Referral of proposed action

Project title: Lord Howe Rise Marine Seismic Survey

1 Summary of proposed action

1.1 **Short description**

The Australian Government, through Geoscience Australia (GA), is proposing to conduct a scientific seismic survey on the Lord Howe Rise in 2016. The survey will be conducted in collaboration with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and contributes to a larger research proposal submitted to the International Ocean Discovery Program (IODP Proposal 871-CPP) titled "First Deep Stratigraphic Record for the Cretaceous Eastern Gondwana Margin: Tectonics, paleoclimate and deep life on the Lord Howe Rise high-latitude continental ribbon". The IODP proposal is to drill a deep stratigraphic hole to a depth of 2–3 km below the seabed in 2018/19. Prior to this, GA and JAMSTEC are required to conduct site assessments, involving a seismic survey in 2016 (**this referral**) and a geotechnical survey in 2017, to inform the selection of drilling sites should the IODP proposal be accepted.

1.2 **Latitude and longitude**

Latitude				Longitude		
location point	degrees	minutes	seconds	degrees	minutes	seconds
1	-27	09	40	155	44	05
2	-27	09	35	159	39	15
3	-26	05	11	160	57	40
4	-26	30	12	163	43	50
5	-26	45	02	166	38	00
6	-27	20	41	166	38	00
7	-28	04	30	160	52	18
8	-27	36	50	155	43	15

Please refer to associated geographic information system (GIS) vector (shapefile) dataset, showing the location and approximate boundaries of the area in which the project is to occur.

1.3 **Locality and property description**

The proposed seismic survey will take place within the bounds of an area that extends 1,100 km across the Lord Howe Rise and up to 220 km north-south (Figure 1). Within this area seismic data will be collected as follows:

- Along a single line that extends approximately 900 km west-to-east across Lord Howe Rise, with the western end of the line located 200 km due east of Brisbane;
- At six sites that are being considered for IODP drilling on the crest of Lord Howe Rise. These sites range between 730 km and 960 km in distance from the mainland.

Description of existing environment

Water depths across the survey area range between ~1,300 and 4,800 m, incorporating the western flank, crest and eastern flank of Lord Howe Rise (Figure 1; Keene et al., 2008). High resolution mapping of the area within which the sites being considered for deep drilling are located, shows that the seabed is characterised by ridges, valleys and plateaus with volcanic peaks that rise up to 450 m above the

surrounding seabed in water depths of about 1500 m (Heap et al., 2009; Nichol et al., 2011). Seabed sediments in this area are uniformly calcareous sandy mud that provides habitat for a variety of burrowing infauna including crustaceans, worms and bivalves (Dundas and Przeslawski, 2009). Epibenthic organisms are sparse to absent, with underwater video observations showing expansive tracts of barren seabed, with only the hard substrate of the volcanic peaks supporting isolated corals and gorgonians (Heap et al., 2009).

1.4	**Size of the development footprint or work area (hectares)**	The bounds of the proposed survey area covers approximately 140,000 km^2 and is entirely within the Australian Exclusive Economic Zone (EEZ)
1.5	**Street address of the site**	Not Applicable.
1.6	**Lot description**	Not Applicable.

1.7 **Local Government Area and Council contact (if known)**

Not Applicable – Local Government approval is not required.

1.8 **Time frame**

The proposed seismic survey is scheduled to take place between 21 March and 13 May 2016, divided into the following schedule of activities:

- 21 – 22 March: Mobilisation in port (Brisbane)
- 23 – 24 March: Transit to survey area
- 25 – 28 March: Survey operations
- 29 – 30 March: Transit to port
- 31 March – 1 April: In port (Brisbane)
- 2 April: Transit to survey area
- 3 – 19 April: Survey operations
- 20 April: Transit to port
- 21 April: In port (Brisbane)
- 22 – 23 April: Transit to survey area
- 24 April – 9 May: Survey operations
- 10 – 11 May: Transit to port
- 12 – 13 May: Demobilisation in port (Brisbane)

1.9	**Alternatives to proposed action**		No
		X	Yes, you must also complete section 2.2
1.10	**Alternative time frames etc.**		No
		X	Yes, you must also complete Section 2.3. For each alternative, location, time frame, or activity identified, you must also complete details in Sections 1.2-1.9, 2.4-2.7 and 3.3 (where relevant).
1.11	**State assessment**	**X**	No
			Yes, you must also complete Section 2.5
1.12	**Component of larger action**		No
		X	Yes, you must also complete Section 2.7

1.13	**Related actions / proposals**	**X**	No
			Yes, provide details:
1.14	**Australian Government funding**		No
		X	Yes, provide details: As an Australian Government listed entity, funding for this project is provided to Geoscience Australia through the Department of Industry, Innovation and Science (National Low Emissions Coal Initiative Program).
1.15	**Great Barrier Reef Marine Park**	**X**	No
			Yes, you must also complete Section 3.1 (h), 3.2 (e)

2 Detailed description of proposed action

2.1 Description of proposed action

The proposed survey will be undertaken on the Research Vessel *Kairei*, operated by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and crewed with scientific personnel from JAMSTEC, Geoscience Australia (GA) and Universities. The survey will include the following activities:

