of change in sound level from a seismic airgun is relatively rapid, and it may be this factor, as much as any, which contributes to observed effects on marine organisms.

Environmental issues relating to seismic surveys are focused on the potential effects on marine mammals and other fauna from the sound waves associated with the seismic energy source. The pulses associated with seismic surveys produce a steep-fronted detonation wave which is transformed into a high-intensity pressure wave (shock wave with an outward flow of energy in the form of water movement). There is an instantaneous rise in maximum pressure followed by an exponential pressure decrease and drop in energy.

The exposure time to the airgun signal will be determined by the firing sequence, the towed speed of the airgun through the water, and the sound level of interest. Large mobile fauna such as marine mammals have been routinely observed to stay away from the airgun source at the higher sound levels, thereby reducing their exposure times. However, observations of fish congregating in the lights of a working seismic vessel have been made, suggesting that they are not adversely affected by the operating seismic source. Furthermore, low level acoustic sources (e.g. mitigation guns or during soft start) have been observed to attract some species of marine mammal (e.g. killer whales), and are thus not considered to adversely affect those species.

There is potential for seismic survey operations to have an adverse effect on marine mammals; mostly in regards to the larger cetacean species although there are also a few smaller species for which there is a serious conservation concern. The Code of Conduct classifies the Species of Concern as those listed in Schedule 2 of the Code of Conduct and includes all NZ cetacean species except common dolphins, dusky dolphins and NZ fur seal (DOC, 2013).

A desktop study is currently underway to investigate the effects of seismic surveys on New Zealand fur seals. This species is inquisitive, and often appear to be attracted to the vessel and array of streamers. Fur seals do not use sound as cetaceans do for navigation, locating prey or communication. Before the Code of Conduct came into regulation under the EEZ Act – Permitted Activities, dispensations could be given to NZ fur seals, a relatively common species with no significant threat at the wider population level if they were present within the 200 m mitigation zone, resulting in a delay to start up procedures of seismic operations. These exemptions are not possible under the new regulatory scheme.

Previous seismic surveys around NZ have generally shown that during the summer months (November-March) NZ fur seals dominate sightings. The seals are generally feeding at the continental shelf break and often have increased aggregations around coastal seal colonies.

The presence of dedicated MMO's onboard the vessel during the Endurance MSS operation will help increase the understanding of impacts or lack thereof to NZ fur seals from operation seismic surveys through observational data.

In addition to the mitigation measures outlined throughout this MMIA, should any strandings occur during the Endurance MSS or up to 14 days after the survey completion date, NZOG will engage Massey University pathologists to conduct necropsies on any stranded mammals.

The sound emissions associated with the proposed Endurance MSS have the potential to disturb marine mammals and other fauna through the following specific effects:

- Physiological effects (lethal or sub lethal injuries): potential injury or fatality of marine fauna from exposure to sound or associated pressure effects to nearby organisms;
- Behavioural disturbance leading to behavioural changes or displacement;
- Disruption to feeding, mating, breeding or nursery activities of marine organisms in such way as to affect the vitality or abundance of populations;
- Interference with the use of acoustic communication signals, or naturally produced cues used by marine animals; and
- Indirect effects, such as changes in the abundance or behaviour of prey animals for marine mammals, seabirds and fish.

6.3.2.1 Sound Transmission Loss Modelling and Sound Attenuation

The Endurance MSS is located within an AEI, and in accordance with the Code of Conduct, a sound transmission loss modelling report was commissioned from Curtin University (Appendix 3). The modelling was undertaken in two parts to account for 1) minimum water depth within the primary survey polygon and 2) minimum water depth for the Galleon-1 well swath tie-in line. These results are discussed separately below.

6.3.2.1.1 Predicted Sound Loss in the Primary Survey Polygon:

The acoustic propagation modelling was used to predict worst case scenario received Sound Exposure Levels (SEL) from the Endurance MSS operation. Bathymetry on which the modelling was based is described on Chart 64 (1:400 000 LINZ). NZOG is confident that this bathymetry is relatively accurate based on comparisons with past seismic work in the Galleon-1 well vicinity. The input parameters for the model were:

- Acoustic specifications - as described in Section 4.1;
- Water depth - a conservative 80 m was used. This depth was based on a depth slightly shallower than predicted in the survey polygon; and
- Sea floor substrate type - the worst possible scenario of a highly reflective gravel/sand mixture was used.

Short range modelling was carried out to check for compliance with the Code of Conduct mitigation zones and long range modelling was undertaken to investigate the geographical distribution of sound energy from the seismic source within the Survey Area as part of the assessment of effects.

Results from the short range sound transmission loss modelling indicated that 95% of receptions of sound are predicted to be below 186 dB re 1 $\mu Pa^2.s$ SEL (the injury criteria) at a horizontal range less than 190 m from the acoustic source, and below 171dB re 1 $\mu Pa^2.s$ SEL (the behaviour criteria) at a range of 1.5 km. All modelled received levels were below the injury criteria at a range of 200 m which concurs with requirements under the Code of Conduct. Hence the 200 m mitigation zone which is designed to protect marine mammals from physiological impacts is deemed be appropriate for the Endurance MSS. This is shown in Figure 25.

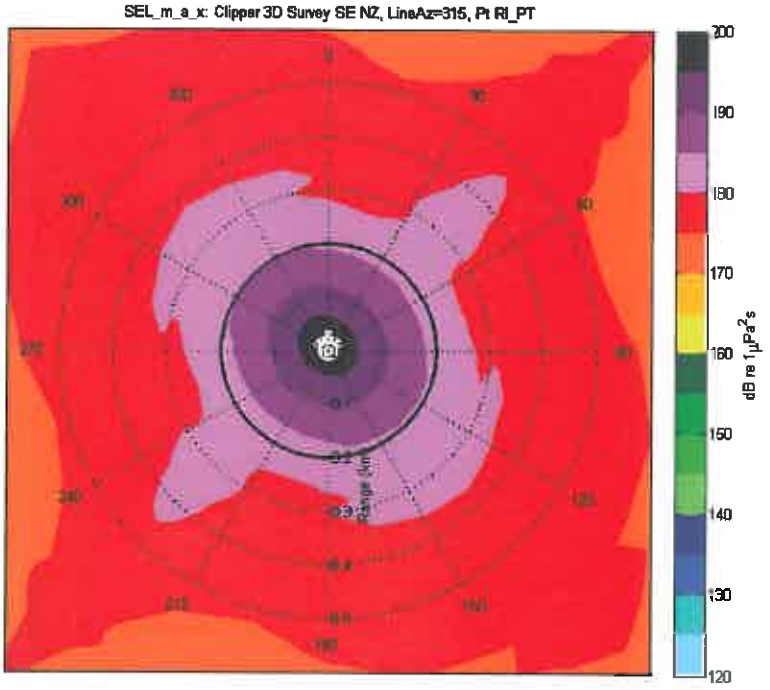

Figure 25: Predicted maximum received SEL at any depth as a function of azimuth and range from the source to a maximum range of 500m. An azimuth of 322° corresponds to the in-line direction. The thick black circle corresponds to the 200m mitigation range.

Figure 26 can be used to assess the predicted efficacy of the 1 km and 1.5 km mitigation zones. Here the modelling indicated that 95% of receptions of sound are predicted to be below 171 dB re 1 μPa^2.s SEL (the behavioural criteria) at a horizontal range of 1.5 km which is the minimum mitigation requirement for species of concern with calves (DOC 2013). However these results predicted that SELs at the 1 km mitigation distance would significantly exceed the required 171dB re 1 μPa^2.s threshold for species of concern without calves. These model results were a clear indication that additional mitigation measures would be required to protect marine mammals from behavioural impacts in shallow waters.

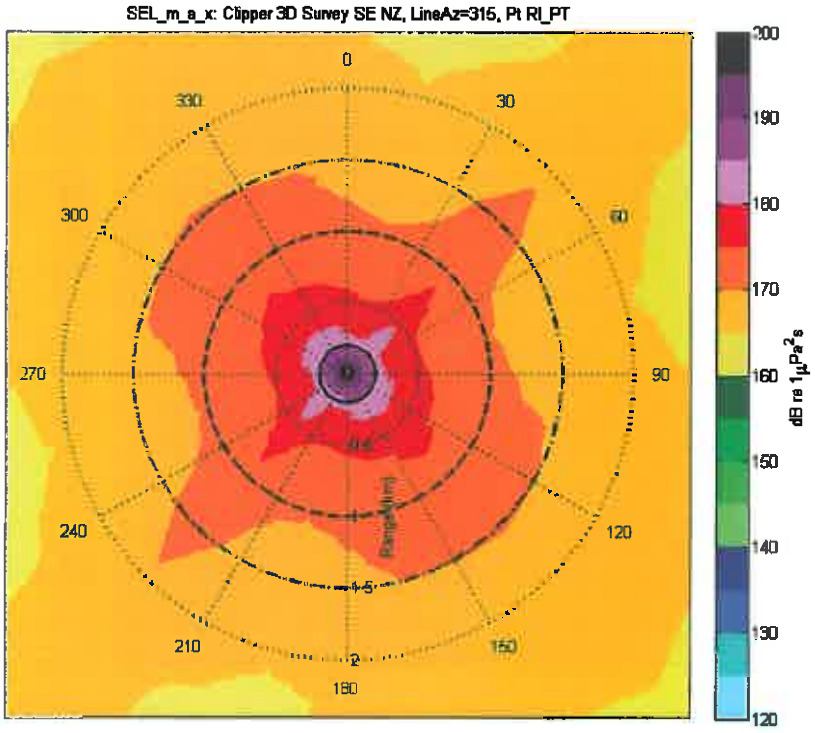

Figure 26: Predicted maximum received SEL as a function of range from the source. An azimuth of 322° corresponds to the in-line direction. The thick black circle corresponds to mitigation ranges of 200m (solid), 1km (dash), and 1.5km (dash-dot).

The horizontal directionality of the array for the Endurance MSS (survey lines are southeast-northwest), which produces the highest SEL in the cross-line direction, which is typical of all airgun arrays.

Figure 27 provides a summary of the short range model results and clearly illustrates the short fall in protection from SELs greater than 171 dB re 1 $\mu Pa^2.s$ at a mitigation distance of 1 km.

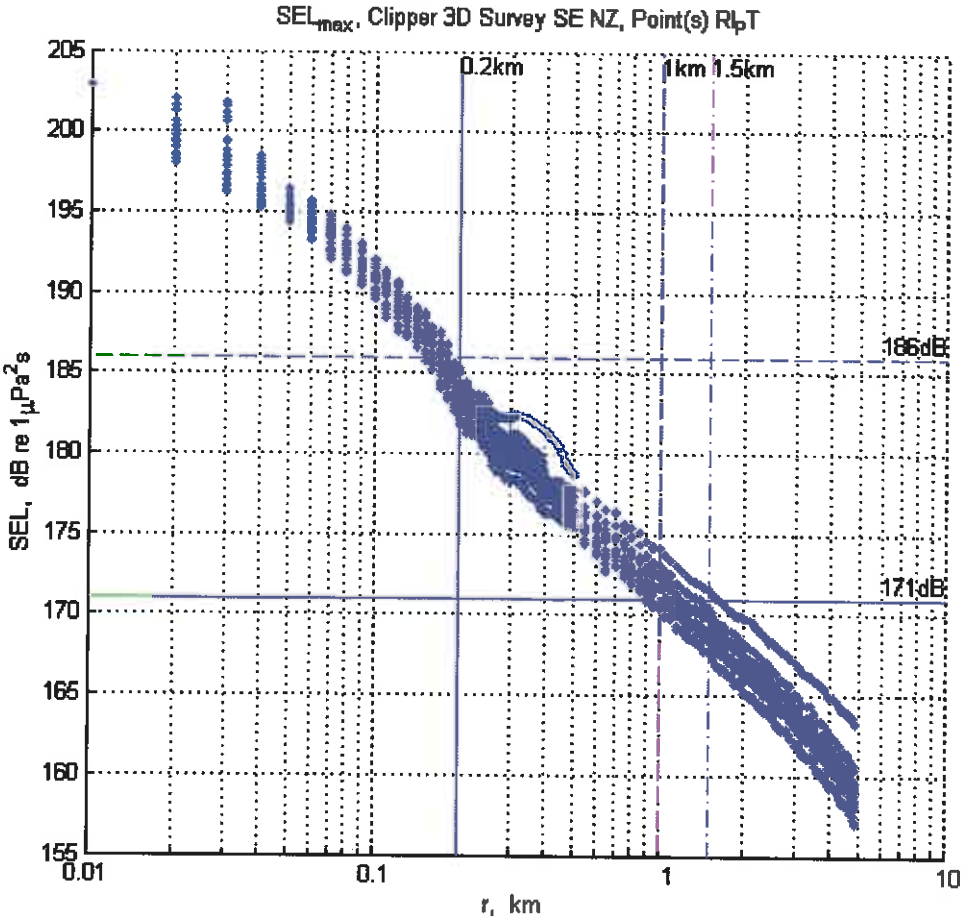

Figure 27: Maximum received sound exposure levels as a function of horizontal range for all modelled azimuths.

In order to address the predicted issues with the 1km mitigation zone in the shallow waters of the polygon, additional modelling was comissioned with the objective of seeking answers to the following question:

- At what water depth do predicted SELs fall within 171 dB re 1 µPa^2.s at the 1km mitigation zone?

Figure 28 and Figure 29 illustrate that the 1km mitigation zone becomes relevant (i.e. that it provides adequate protection from SELs >171 dB re 1 µPa^2.s) at a water depth of 275 m. These results provide clear evidence that more than 1 mitigation regime would be necessary to protect species of concern from behavioural impacts throughout the extent of the Endurance MSS polygon. On this basis the following mitigation regimes are proposed:

'Shallow' Water Mitigation Regime (for use in water depths from 80 – 275 m):

- The adoption of a 1.5 km mitigation zone for the purpose of shut downs with respect to all species of concern (i.e. not just those with calves as per standard requirements under the Code of Conduct).

'Deep' Water Mitigation Regime (for use in water depths > 275 m):

- Adherence to the 2013 Code of Conduct and all mitigation requirements specified therein

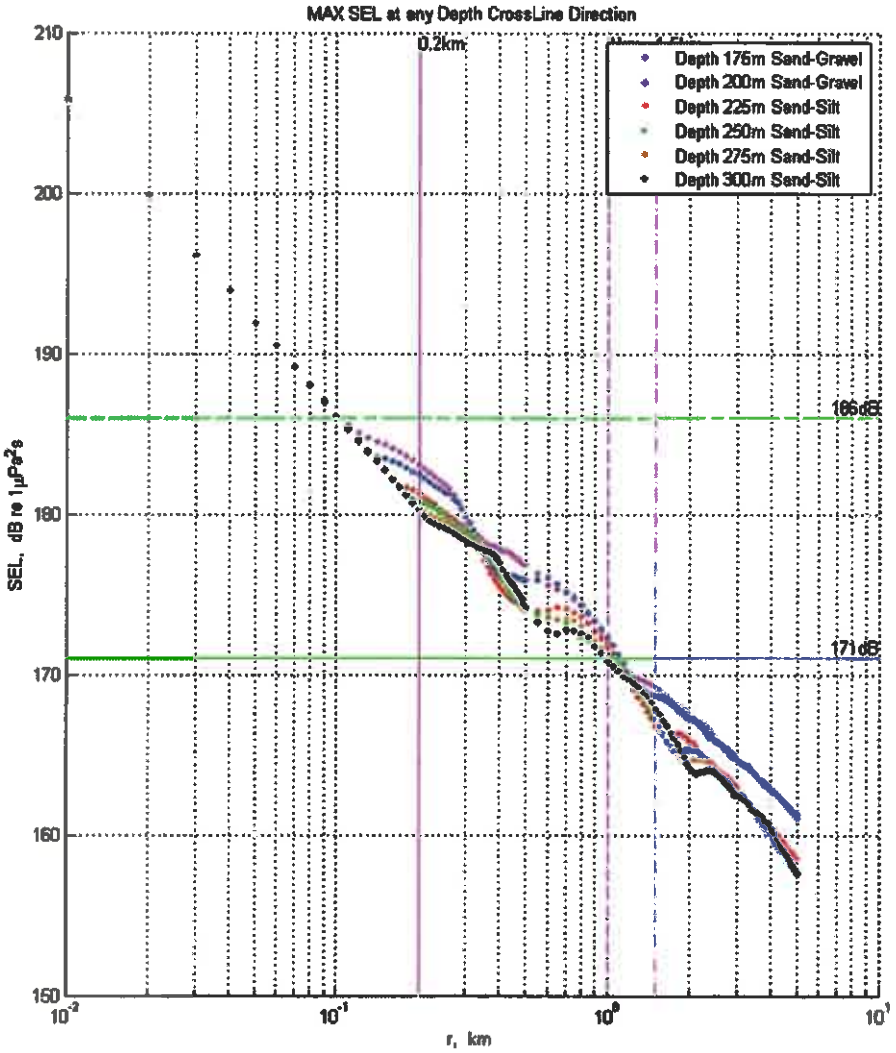

Figure 28: Maximum received sound exposure levels as a function of horizontal range for all modelled azimuths at a selection of water depths.

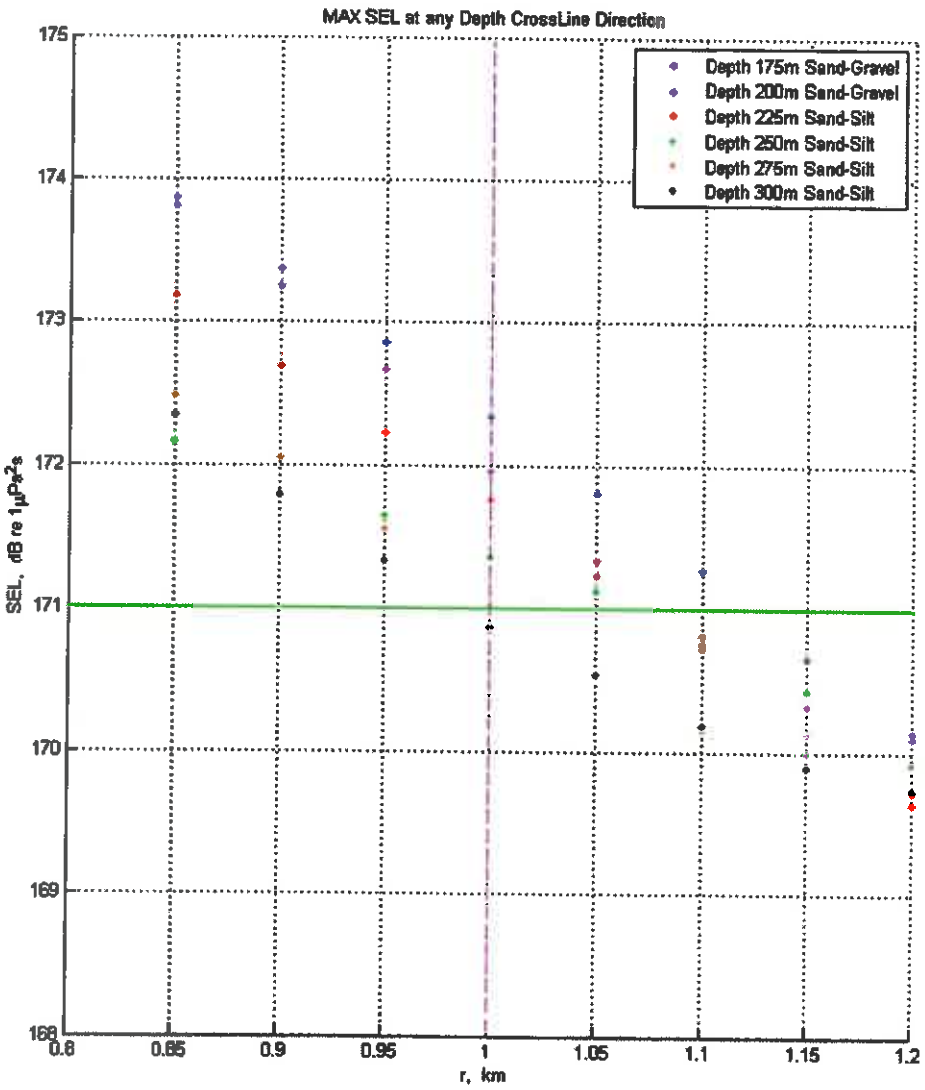

Figure 29: Detail of the distribution of data points at the 1 km mitigation zone which is portrayed in Figure 28.

Long range modelling was also undertaken within the primary survey polygon (Figure 30). The location on which these model SELs are based is minimum water depth predicted for the survey area which occurs on the NW boundary.

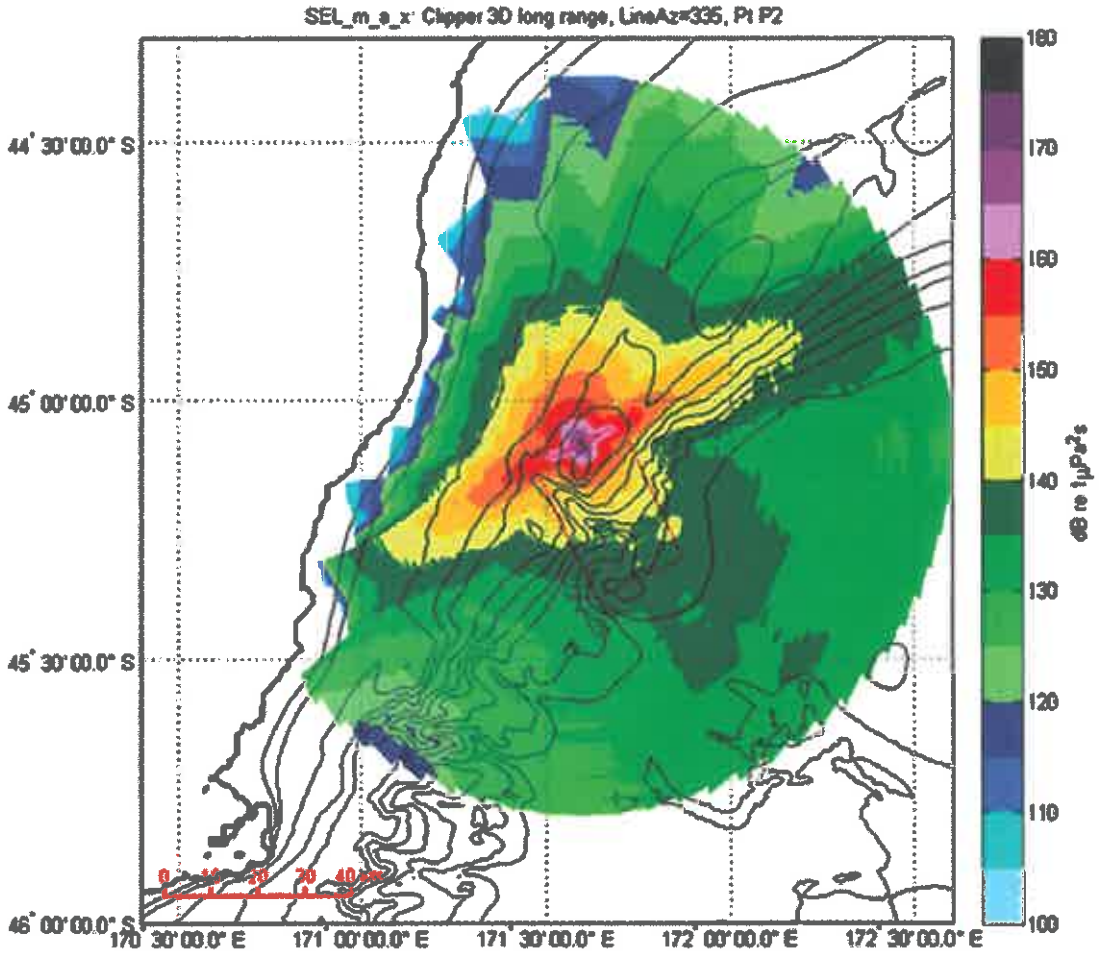

Figure 30: Geographical distribution of modelled long range sound exposure level for the predicted minimum water depth. Note that the colour scale is different from that used for the short range plots above.

6.3.2.1.2 Predicted Sound Loss for the Galleon-1 tie-in line:

The historic Galleon-1 well is located in water depths of c. 90 m; however water depths as shallow as 60 m are not uncommon in the immediate vicinity of the well location. For this reason further modelling was commissioned to address this site in particular; recognising that the site is only about 25 km from shore and a number of marine mammal and sea bird species may utilise this coastal zone for foraging (i.e. NZ fur seal, yellow-eyed penguin and little blue penguin). Short

Short range modelling was carried out to check for compliance with the Code of Conduct mitigation zones at a 60 m water depth (Figure 31). Model results clearly showed that received SELs are predicted to be below 186 dB re 1 μPa^2.s at 200m and below 171 dB re 1 μPa^2.s at 1.8km. For this water depth both the 1 km and 1.5 km mitigation zones described by the Code of Conduct would be deficient in protecting species of concern from behavioural impacts, with SELs significantly exceeding the required 171dB re 1 μPa^2.s threshold for both of these mitigation distances.

These results provide clear evidence that a further mitigation regime would be required. On this basis the following additional mitigation regime is proposed for the survey line in the immediate vicinity of the Galleon-1 well:

Galleon-1 Well Site Mitigation Regime (for use in water depths < 80 m):

- The adoption of a 1.8 km mitigation zone for the purpose of shut downs with respect to all species of concern (i.e. not just those with calves as per standard requirements under the Code of Conduct).

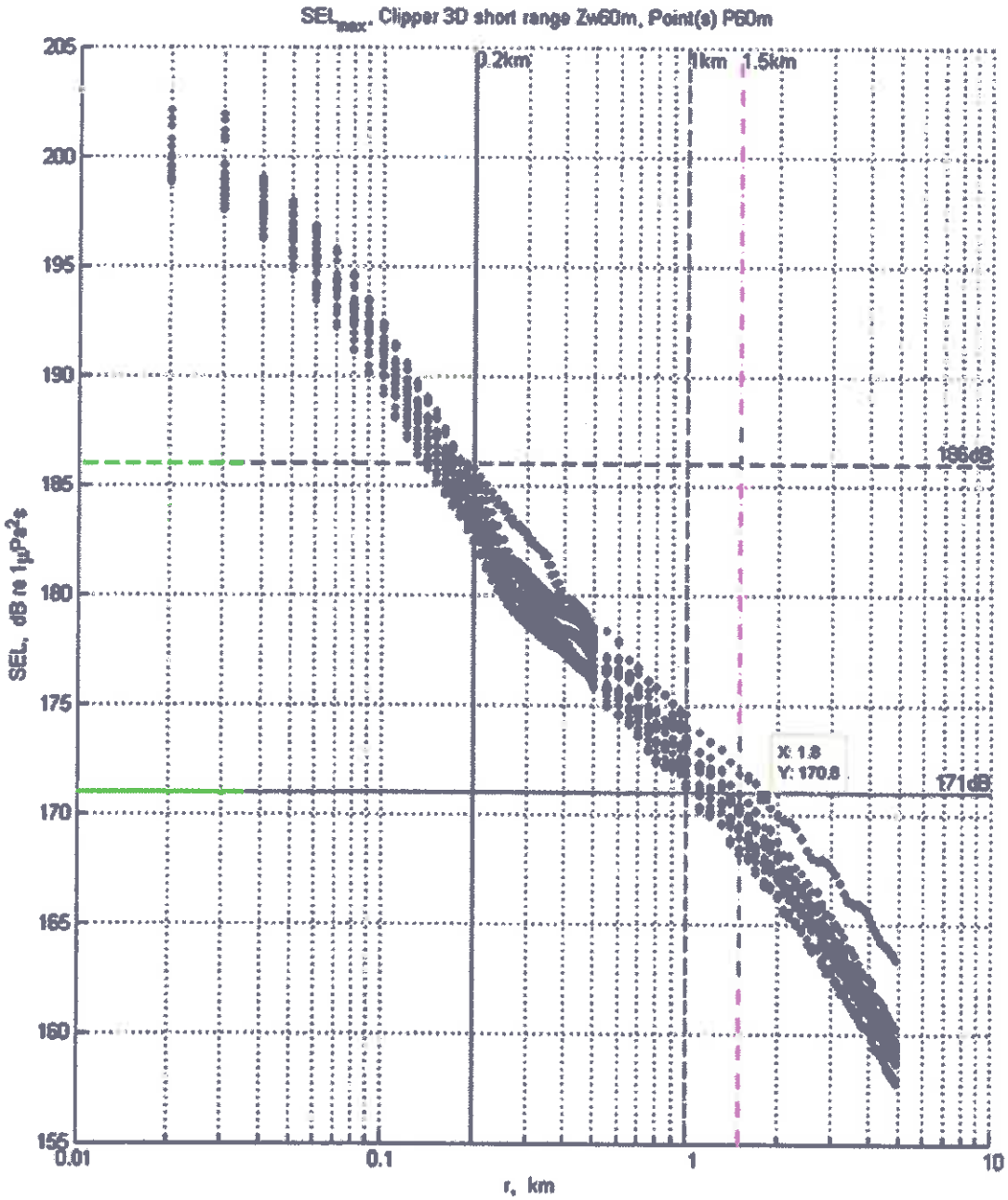

Figure 31: Maximum received sound exposure levels as a function of horizontal range for all modelled azimuths in 60 m water depth.

6.3.2.2 Physiological effects on marine fauna from exposure noise or associated pressure effects

The sound intensities required to produce physiological effects are largely unknown for most marine animals, and what is known is based on a limited number of experiments of varying quality. To cause immediate serious physiological damage, sound levels need to be very high (218 – 230 dB re 1 μPa^2: Southall et al. 2007). High sound levels are found

only very close to the source, and hence the area where damage may occur is limited to the immediate proximity to the airgun array. The sound transmission loss modelling for the Endurance MSS predicts that for all water depths ≥60m the 200 m mitigation zone satisfies the 186 dB re 1 $\mu Pa^2.s$ injury criteria prescribed in the Code of Conduct. Therefore, the potential for serious physiological effect is considered to be ***minor*** for species of concern, and ***moderate*** for other marine mammals.

Physiological effects will be unlikely to occur for the majority of species. Most free-swimming animals have been observed avoiding the acoustic source well before they get within the range at which negative effects occur, and delayed start and soft-start procedures are routinely employed in an effort to clear the area of potentially sensitive fauna prior to surveying activities commencing at full power. There is a general lack of conclusive data on the physiological effects of sound on marine mammals because protected species (including most cetaceans) cannot be sacrificed for physical examinations, and their large size is generally prohibitive of captive studies.

Animals which do not or cannot avoid the approaching survey vessel because of behavioural or physical constraints could be at risk of physiological effects. Such animals include plankton, fish eggs and sessile (i.e. non-mobile) organisms at shallow depths.

Exposure to discrete periods of elevated sound can lead to threshold shifts in hearing, or the elevation of the lower limit of auditory sensitivity. In most cases this is a temporary physiological change. However, exposure to extreme sound intensities, or prolonged exposure to loud sounds could cause a permanent threshold shift. The criteria for deciding whether threshold shifts will be temporary or permanent vary widely with a large number of variables hence cannot easily be predicted.

Studies with beluga whales and species of dolphin have shown that temporary threshold shift did not occur until sound levels were in the order of 225 – 230 dB, and for a seismic survey, this would be a few tens of metres at most from the sound source (OGP/IAGC position paper). The mitigation measures prescribed in the Code of Conduct are specifically designed to ensure that there is a very low probability that marine mammals would ever be this close to the acoustic source.

Studies of captive fish indicate that the severity of threshold shift is directly correlated to the frequency of the sound and duration of exposure. Fathead minnows (*Pimephales promelus*) are hearing specialists, i.e. they possess particularly acute auditory sensitivity over a wide frequency range, and a low hearing threshold due to the presence of accessory structures. Their specialised anatomy suggests that they may be more sensitive to intense sound exposure than fish without this enhanced hearing capability. Skolik & Yan (2002) observed temporary threshold shift in fathead minnows after one hour of exposure to white noise at frequencies above 1 kHz, but no threshold shift at 0.8 kHz. Threshold shift following an hour of exposure at 1,000 Hz lasted less than 24 hours. Popper *et al.* (2005) found varying degrees of threshold shift in northern pike (*Esox lucius*), broad whitefish (*Coregonus nasus*), and lake chub (*Couesius plumbeus*) after exposure to an operating 730 in^3 airgun array, but recovery occurred within 24 hours of exposure. These results strongly suggest that the proposed seismic survey could induce temporary auditory effects on fish near the source, but that the lasting physiological effects of the Endurance MSS on fish would be ***minor***.

Most studies suggest that seismic effects on benthic invertebrates are ***minor***, and occur primarily in shallow water. Data on the impacts of seismic sound on macroinvertebrates (scallop, sea urchins, mussels, periwinkles, crustaceans, shrimp, gastropods, and squid) show that little mortality occurs below sound levels of 220 dB re 1µPa@1m. Some show no mortality at 230 dB re 1µPa@1m (Royal Society of Canada, 2004). Based on the Endurance sound transmission loss modelling, these effects are only predicted to occur at very close proximity to the acoustic source (within a few metres).

6.3.2.3 Behavioural disturbance leading to behavioural changes or displacement

Behavioural responses to seismic surveys, including avoidance, and changes in vocal behaviour have been observed in *Mysticetes* (baleen whales) in particular, which communicate at lower sound frequencies (moans at 10 - 25 Hz recorded). *Odontocetes* (toothed whales and dolphins) are most unlikely to be detrimentally effected, as they utilise sound frequencies far higher than those generated by air guns (> 5 kHz). See Section 6.3.2.5 below.

Observations of the effects of sound from offshore seismic surveys on whales indicate that seismic survey sound may cause changes in localised movements and behaviours in cetaceans; in general swimming away from the source, but on occasion's rapid swimming at the surface, and breaching (McCauley *et al.*, 1998; McCauley *et al.*, 2003). However, seismic survey sound does not appear to cause changes in the regional migration patterns of cetaceans (McCauley *et al.*, 2003). Following cessation of the activity, such effects are likely to disappear within one hour and are therefore considered ***minor***.

A captive exposure study on pink snapper demonstrated minor behavioural responses to air gun signals ranging from startle to alarm responses (McCauley *et al.*, 2003). This study also suggested that fish numbers decrease with habituation, and that fish may actively avoid active seismic surveys in the wild. Reef fish are also expected to move away from the sound source as shown in the McCauley *et al.* (2003) study; however majority of the Survey Area is in deep water (>500 m) and the two most commonly caught species (barracouta and squid) are pelagic fish and do not aggregate in any one location. Given the relatively short duration of this project (21 – 28 days) and the likelihood that most pelagic fish would either avoid or move away from the sound source, the proposed Endurance MSS would likely have ***minor*** impacts on fish behaviour and these would be limited to the duration of the survey.

Experimental data on survivorship demonstrate high survivorship of squid following exposure to sound levels of 220 dB re 1µPa@1m (Royal Society of Canada, 2004). Cephalopods (octopuses, squids, and cuttlefishes) were historically considered to be deaf, but research has indicated that some species exhibit behavioural responses to acoustic stimuli (Komak *et al.*, 2005). A study of the effects of seismic sound on squid behaviour documented startle and alarm responses, but also suggested little change in auditory thresholds over time (McCauley *et al.*, 2003). Cuttlefish have been shown to respond in a variety of ways to vibrations in a wide range of frequencies from 0.02 - 0.6 kHz, however it is currently unclear whether the responses observed indicated alarm or distress. No empirical data is available on arrow squid's ability to detect sound, but extrapolation from studies on cuttlefish and other squid species indicate that they may exhibit some behavioural response to vibrations in their immediate vicinity, but that mortality is generally unlikely as a result of loud sound events.

As a consequence, it is concluded that the Endurance MSS would likely cause ***minor*** disturbances to fish and marine mammal behaviour.

6.3.2.4 Disruption to feeding, mating, breeding or nursery activities of marine organisms

It is possible that the Endurance MSS could temporarily displace marine mammals from productive feeding grounds associated with the Waitaki Canyon. However; most cetacean species that are predicted to be present in the Survey Area are large free-ranging pelagic species (e.g. killer whales) that will have ample opportunity to forage further afield during the survey operational period. There is a low probability of Hector's dolphins being present in the shallow waters around the Galleon-1 well site, however the survey duration in this vicinity will be short-lived and displacement effects will certainly cease within 24 hours.

The closest New Zealand fur seal breeding colony is located at Moeraki and the Survey Area may constitute a reliable feeding area for this species. The survey will overlap with

the peak pupping period which occurs in mid-December (Crawley & Wilson 1976). On the West Coast of the South Island New Zealand fur seals have been recorded foraging out to 158 km from their colony (Sinclair & Wilson 1994); the survey area falls within this range, however other smaller submarine canyons are well within the range of individuals based at the colony as temporary alternative foraging grounds.

Species in close proximity to the seismic vessel are expected to move away from the sound source. However, anecdotal evidence from other seismic operations indicates that this may not occur for NZ fur seals which do not always avoid the survey vessel, what this means in terms of potential impacts on this species is under investigation, but currently not fully understood. Once the seismic vessel has passed through the area and the sound source has dissipated there will be no further effects on individual animals present In summary it is considered that the Endurance MSS would likely have only **minor** effects on cetaceans, and NZ fur seals may be subject to ***moderate*** effects that materialise as temporary behavioural changes.

6.3.2.5 Interference with the use of acoustic communication signals, or naturally-produced cues used by marine animals

The most studied, and best understood, examples of acoustic communication in the marine environment are cetacean vocalisations. Cetaceans emit sound for the purposes of communication and navigation. The ability to perceive biologically important sounds is critical to marine mammals, and acoustic disturbance through human generated noise has the potential to interfere with their natural functions (Di Iorio & Clark, 2009). Seismic surveys could have significant impacts on cetacean's ability to use these signals if anthropogenic sounds are in the same frequency range as the sounds generated by cetaceans (Richardson *et al.*, 1995).

Table 11 summarises the known frequencies of echolocation and communication calls for selected species of toothed whales and dolphins for which the vocal range is known. These species could be present in the Survey Area at the time of the Endurance MSS. The table illustrates that the known spectrum of echolocation signals are at much higher frequencies (6 - 130 kHz) than the high end operational range of seismic sources (<1.0 kHz). The range of frequencies used by cetaceans for communication is generally lower than the range of frequencies used for echolocation, so the greatest potential for interference would occur at the highest end of the seismic spectrum and the lowest end of whales' and dolphins' communication spectrum.

Table 11: Frequencies of Cetacean Communication and Echolocation Vocalisations

Species	Communication Call Frequency Range (kHz)	Echolocation Frequency Range (kHz)
Bottlenose dolphin	0.8 - 24	110 - 130
Common dolphin	0.2 - 16	23 - 67
Killer whale	0.5 - 25	12 - 25
Long-finned pilot whale	1 - 18	6 - 117
Sperm whale	0.1 - 30	2 - 30
Blue whale	0.01 – 0.4	0.01 – 0.4

(Source: Richardson *et al.*, 1995)

The lowest frequencies of some toothed whale communication calls partially overlap with the high end of seismic airguns' operational range. However, most acoustic energy emitted from airguns during deep-water surveys is between 0.0 – 0.3 kHz, well below the lower frequency limits of most toothed whales. Of the species listed in Table 11, the sperm whale, common dolphin and blue whale vocalise at a sufficiently low frequency

(0.01 - 0.4 kHz) to be affected by the frequencies most commonly emitted during seismic surveys.

The study undertaken by Di Iorio & Clark (2009) investigated whether blue whales changed their vocal behaviour during a seismic survey that deployed a low-medium power technology (sparker). In summary it was found that blue whales called consistently more on seismic exploration days than on non-exploration days as well as during periods within 24 hours of when the sparker was operating. This increase was observed for the discrete, audible calls that are emitted during social encounters and feeding (Di Iorio & Clark, 2009) and also consistent with Melcon *et al.*, 2012. It is believed that by the blue whale increasing its rate of calling; it increases the probability that its signal will be successfully received by conspecifics. The survey location within Di Iorio & Clark (2009) was crossed by a busy shipping lane where vessel noise was regularly present, and it was concluded that shipping noise did not account for any changes in the acoustic behaviour.

The mean sound intensity, to which blue whales were exposed in the Di Iorio & Clark (2009) study, was relatively low (114 dB re $1\mu Pa^2s$). Hence it is predicted that blue whales would change their calling behaviour in response to low-medium powered seismic surveys (Duchesne *et al.*, 2007).

From the long range modelling that was undertaken by for the Endurance MSS, the areas around the seismic vessel where these exposure levels are exceeded extend widely from the sound source (Figure 30).

From the literature reviewed it is believed that the Endurance MSS will have a ***minor*** effect with regards to interferences with naturally-produced acoustic signals.

6.3.3 Solid and Liquid Wastes Generated on the Vessels

The proposed Endurance MSS has the potential to detrimentally affect the marine environment through inappropriate management of sewage, galley waste, garbage and oily water on the vessels while at sea. Sewage and food waste discharges may result in nutrient enrichment of local waters, although given the high energy environment in which this would be discharged would dilute rapidly to background conditions.

Various types of waste may be produced, each of which requires proper handling and disposal. The volume of waste generated during the proposed seismic survey will depend upon duration, and the number of crew on-board each vessel (seismic and support vessels). This analysis assumes a maximum possible combined crew of ~ 60 people for the seismic vessel and the support vessel.

6.3.3.1 Generation of sewage and greywater

The liquid wastes from the seismic vessel will include sewage and wastewater from toilets, washrooms, the galley and the laundry.

The has an on-board sewage treatment plant which results in a discharge to sea which is superior to the NZ requirements for such discharges for within the Survey Area. Assuming 150 sewage litres per person per day, volumes generated and discharged to sea will be approximately 9,000 litres per day over the duration of the proposed seismic survey. The support vessel also has a sewage treatment system installed and both the and support vessel have an approved ISPPC.

As a result of the sewage generated by the and support vessel and its appropriate treatment, it is believed only ***negligible*** impacts would occur.

6.3.3.2 Generation of galley waste and garbage

Only biodegradable galley waste, mainly food scraps, will be discharged to the sea in accordance with international standards and the relevant NZ Marine Protection Rules,

namely comminuted (as a minimum). Comminuted waste can be discharged beyond 3 Nm from the shore and these discharges will rapidly dilute to non-detectable levels in the offshore marine environment. Other solid and non-biodegradable liquid wastes will be retained aboard for subsequent disposal to managed facilities ashore.

MARPOL Annex V stipulations will be followed. Records will be kept which will detail the quantity, type and approved disposal route of all wastes generated. All records on waste disposal will be available for official inspection. All wastes, including hazardous returned to shore will be disposed of in strict adherence to local waste management requirements, with all chain of custody records retained by NZOG. Due to these operating procedures in place the impact on the environment from the Endurance MSS are likely to be ***negligible***. Table 12 summarises garbage disposal restrictions.

Table 12: Waste Streams under MARPOL Annex V Classification

Garbage Type	Appropriate Disposal Route
Plastic – including synthetic ropes, fishing nets, packaging materials and plastic bags	Should be compacted and stored on-board for transfer to shore for disposal at an appropriate disposal facility.
Paper, rags, glass, metal, crockery and similar refuse	Should be stored on-board until disposal in a controlled facility onshore is possible.
Maintenance and operational waste: rags, oil soaks, used oil, batteries	Should be stored on-board until disposal in a controlled facility onshore is possible.
Food waste	If biodegradable, then can be comminuted and discharged offshore, as required under Marine Protection Rules (Beyond 3 Nm if comminuted, otherwise 12 Nm).
Sewage	Should be treated by the ship's sewage treatment facility in accordance with international best practice for offshore waters.

6.3.3.3 Generation of oily waters

The generation of oily waters aboard any vessel are generally derived from bilges.

The [redacted] is fitted with a bilge water treatment plant that achieves a discharge level superior to NZ and international (MARPOL) requirements of 15 ppm.

Both the [redacted] and the support vessel will carry approved IOPPCs and have a Shipboard Oil Pollution Emergency Plan (SOPEP) in place.

As a consequence, it is expected that the impact of the discharge of oily water into the sea will be ***negligible***.

6.3.4 Fuel Consumption and Atmospheric Emissions

The principle sources of air emissions are exhaust gases from the vessel engines, and the air compressor generators, and the on-board waste incinerator. An estimate of the fuel consumption from the engine and generator operations, during mobilisation and demobilisation, and for survey operations is presented in Table 13.

The seismic vessel is capable of cruising at about 12 kts when in transit with no equipment deployed. When surveying equipment is in the water, the acquisition speed will be 4.5 kts (8.3 km/h). For the purpose of this estimate, it has been assumed that the average operating speed for the vessel during the Endurance MSS would be 4.5 kts (8.1 km/h).

An estimate of the total fuel use has been made based on the following assumptions:

- Average daily fuel use for the seismic vessel during seismic operations is estimated as 45 m^3 per day during seismic surveying. Greater efficiencies are assumed during transit to and from the Survey Area, with an estimated fuel use of 40 m^3 per day;
- Transit from Wellington to the Endurance Survey Area will take approximately 19.5 hours (at 14 kts); and

The seismic survey will take 21 - 28 days to complete.

Table 13: Estimated Fuel Consumption

Vessel	Activity	Days	Average fuel consumption (tonnes/day)	Fuel consumption (tonnes)
Seismic Vessel	Mobilisation and transit to Survey Area	5.5	Port standby=4.2, Transit=33.6, Deployment=37	183.7
	Seismic acquisition	25	12 Streamers = 42	1050
	Demobilisation to Wellington	4	Recovery=37, Transit=33.6	144.6
Total				**1378.3**

The is fitted with emission scrubbing technology, so that:

- During seismic acquisition, reductions of NO_x (63 – 79%) and SO_x (>90% over shipping industry average) are achieved;
- During transit, reductions of NO_x (40 – 77%) and SO_x (~85% over shipping industry average) are achieved; and
- For CO_2, the discharges between 84 t and 121 t per day, again depending upon whether the vessel is undertaking seismic acquisition or transiting.

The fuel consumption which results in the emissions from the will be small given the short MSS duration. The has been fitted with scrubbing technology at the forefront of international best practice and carries an approved IAPPC. Within the Survey Area, the dispersion of emissions will also be rapid due to prevailing weather conditions, where it is likely that background atmospheric levels will be reached within a few hundred metres from the .

As a result of the short MSS duration, operating at a slow speed during seismic acquisition and the scrubber technology installed on the , it is believed the emissions to the environment will be ***negligible***.

6.4 Impacts of Unplanned Activities

Unplanned activities, including streamer cable break, fuel/oil spills and vessel collision are rare during marine operations. However, marine operations do pose a small potential risk of accidental contamination and hence this assessment has been conducted to cover their possible occurrence.

6.4.1 Streamer Cable Break

The hazards in the area will determine the likelihood of damage to the seismic streamers. These hazards include the potential for damage by tangling during rough weather;

snagging with floating debris; or potential rupturing from abrasions, shark bites, or collisions with other vessels crossing the streamers.

If the streamer cable were to break it is considered that it would have little impact on the marine environment. Unlike fluid-filled streamers, the solid streamers that are onboard have no potential for rupture or release of content. Further, the solid streamer is negatively buoyant which requires motion to maintain depth, and will sink if severed. If a streamer is severed, Self-Recovery Devices (SRD) will deploy for retrieval. Therefore, streamer cable break does not pose a significant crushing hazard to the benthic communities within the Survey Area.

The impact of a streamer cable break is considered to be ***negligible*** as the Endurance MSS will be conducted using international best practise methodology by experienced personnel.

6.4.2 Fuel/Oil Spill from Vessels

The key potential accidental event identified in relation to the Endurance MSS is the potential for a fuel/oil spill from the vessels involved, including the and the support vessel.

The potential events that may occur during the Endurance MSS are:

- Leaking equipment storage containers;
- Accidental releases from containers; and
- Hull/fuel tank failure due to collisions/sinking.

A hull/fuel tank failure would have the largest potential for an environmental impact. The other potential spills are often entirely contained on the vessel and if they do reach the sea they are generally only in small volumes.

All vessels involved in the Endurance MSS have an approved and certified SOPEP and IOPPC as per MARPOL 73/78 and the Maritime Protection Rules Part 130A and 123A respectively. These will be kept on-board the vessels for the duration of the MSS.

The worst-case scenario would be the partial or complete loss of the , fuel following rupture of the vessel's tank in a collision. The maximum possible spill from the would be the total loss of the entire fuel capacity which is 1,925 m^3 of marine gas-oil. However, this size of a spill would only occur as a result of complete failure of the vessel's fuel containment system or catastrophic hull integrity failure. This is considered to be highly unlikely due to the high-tech navigational systems on board and the international best practise environmental procedures in place on the vessel.

If assistance is required due to the size or nature of the spill, this will be managed as a Tier 3 national marine oil spill response by MNZ, with backup from Otago Regional Council and Environment Canterbury. However, if a spill occurred within the 12 Nm CMA then it would be a Tier 2 response, depending on the size of the spill.

In addition to the SOPEP's, has a HSE Management Plan and Emergency Response Plan which will be used in the event of an emergency, including fuel spills. The will have copies of all documents on-board during the MSS.

Spills of a significant quantity of hazardous substances as a result of any of the events outlined above are not considered likely due to the stringent safety, environmental and maritime requirements that will be implemented during the Endurance MSS. Therefore, it is considered that the risks associated with this type of event are ***negligible***.

6.4.3 Vessel Collision or Sinking

The most significant environmental effect associated with vessel collision or sinking is associated with the vessel making contact with the sea floor, and the on-board hazardous substances, specifically the oil and lubricants. This is very unlikely as the risks

associated from the vessel sinking are mitigated through the presence of two vessels at all times during the Endurance MSS. The International COLREGS will be followed at all times. Therefore, it is considered the potential impacts from vessel collision or sinking is ***negligible***.

6.5 Mitigation Measures

The Endurance MSS will adhere to those mitigation measures stipulated in the Code of Conduct under the Level 1 seismic survey classification to minimise any adverse effect to marine mammals resulting from the seismic operation (DOC, 2013), as well as a significant number of additional measures. Also as per the requirements of the Code of Conduct, the Director-General will be informed immediately about any instances of non-compliance with the Code of Conduct and the mitigation measures identified below.

The full operating procedure that NZOG will follow in compliance with the Code of Conduct and the agreed additional mitigation measures is presented as a Marine Mammal Mitigation Plan (MMMP) (Appendix 4).

6.5.1 2013 Code of Conduct Mitigation Measures

6.5.1.1 Standard Mitigation Measures

The Endurance MSS will strictly adhere to the mitigation requirements as prescribed by the 2013 Code of Conduct and outlined in Section 3.4 of this MMIA.

6.5.2 Additional Mitigation Measures

6.5.2.1 Extra Mitigation Regimes based on Sound Transmission Loss Modelling

Sound transmission loss modelling has been undertaken as part of the development of the Endurance MMIA to predict the received sound levels at various distances from the vessel, based on the specific configuration of the acoustic source and the environmental conditions of the Endurance Survey Area (see Section 6.3.2.1). This modelling is a requirement of the Code of Conduct in account of the Endurance MSS is being undertaken within an AEI.

All modelled received levels for water >60 m in depth (which caters for all possible water depths during the Endurance MSS) were below the injury criteria (186 dB re 1 µPa2.s) at a range of 200 m which concurs with requirements under the Code of Conduct.

The modelling also indicated that 95% of receptions of sound are predicted to be below 171 dB re 1 µPa2.s SEL (the behavioural criteria) at a horizontal range of 1.5 km which is the minimum mitigation requirement for species of concern with calves (DOC 2013).

However, short range modelling results predicted that SELs at the 1 km mitigation distance would significantly exceed the required 171dB re 1 µPa2.s threshold for species of concern without calves at the 80 m water depth. Further modelling indicated that this mitigation zone would only become relevant in water depths of 275 m or greater; hence more than one mitigation regime is necessary to protect species of concern from behavioural impacts throughout the extent of the Endurance MSS polygon. On this basis, the following mitigation regimes are proposed and are illustrated in Figure 32:

'Shallow' Water Mitigation Regime (for use in water depths from 80 – 275 m):

- The adoption of a 1.5 km mitigation zone for the purpose of shut downs with respect to all species of concern (i.e. not just those with calves as per standard requirements under the Code of Conduct).

'Deep' Water Mitigation Regime (for use in water depths > 275 m):

- Adherence to the 2013 Code of Conduct and all mitigation requirements specified therein

Short range modelling was also carried out to check for compliance with the Code of Conduct mitigation zones at the predicted minimum water depth (60 m) at the Galleon-1 well site. For this water depth both the 1 km and 1.5 km mitigation zones described by the Code of Conduct would be deficient in protecting species of concern from behavioural impacts, with SELs significantly exceeding the required 171dB re 1 $\mu Pa^2.s$ threshold for both of these mitigation distances.

These results provide clear evidence that a further mitigation regime would be required. On this basis the following additional regime is proposed for the survey line in the immediate vicinity of the Galleon-1 well:

Galleon-1 Well Site Mitigation Regime (for use in water depths < 80 m):

- The adoption of a 1.8 km mitigation zone for the purpose of shut downs with respect to all species of concern (i.e. not just those with calves as per standard requirements under the Code of Conduct).

These additional mitigation zones are intended to minimise the risk of negative effects on marine mammals during the Endurance MSS.

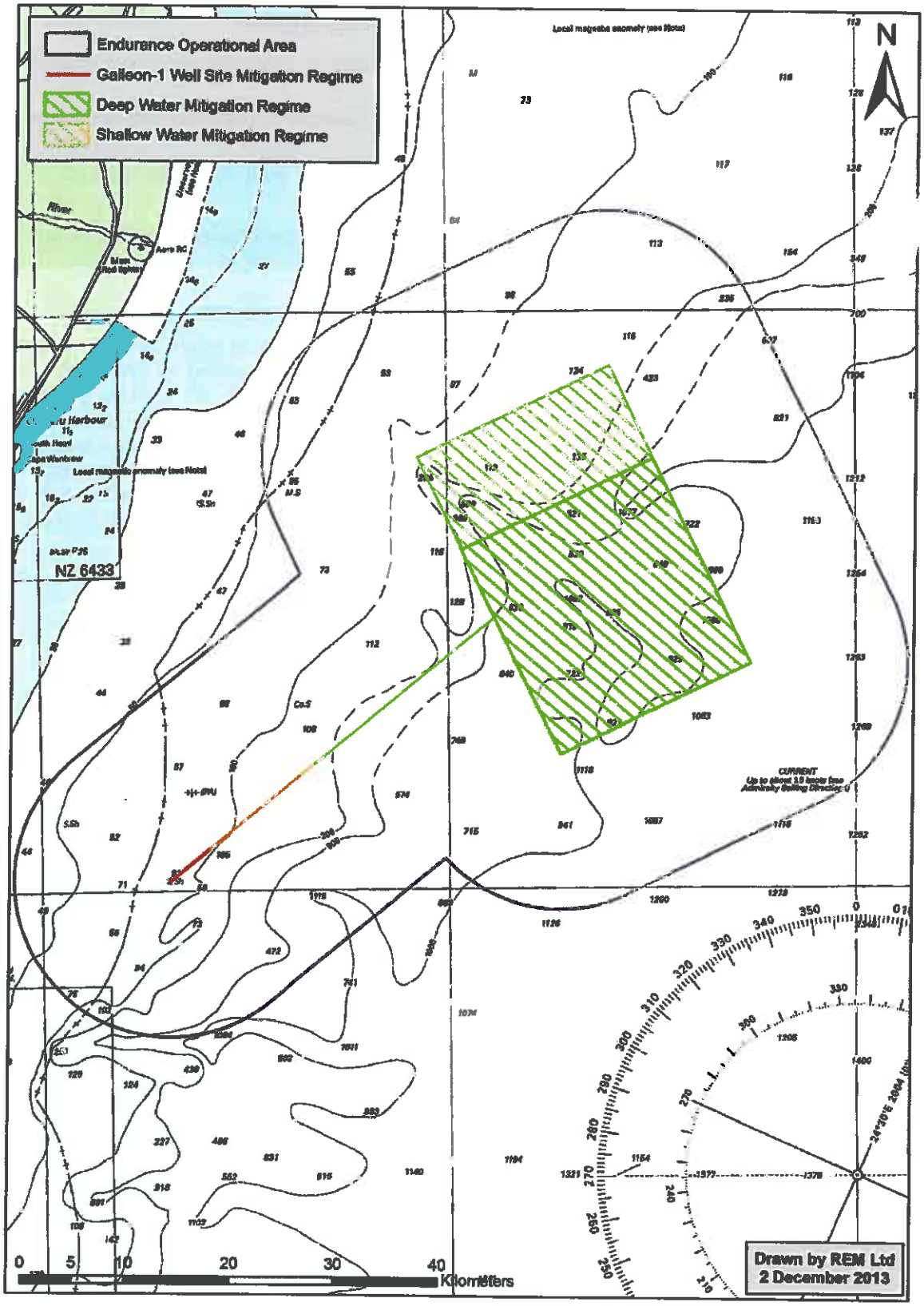

Figure 32: Proposed Mitigation Regime Boundaries of the Endurance MSS

To verify these mitigation regime boundaries, the will depart for the survey area well ahead of the with the intention to:

- Assess the bathymetry in the NW buffer zone to identify any bathymetrical anomalies which are not illustrated on the charts;
- Locate the 275 m contour within the main survey polygon in order to refine mitigation boundaries if appropriate;
- Assess the bathymetry in the vicinity of the Galleon-1 well in order and to refine mitigation boundaries if appropriate.

Any proposed deviations from the mitigation regime boundaries presented here will be subject to approval by the Department of Conservation.

6.5.2.2 Ground truthing of sound transmission loss modelling results

For surveys taking place in an AEI where sound transmission loss modelling is required, Appendix 1 of the Code of Conduct also requires that this modelling is ground-truthed during the survey by appropriate means. During the Endurance 3D survey ground – truthing will be undertaken by isolating the acoustic sound trace received from the hydrophones suspended from the streamers at all the mitigation distances relevant to the Code of Conduct (200 m, 1000 m and 1500 m) and to the additional mitigation measures which will be adopted during the Endurance MSS (1800 m). It is proposed that this ground-truthing will occur at least once at each of the water depths outlined in Table 14.

Table 14: Ground truth reporting schedule

Depth range (m)
60
80
100
125
150
175
200
225
250
275
300
400
500
600
700
800
900
1000

6.5.2.3 Minimising the impacts of underwater sound on marine mammals

In addition to the mitigation regimes described above, NZOG intend to further reduce acoustic inputs into the marine environment by striving to:

- Avoid acoustic source testing in waters < 100 m deep;
- Minimise the run-in distance at the start of each survey line in the NW section of the buffer zone;
- Approach survey lines which abut buffer zone water depths of <100m from a NW to SE direction in order to minimise sound input into shallow waters;

- Ensure that the tie-in line to the Galleon-1 well is conducted in a NE to SW direction in order to provide animals in the distal part of this line ample opportunity to leave the area as sound levels increase during the vessels approach from deeper water.

6.5.2.4 Marine Mammal Observations outside the Survey Area

The ɜ will mobilise from Wellington to the survey area. During transit, a MMO will be on watch and recording marine mammal sightings. Any observations outside of the Survey Area will be reported in the 'Off Survey' forms developed by DOC.

6.5.2.5 Necropsies on any Stranded Marine Mammals

If any stranding's occur between Banks Peninsula and Otago Peninsula during the Endurance MSS or within 14 days of the survey completion date, NZOG will engage Massey University pathologists to conduct necropsies on any stranded marine mammals in an attempt to determine the cause of death.

6.5.2.6 Immediate notifications to Department of Conservation

The Department of Conservation will be immediately notified for the following:

- Should high numbers of a species of concern be observed within the survey area;
- If ground-truthing results indicate the mitigation zones are insufficient for providing protection to marine mammals from physiological or behavioural impacts.

6.5.2.7 Reporting and briefing

Weekly MMO reports will be provided to the Department of Conservation and the Environmental Protection Authority.

The Environmental Protection Authority will be present during the MMO briefing at the survey outset.

6.5.2.8 Passive Acoustic Monitoring

NZOG intend to ensure 'in country' availability of a backup PAM system in the event that the primary system malfunctions and cannot resume monitoring. A contract for the provision of this equipment is currently under negotiation.

6.6 Cumulative Impacts

Cumulative impacts on the environment may arise over time or in combination with other impacts. Currently the Canterbury basin is used for fishing and shipping which will continue during and after the Endurance MSS. As discussed in Section 6.3.2.5 in the study undertaken by Di Iorio & Clark (2009), their seismic survey area overlapped with a busy shipping lane where vessel noise was regularly present. From the study it was concluded shipping noise did not account for any changes in the acoustic behaviour of blue whales. The Survey Area is also offshore of the major shipping routes between ports. As a result, the inclusion of shipping noise from passing shipping traffic has not been considered as part of this cumulative impacts assessment.

We are aware of one other marine seismic survey off the south east coast of New Zealand which may temporally overlap with the proposed Endurance 3D survey. The other proposed survey is a 2D survey approximately 150 km south east of Dunedin. There is a minimum distance of approximately 50 km between the two survey areas.

The culmination of these two surveys, should they overlap in time, will mean that individual marine mammals attempting to avoid the acoustic disturbance will have greater distances to travel to achieve this. This is unlikely to be an issue for free-ranging pelagic species which have ample opportunity to relocate in order to avoid potential disturbance, however, there is the potential for minor effects from prolonged exposure to

increased background noise levels for coastal marine mammals. This is perhaps particularly relevant to those coastal species with relatively small home ranges (e.g. Hector's dolphins and NZ sea lions), or for breeding pinniped species which must return to shore frequently to provision pups during this period (e.g. NZ fur seals and NZ sea lions). It is encouraging however that both the threatened species which are resident in coastal Otago waters (Hector's dolphins and New Zealand sea lions) are known to successfully forage inshore. This inshore foraging range results in a very low probability that these animals will enter the direct vicinity of the two seismic vessels, so the sound levels that they will be exposed to should be well below the thresholds for physiological damage or significant behavioural impacts.

If animals avoid an area due to sound exposure during a MSS, this could result in additional exposure to predators, and loss of foraging or mating opportunities. However, once the MSS stops and the resonant noise within the marine environment has diminished, the potential effects to marine mammals will cease and animals can return to their preferred habitat.

The Endurance MSS will be following the Code of Conduct to mitigate any effects on marine mammals, where the will use the minimum gun size required for the survey, reducing the risk to marine mammals and will shut down or delay starts if marine mammals are within the relevant mitigation zones. Given it is believed that only the Endurance MSS will be operating in the Canterbury basin in mid-December 2013, the potential cumulative impacts on marine mammals or the environment from this proposed survey will be ***minor***.

6.7 Summary of Environmental Effects and Mitigation Measures

Table 15 summarises the project activities, associated effects, and effect mechanisms identified in this assessment.

Table 15: MSS Activities and Associated Impacts

Aspect or Source	Potential Impact	Probability of Occurrence or Exposure	Proposed Monitoring or Mitigation Measures	Residual Outcome or Impact
Routine Activities				
Physical presence of seismic survey vessel, streamer, and support vessel.	Interference with local fishing activities and damage to fishing equipment.	Very low considering the mitigation measures in place.	24/7 operations (weather permitting) to minimise overall duration of survey (~21 days). Compliance with COLREGS. Presence of support vessel at all times. Notice to Mariners will be issued.	Negligible.
	Interaction or interference with marine traffic.	Very low considering the mitigation measures in place.		Negligible.
	Interference and/or damage to marine archaeology, cultural heritage or submarine infrastructure.	Extremely unlikely considering the minimum distance to the coast (32 Km) and the operations will ensure that the streamers will not contact the seabed in the deep water.	Best Practice.	Negligible.
	Indirect effects on fisheries resulting from displacement of targeted species.	Low.	24/7 operations (weather permitting) to minimise overall duration of survey.	Minor.
	Interactions with seabirds.	Likely. Vessels may provide resting opportunities for birds. Collisions or entanglements are unlikely during daylight, but could occur after dark.	No mitigation options available. BPM observers will record any seabird strikes that are witnessed.	Negligible.
	Introduction of marine pests.	Low.	Antifouling systems in place. Adherence to ballast water and hull fouling regulations. Regular maintenance undertaken. Biosecurity clearance was gained before vessel entered NZ.	Negligible.
	Interaction or interference with marine mammals.	Low.	Compliance with the Code of Conduct and mitigation zones Two MMO's will be onboard observing for mammals during daylight hours and all sightings will be recorded. Two PAM operators will be onboard monitoring 24hrs per day.	Minor.
Source sound and transmission.	Physiological effects on marine fauna from exposure noise or associated pressure effects.	Low due to mitigation measures in place.	Compliance with the 2013 Code of Conduct, including: - Presence of 2 trained MMOs for daylight observations. - Pre-start observations, Soft start procedures. - Delay start/shut down procedures. - Use of PAM 24/7 and the presence of 2 trained PAM operators. Development of additional mitigation measures, including: - 2 additional mitigation regimes for shallow water. - Minimisation of acoustic inputs into shallow water. - Conduct the Galleon-1 tie-in line from a NE to SW direction. - Necropsies on any dead stranded marine mammals. - Immediate notifications to DOC in certain circumstances. - Ground truthing sound transmission loss modelling results. - Involvement of EPA in MMO briefing and weekly reporting. - Provision of a backup PAM system	Minor for species of concern; moderate for other marine mammals.
	Behavioural disturbance leading to behavioural changes or displacement.	Will Occur.		Minor.
	Disruption to feeding, mating, breeding or nursery activities of marine organisms.	Low.		Minor for cetaceans; Moderate for NZ fur seal.
	Interference with the use of acoustic communication signals, or naturally produced cues used by marine animals.	Will Occur.		Minor.
	Indirect effects, such as changes in the abundance or behaviour of fish species targeted by established fisheries.	Low.		Negligible.

Aspect or Source	Potential Impact	Probability of Occurrence or Exposure	Proposed Monitoring or Mitigation Measures	Residual Outcome or Impact
Solid and liquid wastes generated on the vessels.	Generation of sewage.	Will occur.	Only biodegradable waste will be discharged. Discharges will dilute to non-detectable levels. Adherence to MARPOL. Approved ISPPC. On-board sewage treatment plant that exceeds NZ Standards. will implement on-board Environmental Compliance.	Negligible.
	Generation of galley waste and garbage.	Will occur.	Waste management plan. Only biodegradable and comminuted waste will be discharged. Adherence to MARPOL. will implement on-board Environmental Compliance.	Negligible.
	Generation of oily waters.	Will occur.	Bilge water treatment system to meet the international standard of 15 ppm before any discharge occurs. ill implement on-board Environmental Compliance.	Negligible.
Atmospheric emissions.	Air emissions.	Very low exposure based on low total emissions in the Survey Area.	Approved IAPPC. Regular monitoring of fuel consumption. Proper maintenance of equipment and generators. On-board Environmental Compliance.	Negligible.
Non-Routine Activities (including accidental events)				
Streamer cable break and cable content release.	Water impact.	Very limited due to it being a solid streamer.	Solid streamer. Support vessel will help minimise potential for other vessels to disturb the streamers.	Negligible.
Fuel/oil spill from vessels.	Water impact. Coastal impact.	Low due to mitigation measures.	SOPEPs in place. High level of environmental standards/plans developed and adhered too. Implementation on-board Environmental Compliance.	Negligible.
Vessel collision or sinking.	Water impact. Coastal impact.	Extremely unlikely.	24/7 operations (weather permitting) to minimise overall duration of survey. Compliance with COLREGS. Presence of support vessel. Notice to Mariners will issued and broadcast on Maritime Radio. Thorough consultation; all users of this environment have been advised of the MSS operation.	Negligible.
Cumulative impacts				
Multiple MSS	Increased background noise levels leading to behavioural disturbance and increased stress levels.	Could occur	Compliance with the Code of Conduct and mitigation zones Two MMO's will be onboard observing for mammals during daylight hours and all sightings will be recorded. Two PAM operators will be onboard monitoring 24hrs per day. Efforts to minimise the duration of the survey as practicable	Minor

7 Environmental Management Plan

7.1 Introduction

/ ..... has its own independent Environmental Management Plan (EMP) which documents the implementation of their Environmental Management System as part of their Health, Safety and Environmental and Quality planning process for their operations.

The management of environmental risks associated with all NZOG's activities is integral to business decision-making processes. Environmental hazards are identified during planning and throughout operations, and their associated risks are assessed and managed via a structured management system. This is the mechanism that ensures that NZOG's standards are maintained, the commitments specified in this MMIA are met, and that unforeseen aspects of the proposed exploration activity are detected and addressed.

An EMP is integral to implementation of the program for the proposed Endurance MSS. This sets out regulatory requirements and commitments outlined in this MMIA, along with performance, monitoring and reporting requirements.

7.2 Implementation

Contractors are expected to operate a management system that is consistent with the requirements and provisions of NZOG's MSS programme. To ensure contractor performance for the purposes of this MSS, NZOG will:

- Assess contractor environmental performance prior to contract execution;
- Include clauses in contract documents specifying contractor responsibilities and expected environmental performance;
- Indicate requirements for contractor training; and
- Include requirements for appropriate monitoring, feedback and sharing information between NZOG and the contractor, such as the provision of weekly waste generation reports.

Some of the control mechanisms, already in place for the are implemented through the EMP and include:

- HSE requirements for contractors;
- A waste accounting system;
- A Waste Management Plan; and
- An Emergency Response Plan, including for small oil and fuel spills.

To verify the EMP and any specific monitoring is properly implemented during the Endurance MSS; operating procedures will be in place, including proper training, awareness sessions, and communication to all relevant crew and staff.

Specific personnel onboard will have designated responsibilities with regard to environmental protection, including supervision and execution of the EMP. The Master will have ultimate responsibility for ensuring the vessel is operated with due regard for environmental protection.

will have the responsibility to ensure that all crew members and relevant shore-based managers have received appropriate education and training in order to carry out their duties associated with the survey, in a safe, healthy, and environmentally responsible manner. During the Endurance MSS, a log will be kept detailing each day's progress and events.

will operate in compliance with NZOG's environmental policy and with all recommendations and commitments stated in this MMIA. Standards and guidelines will be drawn from (but not limited to) the following:

- 2013 Code of Conduct for Minimising Disturbance to Marine Mammals from Seismic Survey Operations;
- Environmental Best Practice Guidelines for the Offshore Petroleum Industry (MfE, 2006); and
- All relevant Maritime and Marine Protection Rules.

The EMP highlights the key environmental considerations for the Endurance MSS, and sets out the mitigation measures and monitoring programmes to be followed.

The measures have been designed to eliminate, offset, or reduce any identified adverse environmental effects to a level that is as low as reasonably practicable. The EMP is consistent with NZOG's environmental policy commitments, and industry practices and guidelines.

The main goals of the EMP is to provide a framework for implementing proposed mitigation measures for the Endurance MSS to minimise environmental effects and ensure these measures fulfil the required regulations for carrying out this activity.

We recommend that the EMP addresses the considerations outlined in Table 16.

Table 16: Environmental Management Plan Recommendations

Objectives	Parameters to be Controlled	Control Frequency	Proposed Actions	Legislation and Protocols to be Applied
Minimise interaction with local fisheries.	Presence of fishing boats.	Pre-survey. Continuous.	24/7 operation (weather permitting) to minimise overall survey duration. Information to fishing authorities and associations, fishing and boating clubs. Support boat investigation and Notice to Mariners issued.	International best practice.
Minimise introduction of marine pests.	Hull fouling. Ballast water discharge.	Continuous.	Antifouling systems in place (recently slipped in October 2013). Adherence to ballast water regulations. Regular maintenance undertaken.	International best practice. Import Health Standard for Ships' Ballast Water from All Countries (Biosecurity Act 1993). Draft CRMS for Vessel Biofouling.
Minimise disruption to marine mammals and other marine fauna.	Presence of marine mammals within a distance of the sound source consistent with Code of Conduct and interaction of marine mammals with the survey vessels.	Continuous observation during daylight hours by trained MMO's. Use of PAM 24/7.	Compliance with Section 6.5. 24/7 operation (weather permitting) to minimise overall survey duration. Presence of four trained MMO's to provide complete coverage for daylight visual observations. Pre-start observations. Soft start procedures. Delay start/shut down procedures. Use of PAM 24/7.	The Code of Conduct. Marine Mammals Protection Act 1978 and the associated Marine Mammals Protection Regulations 1992.
Minimise effects on sea water quality.	Liquid wastes.	Continuous.	Treated water will be discharged to the sea in accordance to the above international standards, NZ regulations or better, and the provisions of NZ's Marine Transport Act.	MARPOL 73/78. NZ Maritime Transport Act 1994.
	Oil and other waste.	Continuous.	Dispose of at an approved shore reception facility in compliance with legal procedures and maintain a waste disposal log. Implementation of SOPEP.	MARPOL 73/78. NZ Maritime Transport Act 1994.
	Bio-degradable wastes.	Continuous.	Can be discharged overboard from the survey and support vessels, beyond 12 Nm from the coastline or 3 Nm if it is comminuted.	MARPOL 73/78. NZ Maritime Transport Act 1994.
Solid waste management.	Solid waste.	Continuous.	Dispose of at an approved shore reception facility in compliance with legal procedures and maintain a waste disposal log.	MARPOL 73/78. NZ Maritime Transport Act 1994.
	Bio-degradable wastes.	Continuous.	Can be discharged overboard from the survey and support vessels, beyond 12 Nm from the coastline or beyond 3 Nm if it is comminuted.	MARPOL 73/78. NZ Maritime Transport Act 1994.
Minimise effects on air quality.	Atmospheric emissions.	Continuous.	Proper maintenance of equipment and generators. Approved IAPPC. Regular monitoring of fuel consumption.	Best practice.
Minimise accidental events.	Collisions. Fuel/oil spills.	Continuous	24/7 operations (weather permitting) to minimise survey duration. Hull is built to Ice 1A1 Class. Solid streamer use. COLREGS. Presence of support vessel. Approved SOPEP in place.	Best Practice. International COLREGS.

8 Conclusion

MSS's are considered routine activities within the oil and gas sector with well-established standard procedures to mitigate the potential impacts resulting from any MSS activity. As highlighted previously, NZOG will as far as practicable implement international best practice management controls and mitigation measures throughout the duration of the MSS as well as complying with the Code of Conduct which is the overriding framework which NZOG will comply with.

NZOG have implemented a few further mitigation measures over and above the Code of Conduct in respect of the Survey Area being within an AEI and striving towards best operator practice.

NZ has a history of significant seismic data acquisition operations with no associated environmental issues reported to date by independent observers. The ..... is a state of the art modern high capacity vessel which has the most advanced seismic acquisition technology on board as well as environmentally sensitive operational equipment with the aim of having a minimal effect on both the environment and marine mammals.

A number of potential effects and mitigation measures which NZOG will implement to minimise any environmental impact on the surrounding areas or on marine mammals have been discussed throughout this MMIA. Therefore, in summary from the information provided in this MMIA and the mitigation and management of the MSS activities, the environmental and marine mammal impacts associated with the Endurance MSS are considered in the most part to be ***negligible*** **or** ***minor***, with **moderate** effects potentially occurring for those marine mammal species not considered to be species of concern and that approach the acoustic source during full capacity to within 200m. These moderate effects may cause temporary behavioural changes, but typically free-swimming animals avoid the immediate vicinity of the sound source, and the use of delayed starts and soft starts will minimise the occurrence of such effects which is indeed their intended purpose under the Code of Conduct.

9 References

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Appendices

This report contains the following appendices.

Number	Title
1	Endurance 3D MSS Information Sheet
2	Specifications for Passive Acoustic Monitoring Systems for Endurance 3D MSS
3	Sound Transmission Loss Modelling for the Endurance 3D MSS
4	Marine Mammal Mitigation Plan for Endurance 3D MSS

APPENDIX 1

Endurance 3D MSS Information Sheets

Resource and Environmental Management Ltd

New Zealand Oil & Gas Devon Limited
Endurance 3D Marine Seismic Survey
Information Sheet
Canterbury Basin

Resource and Environmental Management Limited (REM) has been engaged by NZOG Devon Ltd (NZOG) to conduct a Marine Mammal Impact Assessment (MMIA) for a planned 3D Marine Seismic Survey in the Canterbury Basin (Figure 1).

The prescribed ~700 km^2 seismic survey is located within Petroleum Exploration Permit (PEP) 52717 due east of Oamaru. The aim of the survey is to obtain three dimensional seismic data to better assess the hydrocarbon potential suspected within the permit area. Known as the Endurance 3D, this rectangular shaped survey will be 'tied' to the Galleon-1 well location via a single swath line the vessel will sail.

The Endurance 3D survey is to commence in mid December 2013and is likely to take place for up to 25 days depending on weather constraints. NZOG will use the *'*; a dedicated seismic survey vessel to undertake this survey. The vessel will tow 12 streamers each measuring 8 km in length separated by 100m increments. The streamers have hydrophones positioned along them to pick up the reflected signal from the compressed air sources that are located immediately behind the vessel. Tail buoys (with lights and radar reflectors) will mark the end of the streamers. At full capacity during the survey, the vessel will travel at a speed of ~4.5 knots and therefore has very restricted manoeuvrability. Two support vessels will accompany the seismic ship to provide supplies, scout the approaching survey area making sure the sea is clear of obstructions and inform other users of the presence of the seismic vessel.

NZOG will operate in accordance to the '2012 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations' (Code of Conduct) as required under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 which came into force on June 28th 2013. To adhere to this Code of Conduct a number of mitigation measures will be put in place to prevent any adverse effects occurring towards the marine environment and marine mammals.

Internationally no marine mammal standings' have to date been linked to marine seismic surveys. Should there be a marine mammal stranding during and up to 14 days after the survey completion, NZOG will seek to arrange a necropsy to investigate possible causative factors.

A notice to mariners will be published and a radio navigational warning will be broadcast on channel 16 in the immediate lead up to the Endurance 3D commencing outlining specific nautical details.

Contact Details
Please contact f you have any further questions/matters you would like to raise in regards to the NZOG Endurance Seismic Survey.

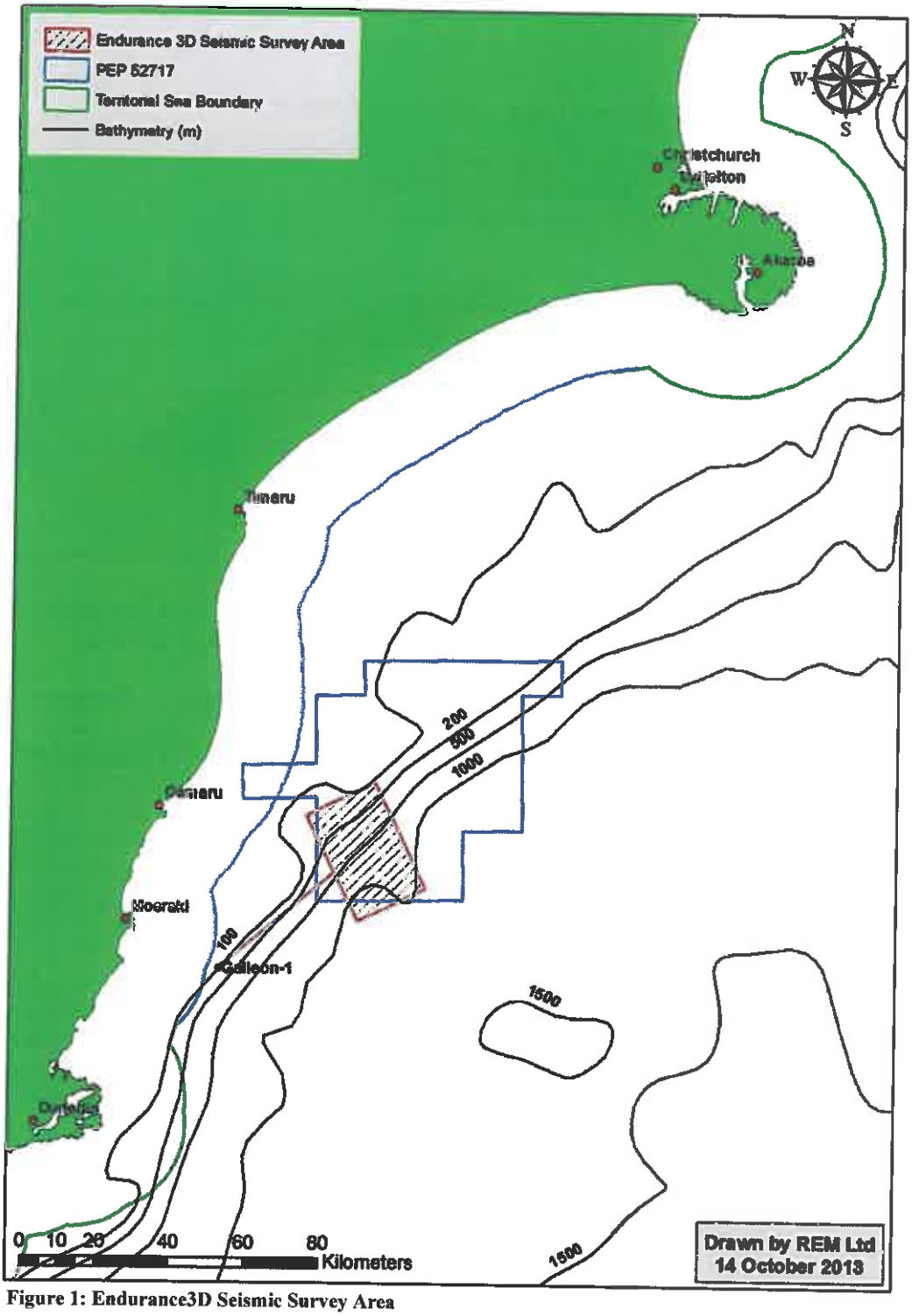


Figure 1: Endurance3D Seismic Survey Area

Resource and Environmental Management Ltd

New Zealand Oil & Gas Devon Limited

Endurance 3D Marine Seismic Survey
Fishers Information Sheet
Canterbury Basin

Resource and Environmental Management Limited (REM) has been engaged by NZOG Devon Ltd (NZOG) to conduct a Marine Mammal Impact Assessment (MMIA) for a planned 3D Marine Seismic Survey in the Canterbury Basin (Figure 1).