Seismic data acquisition

The survey will deploy a multi-channel towed seismic system to acquire 2D data along an east-west transect, up to 900 km in length across the Lord Howe Rise, and at six sites being considered for stratigraphic drilling as part of the IODP proposal (Figure 1). The seismic system will comprise a 32 airgun array with a total capacity of 7800 in^3 (individual gun capacity 100 to 600 in^3), and a single 6-km long hydrophone streamer cable. The array will be towed astern of the vessel at a depth of 10 m along the east-west transect line and 6 m over sites being considered for drilling. At three of the potential drill sites, seismic data will be collected along a grid of six lines, each 30 km in length with a 3 km spacing (Figure 2). At three of the four remaining potential drill sites, seismic data will be collected along one line, 30 km in length. The source will operate with a shot point interval of 200 m along the east-west line and 50 m over the drill sites. Seismic data will be acquired on a 24 hr basis for a period of approximately 22 days (April 3–12, April 24-26 and May 1–9; subject to change).

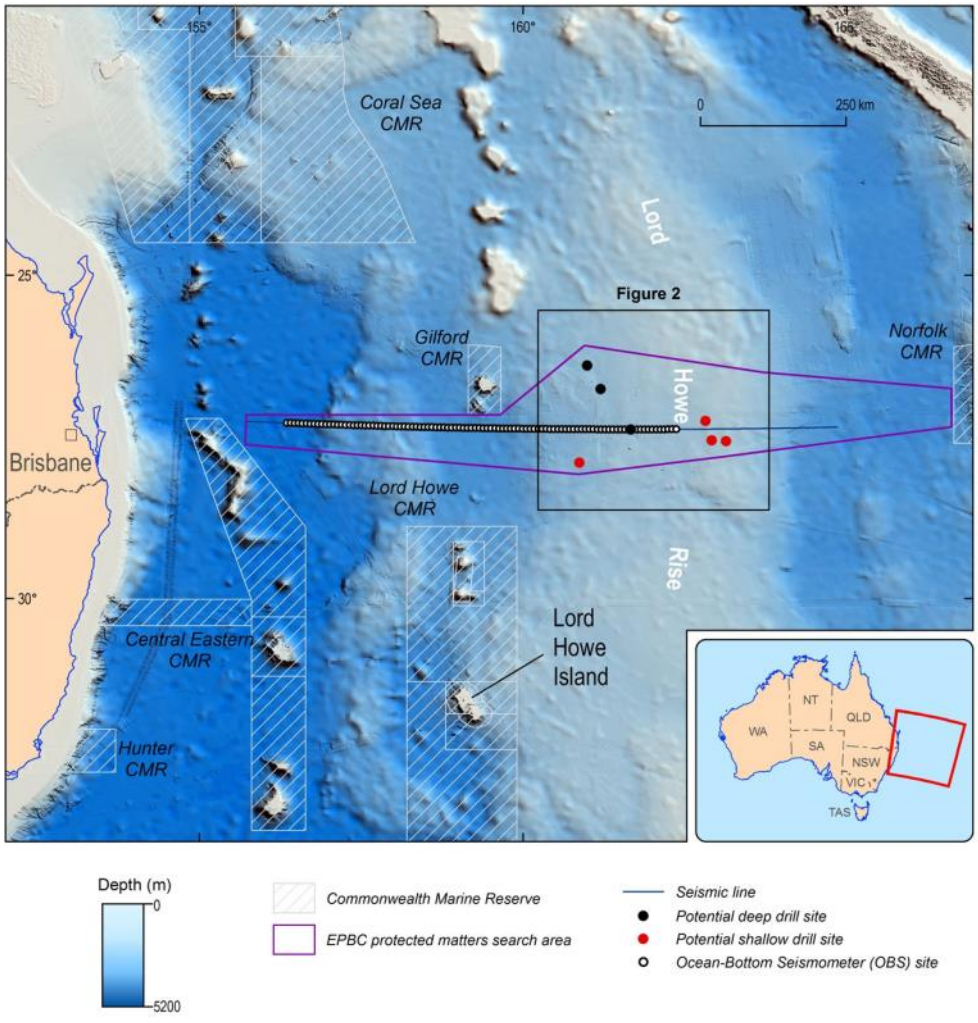

Figure 1: Location map of proposed Lord Howe Rise marine seismic survey.