The prescribed ~700 km^2 seismic survey is located within Petroleum Exploration Permit (PEP) 52717 due east of Oamaru. The aim of the survey is to obtain three dimensional seismic data to better assess the hydrocarbon potential suspected within the permit area. Known as the Endurance 3D, this rectangular shaped survey will be 'tied' to the Galleon-1 well location via a single swath line the vessel will sail.

You have been identified through Ministry for Primary Industries as having fished within or near the Endurance Seismic Survey Area during the period of 1 October 2007 to 30 September 2012. As a result NZOG would like to provide you with some further details of the proposed Endurance Seismic Survey to help avoid any conflict with any upcoming fishing activities.

The Endurance 3D survey is to commence in mid December 2013 and is likely to take place for up to 25 days depending on weather constraints. NZOG will use the '; a dedicated seismic survey vessel to undertake this survey. The vessel will tow 12 streamers each measuring 8 km in length separated by 100m increments. The streamers have hydrophones positioned along them to pick up the reflected signal from the compressed air sources that are located immediately behind the vessel. Tail buoys (with lights and radar reflectors) will mark the end of the streamers. At full capacity during the survey, the vessel will travel at a speed of ~4.5 knots and therefore has very restricted manoeuvrability. Two support vessels will accompany the seismic ship to provide supplies, scout the approaching survey area making sure the sea is clear of obstructions and inform other users of the presence of the seismic vessel.

A notice to mariners will be published and a radio navigational warning will be broadcast on channel 16 in the immediate lead up to the Endurance 3D commencing outlining specific nautical details.

Contact Details
Please contact if you have any further questions/matters you would like to raise in regards to the NZOG Endurance Seismic Survey.

[redacted]

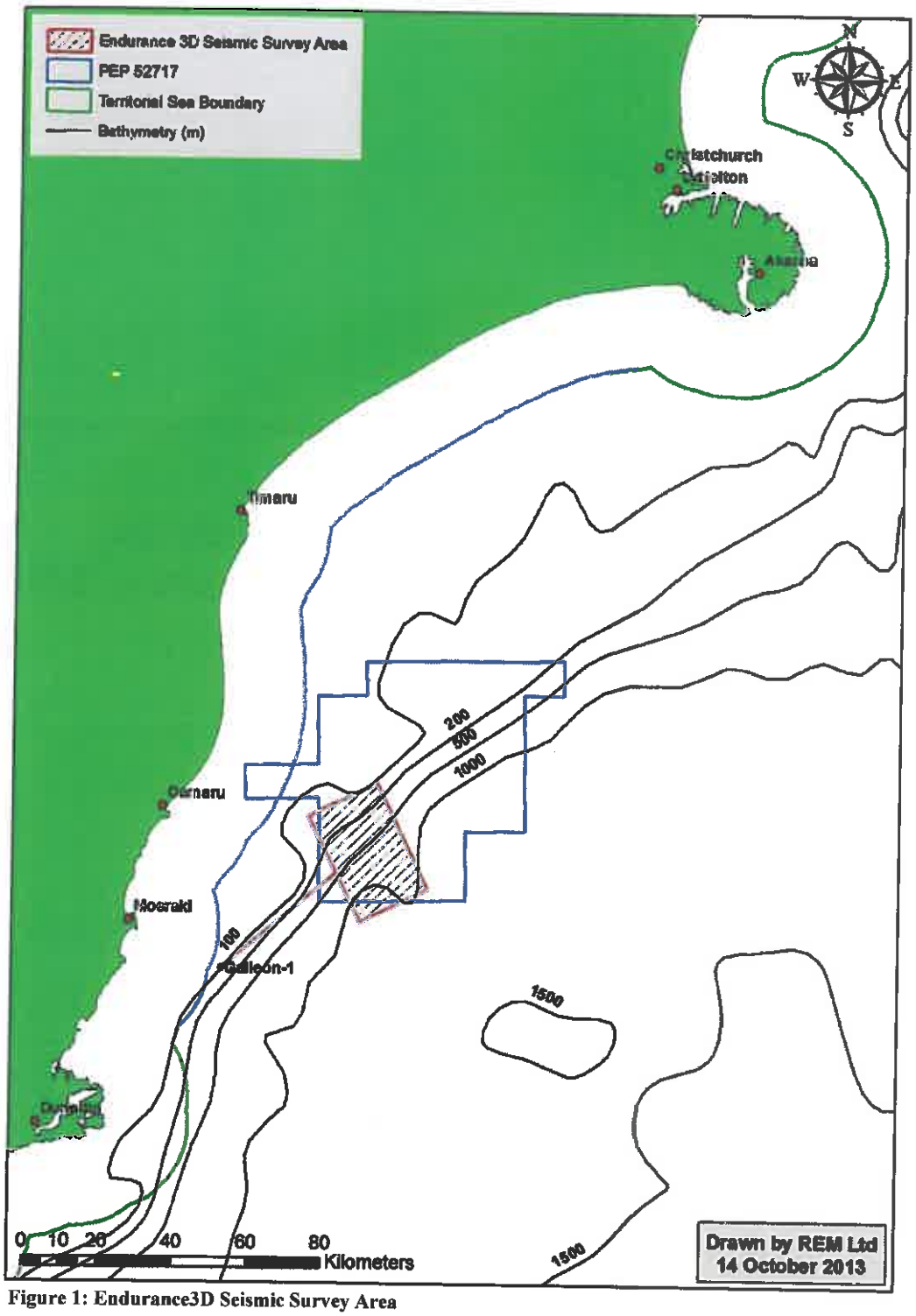
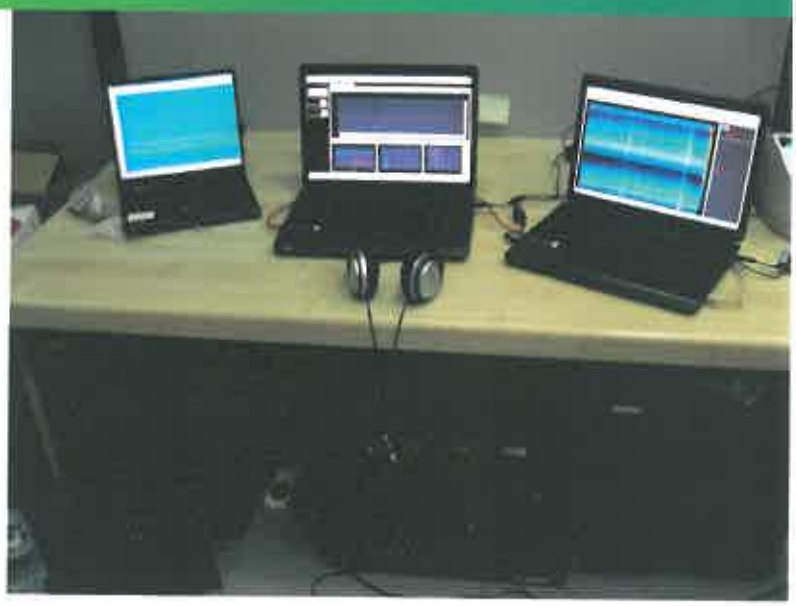


Figure 1: Endurance3D Seismic Survey Area

APPENDIX 2

Specifications for Passive Acoustic Monitoring Systems for Endurance 3D MSS



Night Hawk PAM System

Passive acoustic monitoring is fast becoming a necessity throughout the seismic industry in parts of the world where cetacean monitoring guidelines exist.

Using the Night Hawk PAM system it is possible to accurately detect and locate mammals within a mitigation zone.

Key facts

4 custom high bandwidth omni-directional hydrophones with integral preamplifiers

Flat frequency response 0-140kHz

Integrated depth sensor

Durable polyurethane construction

Aramid fibre reinforced and shielded cable

M-series underwater connections

GPS and AIS NMEA support

Multiple acquisition modules supporting up to 500kHz sampling rate

Industry standard software

Fully compliant with 2010 JNCC guidelines

JNCC compatible data logging software

100% Redundancy

How does it work?

The key components are our custom made hydrophones; four are arranged in a linear towed array up to 500m behind the source vessel.

An integrated preamplifier with configurable gain and shelving EQ ensures the best signal to noise ratio.

The array is securely attached to the vessel in cooperation with the crew where it joins the deck lead, taking data to the acquisition unit.

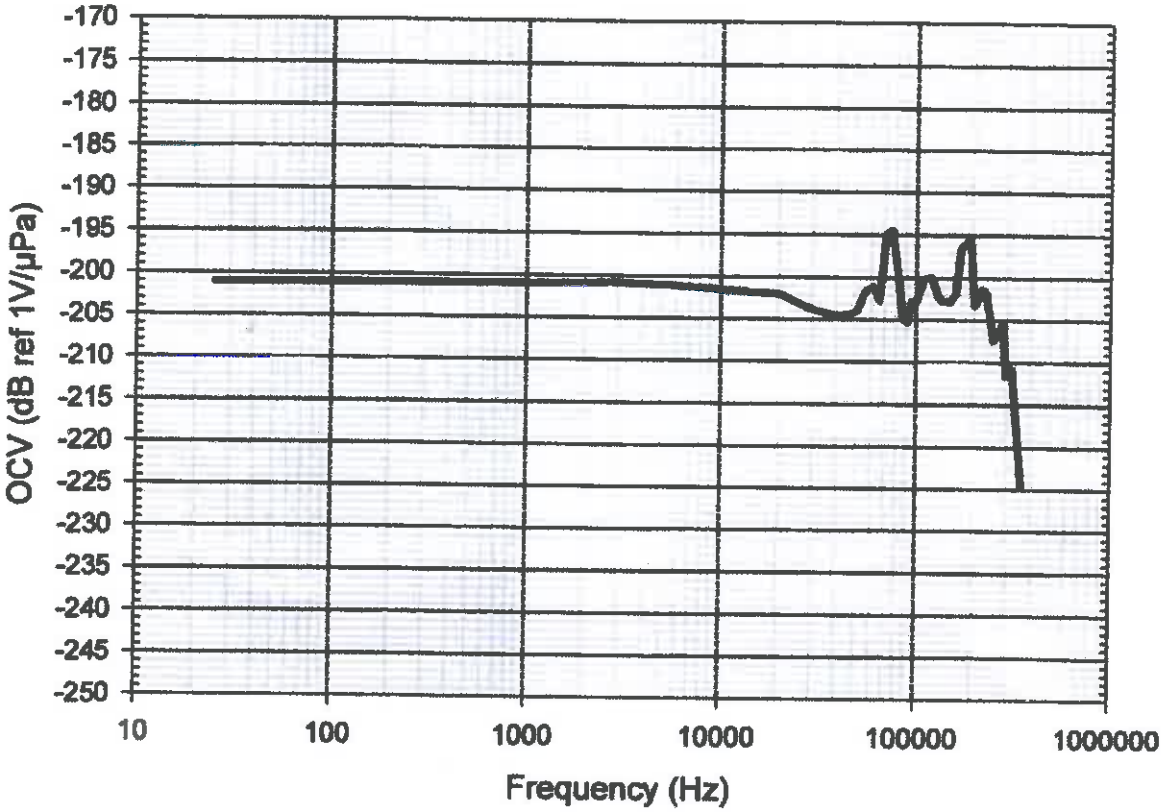
The acquisition unit distributes the signals to A/D converters, provides power and monitors array depth and voltage.

Computers running industry standard software process the incoming data through filters and envelope detectors providing data in any number of user configurable formats.

Using a combination of arrival time difference and real-time GPS data, a view of the mitigation zone can be monitored semi-automatically with Night Hawk and an experienced operator.

For more information regarding the MSeis Night Hawk system please visit our website at \ .
or contact

Receiving Voltage Response



Date: December 18, 2005
Acoustic Test Facility: Sensor Technology Limited
Transducer Model: [redacted]
Water Temperature: 20°C (68°F)
Test Frequency: 25 - 350000 Hz
Spacing: 0.8 meters
Depth: 0.7 meters
Plane: XY

SENSOR
Sensor Technology Limited

From MSeis PAM Wiki

Contents

Aquisition rack

History

, was the most recent permanent PAM system installed by ; on to the fleet. It was completed in July 2011.

Specification

- **Outboard**
  - TH33
  - TH34
  - 125m deck lead
- **8U Trolley Rack**
  - Acquisition Unit (Night Hawk III)
  - Acquisition Unit (Night Hawk III)
  - Heterodyne
- **Computers**
  - FIELDI3-01
  - FIELDI3-02
  - FIELDLENOVO04

- **Acquisition**
  - M-Audio Fast Track Ultra 8R
  - NI 9201
  - Cleanbox
- **Navigation**
  - RS232 Converter
- **Interconnects**
  - Power strip
  - Audio cables
- **Spares and Maintenance**
  - AAA Rechargeable
  - Tape measure
  - Cable ties
  - Cable weight
  - Ratchet straps
  - Portable speakers
  - M-Audio Fast Track Ultra
  - USB-1208 LS
  - Hi Speed USB carrier NI USB-9162

Deployment Guide

Equipment

Aboard the , there are currently (Oct 2011) two hydrophone tow cables, identified as MSeis array TH33 and TH34 measuring 250m in length. They are constructed from 16mm diameter polyurethane shielded cable reinforced with aramid fibre and completed with a SD16 deck connection. At the aft end of the hydrophone tow cable there are 4 solid hydrophone elements with a 1.5m spacing between each, beyond the hydrophones there is 2m length of cable and a two pin connector for attaching a depth sensor. Each hydrophone element has a flat frequency response of 0-140Hz and individual integrated 40dB pre-amplifiers. Also installed is a 125m length of 16mm diameter deck cable to the same specification at the hydrophone tow cable. Full details on on board component are listed above.

Installation

The hydrophone tow cable is installed on spread rope winch #1 ready for use once all seismic equipment has deployed. If seismic equipment is to be retrieved the PAM tow cable must be removed from the winch and decked to allow the winch to be used for recovery.

The deck cable is run from the instrument room under the flooring into the rack room then passed through a fire block to the gun deck below. From here it follows cable trays down the starboard side above gun string 1 and finally back up to the streamer deck next to spread rope winch #1. Here the remaining deck cable is coiled, there is plenty of excess cable should PAM need to be deployed from the port side.

A polypropylene attachment line, known as a Chinese Finger (see below) has been spliced to allow the PAM cable to be tethered to a lead-in. Two attachment lines are available for use, the line currently in use (DEC 2011) has plastic 'flags' along its length to increase drag. The other line does not have these 'flags'. Only a

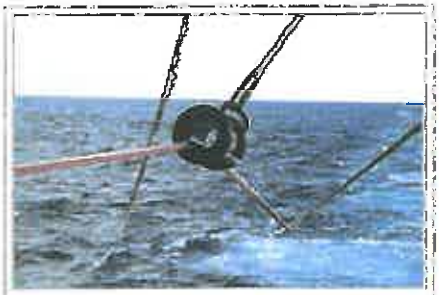
single tethering point is currently used, but it may be beneficial to add additional tether points/attachment lines along the PAM cable if deemed necessary as on similar 3D deployments such as on the A large horse collar is used to attach the top of the line to the lead-in and a P-link is used to attach the bottom of the line to the PAM cable tether point. The purpose of using the large horse collar is to allow the cable to slide down the lead-in, providing both support and spread to the hydrophone tow cable. Previously a large P-link was used however it is suspected that this did not create enough drag to effectively slide down the lead in and a bow was created in the PAM cable. It is worth noting that horse collars were previously trialed as sliders but it was decided that they were too heavy and created a lot of drag and strain on the cable, also they are were thought to be very noisy from vibration, obscuring the spectrogram display. The current marine crew (Dec 2011) has reverted back to using a horse collar. The horse collar is not 100% effective as a bow in the cable is still created. It is suspected that the collar slides only so far then as more cable is let out a bow is formed in the cable. The same problem occurred with the P-link. As mentioned above additional tether points would probably solve this problem.

Spread rope winch #1

Tethering points are created using Chinese fingers, they are made from 2m lengths of spectra rope that has been folded in half and spliced approximately 15cm from the midpoint to create a loop. The rope was then plated around the tow cable that has been wrapped in grip tape/bull dog tape to provide friction and protect the cable. Once the rope has been plated around the cable, the ends were tied off and finally layer of silver tape was applied tightly, ensuring the towing eye was left unobstructed. There are many experienced people on board that can assist with this.

The tethering point is positioned approximately 20m from the first hydrophone element.

A line of spectra rope has also been taped to the PAM cable at regular intervals. The idea is that the rope takes all the strain when the cable is deployed and retrieved. A PAM cable was snapped after deployment down a streamer lead in which also had gun lines attached. The guns were retrieved whilst the PAM cable was still deployed, resulting in a snapped cable. The solution to this is NOT TO DEPLOY THE CABLE DOWN THE STREAMER LEAD IN WHICH ALSO HAS GUN LINES ATTACHED TO IT. The addition of the spectra rope was in part in response to the snapped cable.



PAM cable deployed through pulley suspended from starboard traverse winch

Attachment rope

Deployment

First check with gun mechanics to ensure no gun retrieval or deployment is to occur, also double check the deck cable is disconnected from the hydrophone tow cable. It is recommended deployments take place while the vessel is travelling on a straight course so all seismic equipment is in normal operating positions. Do not attempt deployments in bad weather conditions which could result in the PAM cable becoming tangled around a lead-in. To begin with the PAM operator/s should ask one of the crew to turn on the hydraulic power to allow use of the winches. At the starboard side winch controls there are several shut off valves which enable/disable the levers below.

Tether point attached to cable (Chinese finger)

Lowered winch and fairlead block #4 prepared for deployment

1. Hydraulic shut off valves should be turned to the 12 o'clock position to enable hydraulic power.
2. The PAM cable is to be paid out until the tether point reaches the stern.
3. The starboard traverse winch should be lowered with a horse collar attached. The horse collar should be opened and then fastened behind (reel side) of the tether point.
4. The the polyprop separation rope is attached to the tether point using the small P-link. Silver tape should be wrapped around the P-link to ensure the link cannot vibrate open.
5. Fairlead towing block #4 should be lowered so the lead in is reachable.
6. The separation rope is now attached to the lead in using the large horse collar or P-link (the P-link should be wrapped with silver tape once again).
7. Fairlead towing block #4 should now be raised to the highest point to return the lead in to a normal towing position and also to ensure a steeper angle for the Horse collar / P-link to slide down.
8. The hydrophone section in front of the tether point should now be carefully lowered into the water.
9. The traverse winch should be raised approx 20cm so the cable does not rub against the rail.
10. The cable should now be driven out using the spread rope winch to allow the cable to slide down the lead in. If the P-link fails to slide it may necessary to feed out additional cable behind the tether point over the the stern into the water making a loop to create additional drag.
11. Once the P-link hits the water line the cable should pull sufficiently.
12. Do not deploy at a fast rate, try and maintain some light tension on the cable to stop loops from forming.
13. Once the PAM operator/s is satisfied with the positioning of the cable hydraulics should be turned off by moving the valve to the 3 o'clock position.

Finally connect the deck cable to the hydrophone tow cable.

Hydralic shut-off valve (in off position)

Spread rope winch #1 control

Opening pulley block to insert PAM cable

P-link attached to lead-in

Attaching separation rope to tether point

Sliding P-link down lead-in

Retrieval

The retrieval process is essentially the reverse of a deployment, however extra care should be taken at all stages as any mistakes can result in snapping the PAM cable while it is under tension. Ensure the winch is driven exceptionally slowly in bad weather conditions as surging will create extra tension. If you suspect the PAM cable could be wrapped around the lead in pay out additional slack while the situation is fully assessed with assistance from the seismic department. First check with gun mechanics to ensure no gun retrieval or deployment is to occur. It is recommended recovery takes place while the vessel is travelling on a straight course so all seismic equipment is in normal operating positions.

1. Power down the PAM system.
2. Disconnect the deck cable from the hydrophone tow cable!
3. Hydraulic shut off valves should be turned to the 12 o'clock position to enable hydraulic power.
4. Slowly drive the spread rope winch in to pull the cable up the lead in.
5. Try to distribute the cable evenly over the winch but avoid covering the connector.
6. When the tether point approaches the traverse winch it should be lowered and the horse collar pulled on board.
7. Fairlead towing block #4 should be lowered so the lead in is reachable.
8. Disconnect Horse collar and P-link from the lead in and tether point (respectively).
9. Open the horse collar to release the cable.
10. Continue to slowly retrieve the cable.
11. When the first hydrophone element is visible pull in the rest of the cable by hand as the cable is wound on to the winch, this is to prevent the hydrophone elements from being banged against the ship or rail.

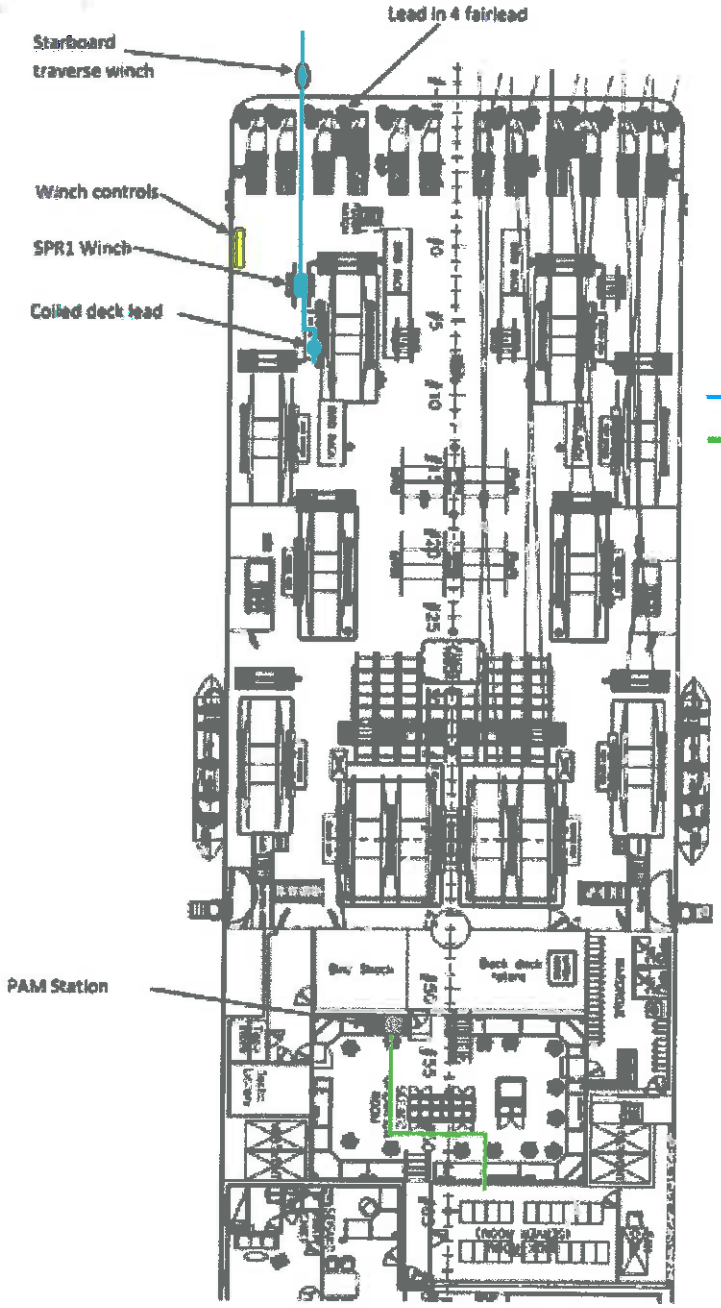
Fairlead towing block #4 should be raised to the normal towing position.

Health & Safety

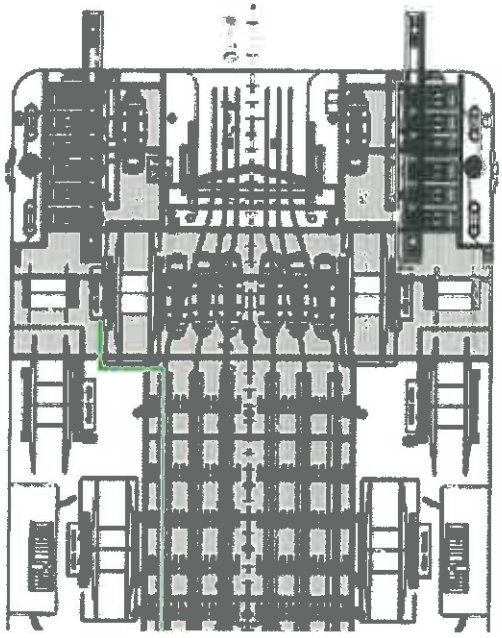
All PPE (safety boots, overalls, glasses, gloves and hard hat) must be used while working on the back decks. If persons are working towards the stern of the vessel, beyond the large red line marked on the deck, a life jacket is also required. Due to safety reasons it is highly advised that the deployment of the array should be conducted by no less than three persons. At all times you must be accompanied by a member of the seismic department when deploying or recovering the array. It is also recommended that the retrieval of the hydrophone array should be conducted during daylight hours to ensure no equipment is entangled prior to or during retrieval. Hydraulic winches are incredibly powerful and it is quite possible to snap a cable by driving them too fast. Do not recover the hydrophone cable to the deck and then store it after. This can have the potential for personnel to get their foot caught in a loop on deck and pulled over the stern or for the person retrieving it to have it pulled out of their hands (e.g. by surging of the vessel or seaweed becoming entangled) resulting in loss of control and damage to the cable.

Layout Diagrams

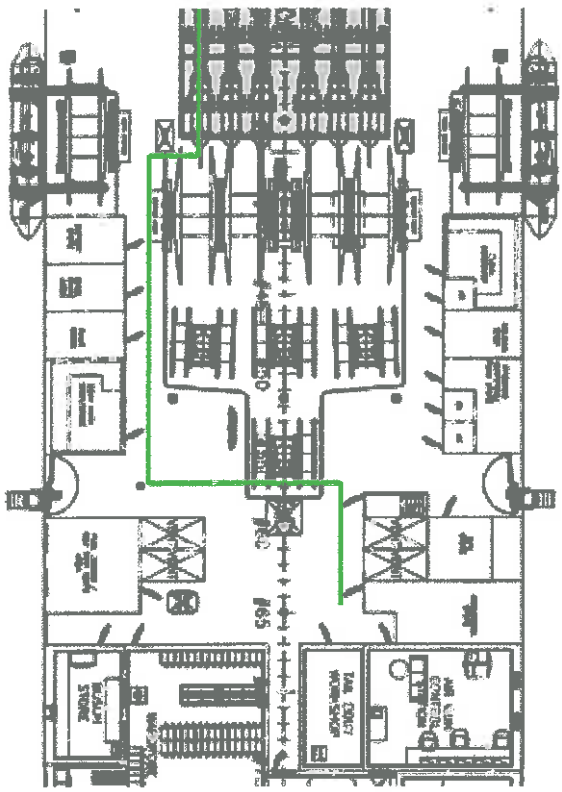
Cable routing



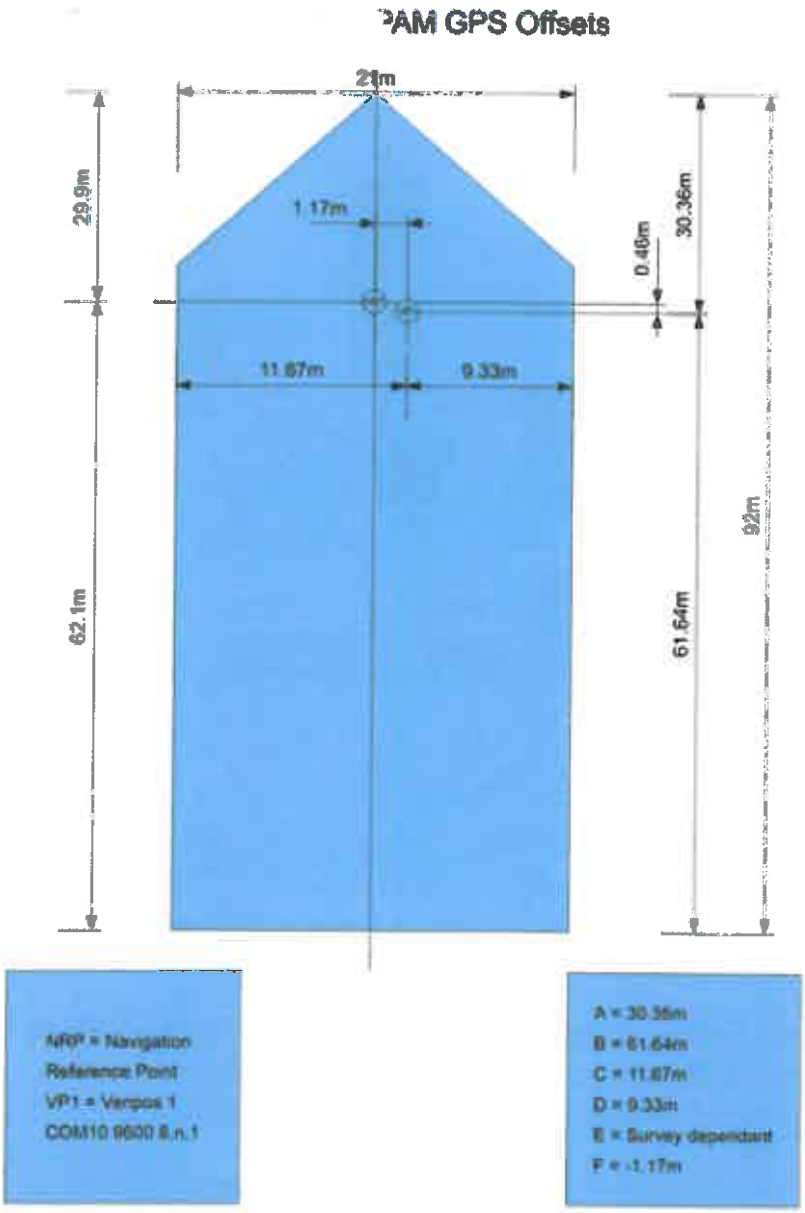
PAM routing diagram – Streamer deck



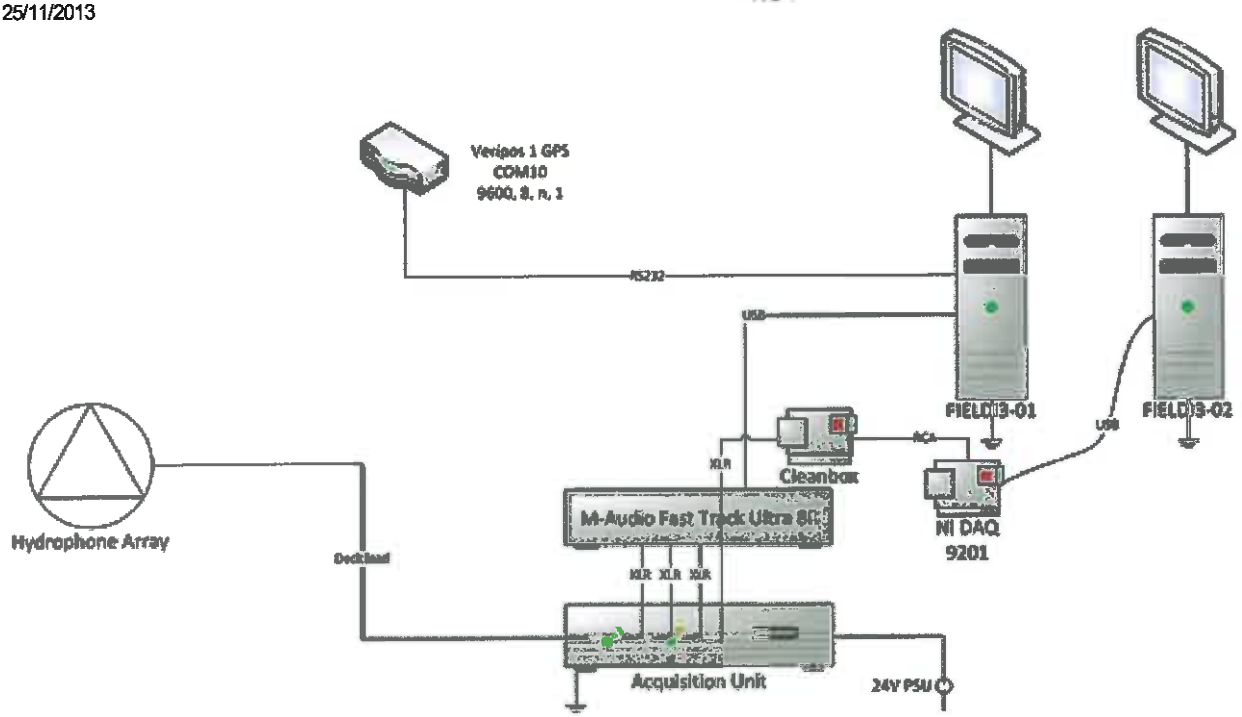
PAM routing diagram – Gun deck



GPS Offsets



Wiring overview



Handover notes

December 2011 - New Zealand

PAM deployment is described and photographed in the sections above, we are currently deployed using array TH34 down lead-in #4 from the starboard separation winch #1.

TH33 was initially deployed and found to be very sensitive on hydrophone elements 1 & 2. This array has be stored in a box on the port side of the streamer deck should you need to use it as a spare. MSeis have been informed of the situation and have a 3rd spare array on standby for shipping should it be required.

If the swell really picks up you will need to recover the array to prevent any risk of entanglement. As a rule of thumb if the weather is too bad for seismic production it is too bad to have PAM deployed. Always recover very carefully in bad weather conditions. If you have to recover make sure the seismic department know you will need additional warning to give you enough time to deploy the cable and complete your watch.

We have an operations desk set up in the instrument room with two PC's running PAMGuard, the system on the left is set up for 3 channel LF acquisition and the system on the right is set up for single channel HF acquisition.

Reporting runs from midnight to midnight UTC with the client requesting to be informed of any detections/sightings for the day. There are no weekly reports, but data is being gathered and summarised for the final report. Any potential shut down mitigation requires the party chief be informed immediately who will then authorise the shut down of the guns or line abort.

The PAM operator is the central point of contact for communication between the seismic department and MMO/PAM team. They are informing us 75 minutes before SOL and then also letting us know the time of soft start and full power. We are using UHF radios for most communications (currently on channel 2) however there are also internal phones you can use and relevant numbers have been posted at the PAM station, on the bridge and in cabins.

Additional PAM spare parts are located in the back deck store next to the PAM station in a black flight case. Some other items have been ordered from MSeis and are due to arrive on the next supply boat.

PPE is required for all back deck work, anything you are missing can be obtained from the gunners who have access to the PPE store. Life jackets are kept in the instrument room on the central column and also by the entrance to the changing room. For any deployment/recovery you must be accompanied by a member of the seismic team.

We have a very good working relationship with the rest of the crew, we have had no issues of non-compliance and they are readily available to help with any back deck work.

Food on board is excellent, meals are served 4 times a day at 5:30-6:30 and 11:30-12:30 both AM and PM. Between meals there seems to be an endless supply of treats! There is a pretty good DVD library on board in the day room and also games consoles to keep you entertained off shift. If you want to use the phones to call home you will need to get a PIN from the captain and you are allowed 40 minutes per week free and any additional usage is charged to you at the end of your rotation. Internet access is also good, you will need to connect to the WiFi network 'CABINS' and you will also need to enter proxy settings in your browser- Server: 10.106.1.3 and Port: 8081.

APPENDIX 3

Sound Transmission Loss Modelling for the Endurance 3D MSS

Clipper 3D Seismic Survey, Underwater Sound Level Modelling. Preliminary Results.

22/11/2013

Results are for a source depth of 8m.

Short range modelling results

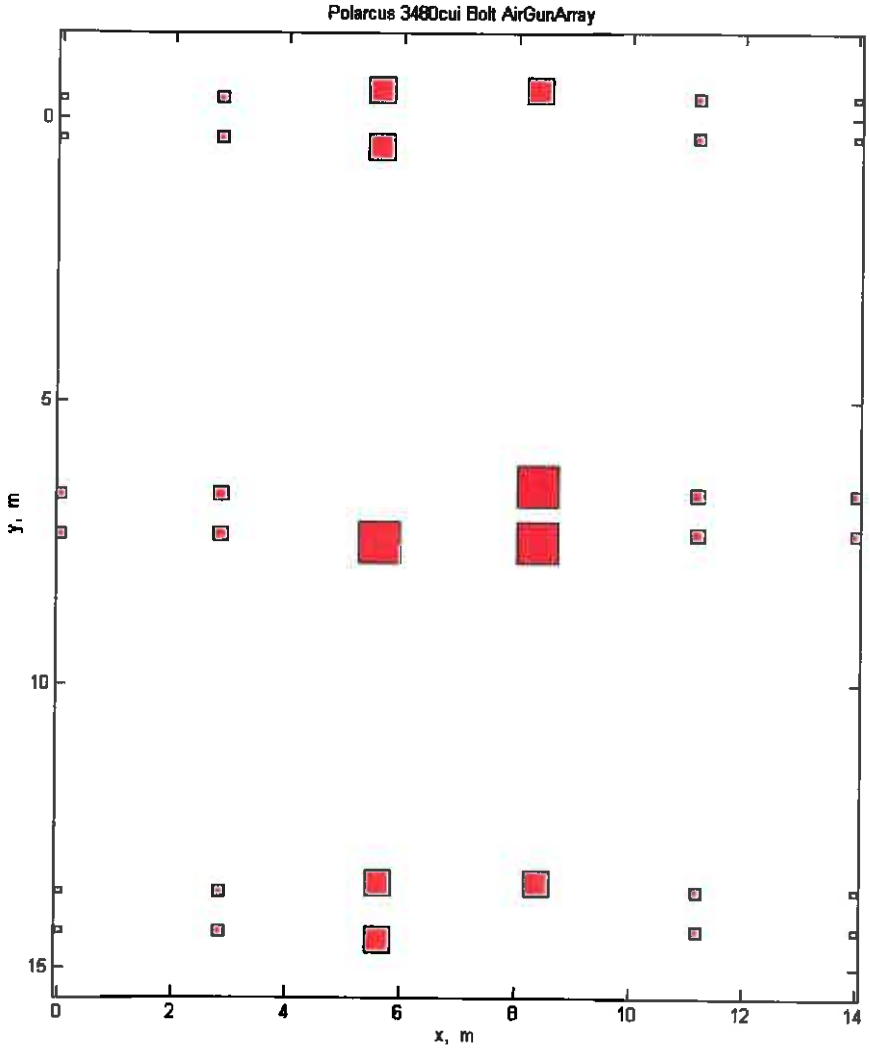


Figure 33. Plan view of the 3480 cui array. Array elements are shown much larger than actual size but are scaled proportional to the cube root of their volume.