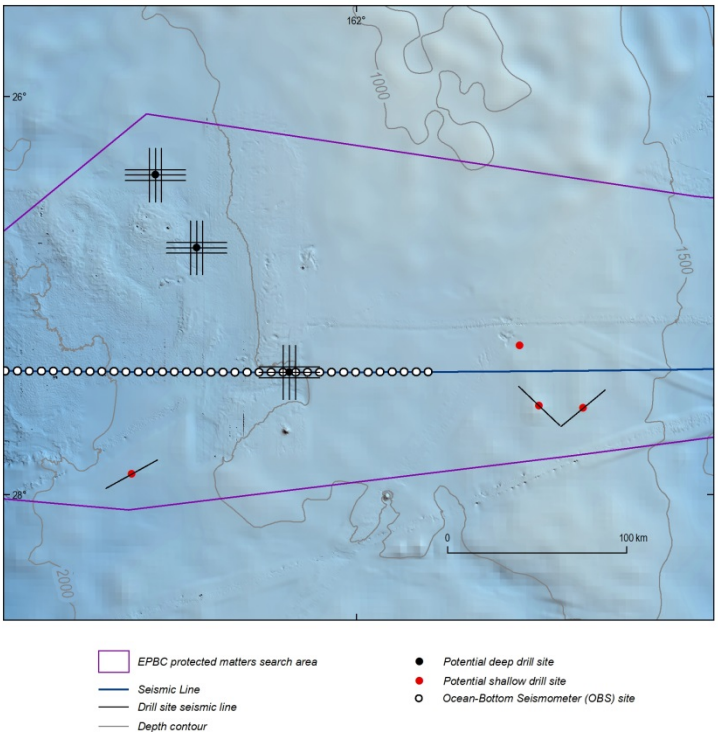

Figure 2: Location of planned seismic acquisition at potential deep and shallow drill sites.

Ocean Bottom Seismometers (OBS)

OBS units are passive instruments that are deployed on the seabed and record seismic energy from all natural and anthropogenic sources. On this survey, OBS instruments will be deployed for up to 21 days at 100 locations along a portion of the 900-km east-west seismic transect. The spacing between OBS units will be approximately 6 km, with gaps of 60 km and 246 km at the western and eastern end, respectively. This approach allows the deployment of an extremely-long receiver array that records seismic signals from greater depth and distance than is achievable using a towed streamer. Each OBS has a footprint of approximately 1 square metre and incorporates a steel anchor that will be left on the seabed following recovery. Separation of the anchor from the seismic recording system is triggered by an acoustic release system. The OBS system ascends to the sea surface and is then recovered to the vessel.

Multibeam echo sounder mapping

The survey will use a SeaBeam 3012 full ocean depth multibeam echo sounder mounted in the hull of the RV *Kairei*. The SeaBeam 3012 is a high performance deep sea echo sounder that collects bathymetric, acoustic backscatter and side scan data for the identification of seafloor features. The system operates at 12 kHz in water depths ranging from 50 m to 11,000 m, at survey speeds of up to 12 knots. It has a maximum swath width of 140º and each of the beams covers a 1–2º arc of the seafloor. Echo sounder pulses (pings) are emitted at variable periods based on the water depth. In the water depths anticipated during this survey, this period is expected to be 0.5 seconds or less. The pings are of relatively short duration (0.7–15 milliseconds). On this survey, multibeam data will be opportunistically acquired along all transits and seismic survey lines. There is no intention to collect data along contiguous survey lines.

Sub-bottom profiles, gravity and magnetic data acquisition

Additional data to be acquired during the survey includes sub-bottom profiles, gravity and magnetics. These data will be collected along all transits and seismic survey lines using a SyQwest Bathy-2010 sub-bottom profiler (hull-mounted), Fluxgate magnetometer (towed) and Bodenseewerk gravimeter (hull-mounted).

2.2 Alternatives to taking the proposed action

This survey will provide new information on the overall geological structure of the Lord Howe Rise, including sediment thickness, crustal architecture, distribution of faults, and seismic velocities of the upper and lower crust and of the mantle. The results of this survey will advance our current knowledge of the tectonic history of the Lord Howe Rise. A deep seismic survey and OBS deployment is the only means by which the data required to understand the geological structure of Lord Howe Rise can be obtained. Accordingly, there are no alternatives to taking the proposed action.

2.3 Alternative locations, timeframes or activities that form part of the referred action

Alternative Locations

The scientific objectives of the project require data acquisition along a seismic profile that provides a cross-section of the Lord Howe Rise and adjacent geological entities. Specifically, the east-west directed separation of the Lord Howe Rise from Australia and subsequent opening of the Tasman Sea during the break-up of Gondwana is such that maximum information will be obtained along an east-west transect for both the deep seismic transect and the OBS deployment. The seismic profile is located so as to cross all of the key geological elements that reflect the geological evolution of the region (i.e. basins and ridges formed during stretching of the crust). Similarly, the sites being considered for deep stratigraphic drilling are located in basins that contain sediments and volcanic rocks that record the geological evolution and climate history of the region. The proposed survey line is located so as to be representative of the geological structure of Lord Howe Rise but also not encroach into Commonwealth Marine Reserves. It is therefore an optimum location, with no alternatives available.

Alternate Timing and Duration

The survey has been planned to occur at a time of year that minimises, as far as practicable, any interaction with threatened, endangered and migratory species, including cetaceans. For migratory species in particular, the survey timing is outside their known seasonal movements (see Section 3.1 (d)). The proposed timing is therefore optimal in terms of minimising potential interactions with marine fauna.

Alternative Methods

The 7,800 cubic inch airgun array was selected as it will provide the seismic energy required to meet the geological objectives of the survey. Specifically, the use of high power airguns will allow the recording of deep-penetrating seismic energy that propagates long distances (>100 km) through the crust and upper mantle (cf. Klingelhoefer et al. 2007, No et al. 2014, Sato et al. 2014, Afilhado et al. 2015, Biari et al. 2015, Moulin et al. 2015). Because seismic velocities vary with rock type, this approach allows the geology of the subsurface to be inferred to depths of 30 km or more in water depths of up to several thousand metres. Additionally, the seismic information collected at the proposed IODP drill sites will support the planning and design of drilling activities, including minimising risks associated with the drilling. An alternative seismic system with lower-capacity airguns would limit the scientific outcomes of the project because they would generate insufficient energy to provide the required depth of penetration, long-distance lateral signal propagation, or resolution of the seismically-inferred geological structure.

Ocean bottom seismometers (Pecher et al. 2014) are fit-for-purpose passive instruments that are the only option for recording seismic energy that has travelled long distances from the airgun source. There are no alternatives to OBS instrumentation.

Alternative Vessel

The proposed survey will be undertaken on the RV *Kairei*, owned and operated by JAMSTEC. This deep-sea research vessel is equipped with a variety of instruments that are suitable for studying seabed bathymetry, sub-seabed structure and deep geological structures. Note: In accordance with requirements for foreign-flagged vessels seeking to undertake scientific research within Australia's Exclusive Economic Zone, an application for Public Vessel Status has been submitted to the Department of Foreign Affairs and Trade.

2.4 Context, planning framework and state/local government requirements

The proposed marine seismic survey does not fall under any planning framework or legislation at state or local government levels. Nor is it subject to the *Offshore Petroleum and Greenhouse Gas Storage Act 2006*, which governs seismic surveys for oil and gas exploration in Australian Waters, as the proposed survey is for scientific research purposes. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the sole Commonwealth legislation under which approval is being sought (this Referral). The proposed activity will comply with the principles of ecologically sustainable development as set out in section 3A of the EPBC Act, and in accordance with Geoscience Australia's Environment Policy (Attachment A).

2.5 Environmental impact assessments under Commonwealth, state or territory legislation

See response to section 2.4 (above).

2.6 Public consultation (including with Indigenous stakeholders)

Consultation with various stakeholders has commenced (see Appendix A). This includes consultation with local fishing stakeholders who operate in the vicinity of the survey area (identified through AFMA), relevant government agencies, port authorities, security and safety services, NGOs and conservation groups, submarine cable communication companies, and other marine users. The proposed action is not expected to affect indigenous stakeholders.

2.7 A staged development or component of a larger project

The proposed seismic survey is the first component of a multi-year project leading up to the deep stratigraphic drilling proposed under the International Ocean Discovery Program in 2018/19. An overview of the larger project is provided below.

Background & Rationale

The Lord Howe Rise is an elongate ribbon of submerged and extended continental crust that separated from Australia during the Late Cretaceous (~74–52 million years ago). Present knowledge of the Lord Howe Rise is based on widely-distributed marine and satellite geophysical data, limited dredge samples and sparse shallow drilling (<600 m below-seafloor). Existing data provide a broad understanding of the Lord Howe Rise's crustal structure and sedimentary basin architecture. Building a more detailed knowledge of the Lord Howe Rise, and the southwest Pacific broadly, requires drilling into rocks that record the >100-million-year geological, tectonic and climatic history of the region. To this end, Geoscience Australia and JAMSTEC are leading an international effort to drill a deep stratigraphic well on the Lord Howe Rise that will core Cretaceous and older sediments and deep basement rocks.

A full proposal for drilling up to 3500 m below the seafloor into a Lord Howe Rise rift basin using the JAMSTEC riser drilling vessel *CHIKYU* was submitted to the International Ocean Discovery Program (IODP) in October 2015 (Proposal 871-CPP). The IODP deep stratigraphic drilling will be preceded by a program of geophysical data acquisition to define the geological framework of the proposed drill site(s), to inform the choice of drill site(s), and to acquire the geotechnical data that is necessary to successfully drill a deep stratigraphic well.

Project Objectives

The objectives of the IODP deep stratigraphic drilling are to:

1) define the role and importance of continental crustal ribbons, like the Lord Howe Rise, in plate tectonic cycles and continental evolution;
2) recover new data in the southwest Pacific to better constrain Cretaceous paleoclimate and linked changes in ocean biogeochemistry; and
3) test fundamental evolutionary concepts for sub-seafloor microbial life over a 100-million-year timeframe.

These objectives are aligned with the IODP 2013–2023 Science Plan (http://iodp.org/program-documents). In addition, the drilling will help to shed a new light on the regional resource potential of the Lord Howe

Rise by contributing samples and data from unexplored sedimentary basins.

Project Implementation

The Project commenced on 1 July 2015 and, if fully funded, is expected to run for four years. The project includes four main activities, two of which—the pre-drilling marine surveys—are planned to take place in the next two years.

1. Deep Seismic Survey for Crustal Structure and Tectonic Framework (March–May 2016) – **THIS REFFERAL**

The Deep Seismic Survey includes acquisition of 2D seismic reflection data and seismic refraction data, recorded by 100 ocean-bottom seismometers, along a 900 km east–west transect across the Lord Howe Rise to map regional crustal structure (Figure 1). Additional data to be acquired include high-resolution multi-channel seismic over the proposed drill sites, multibeam sonar bathymetry, sub-bottom profiles, gravity and magnetics.