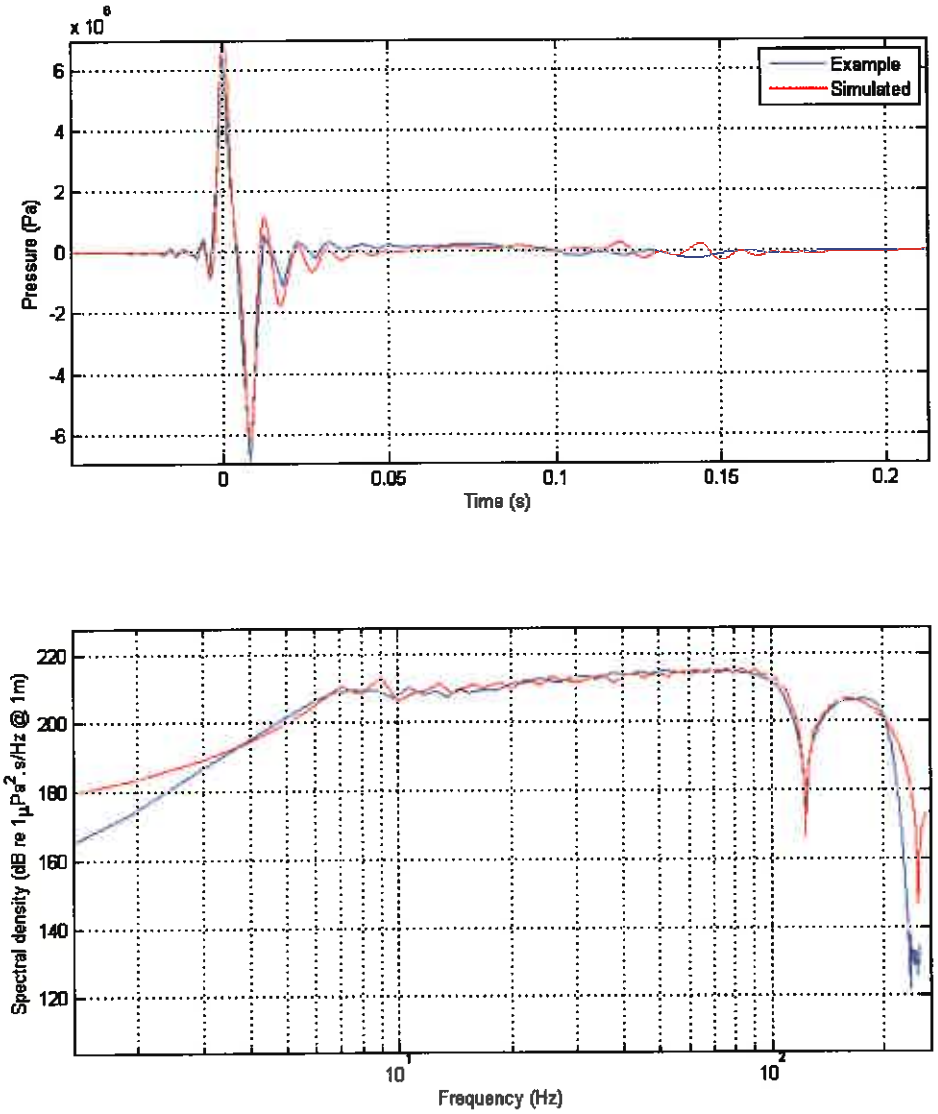


Figure 34. Comparison between the waveforms (top) and spectra (bottom) of the example signal for the vertically downward direction provided by the client (blue) and the signal produced by CMST's airgun array model (red).

Table 17: Shelf region, elastic seabed acoustic data used in propagation modelling.

Layer	Thickness (m)	Density ($kg.m^{-3}$)	Compress-ional wave speed ($m.s^{-1}$)	Compress-ional wave attenuation (dB per wavelength)	Shear Wave Speed ($m.s^{-1}$)	Shear wave attenuation (dB per wavelength)
Sand - Gravel Layer	30	1941	1749	0.7	N/A	N/A
		1986	1794		N/A	N/A
Sedimentary Basement	N/A	2400	3380	0.1	1670	0.2

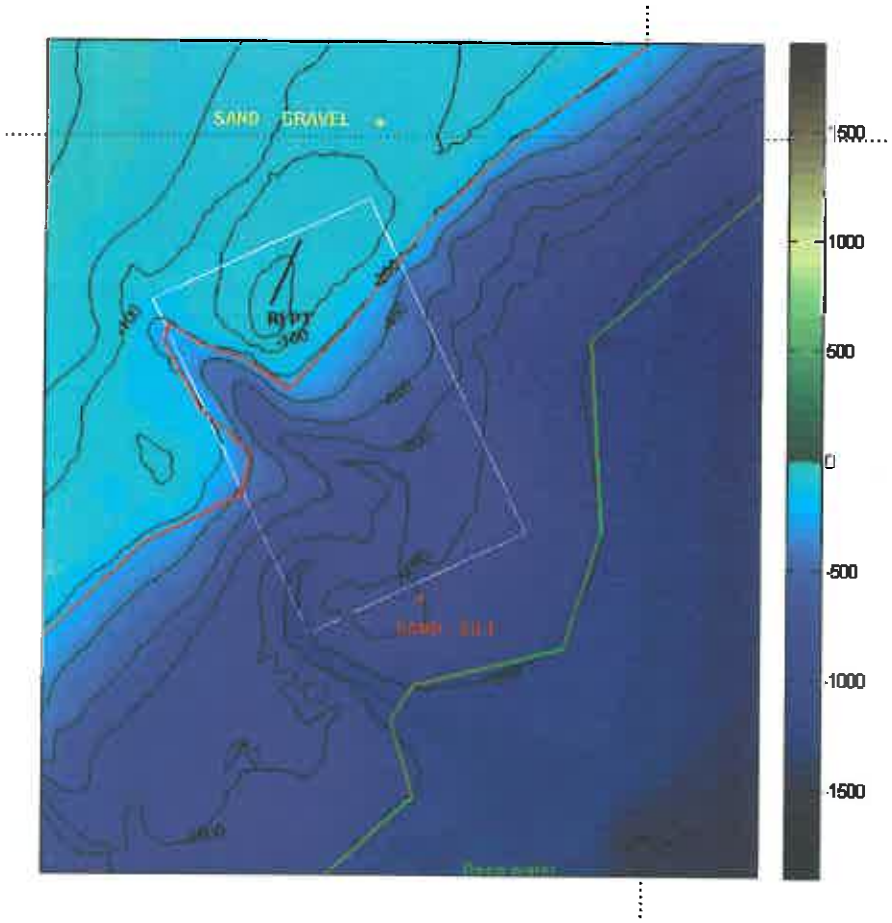


Figure 35. Location of the shallow water modelling point (RI PT) relative to the survey bounds (white plygon) showing detailed bathymetry contours.

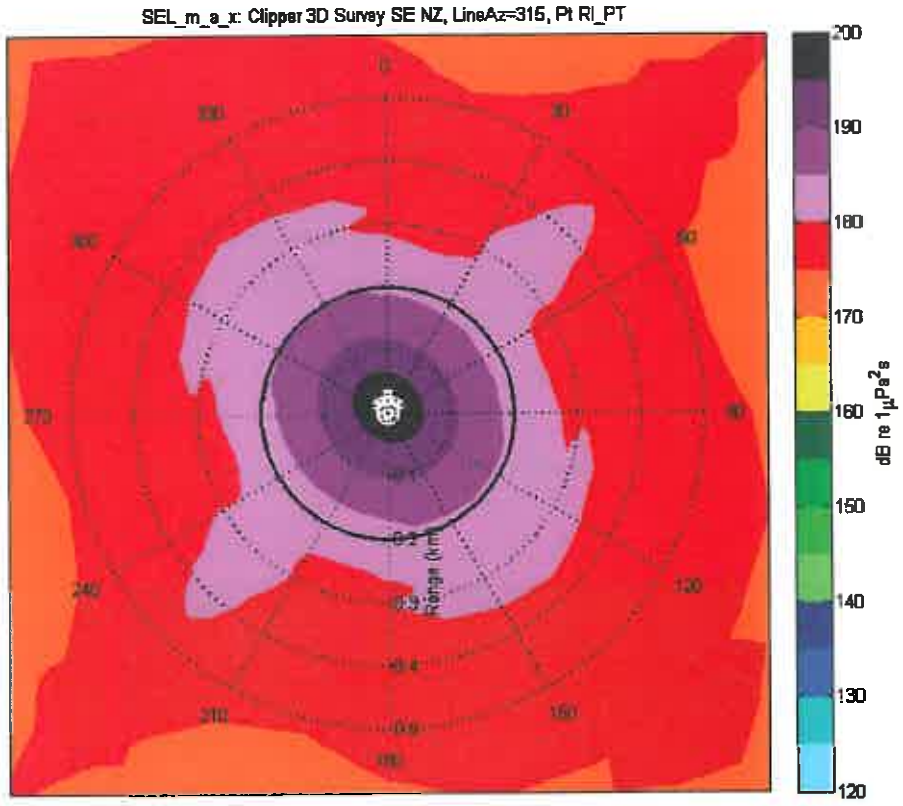


Figure 36. Predicted maximum received SEL at any depth as a function of azimuth and range from the source to a maximum range of 500m. An azimuth of 0° (up) corresponds to the in-line direction. The thick black circle corresponds to the 200m mitigation range.

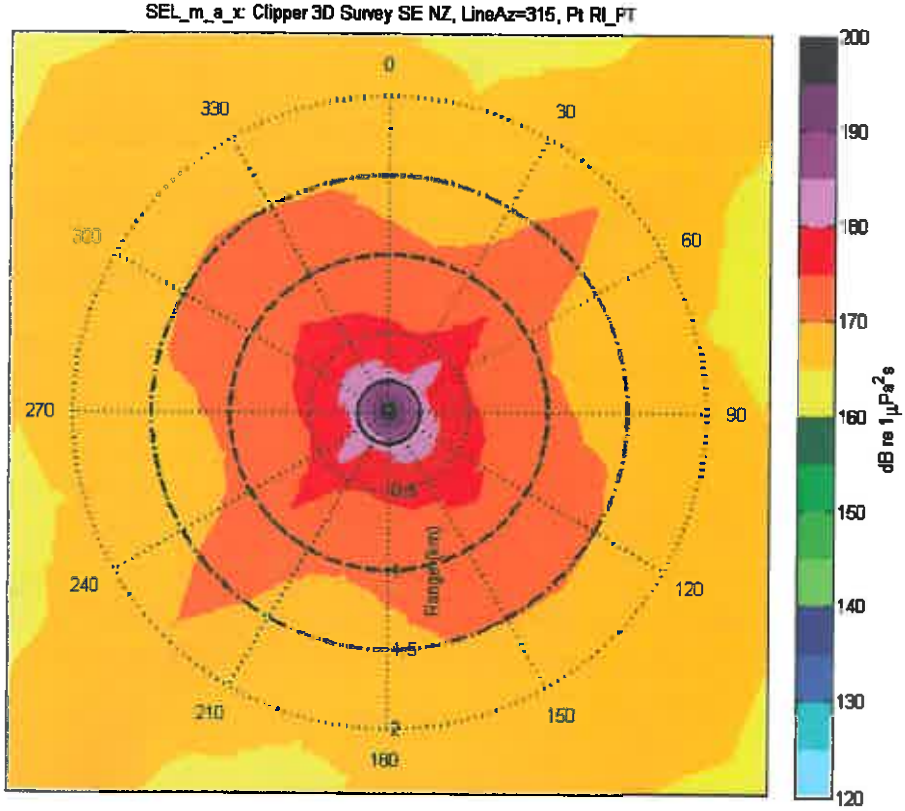


Figure 37. Predicted maximum received SEL at any depth as a function of azimuth and range from the source to a maximum range of 3km. An azimuth of 0° (up) corresponds to the in-line direction. The thick black circle corresponds to mitigation ranges of 200m (solid), 1km (dash), and 1.5km (dash-dot).

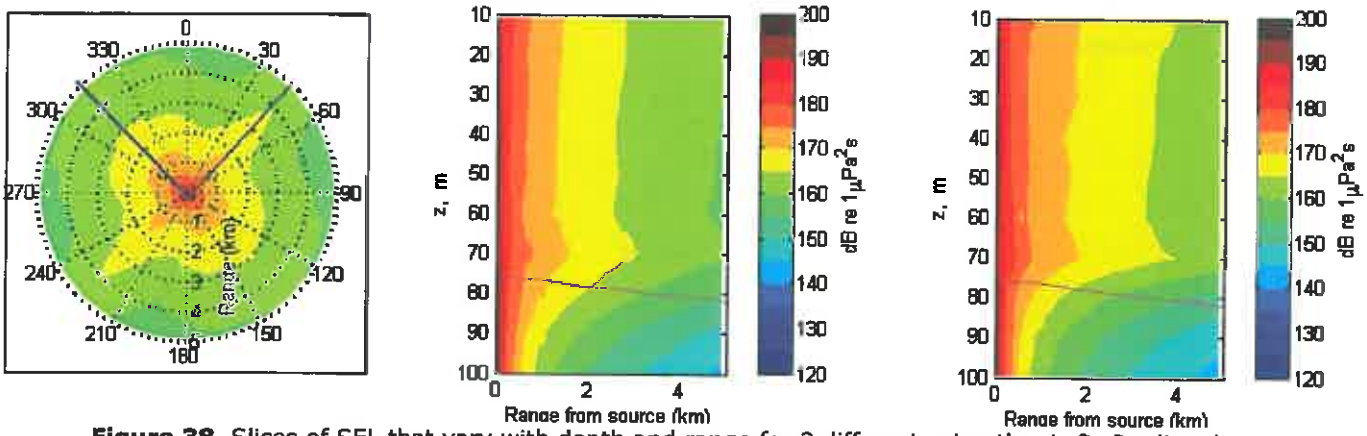


Figure 38. Slices of SEL that vary with depth and range for 2 different azimuths. Left: Predicted maximum received SEL at any depth as a function of azimuth and range from the source this slice azimuths shown by the thick blue lines. Centre: 315° azimuth (in-line) SEL cross-section. Right: 45° azimuth (cross-line) SEL cross-section.

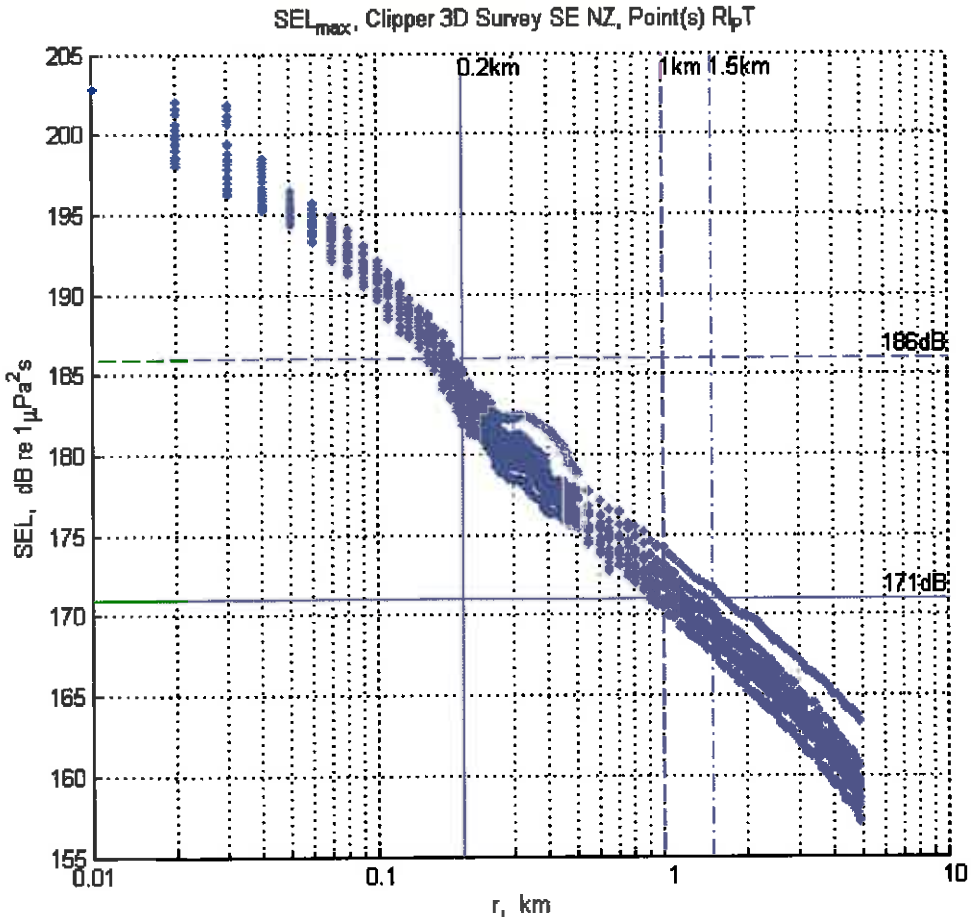


Figure 39. Maximum received sound exposure level at any depth as a function of horizontal range for all modelled azimuths.

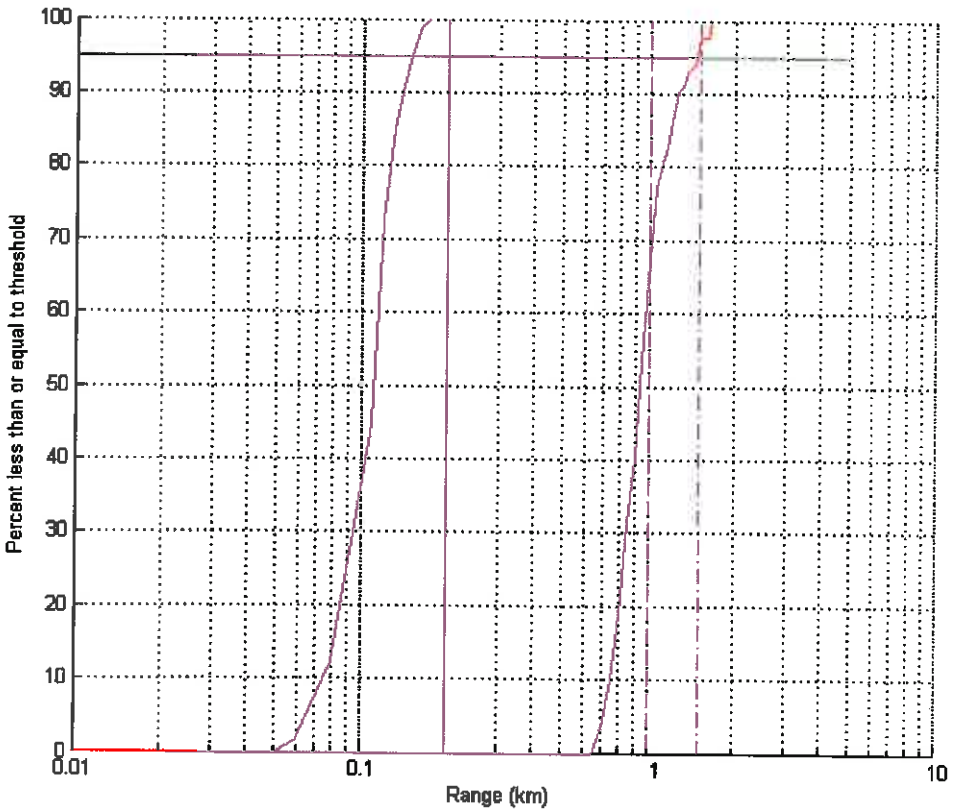


Figure 40. Percentage of received levels exceeding SEL thresholds of 186 dB re 1 $\mu Pa^2.s$ (blue) or 171 dB re 1 $\mu Pa^2.s$ (red) as a function of horizontal range. The green horizontal line is 95% and the vertical magenta lines correspond to ranges of 200m (solid), 1km (broken) and 1.5km (dash-dot).

Long range modelling results

The survey line direction is assumed to be 335° True, which is parallel to the long sides of the survey bounding box.

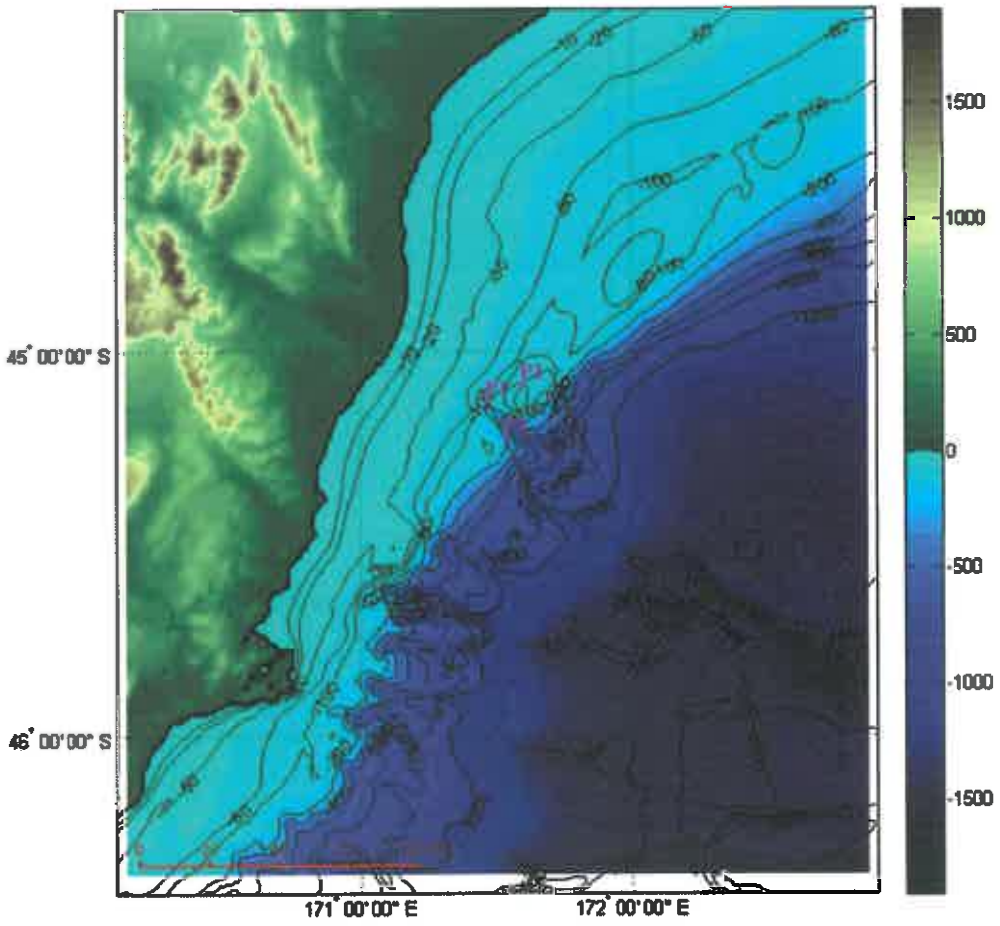


Figure 41. Bathymetry used for long-range modelling showing modelled source locations (P1 to P3).

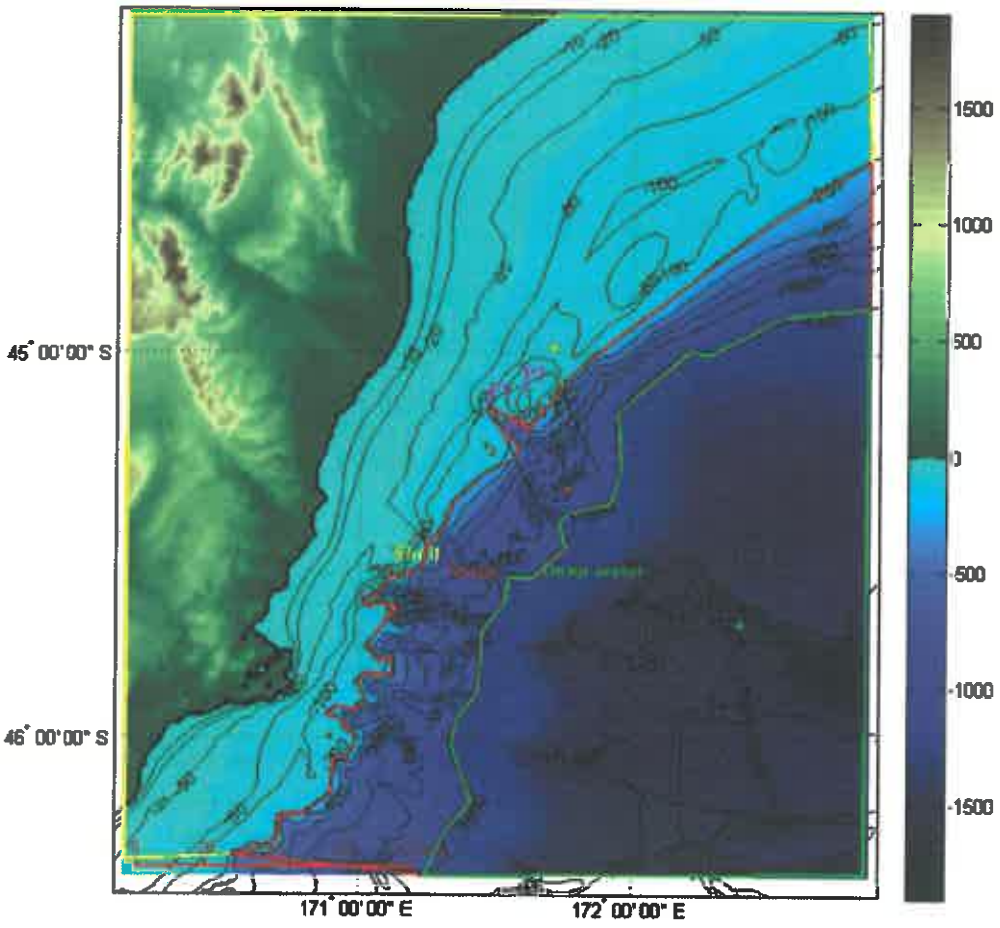


Figure 42. Geoacoustic regions used for long-range modelling.

Table 2: Shelf region seabed acoustic data used in propagation modelling.

Layer	Thickness (m)	Density ($kg.m^{-3}$)	Compressional wave speed ($m.s^{-1}$)	Compressional wave attenuation (dB per wavelength)
Sand- Silt Layer	30	1941	1749	0.7
		1986	1794	
Basement	N/A	1986	1794	0.1

Table 3: Slope region seabed acoustic data used in propagation modelling.

Layer	Thickness (m)	Density ($kg.m^{-3}$)	Compressional wave speed ($m.s^{-1}$)	Compressional wave attenuation (dB per wavelength)
Sand- Silt Layer	30	1772	1646	1.1
		1817	1691	
Basement	N/A	1817	1691	1.1

Table 4: Deep water region seabed acoustic data used in propagation modelling.

Layer	Thickness (m)	Density ($kg.m^{-3}$)	Compressional wave speed ($m.s^{-1}$)	Compressional wave attenuation (dB per wavelength)
Sand- Silt Layer	400	1556	1556	0.47
		2156	2156	
Basement	N/A	2156	2156	0.47

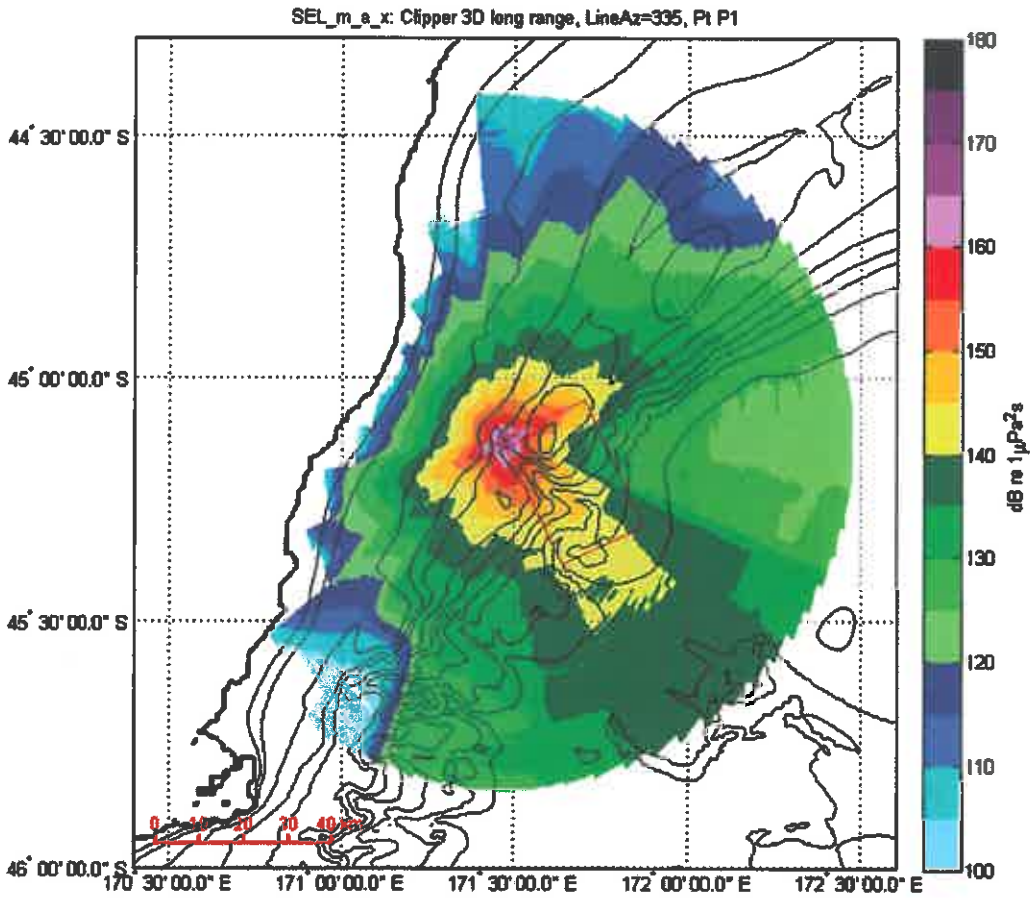


Figure 43. Geographical distribution of modelled sound exposure level for a source at P1. (Maximum level at any depth.) Note that the colour scale is different from that used for the short range plots above.

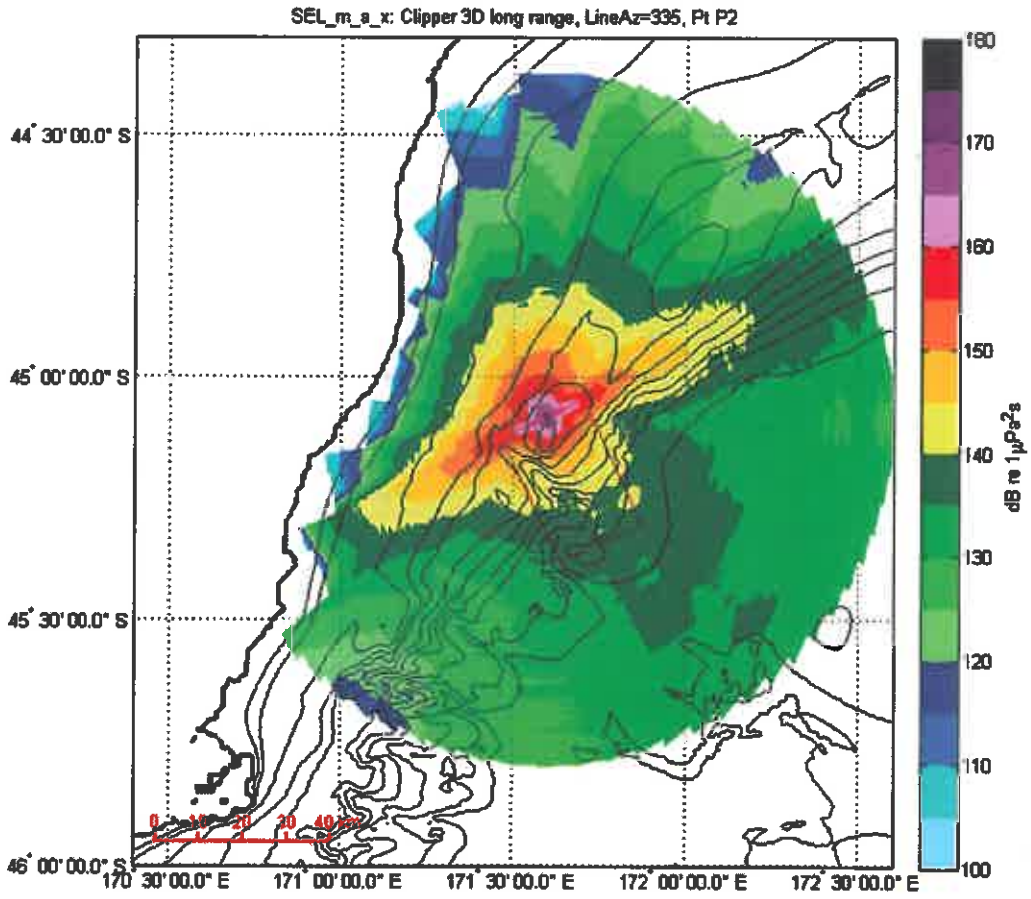


Figure 44. Geographical distribution of modelled sound exposure level for a source at P2. (Maximum level at any depth.) Note that the colour scale is different from that used for the short range plots above.

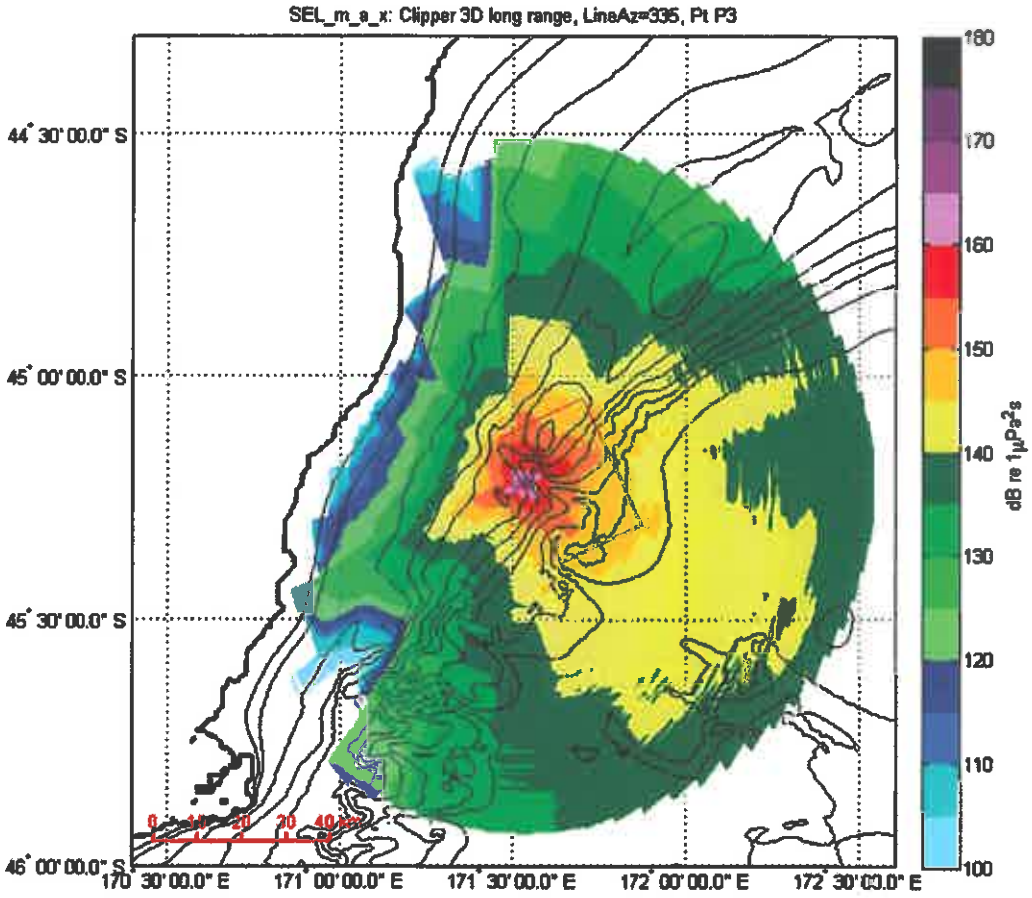


Figure 45. Geographical distribution of modelled sound exposure level for a source at P3. (Maximum level at any depth.) Note that the colour scale is different from that used for the short range plots above.

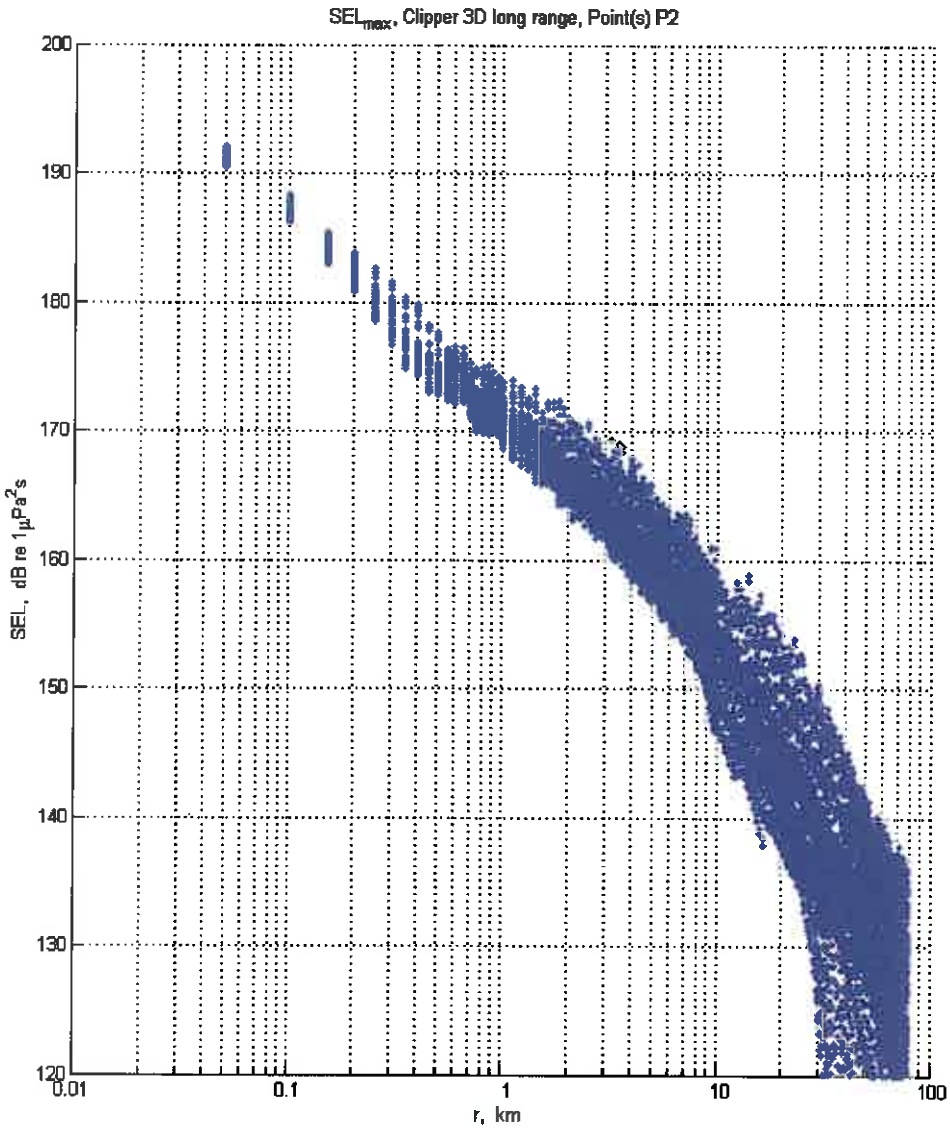


Figure 46. Maximum received sound exposure level at any depth as a function of horizontal range for all modelled azimuths from point P2. (Long-range modelling.)

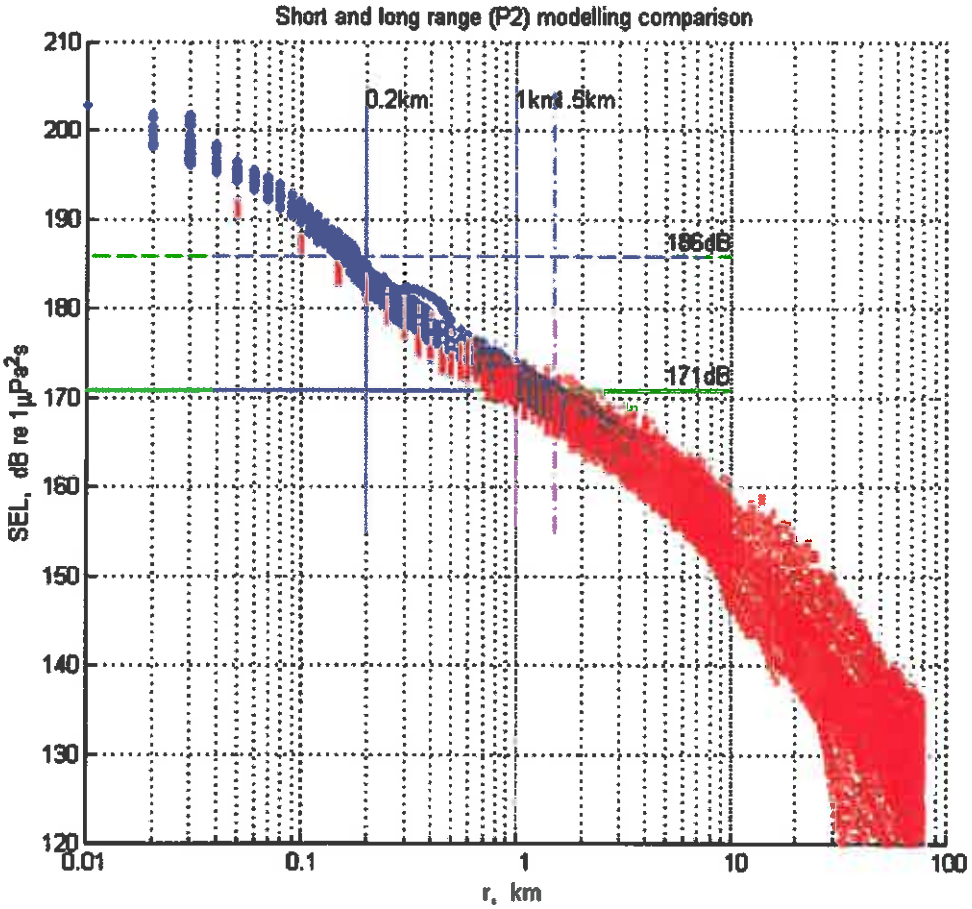


Figure 47. Maximum received sound exposure level at any depth as a function of horizontal range for all modelled azimuths. Blue points are short-range modelling results, red crosses are long-range modelling results for point P2.