2. Detailed Site Survey at Proposed Riser Drilling Site (early/mid 2017)

The Detailed Site Survey will take place at sites selected on the basis of the Deep Seismic Survey. It will include high-resolution seabed and shallow sub-seafloor mapping, collection of shallow (<40 m below-seafloor) sediment cores and underwater video at the site(s) being considered for drilling. The information from this detailed mapping and sampling will be used to understand the geotechnical properties of the seabed affecting drilling operations. These data will also contribute valuable baseline environmental information describing deep-water habitats in a remote area of the Australian maritime jurisdiction.

3. Deep Stratigraphic Drilling (proposed late 2018/early 2019)

If funded, the proposed Deep Stratigraphic Drilling program will include a single riser hole designed to intersect the full stratigraphic succession in a Lord Howe Rise rift basin (Figure 1). A second priority is to drill one or two non-riser, shallow holes into basement horst blocks. Drilling will incorporate full core recovery and down-hole logging. The selection of sites to be drilled cannot take place until the data from the preceding Site Surveys have been interpreted and assessed.

4. Processing and Storage of Data and Samples

All data and samples collected during the project will be made publicly available. Survey data will be available from Geoscience Australia, while core samples will be accessible from IODP. The archival portion of the cores will be located at Geoscience Australia's storage facility.

<u>Deep Seismic Survey for Crustal Structure and Tectonic Framework as a stand-alone referred action</u>

While the seismic survey is a component of a larger project (i.e. it will inform the IODP drilling plan which is yet to be approved and funded), it also represents a stand-alone scientific activity, and is separated in time by up to three years. Given the independent nature of each of the proposed actions, assessment of the current proposed action separately from other related actions will not reduce the ability to achieve the objectives of the EPBC Act. Assessing the actions separately will enable the relevant impacts of each component to be adequately assessed.

3 Description of environment & likely impacts

3.1 Matters of national environmental significance

3.1 (a) World Heritage Properties

Description

There are no World Heritage Properties located within the proposed survey area. The closest World Heritage Site is the Lord Howe Island Group (which comprises Lord Howe Island, Admiralty Islands, Mutton Bird Islands, Ball's Pyramid, and associated coral reefs and marine environments), located approximately 390 km SSW of the closest survey line.

Nature and extent of likely impact

The primary impact of the seismic survey will derive from the propagation of sound generated by the seismic airguns. To understand this impact, Geoscience Australia commissioned Curtin University to undertake acoustic propagation modelling specific to the 7800 in^3 seismic airgun array that will be used on this survey, and to assess the expected ranges for potential impacts of acoustic exposure on cetaceans (see Attachments B and C). The model was designed to extend into surrounding Commonwealth Marine Areas (CMRs) to understand the sound exposure levels that these reserves would likely receive.

Modelling demonstrated that indirect behavioural responses in cetaceans are expected to occur at distances exceeding 250 km from the source, which intersects nearby CMRs (including declared Ramsar wetlands at Elizabeth and Middleton Reefs). It is also possible that sound generated from the seismic airguns will travel as far as the World Heritage listed Lord Howe Island Group. However, modelled sound levels that extend into the northern Lord Howe Island CMR are predicted to range between 110 – 130 dB re 1 $\mu Pa^2.s$ (see Figure 12 and Figure 13 in Attachment B; Section 3.1 (d)). These levels do not exceed guidelines for recoverable injury and mortality for fish or sea turtles (See Table 7.4 in Popper et al. 2014b). The proposed survey is therefore not likely to have direct impacts on World Heritage values of the Lord Howe Island Group. A full description of the potential direct and indirect impacts of received sound levels on matters of national environmental significance (including mobile marine fauna) is provided in Sections 3.1 (d) and 3.1 (e).

3.1 (b) National Heritage Places

Description

There are no National Heritage Places located within the proposed survey area. The nearest National Heritage Place is the Lord Howe Island Group. See response to Section 3.1 (a) (above).

Nature and extent of likely impact

See response to Section 3.1 (a) (above).

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description

There are no Wetlands of International Importance (declared Ramsar Wetlands) within the proposed survey area. The nearest Wetlands of International Importance is the Elizabeth and Middleton Reefs Marine National Nature Reserve, located approximately 190 km from the nearest survey line.

Elizabeth and Middleton Reefs Marine National Nature Reserve was designated a Ramsar site in 2002 due to the rare and representative examples of coral reef wetland that support diverse marine fauna, including uncommon and undescribed fishes (over 300 species) and several endemic species of mollusc. The lagoons of both reefs are strongholds for populations of black cod and the Galapagos shark.

Nature and extent of likely impact

As noted in Section 3.1 (a), sound levels are predicted to extend into the northern Lord Howe Island CMR, which includes Elizabeth and Middleton Reefs, but do not exceed guidelines for recoverable injury and mortality for fish (see Table 7.4 in Popper et al. 2014b). Please refer to Sections 3.1 (d) and 3.1 (e) for a full description of the potential direct and indirect impacts of received sound levels on matters of national environmental significance (including mobile marine fauna). The proposed survey is therefore not likely to have direct impacts on the ecological character of Elizabeth and Middleton Reefs Marine National Nature Reserve.

3.1 (d) Listed threatened species and ecological communities

Description

A search of the Department of the Environment (DoE) Protected Matters Search Tool database was completed to identify matters of national environmental significance within the proposed survey area (Attachment D). The search identified 30 listed threatened species or species habitat that may occur in the area (Table 3.1.1). No threatened ecological communities were identified. A database search using the Atlas of Living Australia was also completed for the proposed study region (see Figures 3–5).

Descriptions of listed threatened species are provided below in the context of their known distributions in Australian waters, including the Temperate East marine region.

Table 3.1.1: Listed threatened species or species habitat that may occur within the proposed study area

Listed threatened Species		
Marine mammals		
Scientific name	Common name	Status
Balaenoptera musculus	Blue Whale	Endangered
Balaenoptera physalus	Fin Whale	Vulnerable
Balaenoptera borealis	Sei Whale	Vulnerable
Eubalaena australis	Southern Right Whale	Endangered
Megaptera novaeangliae	Humpback Whale	Vulnerable
Turtles		
Scientific name	Common name	Status
Caretta caretta	Loggerhead Turtle	Endangered
Chelonia mydas	Green Turtle	Vulnerable
Dermochelys coriacea	Leatherback Turtle	Endangered
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable
Lepidochelys olivacea	Olive Ridley Turtle	Endangered
Natator depressus	Flatback Turtle	Vulnerable
Sharks		
Scientific name	Common name	Status
Carcharodon carcharias	Great White Shark	Vulnerable
Rhincodon typus	Whale Shark	Vulnerable
Seabirds		
Scientific name	Common name	Status
Diomedea epomophora epomophora	Southern Royal Albatross	Vulnerable
Diomedea exulans antipodensis	Antipodean Albatross	Vulnerable
Diomedea exulans exulans	Tristan Albatross	Endangered
Diomedea exulans gibsoni	Gibson's Albatross	Vulnerable
Diomedea exulans (sensu lato)	Wandering Albatross	Vulnerable
Fregetta grallaria grallaria	White-bellied Storm-Petrel	Vulnerable
Macronectes giganteus	Southern Giant-Petrel	Endangered
Macronectes halli	Northern Giant-Petrel	Vulnerable
Phoebetria fusca	Sooty Albatross	Vulnerable
Pterodroma leucoptera leucoptera	Gould's Petrel	Endangered

Seabirds (cont.)		
Scientific name	Common name	Status
Pterodroma neglecta neglecta	Kermadec Petrel (western)	Vulnerable
Thalassarche cauta cauta	Shy Albatross	Vulnerable
Thalassarche cauta salvini	Salvin's Albatross	Vulnerable
Thalassarche cauta steadi	White-capped Albatross	Vulnerable
Thalassarche eremita	Chatham Albatross	Endangered
Thalassarche melanophris	Black-browed Albatross	Vulnerable
Thalassarche melanophris impavida	Campbell Albatross	Vulnerable

Marine mammals

The five listed threatened species of *baleen whale* (blue, fin, sei, humpack and southern right whale) identified in the EPBC Protected Matters search (Table 3.1.1) are wide-ranging oceanic species found in a variety of coastal, shelf and pelagic habitats, but are not (relative to some toothed whales) deep divers (Clapham et al. 1999). Although migration patterns may vary considerably within and among species, most baleen whales undertake extensive seasonal migrations between cold, productive summer feeding grounds in temperate or high latitudes, and winter mating and calving areas in tropical or warm temperate waters (Clapham et al. 1999). The proposed seismic survey has been scheduled during a known period of low cetacean activity, particularly for baleen whales, so as to avoid detrimental impacts on these mammals.

Blue whales: Little is known about the distribution and migration of blue whales in the Southern Hemisphere (Branch et al. 2007). In the Australian region there are two recognised subspecies, the Antarctic (or true) blue whale (*B. m. intermedia*) and the pygmy blue whale (*B. m. brevicauda*). In the austral summer, Antarctic blue whales are typically found south of 55° S, while pygmy blue whales are generally believed to remain north of 54° S (Kato et al. 1995). Feeding aggregations of pygmy blue whales occur at the Perth Canyon off Western Australia (Rennie et al. 2009) and the Bonney Upwelling in western Victoria and south-east South Australia, where they forage from November to April (Gill 2002, Gill and Morrice 2003, Gill et al. 2011). Australian blue whales migrate between these feeding grounds during warmer months to lower latitude breeding grounds during colder months (Bannister et al. 1996, Attard et al. 2010). The operational area for this survey is not located close to any important biological areas for blue whales, nor to any known or likely migration routes (Figure 3). Hence, the likelihood of encountering blue whales during the proposed survey is low.

Fin whales (*Balaenoptera physalus*): This species is found throughout the world's oceans, predominantly in deep offshore waters between latitudes 20° and 75° (Mackintosh 1966) but is more common in temperate waters, and the Arctic and Antarctic Oceans (DoE 2015d). In Australia, there are confirmed records of fin whales for all coastal waters except offshore New South Wales and the Northern Territory (Bannister et al. 1996). Fin whales migrate seasonally from high latitude feeding grounds in summer to relatively low latitude breeding and calving grounds in winter. Arrival time into the summer feeding areas may differ according to sexual class, with pregnant females arriving earlier in the season than other whales (Mackintosh 1966). Fin whales tend to migrate in the open ocean, hence migration routes and the location of winter breeding areas remain largely unknown (DoE 2015d). There are no known migration routes or mating or calving areas in Australian waters (DoE 2015d). The likelihood of encountering Fin whales within the survey area is therefore low.