APPENDIX 4

Marine Mammal Mitigation Plan for Endurance 3D MSS

RPS

Marine Mammal Mitigation Plan

Monitoring and Mitigation for the NZ Environment

Prepared For

NZOG





RPS

Prepared by:

RPS

au

Document No: AOE05930.MMMP
Version/Date: Rev0, December 2013

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Document Status

Version	Purpose of Document	Orig	Review	Review Date	Format Review	RPS Release Approval	Issue Date
DRAFT A	For Client Review				22.11.2013		22.11.2013
DRAFT B	For Client Review						03.12.2013
DRAFT C	For Client Review						05.12.2013
DRAFT D	FINAL DRAFT				05.12.2013		05.12.2013
DRAFT E	Revised FINAL DRAFT				07.12.2013		07.12.2013
Rev0	Final				07.12.2013		07.12.2013

Initials

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APPENDICES

1.0 INTRODUCTION

RPS Energy Pty Ltd has been contracted by NZOG to provide independent mitigation services in relation to marine mammal monitoring during the acquisition of the Endurance 3D marine seismic survey (3D MSS) located within the Canterbury Basin, offshore of the south-east coast of the South Island, New Zealand (Figure 1). The purpose built seismic vessel, be utilised to acquire seismic data for the expressed purpose of determining hydrocarbon deposits. The estimated duration of the survey is from the 15th of December 2013 to 10th – 15th of January 2014.

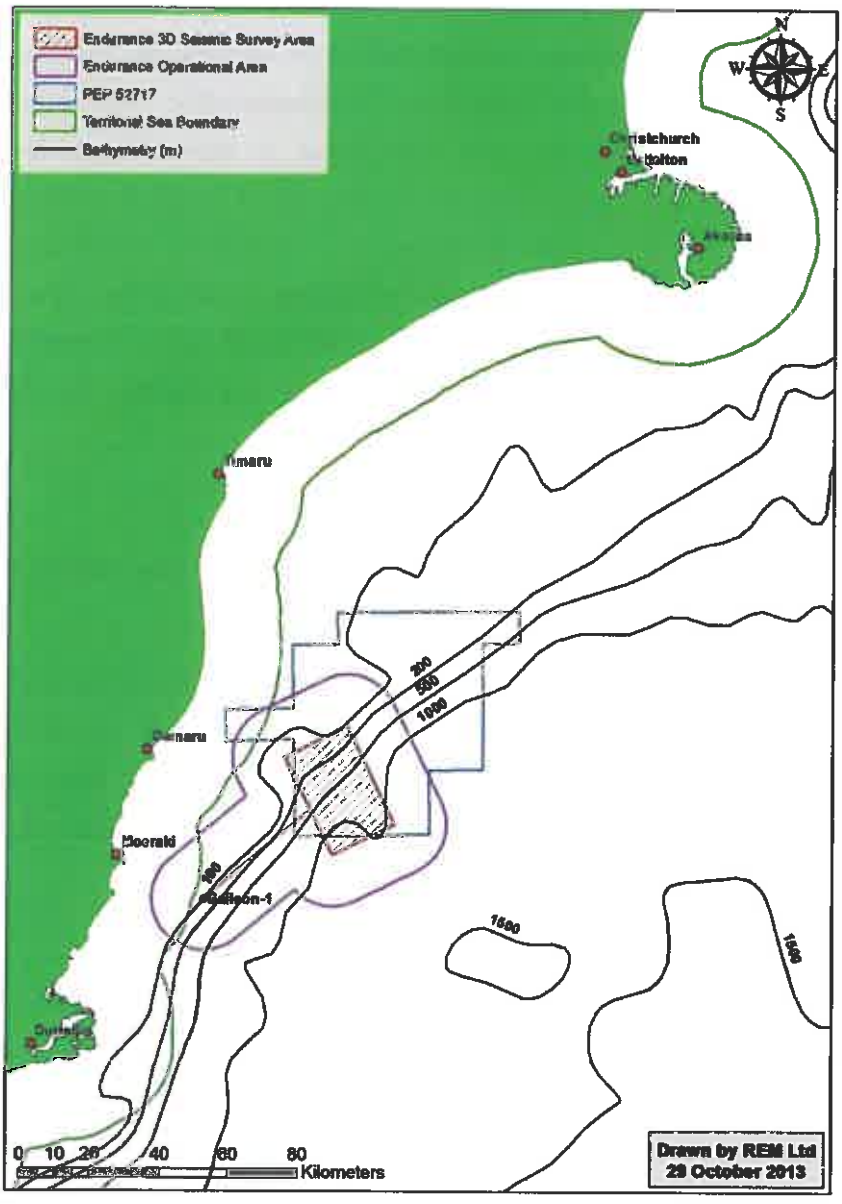

Figure 1: Endurance 3D MSS survey area outlined in red within Canterbury Basin (REM Ltd, 2013).

The use of a seismic source is required to collect seismic data and during operations introduces sound waves into the marine environment. With the introduction of sound into the marine environment, the potential exists wherein marine wildlife species may be negatively affected and/or disturbed. To reduce the risk of impact and/or disturbance, NZOG is committed to implementing the highest level of protection for marine wildlife species during survey operations. NZOG have also developed additional mitigation measures above and beyond the current requirements.

NZOG will employ four independent third party observers contracted through RPS Energy Pty Ltd to remain onboard the survey vessel, throughout the Endurance 3D MSS. The role of the independent observers is to ensure management measures for the protection of marine wildlife species are adhered to in accordance with the local regulatory requirements issued by the Department of Conservation (DOC) *Code of Conduct - Guidelines for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* (DOC, 2013) (Appendix 1) and NZOG's own company polices for environmental protection. NZOG fully recognises the importance of maintaining an exceptionally high level of stewardship and care while operating within the unique and diverse New Zealand marine environment. In demonstration of NZOG commitments, NZOG will implement additional mitigation measures above and beyond the *Code of Conduct* (DOC, 2013).

1.1 PURPOSE AND SCOPE: Marine Mammal Mitigation Plan (MMMP)

The purpose of this document is to itemise in detail current legislative requirements for the protection of marine species as related to the undertaking of a seismic survey in New Zealand waters in addition to a full description of management measures, protocols and procedures required for implementation to reduce any associated risks of disturbance to marine wildlife during survey operations.

1.2 OBJECTIVES: Marine Mammal Mitigation Plan (MMMP)

The objectives of the MMMP set forth below are designed to achieve compliance in accordance with local regulatory requirements and NZOG's own environmental commitments during the proposed project work. Four qualified observers meeting the

Code of Conduct (DOC, 2013) requirements and approved by DOC to undertake designated roles during the survey include 2 X Marine Mammal Observers and 2 X PAM Operators who will:

- Support NZOG in achieving compliance with environmental legislative obligations and NZOG's own environmental commitments for marine mammal species protection during the Endurance 3D MSS;
- Provide concentrated monitoring both visually and acoustically for 'Species of Concern' stipulated in the *Code of Conduct* (DOC, 2013) on a 24 hour basis;
- Record all required observational, acoustic and survey data on a daily basis using required DOC customised Excel data forms (Appendix 2);
- Provide detailed reporting on a daily / weekly basis using standardised report forms which capture all pertinent project data (Appendix 3);
- Produce a comprehensive final report upon completion of the survey describing overall performance and conduct of the survey in accordance with DOC's requirements;
- Provide immediate notification in the event of a non-compliance, resolution and measures to prevent re-occurrence;
- Provide sound recommendations regarding interactions with marine mammal species and/or additional marine mega-fauna species to further reduce any potential impacts.

1.3 Role of RPS Energy Pty Ltd

RPS Energy Pty Ltd has been contracted by NZOG to provide an independent assessment in relation to the overall performance and conduct of the Endurance 3D MSS. RPS Energy Pty Ltd will deploy DOC 'qualified' and experienced offshore personnel to monitor and mitigate during survey operations in accordance with stipulated regulatory requirements for marine species and the marine environment, NZOG's own environmental commitments, while also providing continuous onshore project management support.

2.0 MARINE MAMMAL MITIGATION PLAN – REQUIREMENTS

2.1 Relevant Legislation and Other Guiding Documents

Applicable national legislation for the preservation and protection of marine species and the marine environment during survey operations will include:

- Marine Mammal Protection Act 1978
- Marine Mammal Protection Regulations 1992
- Wildlife Act 1953
- Marine Mammal Impact Assessment (MMIA)
- The Exclusive Economic Zone and Continental Shelf (Environmental Effects-Permitted Activities) Act (EEZ Act 2013)
- *Code of Conduct - Guidelines for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* (DOC, 2013)
- NZOG's HSE Plan

2.2 Marine Mammal Protection Act 1978, Marine Mammal Protection Regulations 1992 and Wildlife Act 1953

The Marine Mammal Protection Act 1978 institutes protection for all whales, dolphins, porpoises and seals from injury, herding, harassment and disturbance. The Wildlife Act 1953 provides protection for all wildlife to include a small number of marine species such as whale sharks and manta rays pursuant to an amendment on 8 July 2010, schedule 7A, by the office of the Minister of Conservation (DOC, 2010). Both Acts are administered by the Department of Conservation (DOC).

An additional requirement under the Marine Mammal Protection Regulations 1992 mandates prompt reporting of any injured or entangled marine mammal species to the Department of Conservation (Appendix 4) and a specific code of practice for non-acoustic related vessel interactions with marine mammals to avoid collision (DOC, 2011).

In the event a marine mammal species is observed injured or entangled or vessel collision with a marine mammal has occurred, DOC shall be notified immediately

and a separate report (Appendix 5) providing specific details of the event shall be completed.

EEZ Act 2013

The Exclusive Economic Zone (EEZ) and Continental Shelf (Environmental Effects-Permitted Activities) Act (EEZ Act) came into effect on 28 June 2013. Under the EEZ Act Marine Seismic Surveys are classified as permitted activities provided the activity complies with the *Code of Conduct* (2013).

2.3 Code of Conduct during Seismic Surveys

In accordance with the above legislative requirements, the Department of Conservation has produced the *Code of Conduct – 'Guidelines for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations'* (DOC, 2013) which details specific procedures and protocols designed to reduce any potential impacts to marine mammals during seismic operations which includes:

- 'Qualified' observers maintain continuous visual and acoustic surveillance for marine species, with specific emphasis placed upon "Species of Concern";
- Dedicated, 'qualified' observers will delay or halt seismic operations if any 'Species of Concern' or other marine mammal approaches within relevant mitigation zone(s) 1500m – 200m of the seismic source;
- Required data on observer effort, operations, sightings / acoustic detections and mitigating actions will be logged daily to DOC's standardised datasheets.

2.3.1 Additional Mitigation Measures Required by NZOG

NZOG have committed to additional mitigation measures above and beyond the Code of Conduct in accordance with their internal company policies to ensure safeguard of marine species and the marine environment while undertaking the

Endurance 3D MSS and to meet commitments within the Marine Mammal Impact Assessment (MMIA). These management measures include:

1. Qualified Observers will maintain observations for marine species during vessel transit periods to / from the survey area. Any animals observed will be recorded to the appropriate 'Off Survey' forms required by DOC;

2. During the Endurance 3D MSS, if MMOs consider increased numbers of cetaceans and/or other Species of Concern are encountered than initially described as in the Marine Mammal Impact Assessment (MMIA), the Director-General shall be informed immediately;

3. Should any stranding of marine mammals occur ashore between Otago Peninsula and Banks Peninsula during the Endurance 3D MSS or two weeks following completion, a necropsy will be performed by Massey University researchers in an attempt to determine cause of death;

4. Provision of MMO and PAM Weekly reports to NZOG for forward to the Department of Conservation and Environmental Protection Authority;

5. Intention for support vessel to assess bathymetry in the NW buffer zone prior to commencement of the survey in order to identify any bathymetrical anomalies which are not illustrated on charts;

6. Intention to avoid acoustic source testing in waters depths < 100m;

7. Intention to minimise the run-in distance at the start of each survey line in the NW section of the buffer zone;

8. Intention to approach survey lines which abut the buffer zone water depths of < 100m from the NW and SE direction in order to minimise sound input into shallow waters;

9. Assurance the tie-in line to the Galleon-1 well will be conducted in a NE to SW direction in order to provide animals in the distal part of this line ample opportunity to leave the area as sound levels increase during the vessel's approach from deeper water;

10. Intention to ensure 'in country' availability of a back up PAM system in the event that the primary system malfunctions and cannot resume monitoring;

11. Increased mitigation zone(s) for marine mammal species during seismic operations conducted in shallow waters; < 80m and 80 - 275m (Section 4.4). Deep water seismic operations > 275m follow relevant mitigation zone(s) for marine mammal species within the *Code of Conduct* (2013);

12. Ground truthing of received sound levels at mitigation distances, with particular emphasis on fine scale results at the shallow water depths (specifically along the tie-in line to the Galleon-1well site).

13. The immediate notification of the Department of Conservation of any ground-truthing results that indicate the mitigation zones are insufficient for providing protection to marine mammals from physiological or behavioural impacts.

2.3.2 Management of Additional Mitigation Measures

Numbered items listed in Section 2.3.1 will be the responsibility and monitored by the following personnel to ensure compliance with the requirements as follows:

MMO / PAM Personnel:
Numbered items: 1,2,4, 6 and 11.

NZOG Client Representative, Polarcus Party Chief, Polarcus Seismic Chief Observer:
Numbered items: 5,7,8,9,12 and 13.

NZOG:
Number items: 3

NZOG Project Manager:
Number items: 10

2.3.3 Seismic Survey Power Levels and Use of Mitigation Source

As stipulated within the *Code of Conduct* (DOC, 2013) sound emissions during the survey should be kept to the minimum levels needed to acquire data while avoiding unnecessary or prolonged activation of the source at higher levels when not collecting data.

Moreover, the *Code of Conduct* (DOC, 2013) does not support nor encourage the use of a small, single airgun (mitigation or low power source) to act as a deterrent to marine species and thus should not be engaged. The combined monitoring effort of both visual and passive acoustic monitoring will provide 24 hours surveillance for species presence. Therefore the seismic source should be switched off entirely at the end of each survey line.

2.3.4 Species of Concern (SOC)

According to the *Code of Conduct* (DOC, 2013), all marine mammals are afforded protection under the Guidelines, however, certain marine mammal species are designated as 'Species of Concern' (Table 1) are afforded a higher

level of protection due to the species type and/or species conservation status as follows:

- All whales as defined in the Marine Mammal Protection Regulations 1992: *'Whale means all species commonly known as whales and includes baleen whales, sperm whales, beaked whales, killer whales and pilot whales';*

- Hector's and Maui dolphins – on the basis of specific national conservation concern for these species (critically endangered);

- Any additional species recommended for inclusion by the Department of Conservation on a case by case basis as specific concerns arise.

Table 1: Species of concern and NZ threat classification (DOC, 2012; 2009).

Baleen whales	**Scientific Name**	**NZ Threat Classification**
Humpback whale	*Megaptera noveangliae*	Migrant
Blue whale	*Balaenoptera musculus*	Migrant
Pygmy blue whale	*Balaenoptera brevicauda*	Migrant
Antarctic minke whale	*Balaenoptera bonaerensis*	Migrant
Dwarf minke whale	*Balaenoptera acutorostrata*	Not Threatened
Sei whale	*Balaenoptera borealis*	Migrant
Fin whale	*Balaenoptera physalus*	Migrant
Southern right whale	*Eubalaena australis*	*Nationally Endangered*
Pygmy right whale	*Caperea marginata*	Data Deficient
Bryde's whale	*Balaenoptera edeni*	*Nationally Critical*
Toothed whales	**Scientific Name**	**NZ Threat Classification**
Sperm whale	*Physeter macrocephalus*	Migrant
Pygmy sperm whale	*Kogia breviceps*	Data Deficient
Dwarf sperm whale	*Kogia simus*	Vagrant
Gray's beaked whale	*Mesoplodon grayi*	Data Deficient
Arnoux's beaked whale	*Berardius arnouxi*	Data Deficient
Cuvier's Beaked whale	*Ziphius cavirostris*	Data Deficient
Strap-toothed beaked whale	*Mesoplodon layardii*	Data Deficient

Southern bottlenose whale	*Hyperoodon planifrons*	Data Deficient
Andrew's beaked whale	*Mesoplodon bowdoini*	Data Deficient
Dense beaked whale	*Mesoplodon densirostris*	Data Deficient
True's beaked whale	*Mesoplodon mirus*	Data Deficient
Gingko-toothed whale	*Mesoplodon gingkodens*	Data Deficient
Hector's beaked whale	*Mesoplodon hectori*	Data Deficient
Pygmy beaked whale	*Mesoplodon peruvianus*	Data Deficient
Shepherd's beaked whale	*Tasmacetus shepherdi*	Data Deficient
Spade-tooth beaked whale	*Mesoplodon traversii*	Data Deficient
Southern right whale dolphin	*Lissodelphis peronii*	Not Threatened
Killer whale	*Orcinus orca*	*Nationally Critical*
False killer whale	*Pseudorca crassidens*	Not Threatened
Pygmy killer whale	*Feresa attenuata*	*Not listed*
Long-finned pilot whale	*Globicephala melas*	Not Threatened
Short-finned pilot whale	*Globicephala macrorhynchus*	Not Threatened
Bottlenose dolphin	*Tursiops truncatus*	*Nationally Endangered*
Hector's dolphin	*Cephalorynchus hectori*	*Nationally Endangered*
Maui dolphin	*Cephalorynchus hectori maui*	*Nationally Critical*
Pinnipeds	**Scientific Name**	**NZ Threat Classification**
New Zealand sea lion	*Phocarctos hookeri*	*Nationally Critical*

2.3.5 Areas of Ecological Importance

Within the *Code of Conduct* (DOC, 2013) specific areas for marine species are described as Areas of Ecological Importance (AEI) (Figure 2) which includes Marine Mammal Sanctuaries. These areas support a diversity of marine species either on a permanent or seasonal basis and are ecologically important for marine species survival. A list of specific area locations and associated marine species are depicted within Table 2.

The proposed survey area for the Endurance 3D MSS is located within an area of ecological importance. Table 3 outlines the species that have been identified as potentially being present in this area.

Other important areas directly related to marine mammal species are the marine mammal sanctuary zones of which a total of 6 exist throughout New Zealand

waters. The South Island maintains four marine mammal sanctuary zones for marine species (Figure 3). The proposed survey area is located 120km south south-west of the Banks Peninsula Marine Mammal Sanctuary (Figure 4). The Banks Peninsula Marine Mammal Sanctuary encompasses 389.31 km of coastline and extends 12 nautical miles (nm) seaward from the coast for a combined total area of 413,000 hectares and is situated along the south-east coast of the south island between the mouths of the Rakaia and Waipara rivers. This particular sanctuary provides important habitat area for the nationally endangered Hector's dolphins (DOC).

Table 2: Areas of permanent and seasonal ecological importance (DOC, 2006).

Permanent Ecological Importance Description of Area	**Latitude Range**	**Species of Concern**
Kaipara Harbour – New Plymouth	36°30' S- 39°4' S	Maui's dolphins
Kahurangi Point – Jackson Head Oamaru – Port Underwood Long Point – Chaslands Mistake	40°46'S - 43°58'S 41°21'S - 45°07'S 46°15'S - 46°38'S	Hector's dolphins
Kaikoura	42°210'S - 42°50S	Sperm and Beaked Whales
Hauraki Gulf	36°00'S - 37°00'S	Bryde's whales
Bay of Plenty East Coast Northland Chatham Rise	36°45'S - 37°45'S 34°40'S - 35°50S 43°00'S - 52°40'S	Beaked whales
Southern New Zealand	45°45'S - 52°40'S	New Zealand sea lion and southern right whales
Seasonal Ecological Importance Description of Area	**Latitude Range**	**Species of Concern & Season**
East coast / Hawkes Bay Cook Strait Otago Southland / Stewart Island	37°30'S - 39°40S 41°00'S - 41°35'S 45°20'S - 46°05'S 46°40'S - 47°15'S	Southern right whales (May – Oct for all areas identified)
Central New Zealand East & West Coasts North Island	40°50'S - 42°45'S 35°00'S - 38°00'S	Humpback whale (May - Oct) Humpback whale (Sept – Dec)

Table 3: Species of concern and other marine mammals which may potentially occur within the survey area.

BALEEN WHALES	TOOTHED WHALES	PINNIPEDS	SCIENTIFIC NAME
Humpback whale*			*Megaptera noveangliae*
Blue whale*			*Balaenoptera musculus*
Pygmy Blue whale*			*Balaenoptera brevicauda*
Minke whale*			*Balaenoptera bonaerensis*
Sei whale*			*Balaenoptera borealis*
Southern right whale*			*Eubalaena australis*
Pygmy right whale*			*Caperea marginata*
Fin whale*			*Balaenoptera physalus*
	Sperm whale*		*Physeter macrocephalus*
	Pygmy sperm whale		*Kogia breviceps*
	Dwarf sperm whale		*Kogia simus*
	Gray's Beaked whale*		*Mesoplodon grayi*
	Arnoux'sBeaked whale*		*Berardius arnouxi*
	Curvier's Beaked whale*		*Ziphius cavirostris*
	Strap-toothed beaked whale*		*Mesoplodon layardii*
	Southern bottlenose whale*		*Hyperoodon planifrons*
	Andrew's beaked whale*		*Mesoplodon bowdoini*
	Blainsville's beaked whale*		*Mesoplodon densirostris*
	Gingko-toothed whale*		*Mesoplodon gingkodens*
	Hector's beaked whale*		*Mesoplodon hectori*
	Pygmy beaked whale*		*Mesoplodon peruvianus*
	Shepherd's beaked whale*		*Tasmacetus shepherdi*
	True's beaked whale*		*Mesoplodon mirus*
	Hector's dolphin*		*Cephalorhynchus hectori*
	Dusky dolphin		*Lagenorhynchus obscurus*
	Common dolphin		*Delphinus delphis*
	Killer whale*		*Orcinus orca*
	False Killer whale*		*Pseudorca crassidens*
	Long-finned Pilot whale*		*Globicephala melas*
	Short-finned Pilot whale*		*Globicephala macrorphynchus*
	Bottlenose dolphin*		*Tursiops truncates*
	Striped dolphin		*Stenella coeruleoalba*

	Hourglass dolphin		*Lagenorhynchus cruciger*
	Southern right whale dolphin		*Lissodelphis peronii*
	Spectacled porpoise		*Phocena dioptrica*
		New Zealand Sea Lion*	*Phocarctos hookeri*
		New Zealand Fur Seal	*Arctocephalus forsteri*
		Southern Elephant Seal	*Mirounga leonina*

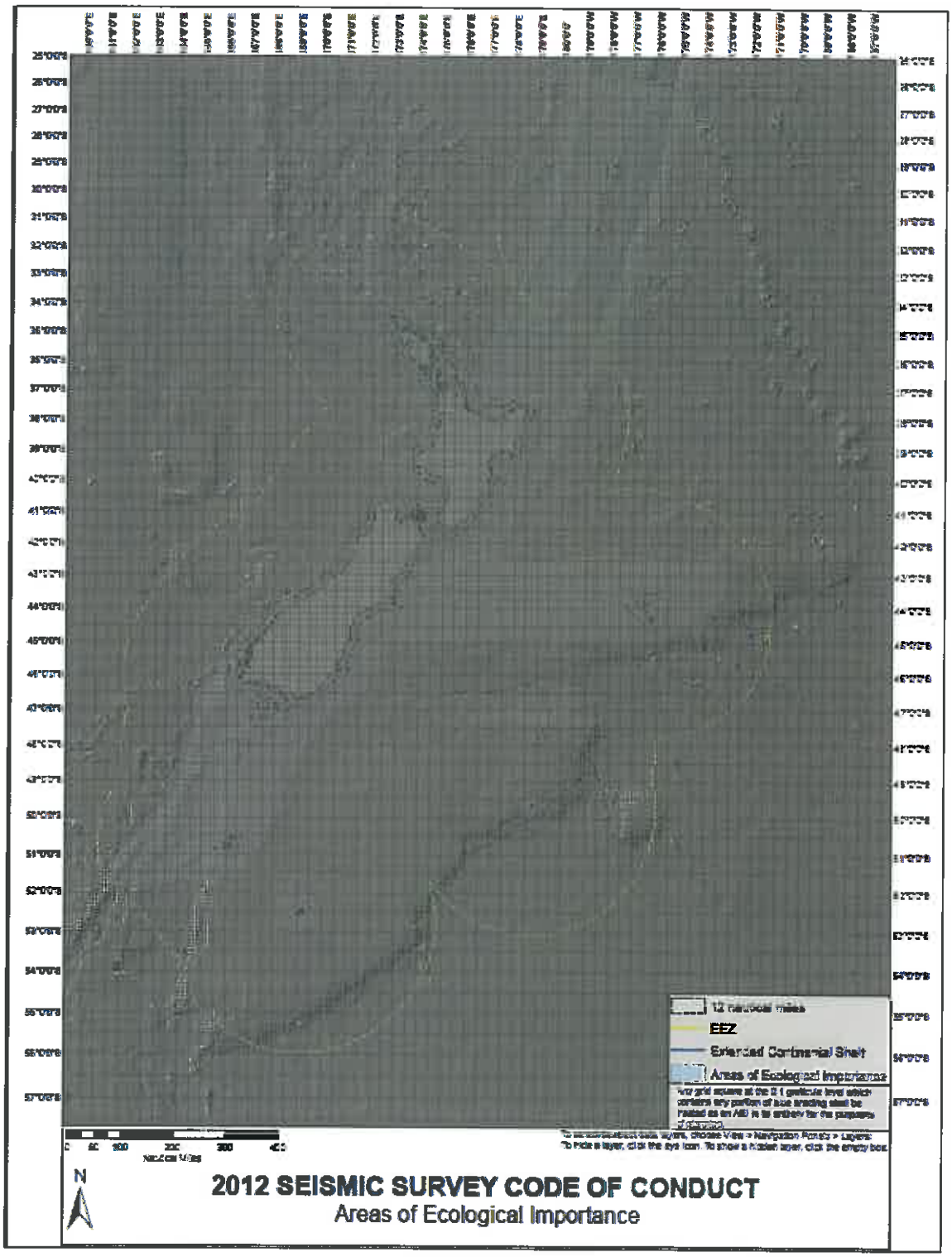

Figure 2: Areas of Ecological Importance (DOC, 2013a).

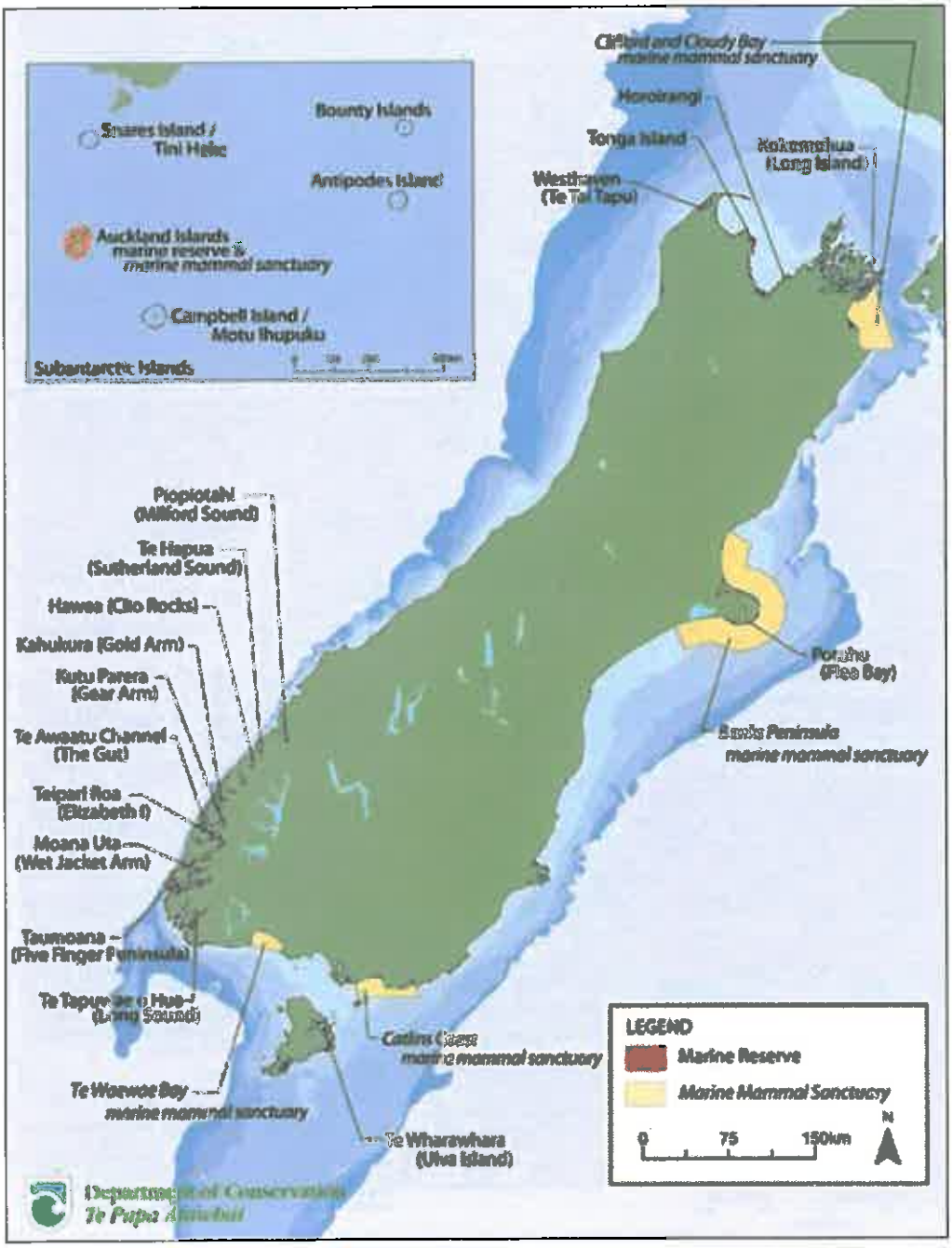

Figure 3: Marine Mammal Sanctuaries and Marine Reserves - South Island (DOC, 2013b)

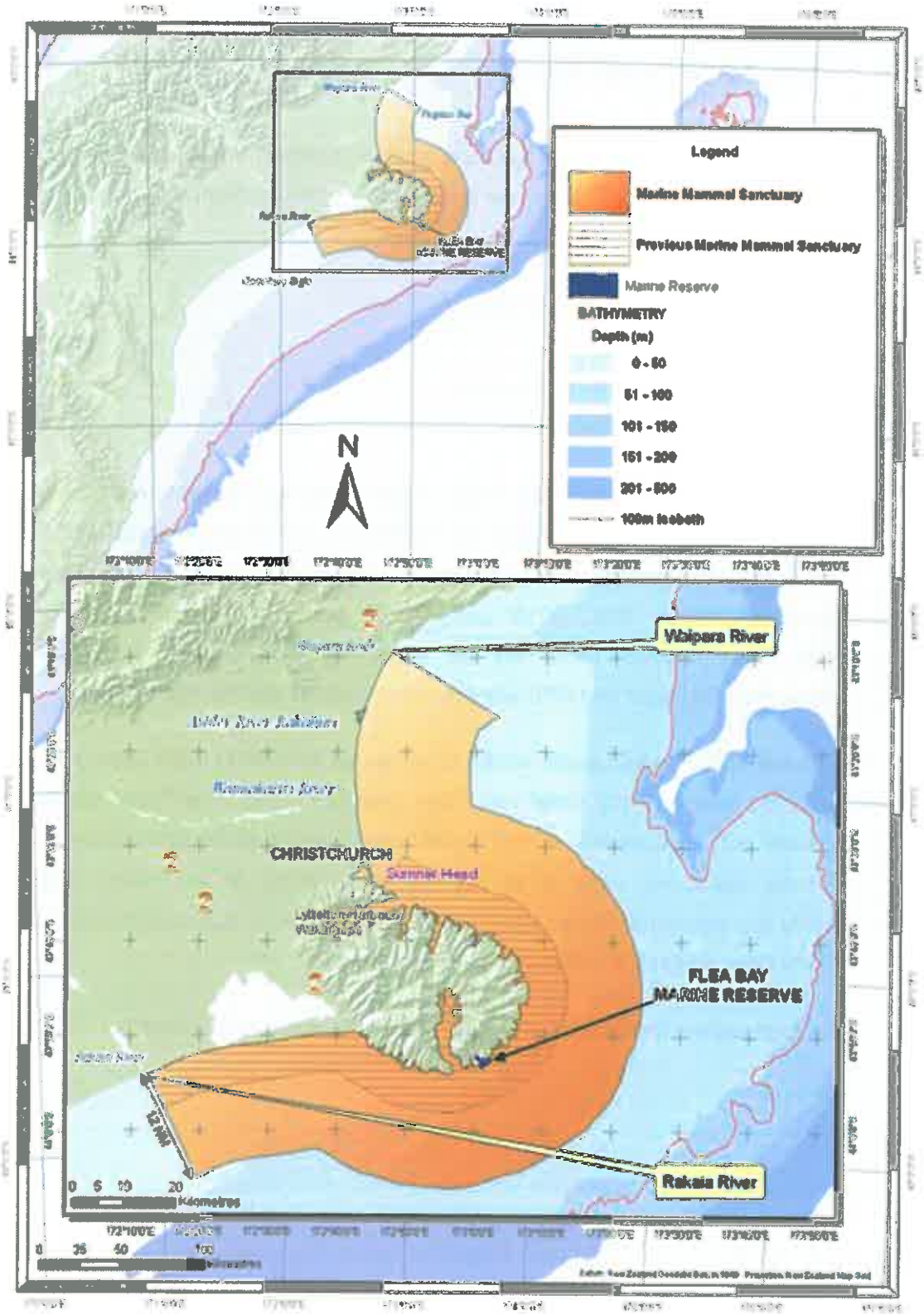

Figure 4: Banks Peninsula Marine Mammal Sanctuary (DOC, 2013c)

3.0 STRUCTURE AND ROLES

3.1 Role of RPS Energy Pty Ltd

RPS has been contracted by NZOG to provide qualified and experienced offshore personnel throughout the survey period. The offshore team will consist of the following personnel:

- Qualified MMO – Team Leader
- Qualified MMO
- Qualified Lead PAM Operator
- Qualified PAM Operator

The MMOs and PAM operators (MMO / PAM Team) will support and advise NZOG by providing 24 hour surveillance for marine species detection (visual and PAM), recording and reporting duties and monitor for compliance in accordance to the *Code of Conduct* (DOC, 2013) and NZOG's additional mitigation requirements. The MMO / PAM Team will be supported by the RPS Marine Fauna Operations Manager and RPS administrative support staff for logistics.

The role of the Team Leader will be to supervise the MMO / PAM Team and liaise with the seismic Party Chief and Client Representative. The Team Leader will ensure the requirements of this MMMP are maintained throughout the survey. Should deviations occur, it will be the responsibility of the Team Leader to notify key personnel immediately, rectify the situation in communications with the Party Chief and NZOG's onboard Representative.

An organogram depicting lines of communication is shown in Figure 5.

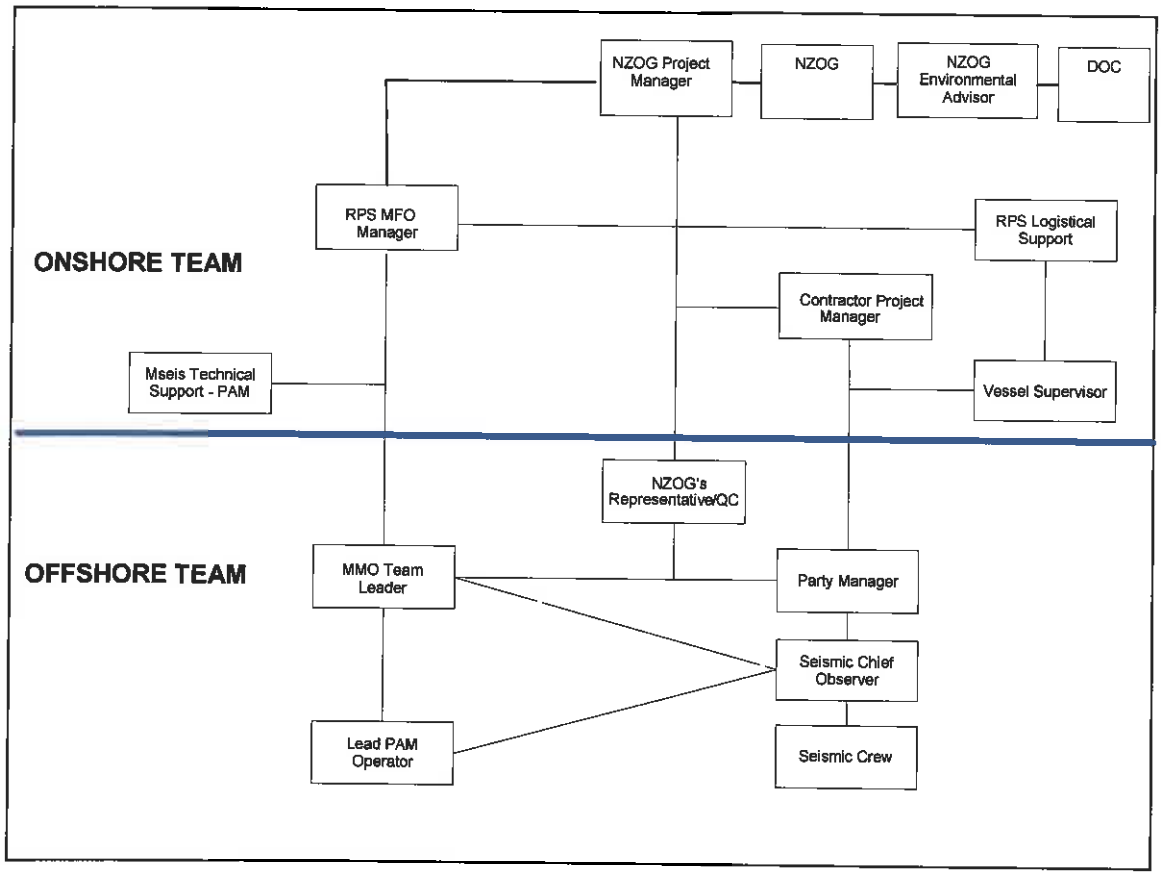

Figure 5: Communications Organisational Chart

3.2 Key Personnel Roles and Responsibilities

For the purpose of marine mammal mitigation and mammal management, staff associated with the survey have the following roles and responsibilities shown in Table 4.

Table 4: Key personnel roles and responsibilities for implementation of the MMMP.