Sei whales (*Balaenoptera borealis*): This species is not well documented in Australian waters (Bannister et al. 1996; DoE 2015b) and there are no known mating or calving areas (Parker 1978). However, sei whales are known to spend the summer at high latitudes for feeding and the winter at lower latitudes for calving and breeding (Horwood 1987). The similarity in appearance of Sei whales and Bryde's whales (*Balaenoptera edeni*) has resulted in uncertainty about distributional limits and frequency of occurrence, especially in warmer waters (>20 °C) where Bryde's whales are more common (Bannister et al. 1996). Sei whales are thought to have the same general pattern of migration as most other baleen whales, including blue and fin whales (see Gill et al. 2008), although the timing is generally considered to be later and they do not reach such high latitudes (Gambell 1968). The Australian Antarctic waters are important feeding grounds for Sei whales (Horwood 1987) and sighting of Sei whales feeding in the Bonney Upwelling area in summer and autumn indicate that this area is potentially an important feeding ground (DoE 2015b). The proposed survey is scheduled to occur outside peak migration times for baleen whales. It is therefore unlikely that Sei whales will be encountered in the survey area.

Southern right whales (*Eubalaena australis*): This species is listed as one of 'Least Concern' by the International

Union for the Conservation of Nature but as 'Endangered' under the EPBC Act 1999. The species has a southern hemisphere circumpolar distribution between latitude 30° and 60°S (Bannister et al. 1996). Between May and October, the Australian population of Southern right whales migrates between higher latitude feeding grounds (40-65°S) to calving/nursery grounds in coastal Australian waters, including the east coast (Kemper et al. 1997). The winter period is the peak for southern right whale abundance, especially along the southern coast of Australia (Kemper et al. 1997). The head of the Great Australian Bight is one of the principal aggregation areas (DoE 2015h). The operational area of the proposed survey lies outside the coastal range of this species. It also lies outside the known biologically important areas for migration (Figure 3). Therefore, the likelihood of encountering this whale species during the survey is low.

Humpback whales (*Megaptera novaeangliae*): This species migrates annually along the continental shelf of Australia's eastern and western coasts between their summer feeding grounds in Antarctica and their tropical breeding grounds in winter. Generally, the species is sighted migrating north between May and August, and south between September and December (Bannister et al. 1996, Noad et al. 2011). Along parts of their migratory route there are narrow corridors and bottlenecks resulting from physical and other barriers where the majority of the population passes close to shore (i.e. within 30 km of the coastline). For example, off the southern coastline of Queensland most whales pass within 10 km of some prominent headlands (Bryden 1985, Brown 1998). The winter breeding area off the east coast of Australia is likely to be dispersed inside the Great Barrier Reef (Simmons and Marsh 1986, Paterson and Paterson 1989) and the migration to and from these waters occurs primarily along the eastern continental coastline (Figure 3). The proposed seismic survey is scheduled to occur outside peak migration times for this species. It is therefore unlikely that humpback whales will be encountered during the survey area.

Turtles

Six species of marine turtle are likely to occur in the proposed survey area. They include the loggerhead turtle, green turtle, hawksbill turtle, leatherback turtle, olive ridley turtle and the Australian endemic flatback turtle. All five species are listed as threatened and migratory under the EPBC Act (Table 3.1.1; Table 3.1.2). However, the proposed survey area does not intersect any known biologically important habitat for these species (Figure 4). Given the lack of nesting habitat in the study area, it is unlikely that foraging or migrating turtles will be encountered during the survey. Additional information on these turtle species is given below.

Loggerhead turtle (*Caretta caretta*): This species is known to breed along the eastern Australian coast, predominantly on beaches close to and north of Bundaberg, as well as the islands of the southern Great Barrier Reef (DoE 2015f). Loggerhead turtles nest from late October, reaching a peak in late December and finish nesting in late February or early March. Hatchlings emerge from nests from late December until about April with most hatching from February to early March (DoE 2015f). During their post-hatchling phase they are carried southward by the East Australian Current to around 30° S (Limpus et al. 1994), then eastward out to New Zealand, before re-entering the region via the Coral Sea as large immature turtles (DoE 2015f).

Green turtle (*Chelonia mydas*): There are seven widely separated breeding aggregations of green turtle recognised in Australia (FitzSimmons et al. 1997, Dethmers et al. 2006, Limpus and Fien 2009). On the east coast, the southern Great Barrier Reef (GBR) genetic stock of green turtles comprises a spatially disjunct metapopulation with numerous foraging grounds spanning ca. 12° latitude (1,800 km) from tropical waters in the northern GBR to warm temperate seasonal waters in southern coastal Queensland (Limpus and Fien 2009). It is individuals from this southern population that are most likely to be found in the Temperate East Marine Region (DSEWPaC 2012c). Like the loggerhead, green turtles are carried southward by the East Australian Current during their post-hatchling phase, leaving the region as it flows eastward to New Zealand, and then into the South Pacific Gyre, which transports them back to Australian waters via the Coral Sea (DSEWPaC 2012c).