Position	Role / Responsibility
NZOG Project Manager	• Ensure all HSE documents are compliant with NZOG and the subcontractor HSE processes • Ensure the HSE documents are available for all RPS personnel involved with the survey • Review and endorse this MMMP • Coordinate project resources to achieve compliance with the MMMP • Provide copies of the MMMP to the Client Representative and Party Chief and ensure all roles are known and understood • Ensure compliance with the MMMP with advice and support from RPS Marine Fauna Operations Manager, MMO Team Leader, NZOG Client Representative • Ensure all NZOG and subcontractor personnel are aware of and support the roles of the MMO / PAM team during the survey. • Intention to ensure 'in country' back-up PAM system in the event the primary system malfunctions and cannot resume monitoring.
NZOG Client Representative	• Ensure the contracting company procedures and operations are consistent with the endorsed MMMP for the project by: • Ensuring that electronic and hard copies of the HSE Plan are available for all RPS personnel • Ensure compliance with the HSE Plan • Implementing and ensuring compliance with this MMMP and Code of Conduct 2013 • Maintaining clear communications between NZOG, the RPS Marine Fauna Operations Manager, RPS MMO / PAM Team and the vessel contractor • Monitoring performance against the requirements of this MMMP • Ensure that a suitable observation position is allocated for the MMOs • Ensure that a suitable workstation is available for the PAM Operators • Working with the RPS MMO / PAM Team to receive daily and weekly reports and undertake reviews/audits against this MMMP when required • Communicating the requirements of this MMMP with the appropriate personnel by ensuring they understand their roles and supplying them with

	electronic and hard copy versions • Supporting RPS personnel during undertaking of their responsibilities during the survey. • Oversees and manages with assistance from Vessel Party Chief and Seismic Chief Observer ground truthing of received sounds levels at specific distances are achieved in accordance with the Marine Mammal Impact Assessment (MMIA). • Notifies the Department of Conservation of any ground-truthing results that indicate the mitigation zones are insufficient for providing protection to marine mammals from physiological or behavioural impacts.
RPS Marine Fauna Operations Manager	• Develop the MMMP for endorsement by the NZOG • Provide qualified and experienced MMO / PAM Team to implement the MMMP during the survey • Provide the necessary resources to allow the MMO / PAM Team to implement the requirements of the MMMP • Liaise with the NZOG Project Manager to ensure compliance with the procedures and commitments of the MMMP are met and maintained • Communicate deficiencies identified to the implementation of the MMMP to the NZOG Project Manager and ensure corrective actions are implemented wherever necessary • Provide advice and support to the MMO / PAM Team wherever required • Provide a first draft and final report to NZOG within two months of survey completion.
RPS Team Leader	• Coordinate the implementation of this MMMP on the seismic survey vessel • Liaise with the NZOG Project Manager, NZOG Client Representative and Polarcus Party Chief • Provide direction and advice to MMO / PAM Team and key personnel onboard the seismic survey vessel with respect to implementation of this MMMP • Provide daily and weekly reports collating all required MMO & PAM data to NZOG for forward to DOC and EPA • Liaise with the seismic survey personnel to identify environmental issues and manage them efficiently and effectively to achieve compliance with this MMMP • Undertake monitoring of the seismic contractor's adherence to the Code of Conduct (2013), NZOG's additional mitigation measures within this MMMP • Communicate deficiencies identified in the implementation of this MMMP to the RPS Marine Fauna Operations Manager, NZOG Project Manager and NZOG Client Representative and ensure corrective actions are implemented and maintained

	• Provide and coordinate advice to the NZOG Client Representative, Party Chief, Vessel Master and any other contracted personnel as required. • Team Leader will advise the Director General immediately, if the MMO / PAM team considers a higher number of marine mammals are present in the area than previously stated in the MMIA. • Ensure adherence to increased mitigation zones for marine species during survey operations and implements required procedures as outlined in Section 4.4 of this MMMP. • *Immediately reports any non-compliance event to DOC under the Code of Conduct and this MMMP.* • *Immediately notifies the Director General, if the MMO considers that higher numbers cetaceans and/or Species of Concern than previously predicted in the MMIA are encountered at any time during the survey.*
RPS MMOs and PAM Operators	• Provide dedicated visual monitoring duties during daylight hours and during vessel transit periods to / from the survey site • Record all sightings of marine mammals using DOC standardised Excel data forms • Provide dedicated PAM monitoring 24 hour per day throughout seismic operations (PAM) • Record all acoustic recordings of marine mammals (PAM) using DOC Excel data forms • MMOs and PAM Operators to liaise with each other to calibrate range finding of PAM system • Liaise with the Party Chief and seismic crew in communicating start of operations at night (no MMOs on watch) and recording seismic operations • Provide advice to the NZOG Client Representative, Party Chief, Vessel Master and any other contracted personnel as required. • Ensure adherence to increased mitigation zones for marine species during survey operations and implements required procedures as outlined in Section 4.4 of this MMMP. • *Immediately reports any failure of PAM to DOC via email as outlined in the Code of Conduct, Section 4.1.2 and this MMMP Section 4.8.* • *Immediately reports any non-compliance event to DOC under the Code of Conduct and this MMMP.* • *Immediately notifies the Director General, if the PAM Operator considers that higher numbers cetaceans and/or Species of Concern than previously predicted in the MMIA are encountered at any time during the survey.*
Polarcus Vessel Master	• Responsible for the safe operation of the vessel • Comply with statutory regulations and project-specific requirements regarding protection of marine mammal and other marine fauna
Polarcus Project	• Confirm the seismic contractor's environmental procedures meet project

Manager	requirements identified for the survey • Ensure overall compliance with the environmental procedures (including this MMMP) required as part of this survey.
Polarcus Party Chief	• Ensure the seismic contractor's procedures and systems comply with NZOG's standards as outlined in NZOG's HSE Plan and any supporting documents for the survey • Ensure all contract personnel understand the responsibilities and roles of the RPS MMO / PAM Team • Ensure that all seismic contractor personnel understand their own responsibilities in implementing this MMMP • Ensure a suitable PAM workstation is available for the PAM Operator • Ensure clear and open lines of communications are maintained between the RPS MMO / PAM Team and the seismic crew • Discuss any deficiencies identified by the RPS Team Leader and the NZOG Client Representative and assist to maintain corrective actions • Assists NZOG Client Representative and Seismic Chief Observer ensuring required ground truthing of received sound levels at specified distances defined within the Marine Mammal Impact Assessment (MMIA) are achieved • Intention to approach to the survey lines which abut the buffer zone in water depths < 100m from the NW and SE direction in order to minimise sound input into the shallow waters
Seismic Chief Observer	• Help identify and provide the optimum lines of communication between the seismic crew and MMO / PAM Team • Ensure communications are maintained with the MMO / PAM Team throughout each seismic shift. • Ensure the on shift MMO and PAM Operator are contacted 45 minutes prior to starting the seismic source for any reason • Ensure the on shift MMO and PAM Operator are contacted just prior to initiation of soft start • Ensure the on shift MMO and PAM Operator are notified when the source has reached full operational power • Ensure the on shift MMO and PAM Operator are contacted at any time the status of the seismic source has changed • Ensure shift operations are conducted in line with the Code of Conduct 2013 • Immediately initiate shutdown procedures as requested by the on shift MMO or PAM Operator for marine species presence within relevant mitigation zone(s) • Delay soft start procedure as requested by on shift MMO or PAM Operator for marine species presence within relevant mitigation zones

	• Provide a copy of the Daily Shot Log listing all operational activity of the seismic source for compliance purposes. • Assists NZOG Client Representative with verification and completion of required ground-truthing for received sound levels at required distances in accordance with the Marine Mammal Impact Assessment (MMIA) • Ensure to minimise run-in distance for the start of each survey line in the NW section of the buffer zone. • Assurance the tie-in line to the Galleon-1 well will be conducted in a NE to SW direction in order to provide animals in the distal part of this line ample opportunity to leave the area as sound levels increase during the vessel's approach from deeper water
Navigation Crew	• Navigation crew will advise MMO & PAM Operator when vessel enters and exists specified water depths at: < 80m, 80 - 275m and > 275m to ensure required additional mitigation measures are implemented effectively at these specific depths described within this MMMP
Seismic Crew	• Apply the requirements of this MMMP to their respective work areas throughout seismic operations • Attend inductions as directed to meet the requirements of this MMMP • Take all reasonable care to ensure their own actions do not cause adverse impacts on marine fauna • Report any sighting of marine mammals to the on shift RPS MMO and immediate supervisor.
Bridge Crew	• Apply the requirements of this MMMP to their respective work areas throughout seismic operations • Attend inductions as directed to meet the requirements of this MMMP • Report any sighting of marine mammals to the on shift RPS MMO.
Ship's Crew	• Attend inductions as directed to meet the requirements of this MMMP.
Chase Vessel Master and Crews	• Attend inductions as directed to maintain an understanding of this MMMP • Report any sightings of marine mammals to the on shift RPS MMO • Comply with statutory regulations and project-specific requirements regarding protection of marine mammal and other marine fauna, particularly best practice procedures to avoid vessel related interactions with marine species. • Intention that Chase vessel, Ocean Pioneer, to undertake pilot bathymetry survey in the NW buffer zone prior to survey start up in order to identify any bathymetrical anomalies which are not illustrated on charts

3.3 Key Personnel Contact Details

Polarcus Party Manager: (Offshore)

Polarcus Seismic Chief Observer: (Offshore)

Ian Angus – Department of Conservation EMERGENCY CONTACT

Department of Conservation

4.0 MARINE MAMMAL MANAGEMENT PROCEDURES

4.1 Project- Specific Inductions

In accordance with this MMMP all participating contractors, NZOG personnel and vessel crews will attend a project-specific induction that provides background and objectives to the project and identifies safety concerns associated with the seismic survey. This induction should be carried out by the Seismic Contractor and NZOG project management personnel prior to departing the port.

4.2 Pre-Mobilisation Requirements

4.2.1 Staff Training and Offshore Certificates

All personnel participating in the marine mammal detections (MMO or PAM Operator) have met requirements and are recognised as 'qualified' under the Code of Conduct. ALL MMOs have a minimum of three years professional experience and > 12 weeks sea-time in NZ waters; PAM Operators have a minimum of three years professional experience and > 12 weeks international sea-time as required by the Code of Conduct 2013. All MMO and PAM operators maintain appropriate certificates for their designated roles, in addition to holding current Basic Offshore Safety Induction and Emergency Training (BOSIET) or Further Offshore Safety Emergency Training Certificate (FOET) and current OGUK or equivalent medicals.

Furthermore, all client representatives maintain same current offshore certificates, Basic Offshore Safety Induction and Emergency Training (BOSIET) or Further Offshore Safety Emergency Training Certificate (FOET) and current OGUK or equivalent medicals.

All RPS Energy Pty Ltd personnel also maintain the required and appropriate offshore personal protective equipment (PPE) to undertake their respective roles.

4.2.2 Preparation of Workstations

The MMO viewing platform will be located on the vessel bridge with access to fly-bridges if required. The viewing platform should be at least 10 m above the sea level (i.e. height of bridge floor plus observer eye height) to optimise viewer capacity. The viewing workstation should include a viewing chair, laptop computer space with immediate access to GPS, camera and range-finding binoculars.

4.3 Communication Protocols

Compulsory communication protocols are to be followed to ensure the effectiveness of implementing this MMMP during the seismic survey. The following protocols describe the timing, personnel required and agendas for dedicated meetings during the survey period:

1. At Start Up and Crew Change
   NZOG Client Representative, MMO Team Leader and relevant onboard personnel (i.e. Operations Manager) to discuss the implementation of the MMMP. The senior contact person to whom all recommended marine mammal related seismic interruptions are to be reported will be identified. Procedures for soft start, start-up delays, and shut-downs should be pre-determined before commencing the survey. A nominated distribution list for receipt of the MMO / PAM daily and weekly reports shall be compiled.

2. Onboard Daily Operational Meetings
   At a pre-determined time and in accordance with watch schedules, the MMO Team Leader, should be present at the daily operational meetings with the NZOG Client Representative and relevant personnel to discuss the previous and future 24 hour operations.

4.4 Operational Procedures

As part of NZOG's commitments within the Marine Mammal Impact Assessment (MMIA), additional mitigation measures beyond standard measures within the Code of Conduct (2013) shall be implemented for the duration of the Endurance 3D MSS. The additional mitigation measures predominantly involve an increase

to mitigation zones in accordance operational activities to be undertaken within specified water depths due to sound modelling results.

Prior to arrival on site:

MMOs will undertake dedicated monitoring during vessel transit periods to and from the survey site. All observations of marine mammal species will be recorded to the appropriate "Off Survey" DOC data form.

In accordance with the Code of Conduct (2013) visual and acoustic monitoring will be undertaken prior to and during all seismic operations. The Team Leader / Lead MMO will prepare a roster to ensure at least one MMO and one PAM Operator are on shift to perform dedicated monitoring duties at the required time throughout the survey period.

Upon arrival on site:

The additional mitigation measures required for this survey will follow three separate regimes incorporating increased mitigation zones when conducting operational activities within specific water depths and standard procedures as outlined within the Code of Conduct (2013). Figure 6 depicts the three regimes and location within the Endurance 3D MSS operational area. Approximated NZTM coordinates for boundaries of each mitigation regime are as follows:
Commencement of the Galleon-1 mitigation regime at:
Western point on the main polygon which delineates shallow water mitigation regime at: ; N; Eastern point on the main polygon which delineates shallow water regime at: . As the coordinates are approximated the chase vessel shall undertake a pilot bathymetry survey in an attempt to refine the 275m and 80m contours.

Following refinement of depth contours and given the vessel's navigators will continuously receive bathymetric data, we would recommend the vessel's navigator relay to the on duty MMO & PAM Operator once the vessel has entered or exited the respective water depths corresponding to the three mitigation regimes.

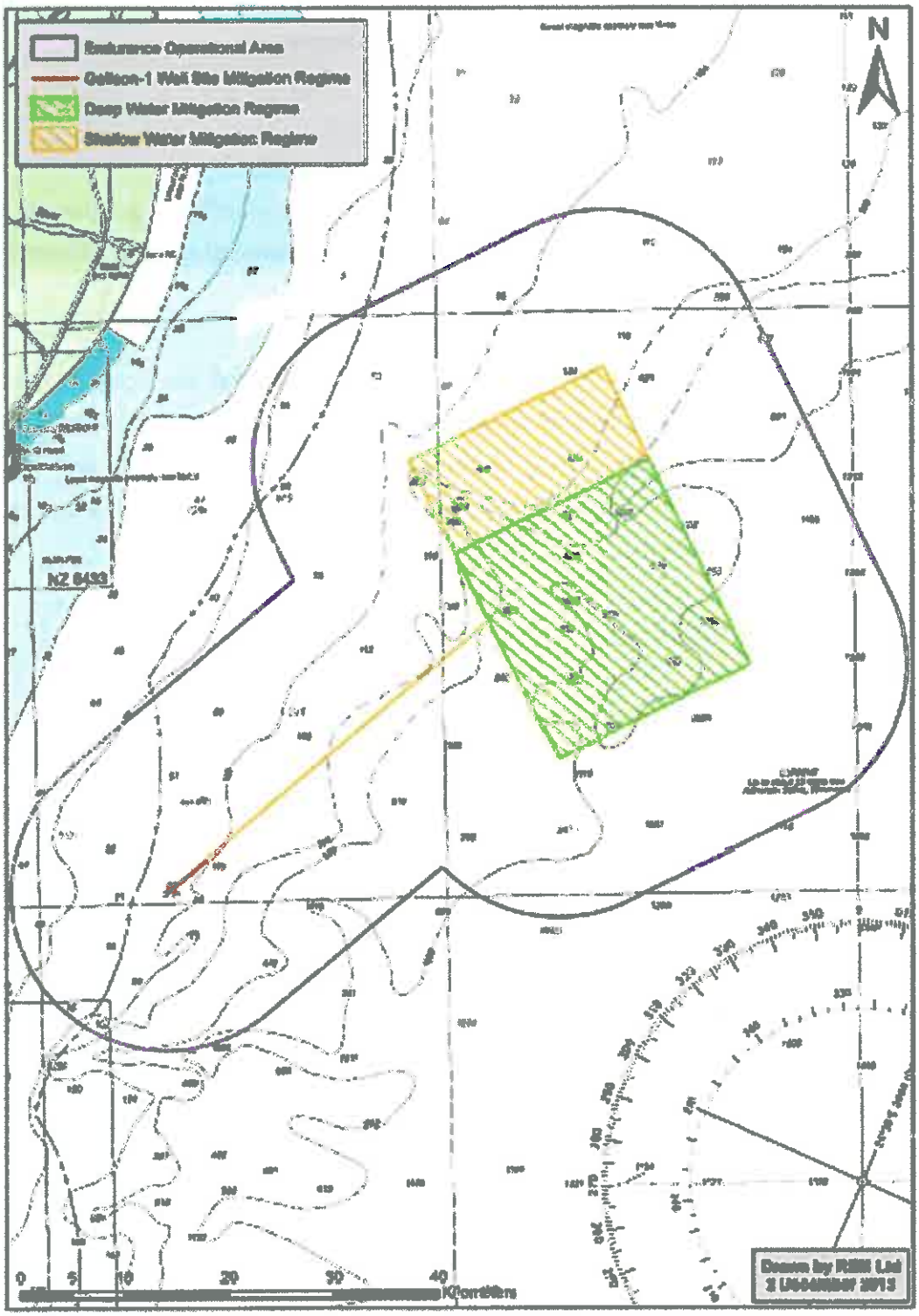

Figure 6: Three Mitigation Regimes for the Endurance 3D MSS (REM, 2013)

The three mitigation regimes outlined below and consolidated within Table 4 shall be implemented during operational activities for the Endurance 3D MSS survey:

Galleon-1 Well Site Mitigation within **Water Depths < 80m**

- Increased mitigation zone to 1.8km applicable to all Species of Concern (SOC) includes SOC + calf and SOCs for Delay and Shut Down procedures; 200m zone for other marine mammals Delay ONLY.

Shallow Water Mitigation within **Water Depths 80 - 275m**

- Increased mitigation zone to 1.5km applicable to all Species of Concern (SOC) includes SOC + calf and SOCs for Delay and Shut Down procedures; 200m zone for other marine mammals Delay ONLY.

Deep Water Mitigation within **Water Depths > 275m**

- Follows standard procedures for Delay and Shut Down prescribed for Level 1 survey within the Code of Conduct (2013); relevant mitigation zone(s) 1.5 km for SOC + Calf; 1.0km for SOC; 200m for Delay and Shut Down; 200m for other marine mammals Delay ONLY.

Table 5: Increased and standard mitigation zone by water depth.

Increased and Standard Mitigation Zones by Water Depth			
Increased Mitigation Zones	Water Depth	Applicable Species	Mitigating Action
1.8km	< 80m	SOC + Calf; SOC	Delay & Shutdown
200m	< 80m	Other Marine Mammal	Delay ONLY
1.5km	80 -275m	SOC + Calf; SOC	Delay & Shutdown
200m	80-275m	Other Marine Mammal	Delay ONLY
Standard Mitigation Zones	Water Depth	Applicable Species	Mitigating Action
1.5km	> 275m	SOC + Calf	Delay & Shutdown
1.0km	> 275m	SOC	Delay & Shutdown
200m	> 275m	Other Marine Mammal	Delay ONLY

The increased and standard requirements (Table 5) shall be implemented by the MMOs and PAM Operators prior to the start of operations and during all seismic operations as follows:

1. Start of operations and during operations;

2. 30 minutes monitoring (visual and acoustic) conducted prior to the commencement of a soft start;

3. Dedicated monitoring (visual and acoustic) will remain continuous during soft start and while source remains actively engaged;

4. Monitoring for marine species detection (visual and acoustic) will focus on the increased mitigation zones and standard mitigation zones outlined in Table 5 in conjunction with water depths;

5. Following a Delay and Shut Down Event, both MMOs and PAM operators must continue monitoring until the species type (i.e. SOC + Calf, SOC or other marine mammal) has:

   5a. been visually observed to exist the increased mitigation zone or standard mitigation zone OR;

   5b. 30minutes has elapsed since the last sighting within the increased mitigation zone or standard mitigation zone OR;

   5c. 10minutes has elapsed since the last fur seal sighting within the 200m zone.

6. Specific requirements apply for start up at a new location in poor sighting conditions which include:

   6a. MMOs have undertaken observations within 20 nautical miles (nm) of the planned start up position for a minimum of 2.0 hours in good sighting

conditions proceeding operations and no marine mammal have been detected;

6b. Where there have been less than 2.0 hours of good sighting conditions within 20 nautical miles of the planned start up position proceeding operations, the source may be activated IF:

- PAM monitoring has been conducted for 2.0 hours immediately prior to proposed operations;
- Two MMOs have conducted observations in the 2.0 hours immediately prior to proposed operations;
- No Species of Concern have been detected, visually or acoustically, during the 2.0 hour period immediately prior to the start of operations within the relevant mitigation zone(s);
- No other marine mammals have been detected, visually or acoustically, within the relevant mitigation zone in the 30minutes immediately prior to proposed operations;
- No fur seals have been sighted in the relevant mitigation zone in the 10minutes immediately prior to the proposed operations.

4.4.1 PAM Operations

A purpose-built tow array with specialised software (including the PAMGUARD package) will be used to acoustically detect and monitor for the presence of vocalising marine mammals. During the seismic operations, dedicated PAM Operators will monitor 24 hours covering both day and night time periods. During daylight hours if cetaceans are detected, the PAM Operator will notify the on shift MMO of the detection. The on shift MMO will immediately attempt to locate the animal(s) (if not submerged) and provide estimated distance and bearing to the animal to achieve concurrent visual and acoustic detections.

The PAM operators will use headphones to listen for sperm whales, baleen whales and other odontocete echolocations and monitor the spectrogram

software to confirm sounds at the appropriate frequency. All cetaceans detected will be classified into broad groups and where possible to species based on their unique acoustic characteristics. Some cetaceans, such as sperm whales, can easily be identified and tracked acoustically due to their unique and frequent echolocations. *Cephalorhynchus* spp dolphins also produce distinct vocalisations including ultrasonic, narrow-banded echolocation clicks at approximately 129 kHz (Kyhn *et al.*, 2009) and have an obvious waveform and power spectrum. The PAM system uses a high frequency National Instruments sound card, which samples up to 500,000 samples/second and is suitable for detecting a large range of sounds.

Based on echolocation detection, PAMGUARD modules will be used to track and determine location (range, bearing and error) of whales. If the PAMGUARD data indicates with high confidence that the animal is approaching or within the increased or standard mitigation zone(s) (Table 5), the PAM Operator will request a Delay or Shutdown in accordance with this MMMP and the *Code of Conduct* (DOC, 2013).

The PAM operator will attempt to determine whether the acoustic detection is a Species of Concern, however, if there is reasonable doubt that the animal is not a Species of Concern and the animal is within the relevant mitigation zone(s), the PAM operator will seek confirmation with the on shift MMO. A precautionary approach should be applied when determining appropriate mitigation protocols and consider factors such as recent sighting frequency of Species of Concern.

Screen grabs and acoustic recordings (.wav files) will be saved and backed up on external hard drives during the seismic survey. All relevant data including acoustic detections, movement patterns and mitigating actions will be entered into the standardised DOC Excel data forms.

4.4.2 PAM and System Failure

The Code of Conduct (2013), Section 4.1.2 mandates specific requirements and timeframes for trouble-shooting or the repair of PAM in relation to seismic operations:

If the PAM system should malfunction or becomes damaged operations may continue for 20minutes without PAM, while the PAM Operator diagnoses the issue. If the diagnose indicates the PAM gear must be repaired to resolve the issue, operations may continue for 2.0 hours without PAM monitoring provided the following conditions are met:

- It is daylight hours and the sea state is less than or equal to Beaufort 4;
- No marine mammals were detected solely by PAM in the relevant mitigation zones within the previous 2.0 hours;
- Two MMOs maintain watch at all times during operations when PAM in not operational;
- DOC is notified via email as soon as practicable with the time and location in which operations began without an active PAM system;
- Operations with an active source, but without an active PAM system, do not exceed a cumulative total of 4.0 hours in any 24 hour period.

4.4.3 Pre-Start Observations

MMOs, PAM Operators and seismic crews will follow defined protocols for start of operations following completion of the required 30minute monitoring period (Appendix 6).

All pre-start observations required by the MMO and PAM Operator will follow in accordance to the additional and standard mitigation requirements outlined within Table 5 and Section 4.1.3 of the *Code of Conduct* (DOC, 2013) for Level 1 surveys which includes:

Visual and acoustic monitoring will be undertaken simultaneously 30minutes prior to soft start procedure to ensure no cetaceans are present within the increased or standard mitigation zone(s) and to ensure no fur seals are present 10 minutes prior to soft start within the standard mitigation zone.

Soft start procedure can only commence once both the on shift MMO and on shift PAM Operator confirm to the seismic operator, that no Species of Concern or other marine mammals are present within the increased or standard mitigation zones, ensuring it is safe to commence a soft start procedure.

4.5 Soft Start Procedure and Seismic Operations

A soft start procedure is aimed to provide sufficient time for marine mammals which may be in the area nearby time to move away from source before the source reaches full operational output. The soft-start procedure involves gradually increasing the emitted sound levels of the seismic source by systematically activating the source array from lowest volume level to full operational volume over a specific period of 20 - 40 minutes. All Soft start procedures will follow in accordance to the *Code of Conduct* (DOC, 2013) as outlined within Section 3.8.10 for Level 1 survey as follows:

1. Soft-start should occur between 20 - 40 minutes to reach full operational capacity. If there is a problem during the soft-start (e.g. technical issue with airguns) and the 40 minute period is exceeded, it is preferable to extend the soft-start period rather than shut down. However, if the problem is severe and occurring in the shallow water areas < 100m, this may not be applicable;

2. Visual and acoustic monitoring will be maintained continuously during soft-start and all seismic source operations to detect marine mammals;

3. Once seismic operations are underway, if a species of concern is visually or acoustically detected within the increased or standard mitigation zone(s), the on shift MMO or on shift PAM Operator will notify immediately the seismic crew to shutdown the source;

4. Both the on shift MMO and PAM Operator will continue to monitor / track marine mammals during the shutdown period;

5. Either the on shift MMO or PAM Operator will notify seismic crews providing an "all clear" indicating it is safe to re-commence operations with a soft start procedure.

4.6 Source Testing

In accordance with the *Code of Conduct* (DOC, 2013), Section 3.8.8, all testing of the seismic source will follow a soft start procedure, though, the 20minute minimum duration shall not apply. However, where possible, testing of the source

shall include a gradual build up of the source output to the required test level but not be conducted at a faster rate than a normal soft start procedure.

The required 30minute Pre-Start of Observation period (visual and acoustic) shall apply prior to all seismic source testing. If a marine mammal (includes Fur seals) is detected within the increased or standard mitigation zone(s) during the pre-start observational period or during testing, the required Delay and Shutdown procedures applicable to species type (i.e. SOC + Calf, SOC and other marine mammal) will be immediately implemented by the on shift MMO or on shift PAM Operator.

For the Endurance 3D MSS survey, testing of the seismic source should not occur in water depths < 100m.

4.7 Line Turns and the Mitigation Source

In accordance with the *Code of Conduct* (DOC, 2013), the use of a small, single airgun during line turns for Level 1 surveys is not supported nor recommended and thus should not be undertaken. The seismic source shall be switched off entirely at the end of line (EOL), with required soft start procedures implemented prior to the undertaking the next start of line (SOL).

4.8 Ground–truthing of Sound Transmission Loss Modelling

For surveys taking place in an AEI where sound transmission loss modelling is required, Appendix 1 of the Code of Conduct also requires that this modelling is ground-truthed during the survey by appropriate means. During the Endurance 3D survey ground –truthing will be undertaken by isolating the acoustic sound trace received from the hydrophones suspended from the streamers at all the mitigation distances relevant to the Code of Conduct (200 m, 1000 m and 1500 m) and to the additional mitigation measures which will be adopted during the Endurance MSS (1800 m). It is proposed that this ground-truthing will occur at least once at each of the water depths outlined below.

Depth range (m)
60
80

100
125
150
175
200
225
250
275
300
400
500
600
700
800
900
1000

The NZOG Client Representative will liaise with the Vessel Party Manager and Seismic Chief Observer to ensure that the ground-truthing methods and reporting occurs according to the depth schedule above and meets the full requirements outlined with the Marine Mammal Impact Assessment (MMIA), Section 6.5.2.2. pg 89.

4.9 Recording and Reporting

Both the MMO and PAM Operators will log all required observational / acoustic data outlined within Appendix 2 of the *Code of Conduct* (DOC, 2013) using the standardised DOC Excel data forms (Appendix 2). Differentiation is required for sighting and/or acoustical detections occurring either on or off the survey site. Thus both the ON SURVEY and OFF SURVEY DOC data forms will be strictly followed. The OFF SURVEY forms will be used during vessel transit periods to / from the project survey area and/or during any other periods when outside the operational survey area.

The DOC datasheets must always have macros enabled to function properly and cut and paste should never be used with these spreadsheets. Additionally, it is recommended to not use the DOC datasheets on any Apple computers.

The MMO Team Leader will provide Daily and Weekly reports respectively to NZOG for forward to Department of Conservation and Environmental Protection Authority (Appendix 3). The distribution list for other key personnel on the project to receive reports shall be nominated by NZOG at project start up.

Upon completion of the Endurance 3D MSS and within the required two week period, the standardised raw DOC Excel dataforms shall be submitted to the Director General in accordance with Section 3.5 in the *Code of Conduct* (DOC, 2013).

Moreover, upon completion of the survey a comprehensive final MMO and PAM trip report collating all required project data as outlined within Appendix 2 of the *Code of Conduct* (DOC, 2013) will be submitted. The final report shall be delivered to NZOG for forward to the Director General within the required two month period.

4.10 Compliance Reporting to the Department of Conservation

Any non-compliance event in relation to this MMMP and Code of Conduct (2013) should be reported without delay to the Department of Conservation (DOC). Additional items which require immediate reporting under the Code of Conduct include:

- If MMOs or PAM Operators consider that a higher number of cetaceans and/or Species of Concern than predicted in the MMIA are encountered at any time during the survey, shall be immediately reported to the Director General;

- If failure of the PAM system occurs, DOC is notified via email as soon as practicable with the time and location in which operations began without an active PAM system.

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APPENDIX 1

Code of Conduct 2013

2013 Code of Conduct

for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations

Department of Conservation
Te Papa Atawhai

Cover image: Seismic survey vessel *Polarcus Alima* entering Wellington Harbour 2012. *Photo: Polarcus Ltd.*

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CONTENTS

1. Introduction

The *2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* (the Code) has been developed by the Department of Conservation in consultation with a broad range of stakeholders in marine seismic survey operations in New Zealand.

The Code replaces the *2012 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* and comes into effect on 29 November 2013, and will remain in effect until superseded. It is open for adoption by any organisation engaged in seismic survey activities in New Zealand continental waters.

The Code must be read in conjunction with the *2012 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations: Reference Document* (the Reference Document), which provides background information and guidance to assist with interpretation.

The Department of Conservation administers the Marine Mammals Protection Act 1978 (MMPA), which makes provision for the protection, conservation, and management of marine mammals within New Zealand and within New Zealand fisheries waters. Under section 3A of that Act, the Department is mandated to administer and manage marine mammals and this Code has been developed under that mandate.

1.1 Application

The MMPA's application offshore extends to New Zealand fisheries waters (which includes the territorial sea and exclusive economic zone), the Code applies to New Zealand continental waters (which includes the waters beyond the outer limits of the exclusive economic zone but over the continental shelf).

Regulations created under the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012 allow seismic surveying as a permitted activity, as long as the proponent complies with the conditions of the Code.

In the territorial sea and in waters outside the exclusive economic zone but over the continental shelf, compliance with the Code remains voluntary and is neither legally binding nor enforceable under the MMPA. Persons who intend to adopt the Code while conducting seismic surveys should follow the steps outlined in Appendix 5 to confirm such intention to the Director-General of Conservation.

2. Definitions

Acoustic source means a source of acoustic pressure waves used, or intended to be used, for the purpose of an acoustic seismic survey; and in relation to a source vessel, means an acoustic source on or controlled from the vessel.

Activate means powering up the acoustic source, and includes reactivate.

Adaptive management means a systematic, iterative decision-making process enabling continuous improvement through flexible decision making that can be adjusted in the face of uncertainties and natural variability as outcomes from management actions and other events become better understood.

Areas of Ecological Importance (AEI) means any of the areas defined in Schedule 1.

Borehole seismic surveying means check-shot and all types of vertical seismic profile surveying.

Calf/calves means a smaller animal (less than two-thirds the body size of an adult) travelling in close association with an adult.

Cetacean means an animal that is a whale or dolphin within the meaning of the Marine Mammals Protection Regulations 1992.

Check-shot surveying is a form of seismic surveying used for correlation of well data with conventional surface seismic data. A receiver (hydrophone or clamped geophone) is progressively positioned at a succession of depths in a borehole and records a series of sound waves emanating from an acoustic source at a fixed point at the surface. Check-shot surveying differs from vertical seismic profile surveying in that a check-shot survey involves a small number of hydrophone depth positions of the order of 100 metres apart, whereas a vertical seismic profile survey often involves a larger number of depth positions of the order of 20 metres apart.

Day or daylight hours means between sunrise and sunset at any given location, and includes the twilight hours of dawn and dusk where there is sufficient light to make effective observations, in the opinion of the qualified marine mammal observer.

Director-General means the Director-General of Conservation.

Explosive means a material (usually chemical), either as a pure single substance or mixture of substances, which is capable of producing a sudden release of gas, heat and pressure by its own energy in the form of an explosion.

Generator-Injector (GI) airgun means a seismic source consisting of two chambers: the generator (G) chamber which creates a sound wave and bubble as in a standard air gun, and an injector (I) chamber that is triggered immediately after the generator into the first bubble to control bubble oscillation.

Good sighting conditions means in daylight hours, during visibility of more than 1.5 km, and in a sea state of less than or equal to Beaufort 3.

Level 1 survey means any marine seismic survey using an acoustic source with a total combined operational capacity exceeding 7 litres/427 cubic inches.

Level 2 survey means any marine seismic survey using an acoustic source with a total combined operational capacity of between 2.50–6.99 litres/151–426 cubic inches capacity.

Level 3 survey means any marine seismic survey using low-energy, high-resolution electro-mechanical sources. These may include small seismic sources of less than 2.49 litres/150 cubic inches capacity, sparkers, pingers and boomers. Level 3 surveys are exempt from the provisions of the Code.

Line turn means the interval between active survey lines where the vessel manoeuvres into position for the next survey line and acquisition of seismic data ceases.

Marine mammal means any cetacean or pinniped species.

Marine Mammal Impact Assessment (MMIA) is a process through which the range of impacts on marine mammals associated with seismic survey activities are determined and steps identified to avoid, remedy or mitigate negative effects and coordinate research activities, as outlined in Appendix 1. Alternatively referred to as environmental impact assessment (EIA) in other legislation.

Marine Mammal Sanctuary (MMS) means any Marine Mammal Sanctuary as defined in section 22 of the Marine Mammals Protection Act 1978.

Marine seismic survey is a method of exploration geophysics that uses active acoustic sources to estimate the structure, stratigraphy and properties beneath the sea floor. The method generates a controlled sound wave from an acoustic source, and detects returned sound energy through an array of acoustic receivers that may either be towed behind a vessel or combined with seismographs placed upon the sea floor.

Mitigation zone a circle with a horizontal radius set at varying distances from the centre of the acoustic source array, not the survey vessel, specified relative to the sensitivity of the marine mammal group concerned.

New Zealand continental waters means the territorial sea; the waters of the exclusive economic zone; and, the waters beyond the outer limits of the exclusive economic zone but over the continental shelf, of New Zealand.

Night or night-time hours means between sunset and sunrise at any given location

Offset vertical seismic profiling (Offset VSP) is similar to a standard VSP, but uses a stationary acoustic source positioned at a fixed distance from the borehole.

Operational area means the entire geographical area potentially used for acoustic source activation throughout the proposed marine survey, including seismic data acquisition lines, acoustic source testing and soft start initiation.

Operational capacity (of the acoustic source) means the cumulative internal volume of all operational acoustic devices within an acoustic source array, including the active generator volume of GI airguns, measured in litres or cubic inches and notified in the Marine Mammal Impact Assessment. Operational capacity does not include redundant acoustic devices that are mounted within the acoustic source array for back-up purposes or the injector volume of GI airguns. Notified operational capacity should not be exceeded during the survey, except where unavoidable for source testing and calibration purposes only. All occasions where activated source volume exceeds notified operational capacity must be fully documented in observer reports.

Operator means the party conducting the marine seismic survey operations.

Other Marine Mammals (as applicable to the 200 m mitigation zones for Level 1 and 2 surveys) means a marine mammal not designated as a Species of Concern in Schedule 2. In New Zealand waters this would most frequently mean New Zealand fur seal (*Arctocephalus forsteri*), common dolphin (*Delphinus delphis*) and dusky dolphin (*Lagenorhynchus obscurus*).

Passive Acoustic Monitoring (PAM) means the use of calibrated hydrophone arrays with full system redundancy to estimate bearing and distance of vocalising cetaceans to at least 1.5 km for Level 1 surveys or at least 1 km for Level 2 surveys. The arrays incorporate appropriate hydrophone elements (1 Hz–180 kHz range) and [sound] data acquisition card technology for sampling relevant frequencies (to 360 kHz) used by New Zealand cetacean species, and are coupled with appropriate observations by software-aided monitoring and listening by a qualified PAM operator skilled in bioacoustic analysis, and computer system specifications capable of running appropriate PAM software effectively.

Pinniped means an animal that is a seal or sea lion within the meaning of the Marine Mammals Protection Regulations 1992.

Poor sighting conditions means either at night, or during daylight visibility of 1.5 km or less, or in a sea state of greater than or equal to Beaufort 4.

Proponent means the party responsible for planning the marine seismic survey, usually the prospecting/exploration/mining permit holder.

Qualified marine mammal observer (MMO) means an observer trained and qualified in accordance with DOC standards and experienced in visual whale and dolphin identification and behaviour, and distance/direction of travel estimations.

Qualified observer means either a qualified marine mammal observer or a qualified PAM operator, having successfully completed the relevant training course recognised by the Department of Conservation and logged a minimum of twelve weeks' sea-time observing in that capacity in New Zealand continental waters.

Qualified PAM operator means an observer trained and qualified in accordance with DOC standards and experienced in whale and dolphin detection using Passive Acoustic Monitoring equipment and techniques.

Shutdown means stopping an active marine seismic survey by immediately turning off power to the acoustic source.

Soft start, in relation to an acoustic source, means the gradual increase of the source's power to the operational power requirement over a period of at least 20 minutes and no more than 40 minutes, starting with the lowest capacity/power acoustic source.

Sound exposure level means a measure of the received energy in the sound source pulse and represents the sound pressure level that would be measured if the pulse energy were spread evenly across a 1-s period.

Sound transmission loss modelling means the process carried out during the environmental impact assessment stage, in advance of a marine seismic survey in an Area of Ecological Importance or Marine Mammal Sanctuary, where acoustic propagation is modelled to predict the received sound levels at various distances, based on the specific configuration of the acoustic source and environmental conditions in the operational survey area.

Source (of acoustic pressure waves) includes any device used to create a pulse of acoustic energy in the ocean and includes airgun, boomer, electromechanical, or chemical device.

Source vessel means a vessel from which an acoustic source is being or is to be deployed for the purposes of a marine seismic survey.

Source vessel observer means a qualified marine mammal observer on board the source vessel.

Species of Concern (SOC) means any individual of the species listed in Schedule 2.

Trained observer means either a marine mammal observer or PAM operator who has successfully completed an appropriate training course recognised by the Department of Conservation or demonstrated competence in observational standards to the satisfaction of the Director-General.

Vertical seismic profiling (VSP) is a form of marine seismic surveying used for correlation of well data with conventional surface seismic data, whereby a receiver (hydrophone or clamped geophone) is progressively positioned at a succession of depths in a borehole, and records a series of sound waves emanating from an acoustic source at a fixed point at the surface near the borehole. VSP surveying differs from check-shot surveying in that a VSP survey involves a large number of depth points of the order of 20 metres apart, whereas a check-shot survey involves a smaller number of depth positions of the order of 100 metres apart.

Walkaway vertical seismic profiling (Walkaway VSP) is similar to a standard VSP, but uses a moving acoustic source at the surface.

3. Part 1: Marine seismic surveys in New Zealand continental waters

This section details the common requirements applicable to all marine seismic survey operations recognised in New Zealand continental waters as being subject to the Code.

Level 1 surveys (>427 cubic inches) primarily include large-scale geophysical investigations that would routinely be employed in oil and gas exploration activities with dedicated marine seismic survey vessels, but may also apply to other studies using high-power acoustic sources. This level features the most stringent requirements for marine mammal protection, and is the main focus of the Code.

Level 2 (151–426 cubic inches) provides for lower scale seismic investigations often associated with scientific research. As these survey programmes are normally conducted from smaller, sometimes multi-mode platforms using moderate power seismic sources or smaller seismic source arrays, the risks to marine mammals are decreased. Therefore the mitigation procedures are reduced accordingly.

Level 3 surveys (<150 cubic inches) include all other small scale seismic survey technologies, and are considered to be of such low impact and risk—with nominal noise levels lower than commercial shipping—that they are not subject to the provisions of the Code.

Borehole seismic surveying (also referred to as vertical seismic profiling) is a specific survey activity related to offshore oil and gas well-bore investigations. Such operations are by necessity limited to a small geographic area and may be conducted from static platforms. Borehole seismic surveys may be determined to be within any of the above levels according to the acoustic source power employed.

In addition to the common provisions detailed in this section, further specific measures related to each specific level are outlined in the relevant sections in Part 2.

3.1 Notification

No person may carry out a marine seismic survey from a vessel in New Zealand continental waters, except a Level 3 survey as identified above, unless he or she has, at the earliest opportunity but not less than three months before commencing the survey, notified the Director-General in writing[1] that such a survey is being planned. Notification does not require provision of all required information; it may simply be to indicate potential intent to the Director-General in order to initiate the communication process. The proponents may meet with relevant departmental staff to discuss aspects of survey planning, and are encouraged to seek advice on possible mitigation options at an early stage.

In the event of exceptional circumstances or an opportunistic survey arising within the three-month notification period, the proponent will notify the Director-General at the earliest opportunity but not less than two weeks before commencing the survey. The notification will be supported by:

- Evidence, to the satisfaction of the Director-General, of the exceptional or opportunistic nature of the survey, and
- A written Marine Mammal Impact Assessment (MMIA).

[1] Can include email notification.

3.2 Pre-survey planning and the MMIA process

The fundamental component of the planning process for Level 1 and 2 surveys is the preparation of the MMIA, which must be made available to any personnel involved in observational capacities. Further specific details can be found in Appendix 1 to guide this process.

Particular attention needs to be given to minimising effects where surveys are planned in any of the Areas of Ecological Importance (which includes the marine mammal sanctuaries) as detailed in Schedule 1. Under normal circumstances marine seismic surveys will not be planned in any sensitive, ecologically important areas or during key biological periods where Species of Concern are likely to be breeding, calving, resting, feeding or migrating, or where risks are particularly evident such as in confined waters (for example, embayments or channels). However, where conducting surveys in such areas and seasons is demonstrated to the satisfaction of the Director-General to be necessary and unavoidable, further measures[2] may be required to minimise potential impacts. In these instances, proponents will seek advice from the Director-General to develop and agree on mitigation strategies for implementation. This should lead to the development of an appropriate marine mammal mitigation plan for use by observers and crew to guide operations.

A core component of the planning process is for the exploration permit holder to determine the lowest practicable power levels for the acoustic source array that will achieve the geophysical objectives of the survey—and to limit operations to this maximum level.

While the Code is primarily concerned with protection of marine mammals, proponents are strongly encouraged to adopt whatever means are available to avoid or mitigate negative effects on other key species (such as turtles, penguins and seabirds) or key habitats identified in the planning stage as being potentially impacted.

Where Passive Acoustic Monitoring (PAM) is incorporated as a mitigation tool in the survey methodology, pre-survey planning should include input from the lead PAM operator, where possible, to ensure appropriate system specifications. Technical details of the PAM system will be provided to the Director-General in conjunction with the MMIA, along with a general description of proposed system deployment. Further information related to PAM operations can be found in the Reference Document.

Proponents will work with the Department to develop and agree any necessary additional mitigation measures based on the risks identified and the advice of the Director-General, and incorporate them into the survey methodology. While there is no formal approval process resulting in a 'consent', in each case the Director-General will determine whether the MMIA is sufficient for the purposes of the Code.

[2] Further measures may include, for example, additional observers or observation platforms, aerial observation, acoustic source power restrictions, deployment of static PAM equipment in sensitive areas, incorporation of other supplementary detection methods, or designing the survey so as to avoid trapping marine mammals in confined areas such as narrow, constricted seaways.

3.3 Operational area

It is at the discretion of the proponent to specify the geographical extent of the area needed for their operational activities. This will include locations outside the areas targeted for seismic survey data acquisition where acoustic source equipment testing might need to occur, and where soft starts are initiated in the approach to a survey line. All such areas must be included in the MMIA process. Acoustic seismic sources will not be activated outside the specified operational areas at any time, including for any necessary seismic source testing.

3.4 Training and experience requirements of observers

To be a trained observer (either MMO or PAM[3]), a person will have:

- Successfully completed the respective marine mammal observation course or PAM operator course recognised by the Director-General as being consistent with DOC standards, or
- Demonstrated all required competencies through an assessment process recognised by the Director-General as being consistent with DOC standards.

To be a qualified observer, in addition to the above a person will have:

- Logged a minimum of 12 weeks' relevant sea-time engaged in marine seismic survey operations in New Zealand continental waters, either as an MMO or PAM operator under the supervision of an appropriately qualified observer.

It is important to ensure the independence of qualified observers engaged in Level 1 surveys. Therefore, seismic survey vessel crew cannot be considered as qualified observers irrespective of training or experience. However for Level 2 seismic survey vessels[4], crew trained and experienced as outlined above may function as qualified observers for the purposes of the Code.

For the entire duration of the Code, PAM operators with 3 years' professional experience[5] and a minimum of 12 weeks' relevant international sea-time may be engaged if no other suitable qualified observer is available.

Additional information related to the performance, standards and training of qualified observers, as well as the range of interim measures established to ensure a smooth transition into the new regime, can be found in the Reference Document.

[3] To clarify, there can be no cross-over between MMO/PAM observer classes unless the relevant training and experience criteria have been met for each activity. A trained or qualified MMO cannot work as a PAM operator without the necessary training or experience, and vice versa.

[4] Practical onboard limitations may exist on Level 2 surveys as smaller vessels are normally used with limited accommodation capacity for additional personnel.

[5] Due to the relatively recent emergence of PAM technology, it may prove difficult to locate suitable operators with 3 years' experience. In such circumstances, the proponent should contact the Director-General to discuss potential alternative options.

3.5 Recording and reporting

All sightings of marine mammals during the survey period, including any beyond the maximum mitigation zone boundaries or while in transit, will be recorded in a standardised format (see Appendix 2). A written trip report shall be submitted by the proponent to the Director-General at the earliest opportunity but no longer than 60 days after completion of the survey.

Recording and reporting of observations of other marine species are also encouraged—noting whether opportunistic or systematic (during required observations)—especially where stakeholders have identified particular sensitivities or interests.

In addition to the above summary report, the qualified observers will submit all raw datasheets directly to the Director-General, at the earliest opportunity but no longer than 14 days after completion of each deployment. Proprietary information provided to the Director-General through these reporting processes will be treated in confidence. Only data on marine mammal detections will be made publicly available, primarily in summary form through updates to information resources for Areas of Ecological Importance, but potentially also for detailed analytical research.

The Director-General should be informed immediately if the qualified observers consider that higher numbers of cetaceans and/or Species of Concern than predicted in the MMIA are encountered at any time during the survey. In such instances where the Director-General determines that any additional measures are necessary, these will be implemented without delay. The Director-General should also be informed immediately about any instances of non-compliance with the Code.

The provisions outlined in this section are distinct from any reporting requirements that may apply under the Crown Minerals (Petroleum) Regulations 2007. These must be undertaken separately, and submitted to New Zealand Petroleum and Minerals.

3.6 Marine Mammal Sanctuaries

No person may carry out a marine seismic survey within a Marine Mammal Sanctuary (MMS) unless he or she has, at the earliest opportunity but not less than three months before commencing the survey:

- Notified the Director-General in writing of his or her intention to carry it out
- Submitted a written environmental impact assessment, and subsequently
- Agreed to comply with any additional conditions, such as increasing the mitigation zones or number of qualified observers required, imposed by the Director-General for operating in a MMS.

3.7 Explosives

No person can use explosives as an acoustic source in New Zealand continental waters.[6]

[6] It should be noted that on occasion the NZ Defence Force is engaged in disposal of munitions, which may be scientifically monitored to derive seismic survey data. Since the primary focus is disposal of wastes, these activities are not covered by the provisions of the Code, but may be subject to other legislation.

3.8 Operational requirements

3.8.1 Observer effort

While two qualified MMO are required on board at all times, as a minimum one must be on watch during daylight hours while the acoustic source is in the water[7] in the operational area. Of the two qualified PAM operators required on board at all times[8], as a minimum one must be on watch while the acoustic source is in the water in the operational area.

It is acceptable for there to be one qualified observer and one trained observer in each observation role (MMO/PAM) on board, if an agreement is in place for an appropriately qualified observer to act in a mentoring capacity to a trained observer for the duration of a voyage.

If the acoustic source is in the water but inactive, such as while waiting for bad weather conditions to pass, the qualified observers have the discretion to stand down from active observational duties and resume at an appropriate time prior to recommencing seismic operations. This strictly limited exception must only be used for necessary meal or refreshment breaks or to attend to other duties directly tied to their observer role onboard the vessel, such as adjusting or maintaining PAM or other equipment, or to attend mandatory safety drills.

So long as it does not cause health and safety issues, it is recommended that both qualified MMO are on watch during pre-start observations during daylight hours, or at any other key times where practical and possible.

Furthermore, an MMO with adequate understanding of the PAM system in operation[9], while not required for visual observation duties, may provide temporary cover in place of a qualified PAM operator to ensure continuation of 24-hour monitoring. This strictly limited exception is in order to allow for any necessary meal or refreshment breaks. A direct line of communication must be maintained between the MMO and the supervising PAM operator at all times. In such instances, the qualified PAM operator remains ultimately responsible for the duration of the duty watch.

The maximum on-duty shift duration for observers must not exceed 12 hours in any 24-hour period. Schedules must provide for completion of reporting requirements.

3.8.2 MMO duties

While acting in their designated role, MMOs will:

- Give effective briefings to crew members, and establish clear lines of communication and procedures for onboard operations
- Continually scan the water surface in all directions around the acoustic source (not the vessel) for presence of marine mammals, using a combination of the naked eye and high-quality binoculars, from optimum vantage points for unimpaired visual observations with minimum distractions
- Use GPS, sextant, reticle binoculars, compass, measuring sticks, angle boards, or any other appropriate tools to accurately determine distances/bearings and plot positions of marine mammals whenever possible throughout the duration of sightings

[7] Even in periods of poor sighting conditions there can be intervals where improvements in sighting conditions allow valuable observations to be made.

[8] If PAM is incorporated in the survey methodology.

[9] As assessed by the relevant qualified PAM operator on duty in each instance.

- Record and report all marine mammal sightings, including species, group size, behaviour/activity, presence of calves, distance and direction of travel (if discernible)
- Record sighting conditions (Beaufort Sea State, swell height, visibility, fog/rain, and glare) at the beginning and end of the observation period, and whenever the weather conditions change significantly
- Record acoustic source power output while in operation, and any mitigation measures taken
- Communicate with the Director-General to clarify any uncertainty or ambiguity in application of the Code, and
- Record and report any instances of non-compliance with the Code.

3.8.3 PAM operator duties

While acting in their designated role, PAM operators will:

- Give effective briefings to crew members, and establish clear lines of communication and procedures for onboard operations
- Deploy, retrieve, test and optimise hydrophone arrays
- On duty watch, concentrate on continually listening to received signals and/or monitoring PAM display screens in order to detect vocalising cetaceans, except for when required to attend to PAM equipment[10]
- Use appropriate sample analysis and filtering techniques
- Record and report all cetacean detections, including, if discernible, identification of species or cetacean group, position, distance and bearing from vessel and acoustic source
- Record type and nature of sound, time and duration heard
- Record general environmental conditions
- Record acoustic source power output while in operation, and any mitigation measures taken
- Communicate with the Director-General to clarify any uncertainty or ambiguity in application of the Code, and
- Record and report any instances of non-compliance with the Code.

Further information related to the required performance standards of qualified observers can be found in Appendix 3.

3.8.4 Authority to shut down or delay start

Any qualified observer on duty has the authority to delay the start of operations or shut down an active survey according to the provisions of the Code.

Where MMO are supported by PAM or other alternative technology operators during surveys, marine mammal detections by any means should initiate a process of dialogue between the qualified observers on duty at the time. This is to ensure that decisions potentially affecting survey operations are made in a robust and mutually supportive manner, based on the skills, experience, capability and professional judgement of the observers. However, mitigation action is not dependent on marine mammals being detected by PAM and confirmed by a MMO—either qualified observer has the authority to act independently in each instance, if necessary.

[10] Undertaking work-related tasks, such as completing reporting requirements, while monitoring equipment is allowed during duty watch, but PAM operators must not be distracted by non-work activities such as listening to music or watching TV/DVDs etc.

It should be noted that consistent with a precautionary approach, if operating in an area where calves are expected to be present or have been observed during the survey, that vocalising cetacean detections by PAM should be assumed to be emanating from a cow/calf pair. In this case the more stringent mitigation zone provisions should be applied, unless determined otherwise by the MMO during good sighting conditions.

Due to the limited detection range of current PAM technology for ultra-high frequency cetaceans[11] (<300 m), any such bioacoustic detections will require an immediate shutdown of an active survey or will delay the start of operations, regardless of signal strength or whether distance or bearing from the acoustic source has been determined. Shutdown of an activated acoustic source will not be required if visual observations by a qualified MMO confirm that the acoustic detection was of a species falling into the category of 'Other Marine Mammals'.

3.8.5 Observer deployment

The preference for operational deployment of observers is on the acoustic source vessel. However, if there are critical operational constraints in positioning observation teams on the source vessel, they may be redeployed onto chase or receiver vessels providing that their ability to perform in their specific roles is not compromised. The qualified observers affected must be involved in any discussions in this regard and agree to any redeployment arrangements.

Technology is currently emerging that allows remote monitoring of onboard PAM equipment. Where incorporated into survey methodology, remote monitoring can support, but not replace the minimum complement of two qualified PAM operators required onboard.

3.8.6 Crew observations

If a crew member onboard any vessel involved in survey operations (including chase or support vessels) observes what may be a marine mammal, he or she will promptly report the sighting to the qualified MMO, and the MMO will try to identify what was seen and determine their distance from the acoustic source.

In the event that the MMO is not able to view the animal, they will provide a sighting form to the crew member and instruct on how to complete the form. Vessel crew can relay either the form or basic information to the MMO. If the sighting was within the mitigation zones, it is at the discretion of the MMO whether to initiate mitigation action based on the information available.

Sightings made by members of the crew will be differentiated from those made by MMOs.

3.8.7 Acoustic source power output

The operator will ensure that information relating to the activation of an acoustic source and the power output levels employed throughout survey operations is readily available to support the activities of the qualified observers in real time by providing a display screen for acoustic source operations.

It is the responsibility of the operator to immediately notify the qualified observers if operational capacity is exceeded at any stage.

[11] For the purposes of the Code, ultra-high frequencies are defined as those between 30 and 180 kHz.

3.8.8 Acoustic source tests

Seismic source tests will be subject to the relevant soft start procedures for each survey level, though the 20-minute minimum duration does not apply. Where possible, power should be built up gradually to the required test level at a rate not exceeding that of a normal soft start. Level 1 and 2 seismic source tests with a maximum combined source capacity of <2.49 litres or 150 cubic inches do not require soft start procedures, and can be undertaken following relevant pre-start observations.

Acoustic source tests cannot be used for mitigation purposes, or to avoid implementation of soft start procedures.

3.8.9 Multiple acoustic sources

In specific instances where two acoustic sources of differing power outputs (that fall in different Levels under the Code) are employed simultaneously in a survey, the relevant provisions of the Code will be applied according to the combined operational capacities of the acoustic sources.

Where two acoustic sources of differing power outputs are employed at different times during a survey, the relevant requirements of the Code shall apply in each case according to the operational capacity of the specific acoustic source in use.

3.8.10 Soft starts

Level 1 or 2 acoustic sources will not be activated at any time except by soft start, unless the source is being reactivated after a single break in firing (not in response to a marine mammal observation within a mitigation zone) of less than 10 minutes immediately following normal operations at full power, and the qualified observers have not detected marine mammals in the relevant mitigation zones as outlined in section 4.1.4 (Level 1 surveys) or 4.2.4 (Level 2 surveys). This means a gradual increase of the source's power, starting with the lowest capacity gun, over a period of at least 20 minutes and no more than 40 minutes.

It is not permissible to repeat the 10-minute break exception from soft start requirements by sporadic activation of acoustic sources at full or reduced power within that time.

Soft starts will be scheduled so as to minimise, as far as possible, the interval between reaching full power operation and commencing a survey line.

3.8.11 Line turns

Operators are strongly encouraged to reduce unnecessary marine noise, if possible and practical, by shutting down at the end of a line and reactivating the acoustic source according to the applicable soft start procedures and pre-start observations.

However the use of acoustic sources for mitigation purposes during line turns immediately following normal full power operations is allowed, providing that the power output of the acoustic source during line turns is reduced to levels that limit effective ensonification to the maximum mitigation zone boundary. Use of acoustic sources for mitigation purposes should only be used in exceptional circumstances where demonstrated by the proponent to be necessary, and must be discussed and agreed with the Director-General as part of the MMIA process.

If mitigation acoustics are employed, they will be subject to the same shutdown provisions as normal seismic survey operations.

4. Part 2: Specific requirements for each level of marine seismic survey

4.1 Level 1 surveys

4.1.1 Pre-survey planning

No person may carry out a Level 1 marine seismic survey in New Zealand continental waters unless he or she has, at the earliest opportunity but not less than one month before commencing the survey, submitted to the Director-General a written MMIA (see Appendix 1).

When planning to operate in areas of identified sensitivity, proponents should develop adaptive management procedures to ensure that survey activities can be modified to respond to unforeseen circumstances and minimise risks of negative impacts by incorporating additional mitigative measures. In all circumstances, the provisions of the Code must be considered as the minimum required.

4.1.2 Observer requirements

For all Level 1 surveys the minimum qualified observer requirements are:

- **At all times there will be at least two qualified MMOs on board, and**
- **At all times there will be at least two qualified PAM operators on board**
- The qualified observers will be dedicated in that their roles on the vessel are strictly for the detection and data collection of marine mammal sightings, and instructing crew on their requirements when a marine mammal is detected within the relevant mitigation zone, and
- At all times while the acoustic source is in the water, at least one qualified MMO (during daylight hours) and at least one qualified PAM operator will maintain watches for marine mammals.

Observations by qualified observers are also encouraged at all other times where practical and possible.

If the PAM system has malfunctioned or become damaged, operations may continue for 20 minutes without PAM while the PAM operator diagnoses the issue. If the diagnosis indicates that the PAM gear must be repaired to solve the problem, operations may continue for an additional **2 hours** without PAM monitoring as long as all of the following conditions are met:

- It is daylight hours and the sea state is less than or equal to Beaufort 4
- No marine mammals were detected solely by PAM in the relevant mitigation zones in the previous 2 hours
- Two MMOs maintain watch at all times during operations when PAM is not operational
- DOC is notified via email as soon as practicable with the time and location in which operations began without an active PAM system
- Operations with an active source, but without an active PAM system, do not exceed a cumulative total of 4 hours in any 24 hour period.

4.1.3 Pre-start observations

Normal requirements

A Level 1 acoustic source can only be activated if it is within the specified operational area, and no marine mammals have been observed or detected in the relevant mitigation zones as outlined in section 4.1.4.

The source cannot be activated during daylight hours unless:

- At least one qualified MMO has continuously made visual observations all around the source for the presence of marine mammals, from the bridge (or preferably an even higher vantage point) using both binoculars and the naked eye, and no marine mammals (other than fur seals) have been observed in the relevant mitigation zone for at least 30 minutes, and no fur seals have been observed in the relevant mitigation zones for at least 10 minutes, and
- Passive Acoustic Monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation and no vocalising cetaceans have been detected in the relevant mitigation zones.

The source cannot be activated during night-time hours or poor sighting conditions unless:

- Passive Acoustic Monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation, and
- The qualified observer has not detected vocalising cetaceans in the relevant mitigation zones.

Additional requirements for start up in a new location in poor sighting conditions

In addition to the normal pre-start observation requirements outlined above, when arriving at a new location in the survey programme for the first time, the initial acoustic source activation must not be undertaken at night or during poor sighting conditions unless either:

- MMOs have undertaken observations within 20 nautical miles of the planned start up position for at least the last 2 hours of good sighting conditions preceding proposed operations, and no marine mammals have been detected; or
- Where there have been less than 2 hours of good sighting conditions preceding proposed operations (within 20 nautical miles of the planned start up position), the source may be activated if:
  - PAM monitoring has been conducted for 2 hours immediately preceding proposed operations, and
  - Two MMOs have conducted visual monitoring in the 2 hours immediately preceding proposed operations, and
  - No Species of Concern have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 2 hours immediately preceding proposed operations, and
  - No fur seals have been sighted during visual monitoring in the relevant mitigation zone in the 10 minutes immediately preceding proposed operations, and
  - No other marine mammals have been sighted during visual monitoring or detected during acoustic monitoring in the relevant mitigation zones in the 30 minutes immediately preceding proposed operations.

4.1.4 Delayed starts and shutdowns

Species of Concern with calves within a mitigation zone of 1.5 km

If, during pre-start observations or while a Level 1 acoustic source is activated (which includes soft starts), a qualified observer detects at least one cetacean with a calf within 1.5 km of the source, start up will be delayed or the source will be shut down and not be reactivated until:

- A qualified observer confirms the group has moved to a point that is more than 1.5 km from the source, or
- Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1.5 km of the source, and the mitigation zone remains clear.

Species of Concern within a mitigation zone of 1 km

If, during pre-start observations or while a Level 1 acoustic source is activated (which includes soft starts), a qualified observer detects a Species of Concern within 1 km of the source, start up will be delayed or the source will be shut down and not reactivated until:

- A qualified observer confirms the Species of Concern has moved to a point that is more than 1 km from the source, or
- Despite continuous observation, 30 minutes has elapsed since the last detection of the Species of Concern within 1 km of the source, and the mitigation zone remains clear.

Other Marine Mammals within a mitigation zone of 200 m

If, during pre-start observations prior to initiation of a Level 1 acoustic source soft start, a qualified observer detects a marine mammal within 200 m of the source, start up will be delayed until:

- A qualified observer confirms the marine mammal has moved to a point that is more than 200 m from the source, or
- Despite continuous observation, 10 minutes has passed since the last detection of a New Zealand fur seal within 200 m of the source and 30 minutes has elapsed since the last detection of any other marine mammal within 200 m of the source, and the mitigation zone remains clear.

If all mammals detected within the relevant mitigation zones are observed moving beyond the respective areas, there will be no further delays to initiation of soft start.

4.2 Level 2 survey

4.2.1 Pre-survey planning

No person may carry out a Level 2 marine seismic survey in New Zealand continental waters unless he or she has, at the earliest opportunity but not less than one month before commencing the survey, submitted to the Director-General a written MMIA (see Appendix 1).

In the event of exceptional circumstances or an opportunistic survey arising that does not provide sufficient time to complete an MMIA, the proponent will provide evidence to that effect to the satisfaction of the Director-General at the earliest opportunity but not less than two weeks before commencing the survey. Though a full MMIA may not be required in such circumstances, high-level information on any potential marine mammal sensitivities in the operational area based on available data must be determined as a minimum.

4.2.2 Observer requirements

For all Level 2 surveys the minimum qualified observer requirements are:

- **At all times there will be at least two qualified MMO on board**
- The qualified observers will be dedicated in that their roles during the period of seismic surveying on the vessel are strictly for the detection and data collection of marine mammal sightings and instructing crew on their requirements when a marine mammal is detected within the relevant mitigation zone; and,
- At all times while the acoustic source is in the water (during daylight hours), at least one qualified MMO will maintain a watch for marine mammals.

PAM is likely to be a requirement for Level 2 surveys in the future when mandatory regulations are being considered. However, at this stage under the Code it remains an optional consideration for Level 2 surveys. Where PAM is incorporated, the additional minimum qualified observer requirements are:

- At all times there will be at least **two qualified PAM operators** on board the source vessel, and
- At all times while the acoustic source is in the water, at least one qualified PAM operator will maintain a watch for marine mammals.
- If the PAM system has malfunctioned or become damaged, operations may continue in the absence of PAM while repairs are conducted.

4.2.3 Pre-start observations

A Level 2 acoustic source can only be activated if it is within the specified operational area, and no marine mammals have been observed or detected in the respective mitigation zones.

The source cannot be activated during daylight hours unless:

- At least one qualified MMO has continuously made visual observations all around the source for the presence of marine mammals, from the bridge (or preferably an even higher vantage point) using both binoculars and the naked eye, and no marine mammals have been observed in the respective mitigation zones for at least 30 minutes, and
- If incorporated, Passive Acoustic Monitoring[12] for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation and no vocalising cetaceans have been detected in the respective mitigation zones.

The source cannot be activated during night-time hours or poor sighting conditions unless:

- Passive Acoustic Monitoring for the presence of marine mammals has been carried out by a qualified PAM operator for at least 30 minutes before activation and no vocalising cetaceans have been detected in the relevant mitigation zones.

Operations at night or during poor sighting conditions

If PAM or other alternative technologies acceptable to the Director-General are incorporated to support marine mammal observations and are fully operational, Level 2 acoustic sources may be activated and active surveys may proceed at night or during poor sighting conditions, according to the provisions of the Code, following pre-start observations detailed above.

[12] If PAM is in operation, all non-essential sources of marine noise (such as multi-beam sonar) should be switched off during pre-start observations to reduce interference.

However, when observations are limited to MMOs for Level 2 survey operations, start up can be initiated and active surveys may proceed at night or during poor sighting conditions only if:

- There have not been more than 3 marine mammal instigated shutdowns or delayed starts in the previous 24 hours of active survey operations in good sighting conditions, or
- If active survey operations were not conducted in the previous 24 hours, MMOs have undertaken observations within a radius of 20 nm of the proposed start-up position for at least the last 2 hours of good sighting conditions during the daylight hours preceding proposed operations and no marine mammals have been detected.

4.2.4 Delayed starts and shutdowns

Species of Concern with calves within a mitigation zone of 1 km

If, during pre-start observations or while a Level 2 acoustic source is activated (which includes soft starts), a qualified observer detects at least one cetacean with a calf within 1 km of the source, start up will be delayed or the source will be shut down and not be reactivated until:

- A qualified observer confirms the group has moved to a point that is more than 1 km from the source, or
- Despite continuous observation, 30 minutes has elapsed since the last detection of the group within 1 km of the source, and the mitigation zone remains clear.

Species of Concern within a mitigation zone of 600 m

If, during pre-start observations or while a Level 2 acoustic source is activated (which includes soft starts), a qualified observer detects a Species of Concern within 600 m of the source, start up will be delayed or the source will be shut down and not reactivated until:

- A qualified observer confirms the Species of Concern has moved to a point that is more than 600 m from the source, or
- Despite continuous observation, 30 minutes has elapsed since the last detection of a Species of Concern within 600 m of the source, and the mitigation zone remains clear.

Other Marine Mammals within a mitigation zone of 200 m

If, during pre-start observations prior to initiation of a Level 2 acoustic source soft start, a qualified observer detects a marine mammal within 200 m of the source, start up will be delayed until:

- A qualified observer confirms the marine mammal has moved to a point that is more than 200 m from the source, or
- Despite continuous observation, 10 minutes has passed since the last detection of a New Zealand fur seal within 200 m of the source and 30 minutes has elapsed since the last detection of any other marine mammal within 200 m of the source, and the mitigation zone remains clear.

If all mammals detected within the relevant mitigation zones are observed moving beyond the respective areas, there will be no further delays to initiation of soft start.

4.3 Borehole seismic surveys

4.3.1 Pre-survey planning

No person may carry out a borehole seismic survey in New Zealand continental waters unless he or she has, at the earliest opportunity but not less than one month before commencing the survey, submitted to the Director-General a written MMIA (see Appendix 1).

When planning to operate in areas of identified sensitivity, proponents should develop adaptive management procedures to ensure that borehole seismic survey activities can be modified to respond to unforeseen circumstances and minimise risks of negative impacts by incorporating additional mitigation measures. In all circumstances, the provisions of the Code must be considered as the minimum required.

4.3.2 Observer requirements

Observer requirements shall depend on the capacity of the acoustic source being used for the borehole seismic survey, and shall comply with the requirements for the applicable Level 1 or 2 survey.

4.3.3 Crew observations

If a crew member onboard any vessel or drilling rig involved in borehole seismic survey operations observes what may be a marine mammal, he or she will promptly report the sighting to the qualified MMO, and the MMO will try to identify what was seen and determine their distance from the acoustic source.

In the event that the MMO is not able to view the animal, they will provide a sighting form to the crew member and instruct on how to complete the form. Vessel or drilling rig crew can relay either the form or basic information to the MMO. If the sighting was within the mitigation zones, it is at the discretion of the MMO whether to initiate mitigation action based on the information available.

Sightings made by members of the crew will be differentiated from those made by qualified observers.

4.3.4 Pre-start observations

Pre-start observation requirements shall depend on the capacity of the acoustic source being used for the borehole seismic survey, and shall comply with the requirements for the applicable Level 1 or 2 survey.

4.3.5 Soft starts

It is recognised that alternative acoustic source technologies may be used for borehole seismic surveys, and that soft start may not be possible in the same manner as a conventional marine seismic source array. Where possible, initial activation of the acoustic source must involve the gradual increase of the source's power over a period of at least 20 minutes and no more than 40 minutes, unless the source is being reactivated after a break in firing less than 10 minutes before that time. In the case of borehole seismic surveying, activation of the acoustic source at least once within sequential 10 minute periods shall be regarded as continuous operation.

4.3.6 Delayed starts and shut downs

Delayed start and shutdown requirements shall depend on the capacity of the acoustic source being used for the borehole seismic survey, and shall comply with the requirements for the applicable Level 1 or 2 survey.

Appendix 1: Marine Mammal Impact Assessment

The purpose of the MMIA procewss is to ensure that the proponent has:

- Identified all potential effects of their activities on marine species and habitats in the receiving environment
- Provided an opportunity for appropriate expert technical advice to be considered
- Avoided, wherever possible, operating in sensitive, ecologically important areas or during key biological periods where Species of Concern are likely to be breeding, calving, resting, feeding or migrating, or where marine mammals are present in confined waters, and
- Implemented whatever measures may be necessary to minimise the identified impacts to acceptable levels.

An MMIA will contain sufficient information to enable the Director-General to understand the nature of the proposed marine seismic survey activities and their effects on the environment, in such detail as corresponds to the scale and significance of the effects that the activities may have. Information will be provided on risks of negative impacts on the particular environmental sensitivities of the proposed area of operations, and consideration will be given to the timing, duration and intensity of the survey. An MMIA will:

- Describe the activities related to the proposed marine seismic survey
- Describe the state of the local environment in relation to marine species and habitats, with particular focus on marine mammals, prior to the activities being undertaken
- Identify the actual and potential effects of the activities on the environment and existing interests, including any conflicts with existing interests
- Identify the significance (in terms of risk and consequence) of any potential negative impacts and define the criteria used in making each determination
- Identify persons, organisations or tangata whenua with specific interests or expertise relevant to the potential impacts on the environment
- Describe any consultation undertaken with persons described above and specify those who have provided written submissions on the proposed activities
- Include copies of any written submissions from the consultation process
- Specify any possible alternative methods for undertaking the activities to avoid, remedy, or mitigate any adverse effects
- Specify the measures that the operator intends to take to avoid, remedy, or mitigate the potential adverse effects identified
- Specify a monitoring and reporting plan, and
- Specify means of coordinating research opportunities, plans, and activities relating to reducing and evaluating environment effects.

For the purposes of the Code, the meaning of the word 'effect' includes:

- Any positive or adverse effect
- Any temporary or permanent effect
- Any past, present, or future effect
- Any cumulative effect that arises over time or in combination with other effects
- Any potential effect of high probability, and
- Any potential effect of low probability that has a high potential impact.

Where activities are planned in Areas of Ecological Importance or Marine Mammal Sanctuaries, sound transmission loss modelling will be incorporated into the MMIA methodology and ground-truthed during the course of the survey by appropriate means. Such modelling will indicate predicted sound levels within the various mitigation zones and potential impacts on species present. If sound levels are predicted to exceed either 171 dB re 1 μPa^2-s at distances corresponding to the relevant mitigation zones for Species of Concern or 186 dB re 1 μPa^2-s at 200 m, consideration will be given to either extending the radius of the mitigation zone or limiting acoustic source power accordingly.

While the focus of the MMIA will be on marine mammals, proponents should also identify broader effects on other significant species or habitats, and include consideration of options for mitigation of any negative impacts—such as incorporation of turtle exclusion devices to prevent entrapment within their distribution range.

An MMIA for the purposes of the Code could be one component of a larger Health Safety and Environment (HSE) plan governing operations, which are commonly employed in the oil and gas sector. In such instances submission of the HSE plan or its relevant parts will be acceptable, providing the details outlined above are included as a minimum. Similarly, where industry practice is to prepare a generic project environmental impact assessment (EIA) at the permit award stage, additional studies will be required to complete the MMIA submitted under the Code if information gaps are identified when specific details of the marine seismic survey are confirmed.

There is no formal approval issued by the Director-General. However, the MMIA review process provides for the Department of Conservation's marine mammal specialist technical advisors to give appropriate guidance according to the relative impacts and risks of the proposed survey. The MMIA review will be coordinated by the National Office and will involve all relevant technical specialists from across the organisation, depending on the specific circumstances of the survey programme. The Director-General will endeavour to provide an initial response within 10 working days, and within 5 working days for any subsequent matters.

In each case, the Director-General will seek assurance that the measures provided for in the Code, or any additional measures proposed by the proponent, are appropriate to the risks identified. Where such assurance is not provided, the Director-General will advise on any further actions that are deemed necessary to minimise impacts. Proponents will work with the Department to develop and agree any necessary additional mitigation measures based on the advice of the Director-General, and incorporate them into the survey methodology.

The final MMIA must be made available to any personnel engaged in observational duties. Furthermore, where additional mitigation measures have been agreed, a specific marine mammal mitigation plan for the survey should be developed and circulated amongst observers and crew to guide offshore operations.

Appendix 2: Observer reporting

MMO and PAM operators are jointly responsible for recording observational data generated while on duty, and compiling a summary report. This report will detail:

- The identity, qualifications and experience of those involved in observations
- Observer effort, including totals for watch effort (hours and minutes)
- Observational methods employed
- Name of the operator and any vessels/aircraft used
- Specifications of the seismic source array, and PAM array (if included)
- Position, date, start/end of survey, GPS track logs of vessel movements
- Totals for seismic source operations (hours and minutes) indicating respective durations of full-power operation, soft starts and acoustic source testing, and power levels employed, plus at least one random soft start sample per swing
- Sighting/acoustic detection records indicating:
    1. method of detection
    2. position of vessel/acoustic source
    3. distance and bearing of marine mammals related to the acoustic source
    4. direction of travel of both vessel and marine mammals
    5. number, composition, behaviour/activity and response of the marine mammal group (plotted in relation to vessel throughout detection)
    6. confirmed identification keys for species or lowest taxonomic level
    7. confidence level of identification
    8. descriptions of distinguishing features of individuals where possible
    9. acoustic source activity and power at time of sighting
    10. environmental conditions
    11. water depth, and
    12. for PAM detections, time and duration heard, type and nature of sound
- General location, time, duration and reasons where observations were affected by poor sighting conditions
- Position, time and number of delays and shutdowns initiated in response to the presence of marine mammals
- Position, duration and maximum power attained where operational capacity is exceeded
- Any instances of non-compliance with the Code.

Differentiation should be made between data derived from:

- MMO and PAM operators
- qualified observers and others
- watches during survey operations (ON Survey) or at other times (OFF Survey).

Data must be recorded in a standardised format, which can be downloaded from the Department of Conservation website[13] at http://www.doc.govt.nz/notifications.

[13] It is critical for observers to ensure that the report form functions correctly on their computer system before going to sea. Ensuring access to spare computer capacity onboard is also highly recommended.

Appendix 3: MMO and PAM operator standards

MMO standards

The standards for being considered a trained marine mammal observer include demonstrating proficiency in the following areas as minimum requirements:

- Understanding mitigation and reporting requirements under the Code
- Measuring distance, true speed and direction of travel of marine mammals and vessel movement
- Navigation (e.g. true vs magnetic north, course vs heading)
- Plotting positions of marine mammals in relation to vessel and acoustic source
- Detection and identification of New Zealand marine mammal species, and behaviour/activity assessment
- Understanding relevant aspects of seismic survey operations.

While engaged in observation duties onboard seismic survey vessels, qualified marine mammal observers are expected to be able to use the following tools effectively:

- Reticle binoculars and/or sextant[14] for medium- to long-range (>500 m) distance determinations
- Measuring sticks (in addition to reticle binoculars or sextant) for short-range distance determinations
- Angle boards and compass for bearing determinations from vessel
- GPS to record vessel coordinates accurately and download track logs.

'Eye-estimations' of distance are strongly discouraged, and may only be used when the horizon is not visible as a reference for distance calculations or where insufficient time is available to employ more accurate methods of measurement.

Alternative technologies for visual observations and distance determination, such as thermal imaging or high-definition photography systems, are being trialled and may prove to be more effective under certain conditions. Where demonstrated to be at least as good as, if not better than sextant or reticle binoculars, these may be used to supplement visual observations.

[14] The sextant remains the most reliable and accurate instrument for determining distances at sea where the horizon is visible. However, despite its technological simplicity and long history of maritime use, its use by observers has been limited to date. Relatively inexpensive, lightweight plastic versions are widely available, and while it remains at the discretion of the MMO whether to use one in each specific circumstance, it is strongly encouraged that all MMO have a sextant available as a professional tool.

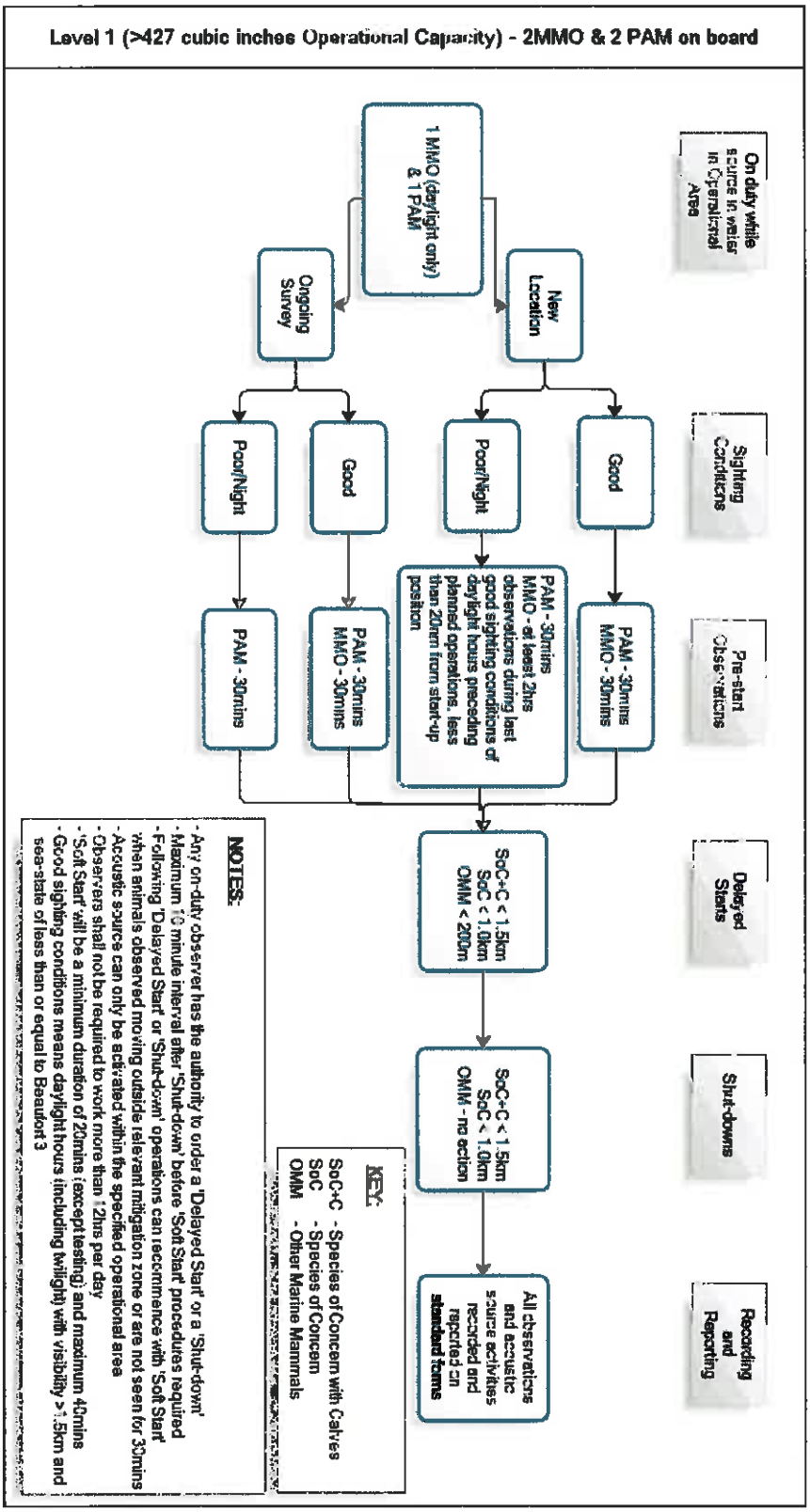
PAM operator standards

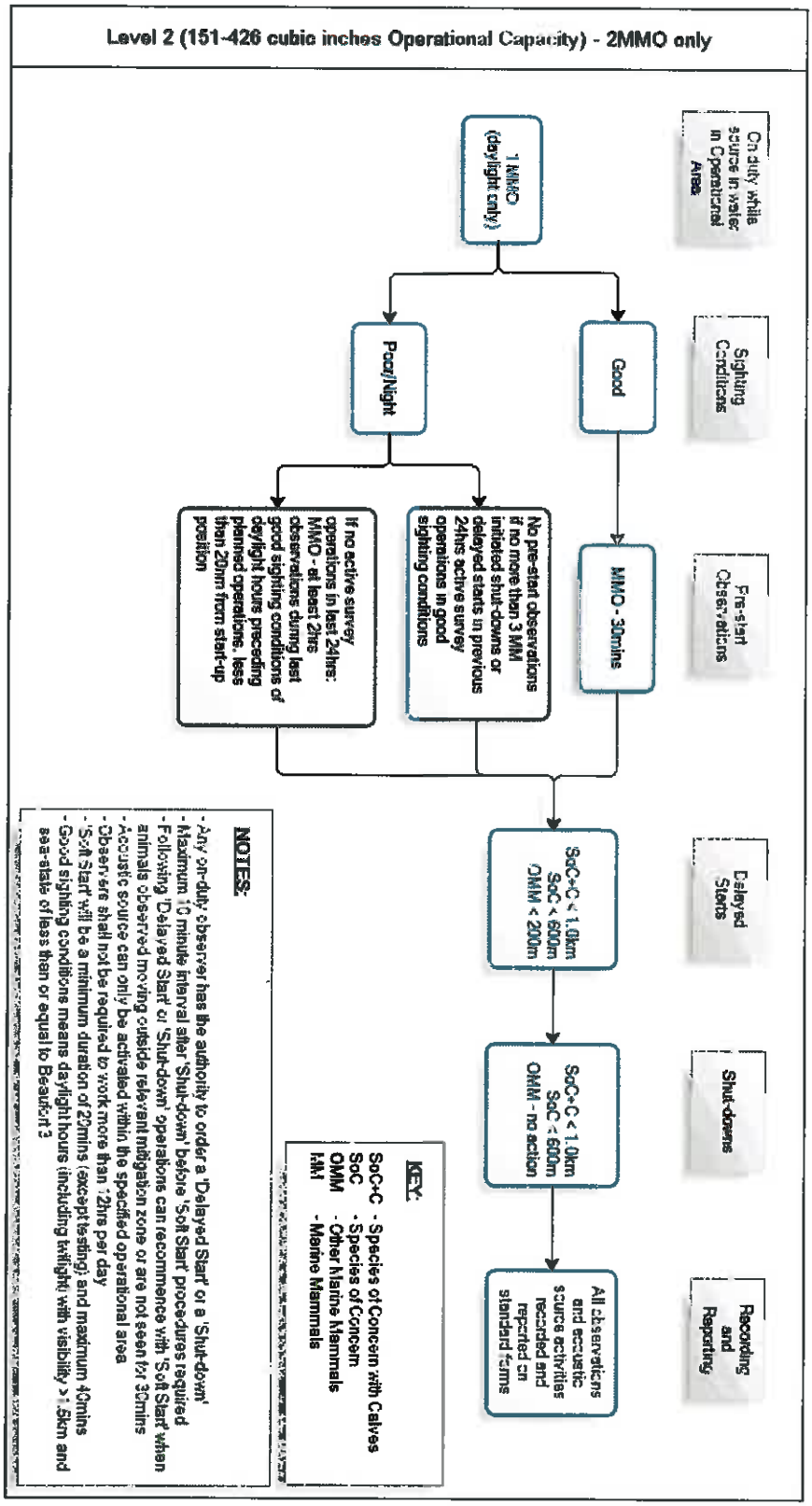
The standards for being considered a trained PAM operator include demonstrating proficiency in the following areas as minimum requirements:

- Understanding mitigation and reporting requirements under the Code
- Optimised deployment and configuration of PAM equipment to ensure effective detections of cetaceans for mitigation purposes
- Detection and identification of vocalising species or cetacean groups
- Measuring distance and bearing of vocalising cetaceans while accounting for vessel movement
- Navigation (e.g. true vs magnetic north, course vs heading)
- Plotting positions of cetaceans in relation to vessel and acoustic source
- Understanding relevant aspects of seismic survey operations.

PAM operators should regularly refresh their detection skills through practice with simulation-modelling software, particularly with species relevant to the region of proposed operations (if available), in preparation for the start of the survey programme. Operators should keep up to date with training on the latest software/hardware advances.

Appendix 4: Operational flowcharts




Level 2 (151-426 cubic inches Operational Capacity) - 2MMO only
On duty while source in water in Operational Area
1 MMO (daylight only)
Sighting Conditions
Good
Poor/Night
Pre-start Observations
MMO - 30mins
No pre-start observations if no more than 3 MM initiated shut-downs or delayed starts in previous 24hrs active survey operations in good sighting conditions
If no active survey operations in last 24hrs: MMO - at least 2hrs observations during last good sighting conditions of daylight hours preceding planned operations, less than 20nm from start-up position
Delayed Starts
SoC+C < 1.0km
SoC < 600m
OMM < 200m
Shut-downs
SoC+C < 1.0km
SoC < 600m
OMM - no action
Recording and Reporting
All observations and acoustic source activities recorded and reported on standard forms
KEY:
SoC+C - Species of Concern with Calves
SoC - Species of Concern
OMM - Other Marine Mammals
MM - Marine Mammals
NOTES:
- Any on-duty observer has the authority to order a 'Delayed Start' or a 'Shut-down'
- Maximum 10 minute interval after 'Shut-down' before 'Soft Start' procedures required
- Following 'Delayed Start' or 'Shut-down' operations can recommence with 'Soft Start' when animals observed moving outside relevant mitigation zone or are not seen for 30mins
- Acoustic source can only be activated within the specified operational area
- Observers shall not be required to work more than 12hrs per day
- 'Soft Start' will be a minimum duration of 20mins (except testing) and maximum 40mins
- Good sighting conditions means daylight hours (including twilight) with visibility > 1.5km and sea-state of less than or equal to Beaufort 3

Level 2 (151-426 cubic inches Operational Capacity) - 2MMO & 2 PAM on board
On duty while source in water in Operational Area
1 MMO (daylight only) & 1 PAM
Sighting Conditions
Good
Poor/Night
Pre-start Observations
PAM - 30mins MMO - 30mins
PAM - 30mins
Delayed Starts
SoC+C < 1.0km SoC < 600m OMM < 200m
Shut-downs
SoC+C < 1.0km SoC < 600m OMM - no action
Recording and Reporting
All observations and acoustic source activities recorded and reported on standard forms
KEY:
SoC+C - Species of Concern with Calves
SoC - Species of Concern
OMM - Other Marine Mammals
NOTES:
- Any on-duty observer has the authority to order a 'Delayed Start' or a 'Shut-down'
- Maximum 10 minute interval after 'Shut-down' before 'Soft Start' procedures required
- Following 'Delayed Start' or 'Shut-down' operations can recommence with 'Soft Start' when animals observed moving outside relevant mitigation zone or are not seen for 30mins
- Acoustic source can only be activated within the specified operational area
- Observers shall not be required to work more than 12hrs per day
- 'Soft Start' will be a minimum duration of 20mins (except testing) and maximum 40mins
- For PAM operations, all non-essential sources of noise (eg multibeam) switched off during pre-start observations
- Good sighting conditions means daylight hours (including twilight) with visibility > 1.5km and sea-state of less than or equal to Beaufort 3

Appendix 5: Adoption

Acceptance of the *2013 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* (the Code) and Agreement to Follow its Provisions

Persons who intend to follow the Code while conducting seismic surveys in New Zealand continental waters should take the following steps to confirm such intention—

a. Download and print a copy of the code from www.doc.govt.nz
b. Complete the following form with necessary details as indicated
c. Send the signed copy of this page to the Director-General of Conservation at the address/email below.

Taking the above steps will ensure that the Director-General of Conservation is aware of the extent of uptake of the Code in industry practice. Acceptance of the Code and fulfilling its recommendations will also mean that the Director-General will be furnished with relevant reports from time to time. Such reports would assist in developing further knowledge about the relevant marine mammals, and in turn improve conservation work with respect to them.

I, (*name*) _____

of (*address*)_____,
being authorised by and on behalf of
(*name of the company/body corporate*) _____
accept the *2012 Code of Conduct for Minimising Acoustic Disturbance to Marine Mammals from Seismic Survey Operations* and its supporting Reference Document and agree that its provisions will be followed in respect of seismic survey operations, conducted under the authority of
(*name of the company/body corporate*)_____
in New Zealand continental waters during the term of the Code.
I understand that following acceptance of the Code,
(*name of the company/body corporate*)_____
will provide all relevant notifications and reports to the Director-General as expected under the Code. I also understand that the Code is voluntary, and its acceptance and agreement to follow its provisions does not bind
(*name of the company/body corporate*) _____
in any way under the Marine Mammals Protection Act 1978.

Signature: _____

Date: _____

Send a copy of this form to:

Director-General,
Department of Conservation
PO Box 10420, Wellington 6143

OR marinemammals@doc.govt.nz

Schedule 1: Areas of Ecological Importance

As detailed in Part 1, seismic survey operations within any AEI (which includes the Marine Mammal Sanctuaries) have more comprehensive planning requirements and considerations, including specific additional measures in the MMIA process (see Appendix 1).

The locations and extent of AEI in New Zealand continental waters have been determined from the Department's database records for marine mammal sightings and strandings, as well as from fisheries-related data maintained by the Ministry for Primary Industries through the National Aquatic Biodiversity Information System (NABIS). In addition, technical input from marine mammal experts has been used to refine the AEI maps where data may be absent or incomplete.

The databases are continually evolving, so the AEI will be updated and refined as new information comes to light. To assist planning, online resources have been developed on the Department of Conservation website which will be subject to ongoing review.

Information on AEI can be found at the following URL:

http://www.doc.govt.nz/aei

It must be remembered that since understanding about marine mammal distribution and life history is incomplete, the information related to an AEI should not be considered conclusive. There may be other areas beyond the identified AEI where particular sensitivities could exist. Where such areas are identified in the MMIA process, the proponent should discuss potential impacts and mitigation measures with the Director-General.

Schedule 2: Species of Concern

LATIN NAME	COMMON NAME
Megaptera novaengliae	Humpback Whale
Balaenoptera borealis	Sei Whale
Balaenoptera edeni	Bryde's Whale
Balaenoptera bonaerensis	Antarctic Minke Whale
Balaenoptera acutorostrata subsp.	Dwarf Minke Whale
Balaenoptera musculus	Blue Whale
Balaenoptera physalus	Fin Whale
Balaenoptera musculus brevicauda	Pygmy Blue Whale
Eubalaena australis	Southern Right Whale
Caperea marginata	Pygmy Right Whale
Lissodelphis peronii	Southern Right-whale Dolphin
Globicephala melas	Long-finned Pilot Whale
Globicephala macrorhynchus	Short-finned Pilot Whale
Peponcephala electra	Melon-headed Whale
Physeter macrocephalus	Sperm Whale
Kogia sima	Dwarf Sperm Whale
Kogia breviceps	Pygmy Sperm Whale
Mesoplodon grayi	Gray's Beaked Whale
Berardius arnuxii	Arnoux's Beaked Whale
Ziphius cavirostris	Cuvier's Beaked Whale
Mesoplodon layardii	Strap-toothed Whale
Hyperoodon planifrons	Southern Bottlenose Whale
Mesoplodon bowdoini	Andrew's Beaked Whale
Mesoplodon mirus	True's Beaked Whale
Mesoplodon densirostris	Blainville's Beaked Whale
Mesoplodon gingkodens	Ginkgo-toothed Whale
Mesoplodon hectori	Hector's Beaked Whale
Mesoplodon peruvianus	Pygmy/Peruvian Beaked Whale
Tasmacetus shepherdi	Shepherd's Beaked Whale
Orcinus orca	Killer Whale
Pseudorca crassidens	False Killer Whale
Feresa attenuata	Pygmy Killer Whale
Cephalorhynchus hectori	Hector's Dolphin
Cephalorhynchus hectori maui	Maui's Dolphin
Phocarctos hookeri	New Zealand Sea Lion
Tursops truncatus	Bottlenose Dolphin

newzealand.govt.nz

APPENDIX 2
DOC Excel Data forms

Cetacean Sighting Form - Off seismic survey

(Re. Lion March 2012)

Job Name/Number:	Bonanza	Detection Number	T	Observation point	Observation Point 1
Seismic ship:	Queen Mary III				
Dectected from:		Observers	First dectected by:		
Aircraft					
[illegible]			Non-MMO:		
Sighting conditions		Family			
Visibility		Species			
[illegible]					
Beaufort sea state		Confidence of species identification			
Swell height					
Observation platform		Numbers	minimum	maximum	best est
Survey line		Adult			
First sighted by		Calf			
Sighted at [illegible]		Total	0	0	0
Other [illegible]					
Position [illegible]					

New Cetacean Sighting

Submit Data

Delete Record

Description of animals (e.g. length, shape, colour & pattern markings, shape & size of dorsal fin, shape of head, blow) or sound(type and nature of sound, eg clicks, whistles, creaks, burst pulses, continous, sporadic, strength of signal)

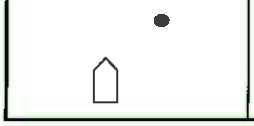
Action taken	Distance	Give shut down time and any subsequent ramp up(s)
Shut down		

General behaviour of animals. (Plus any subsequent changes in behaviour.)

Behaviour.	First		predominate		Last	

General Mammal course	Drawings/Photos/True plot

Position of first sight



MITIGATION ZONES		
	Level 1	Level 2
SoC + C	< 1.5km	< 1km
SoC	< 1km	< 600km
OMM	< 200m	< 200km

Time	Vessel latitude (south)		Vessel longitude (east/west)		Latitude	Longitude	Vessel course	Distance observer	Bearing to mammal	Mammal course	Gun/Vessel status	NM Distance to array	OPS ref	Garmin GPS positions (optional)	
	degrees	minutes.decimal	degrees	minutes.decimal	automated	automated	(degrees)	(km)	(degrees)	(compass)	(abbrevition)	(km)	Waypoint No.	Date & time	Position

SURVEY NAME:	0														
OBSERVER/S:	0		0	0	0	ON SURVEY EFFORT					Auto-filled cells				
PROPONENT:	0					Effort while surveying					User-filled cells		New Marine Mammal Detection		
VESSEL:	0														
Date (For time started) dd.mm.yy	General Area	Time Start (NZDT)	Time Stopped (NZDT)	Duration	Array Status	Influence on Observations	Beaufort Sea State	Swell Height	Visibility	Monitoring	Sighting Conditions for Visual Observations	NZ Fur Seal Detection ID (eg.S001)	Marine Mammal Detection ID (eg.001)	Comments	
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APPENDIX 3
Daily and Weekly Reports

MMO / PAM Daily Report	Client: NZOG		Survey Name: Endurance 3D MSS
	Report Number: 01	Report Date: DD/MM/YYYY	Survey Vessel:

Report Distribution: - NZOG Project Manager
XXX - NZOG Client Rep
RPS MFO Mgr

Submitted by: MMO Team Leader

Date Submitted: DD/MM/YYYY

1. Visual and Acoustic Monitoring Effort

Visual Monitoring Effort - Marine Mammal Observers (MMOs)	Frequency	Duration (hh:mm)
Total duration of visual monitoring effort conducted (hours and minutes):		00:00
Number and duration of pre-start observations conducted during daylight hours and good visibility (hours and minutes):	00	
Number and duration of pre-start observations conducted during dawn/dusk or in poor visibility (hours and minutes):	00	
Total number and duration of visual pre-start observations conducted (hours and minutes):	00	
Total duration when the source was actively engaged during visual monitoring effort (hours and minutes):		
Passive Acoustic Monitoring (PAM) Effort - PAM System Operators		
Total duration of acoustic monitoring effort conducted (hours and minutes):		
Number and duration of pre-start observations conducted during daylight hours and good visibility (hours and minutes):		
Number and duration of pre-start observations conducted during dawn/dusk or in poor visibility (hours and minutes):		
Total number and duration of pre-start observations conducted (hours and minutes):		
Total duration when the was actively engaged during acoustic monitoring effort (hours and minutes):		

2. Cetacean and Marine Mega-fauna Records

Marine Fauna Observers (MFOs)	Number of Records	Number of Animals
Total number of cetacean sighting records documented:	00	00
Total number of seal sighting records documented:	00	00
Total number of marine mega-fauna sighting recorded documented:		
Passive Acoustic Monitoring (PAM) System Operators		
Total number of cetacean acoustic detection events documented:		
Concurrent Marine Fauna Observers (MFOs) and Passive Acoustic Monitoring (PAM) System Operators		
Total number of concurrent cetacean sighting and acoustic detection events documented:		

2.1 Summary of Cetacean Records

Record No.	Date	Time (WST)	Detection Method	Species	No. of Animals	Vessel Position (Latitude)	Vessel Position (Longitude)	Range to Cetacean(s) (CPA metres)	Bearing to Cetacean(s) (Degrees)	Cetacean(s) Movement/ Behaviour	Source Activity	Mitigating Action Taken

2.2 Summary of Marine Mega-fauna Records

Record No.	Date	Time (WST)	Detection Method	Species	No. of Animals	Vessel Position (Latitude)	Vessel Position (Longitude)	Range to Animal(s) (CPA metres)	Bearing to Animal(s) (Degrees)	Animal(s) Movement/ Behaviour	Source Activity	Mitigating Action Taken

Detection Method: **V**: Visual; **A**: Acoustic; **VA**: Visual and Acoustic; **AV**: Acoustic and Visual
Movement Codes: **TV**: towards vessel; **AV**: away from vessel; **PV**: parallel with vessel; **NO**: no movement; **UN**: unknown; **OM**: other movement
Behavioural Codes: **NS**: normal swimming; **FT**: fast travel; **ST**: slow travel; **PO**: porpoising; **SB**: swimming below surface; **MI**: milling: **BR**: bow/wake riding; **RL**: resting/logging at surface; **BA**: basking at surface; **SA**: surface active (lob tailing/pectoral slapping) **BR:** breaching **DI**: dive; **DF**: dive with fluke; **FF**: feeding/foraging; **SB**: social behaviour; **OBV**: only blow visible (whale); **OSV**: only splashes visible (dolphins); **ODV**: only dorsal fin visible; **OB**: other behaviour
Source Activity Codes: **NG**: no guns; **GT**: gun test; **SS**: soft start; **FP**: full power (acquisition); **NG/SD**: no guns/shut down; **NG/WD**: no guns/weather downtime; **NG/TD**: no guns/technical downtime; **NG/PT:** no guns/PAM downtime
Mitigating Action Codes: **SSD**: soft start delay; **SD:** shut down; **NA**: no mitigating action required during the sighting/acoustic event

3. Seismic Operations and Mitigating Actions Taken

Mitigation Procedures and Actions	Frequency	Duration (hh:mm)
Total number of soft-start procedures implemented:	0	
Total number of line sequences acquired and in progress:	0	
Number of Delay procedures implemented and duration marine species present in the relevant mitigation zone (hh:mm):	0	00:00
Number of Shutdown procedures implemented and duration marine species present in the relevant mitigation zone (hh:mm):	0	00:00
Total number of mitigating actions implemented (delay and shutdown procedures):	0	
Total estimated downtime/loss of production due to mitigating actions taken (hours and minutes):		00:00
Total number of non-compliant events:	0	

3.1 Start-up Delay Procedures

3.2 Shut Down Procedures

3.3 Compliance – Code of Conduct

MMO and PAM Weekly Report	
Survey Name: Endurance 3D MSS	Report Number: 1
Survey Vessel:	Reporting Period: XX to XX

Report Distribution: · Project Manager
XXXX NZOG Client Rep

RPS MFO Mgr

Submitted by: XXXX MMO Team Leader
Date Submitted: DD / MM / YYYY

1. Visual and Acoustic Monitoring Effort

2. Weather / Environmental Conditions During Monitoring

Table 1. Summary of monitoring effort conducted during the reporting period.

Visual Monitoring Effort - Marine Mammal Observers (MMOs)	Frequency	Duration (hh:mm)
Total time of visual monitoring effort conducted (hours and minutes):		00:00
Number and duration of pre-start observations conducted during daylight hours and good visibility:		
Number and duration of pre-start observations conducted during dawn/dusk or in poor visibility:		
Total number and duration of pre-start observations conducted (hours and minutes):		
Total time when the source was actively engaged during visual monitoring effort (hours and minutes):		
Passive Acoustic Monitoring (PAM) Effort - PAM System Operators		
Total time of PAM effort conducted (hours and minutes):		
Number and duration of pre-start observations conducted during daylight hours and good visibility:		
Number and duration of pre-start observations conducted during dawn/dusk or poor visibility:		
Total number and duration of pre-start observations conducted (hours and minutes):		
Total time when the source was actively engaged during acoustic monitoring effort (hours and minutes):		

Table 2. Summary of source operations and mitigating actions implemented during the reporting period.

Source Operations	Frequency	Duration (hh:mm)
Total number of acoustic source uses:		
Total number of seismic tests undertaken:		00:00
Total number of soft starts undertaken:		
Total number of line sequences (completed or in progress):		
Total time the source was actively engaged within the reporting period (hours and minutes):		
Mitigation Procedures and Actions		
Total number of cetacean delay or shutdown procedures implemented:		
Total number of fur seal delay or shutdown procedures implemented:		
Total number of mitigating actions taken:		
Total downtime/loss of production due to mitigating actions (hours and minutes):		
Total number of non-compliant incidents:		

Figure 1: Total monitoring effort both visual and PAM during the reporting period.

Figure 2: Percentage of monitoring effort undertaken relative to Beaufort wind force scale.

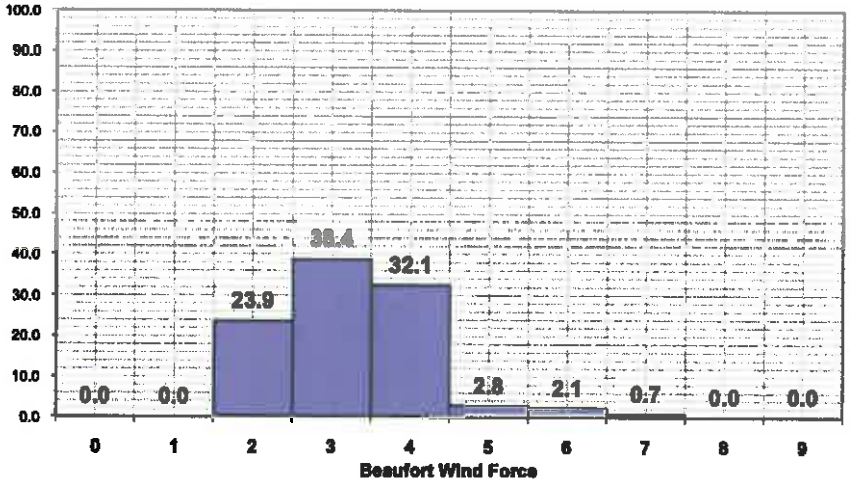


Figure 3: Percentage of monitoring effort undertaken relative to sea state conditions.

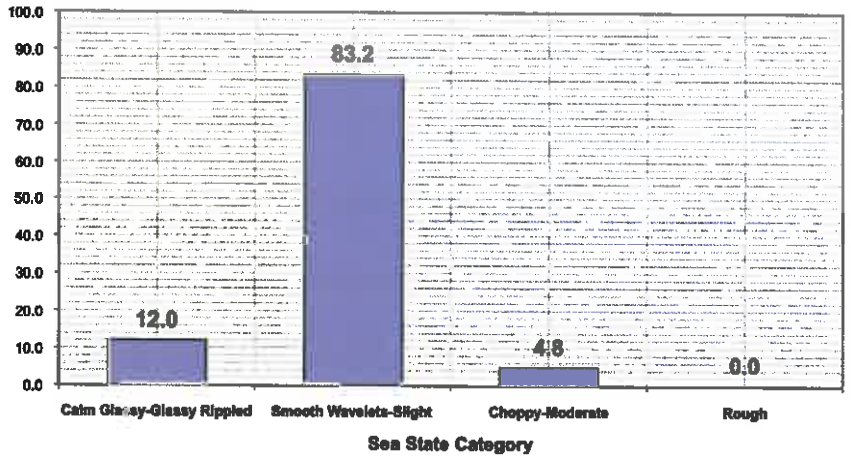
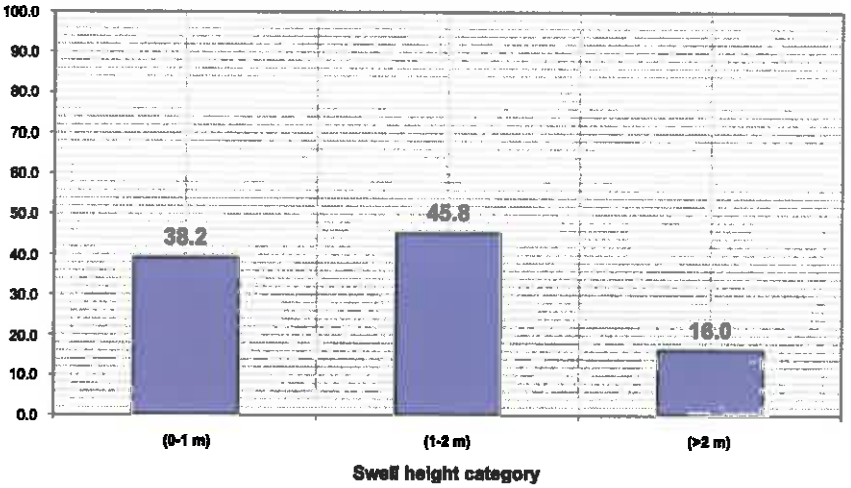


Figure 4: Percentage of monitoring effort undertaken relative to swell conditions.



3. Cetaceans and Marine Mega-fauna Records

Table 3. Summary of cetacean sighting records documented during the reporting period.

Record No.	Date	Time (WST)	Detection Method	Species	No. of Animals	Vessel Position (Latitude)	Vessel Position (Longitude)	Range to Cetacean(s) (CPA metres)	Bearing to Cetacean(s) (Degrees)	Animal(s) Movement/ Behaviour	Source Activity	Mitigating Action Taken

Table 4. Summary of marine mega-fauna sighting records documented during the reporting period.

Record No.	Date	Time (WST)	Detection Method	Species	No. of Animals	Vessel Position (Latitude)	Vessel Position (Longitude)	Range to Cetacean(s) (CPA metres)	Bearing to Cetacean(s) (Degrees)	Animal(s) Movement/ Behaviour	Source Activity	Mitigating Action Taken

Detection Method: **V**: Visual; **A**: Acoustic; **VA**: Visual and Acoustic; **AV**: Acoustic and Visual

Movement Codes: **TV**: towards vessel; **AV**: away from vessel; **PV**: parallel with vessel; **NO**: no movement;; **UN:** unknown; **OM**: other movement

Behavioural Codes: **NS**: normal swimming/travel ; **FT**: fast swimming/travel; **ST**: slow swimming/ travel; **PO**: porpoising; **SB**: swimming below surface; **MI**: milling: **BR**: bow/wake riding; **RL**: resting/logging at surface; **BA:** basking at surface; **SA**: surface active (lob tailing/pectoral slapping) **BH**: Breaching; **DI**: dive; **DF**: dive with fluke; **FF**: feeding/foraging; **SB**: social behaviour; **OBV**: only blow visible; **OSV;** only splashes visible (dolphins); **ODV:** only dorsal fin visible; **OB:** other behaviour

Source Activity Codes: **NG**: no guns; **GT**: gun test; **SS**: soft start; **FP**: full power (acquisition); **NG/SD**: no guns/shut down; **NG/WD**: no guns/weather downtime; **NG/TD**: no guns/technical downtime

Mitigating Action Codes: **PS**: pre-start observation; **SSD**: soft start delay; **SD:** shut down; **NA**: no mitigating action necessary during the sighting/acoustic event

Figure 5: Cetaceans, seals and marine mega-fauna sighting / acoustic detections from within the Endurance 3D MSS area during the reporting period.

4.0 Compliance with the Code of Conduct

4.1 Source Operations and Mitigation Procedures

4.2 Pre-Start Observation (visual and acoustic) Procedures

4.3 Start-up Delay (visual and acoustic) Procedures

4.4 Shutdown (visual and acoustic) Procedures

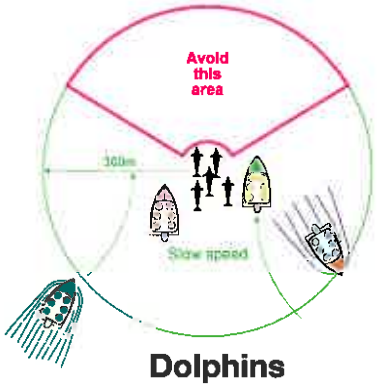
5.0 Meeting NZOG's Additional Mitigation Measures

APPENDIX 4

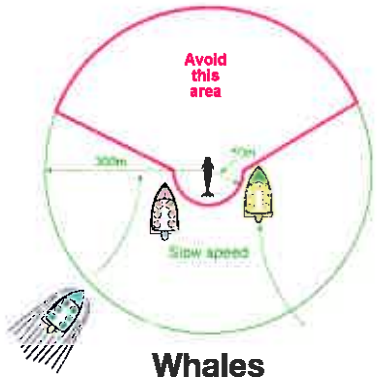
Sharing our coasts with marine mammals

At sea

- Ensure that you travel no faster than idle or 'no wake' speed within 300 metres of any marine mammal.
- Approach whales and dolphins from behind and to the side.
- Do not circle them, obstruct their path or cut through any group.
- Keep at least 50 metres from whales (or 200 metres from any large whale mother and calf or calves).
- Swimming with whales is not permitted.
- You may swim with seals and dolphins but not with dolphin pods with very young calves.
- Avoid approaching closer than 20 metres to seals and sea lions hauled out on shore.
- Idle slowly away. Speed may be gradually increased to out-distance dolphins and should not exceed 10 knots within 300 metres of any dolphin.



Dolphins



Whales

Bottlenose dolphin showing severe propeller marks
C. D. Rundgren

Appropriate boating behaviour can minimise risk to marine mammals
Kim Westerskov

All seals, dolphins, whales and porpoises are fully protected under the Marine Mammals Protection Act 1978, it is an offence, amongst other things, to harass or disturb marine mammals. Offences carry penalties of up to 6 months imprisonment or fines up to $250,000 and further fines of up to $10,000 for every marine mammal in respect of which the offence is committed.

Refer to the Marine Mammals Protection Regulations 1992 for a complete list of conditions prescribing behaviour around marine mammals.
Visit: **www.legislation.govt.nz.**

DOC HOTline

If you notice a marine mammal being harassed, severely injured or entangled, please contact the Department of Conservation immediately on
0800 DOC HOT (0800 362 468)

Published by
Aquatic and Threats Unit
Department of Conservation
PO Box 10-420
Wellington, NZ

For more information: www.doc.govt.nz

DOC HOTline
0800 362 468
Report any safety hazards or conservation emergencies

New Zealand Government

Sharing our coasts with marine mammals

NEW ZEALAND

Photo: Judy Rodda, Crown Copyright

Department of Conservation
Te Papa Atawhai

Shaun Templeton, *Elm Wildlife Tours*

Dennis Buurman Photography

As an island nation, with most Kiwis living within an hour of the coast, most of us will be fortunate enough at some stage to encounter marine mammals – whether seals or sea lions hauled out on shore, or dolphins and whales at sea. From the tip of the north to the deep south, New Zealand is a hotspot for marine mammals. Dolphins mingle with the boaties in Auckland's back yard, the Hauraki Gulf. Seals laze on the capital city's southern coast, and even whales can be seen resting between dives above the Kaikoura canyon, the South Island's marine mammal Mecca.

Hunting in the past reduced many marine mammal populations to a fraction of their former size. Nowadays, cameras have replaced harpoons and clubs and some marine mammal populations have been slowly recovering.

However, with growing public interest in marine mammals and the expansion in sea-based tourism come a new suite of threats, including boat strike, noise pollution, harassment, displacement and separation of mothers and their young. The Marine Mammal Protection Regulations 1992, as summarised here, aim to minimise these threats by prescribing appropriate behaviour around marine mammals. Commercial tourist operators require permits and are subject to further rules.

If you see whales, dolphins or seals while boating or visiting the coast, a few simple rules will ensure an enjoyable encounter for you and for them.

General

- Do not disturb, harass or make loud noises near marine mammals.
- Contact should be ceased should marine mammals show any signs of becoming disturbed or alarmed.
- Do not feed or throw any rubbish near marine mammals.
- Avoid sudden or repeated changes in speed or direction of any vessel or aircraft near a marine mammal.
- There should be no more than three vessels and/or aircraft within 300 metres of any marine mammal.

On shore

- Give seals and sea lions space. Where practicable stay at least 20 metres away.
- Avoid coming between fur seals and the sea.
- Keep dogs on a leash and well away.
- Where practicable, do not drive vehicles closer than 50 metres of a marine mammal.
- Never attempt to touch seals or sea lions – they can be aggressive and often carry diseases.

In the air

- Aircraft should maintain a horizontal distance of greater than 150 metres when flying near any marine mammal.
- Avoid flying or imposing a shadow directly over a marine mammal either at sea or on shore.

Dusky dolphins, *Ken Wanerskov*

New Zealand fur seal, *Tui De Roy*

Southern right whale mother and calves, *Dennis Buurman Photography*

New Zealand sea lion mother and pup, *Pete Moore, Crown Copyright*

Hector's Dolphin, *Erin Gross, Crown Copyright*

APPENDIX 5

Marine Mammal Injured or Entanglement Incident Form

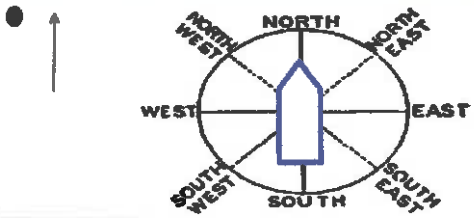
RPS Energy

RECORD OF INCIDENT

Date:		Time (local):		Incident Record No.	
				Incident Type	
Latitude (deg, min, sec)	°S	Vessel Name:		Vessel Speed (kts)	
Longitude (deg, min, sec)	°E	Vessel Hdg (Gyro):	°	Survey Location (Block)	
Species Type		Animal's Body Length			
Species Category		Common Name		Confidence in Identification	
Total Number of Animals		Number of adults		Number of juveniles / calves	

Please describe incident type in detail:

SHOW Vessel Heading by clicking on blue vessel and rotate using green dot
DRAW Animal's Position & Heading Relative to the Vessel: Click & drag red circle (animal) and black arrow to show direction of travel



Wind Force (Beaufort Scale)	Visibility	Overall Weather Type
Swell Height (meters)	Swell Direction	

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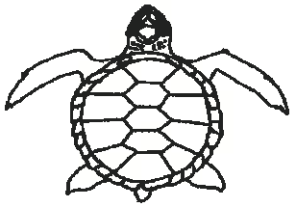
WHALE DOLPHIN SEA TURTLE



Did strike result in a death?

If no, list last sighted time; direction of travel and coordinates:

Additional Notes on Animal's

Last Sighted Time:		Direction of Travel: (8 compass points)	
Latitude (deg/min/sec):		Longitude (deg/min/sec):	

Report Completed By:

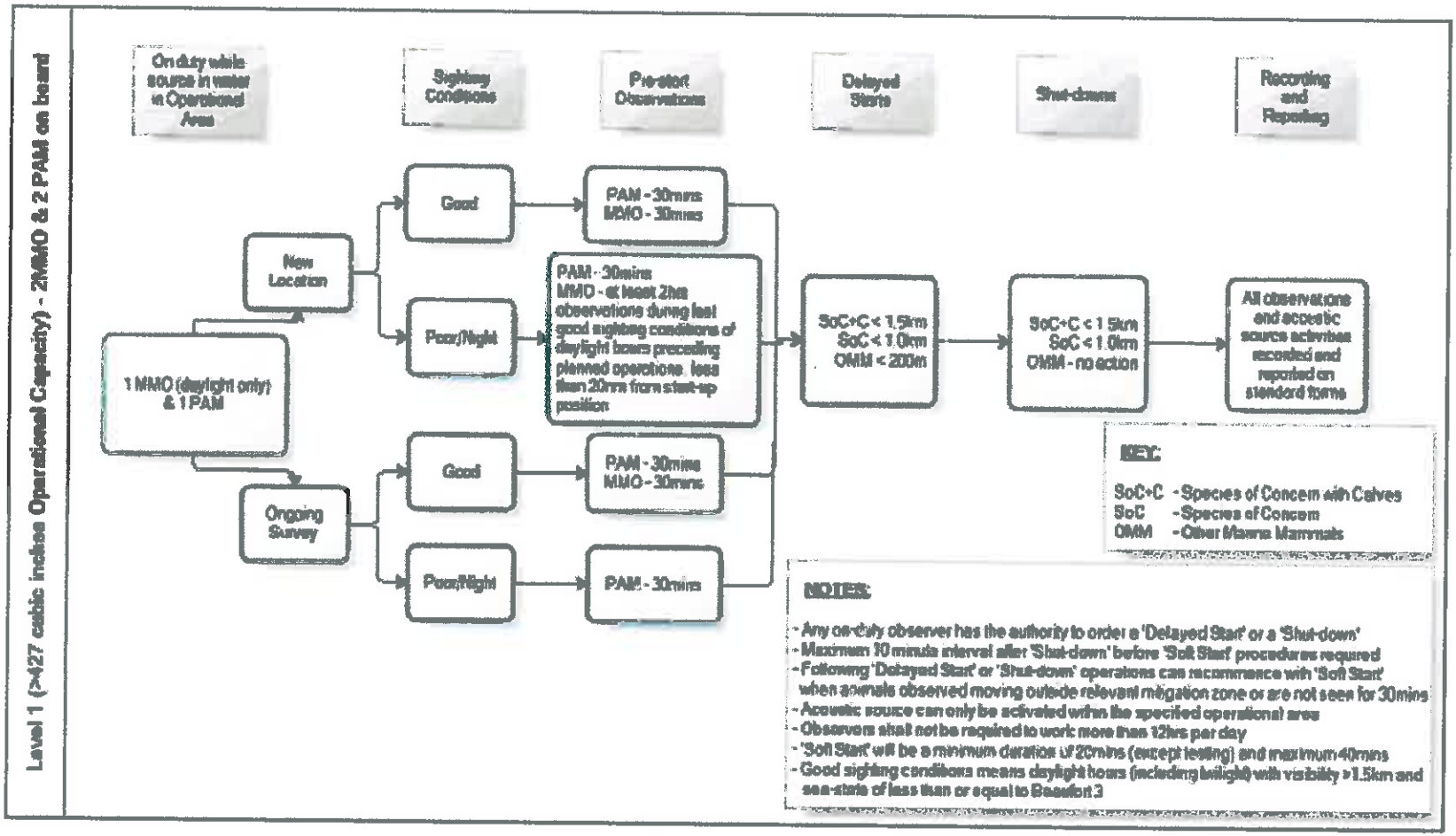
Enter Full Name	
Job Title	
Company Name	
Company Email	
Company Phone	
Date Reported:	dd/mm/yr
How Reported?	phone or email

REPORTING TO:

The Marine Conservation Unit, Department of Conservation NZ
CALL: 0800 DOC HOT (0 800 362 468) Emergency Hotline
EMAIL: marinemammals@doc.govt.nz
WEBSITE: http://www.doc.govt.nz/publications/conservation/native-animals/marine-mammals/staying-our-coasts-with-marine-mammals/

APPENDIX 6

MMO & PAM Operational Flowchart


Level 1 (>427 cubic inches Operational Capacity) - 2MMO & 2 PAM on board
On duty while source in water in Operational Area
Sighting Conditions
Pre-start Observations
Delayed Starts
Shut-downs
Recording and Reporting
1 MMO (daylight only) & 1 PAM
New Location
Ongoing Survey
Good
Poor/Night
Good
Poor/Night
PAM - 30mins MMO - 30mins
PAM - 30mins MMO - at least 2hrs observations during last good sighting conditions of daylight hours preceding planned operations, less than 20nm from start-up position
PAM - 30mins MMO - 30mins
PAM - 30mins
SoC+C < 1.5km SoC < 1.0km OMM < 200m
SoC+C < 1.5km SoC < 1.0km OMM - no action
All observations and acoustic source activities recorded and reported on standard forms
KEY:
SoC+C - Species of Concern with Calves
SoC - Species of Concern
OMM - Other Marine Mammals
NOTES:
- Any on-duty observer has the authority to order a 'Delayed Start' or a 'Shut-down'
- Maximum 10 minute interval after 'Shut-down' before 'Soft Start' procedures required
- Following 'Delayed Start' or 'Shut-down' operations can recommence with 'Soft Start' when animals observed moving outside relevant mitigation zone or are not seen for 30mins
- Acoustic source can only be activated within the specified operational area
- Observers shall not be required to work more than 12hrs per day
- 'Soft Start' will be a minimum duration of 20mins (except testing) and maximum 40mins
- Good sighting conditions means daylight hours (including twilight) with visibility >1.5km and sea-state of less than or equal to Beaufort 3