Hawksbill turtle (*Eretmochelys imbricata*): This species has a worldwide circumtropical and subtropical distribution and Australian waters are habitat for the largest remaining stocks of breeding *E. imbricata* within the Indian Ocean–Western Pacific Ocean region (Limpus et al. 2008). There are two genetically separate subpopulations in Australia; one in the northern Great Barrier Reef, Torres Strait and Arnhem Land; and the other on the North West Shelf of Western Australia (Limpus et al. 2008, DoE 2015g). Of these subpopulations, the northern Great Barrier Reef population lives adjacent to the Temperate East Marine Region (DSEWPaC 2012c) and it is individuals from this subpopulation that are most likely to be found in the survey area. Hawksbill turtles that forage within the GBR migrate to breed in areas throughout the Indo-Pacific region, including Vanuatu, Solomon Islands, Papua New Guinea and Indonesia (Miller et al. 1998). Only small disjunct foraging assemblages are found on the shallow reefal areas beyond the continental shelf including the Coral Sea

platform, Elizabeth and Middleton Reefs, and reefs associated with Norfolk and Lord Howe Islands (Tzioumis and Keable 2007).

Leatherback turtle (*Dermochelys coriacea*): This species is distributed worldwide across tropical and temperate seas and is considered to be in serious decline across the Pacific Ocean basin (Spotila et al. 1996). Although there are no major nesting sites in Australia, the species is known to forage in Australian waters, including in the Temperate East Marine Region, migrating from larger nesting populations in neighbouring countries, particularly in Indonesia, Papua New Guinea and the Solomon Islands (Hamann et al. 2007, Limpus and Fien 2009). Leatherback turtles migrate as juveniles and adults through the pelagic environment of the Coral Sea, Tasman Sea (Figure 4) including Bass Strait and therefore could be encountered throughout the oceanic areas of the east marine region (Tzioumis and Keable 2007).

Olive ridley turtle (*Lepidochelys olivacea*): The foraging ecology and migration routes of this endangered species are poorly known in Australia, being inferred from captures in trawl net fisheries and some satellite tracking (Whiting et al. 2007, Hamel et al. 2008). The ability to perform long benthic dives (<2 h) allows this species to exploit deeper benthic environments in addition to the shallow coastal areas more generally occupied by adult hard-shelled sea turtles (e.g. green and hawksbill turtles) (McMahon et al. 2007). The origin of the individuals that forage along the eastern Australian continental shelf is undetermined (Tzioumis and Keable 2007).

Flatback turtle (*Natator depressus*): This species is reproductively endemic to the Australian continental shelf with principal feeding grounds concentrated in turbid, shallow inshore water off north-eastern Australia and in the Gulf of Carpentaria. There are no records beyond the continental shelf (Limpus et al. 1983). The species is rarely found foraging in reefal habitats or in intertidal and shallow subtidal habitats and the turtle does not breed in eastern Australia (Tzioumis and Keable 2007). The major eastern Australian breeding aggregations occur on continental islands in inshore areas of the southern Great Barrier Reef (GBR) at Peak, Wild Duck, Avoid and Curtis Islands (Limpus et al. 1983).

Sharks

Whale sharks (*Rhincodon typus*): This species is listed as both vulnerable and migratory under the EPBC Act 1999. It is also classed as vulnerable in the World Conservation Union's Red List. This species is the world's largest fish and one of only three species of plankton-feeding shark. It is broadly distributed in tropical and temperate seas, usually between latitudes 30°N and 35°S and is widely distributed in Australian waters. The reproductive biology of whale sharks is almost unknown, but it is thought that whale sharks mate in waters surrounding Taiwan, the Philippines and India (DoE 2015j). Although mostly solitary, whale sharks form feeding aggregations in some regions during periods of increased food supply. Between March and May, whale sharks congregate on Ningaloo Reef (Western Australia) in response to increased nutrients available after mass coral spawning (Meekan et al. 2006). The migratory habits of whale sharks after they leave Ningaloo are poorly understood, but seasonal aggregations occur off Christmas Island (Indian Ocean) between December and January and in the Coral Sea between November and December (DoE 2015j). Tagging of several animals at Ningaloo revealed that they subsequently swam to Christmas Island and Indonesia (Meekan et al. 2006, DoE 2015j and references therein). Sightings have also been confirmed further south than Kalbarri (on the mid-west coast of Western Australia), Eden (on the New South Wales south coast) and Balls Pyramid (Tasman Sea). Given the seasonal patterns of known whale shark aggregations, it is considered unlikely that whale sharks will be encountered during the proposed survey.

White sharks (*Carcharodon carcharias*): The Temperate East Marine Region and adjacent waters are known to support aggregations of white shark. The species is listed as both vulnerable and migratory under the EPBC Act 1999 due to its life history characteristics (long lived and low levels of reproduction), limited local distribution and abundance, and pressure from Australian commercial and recreational fisheries and shark control programs (DoE 2015e). In Australian waters, white sharks extend from southern Queensland around the southern coastline to North West Cape in Western Australia (DoE 2015e). It is commonly encountered on the continental shelf, often close inshore, and has been recorded from the surface down to water depths of 1,280 m (Bruce et al. 2006). Movements of tagged white sharks, together with data from bycatch records and shark control programs, suggest a seasonal movement northward along the east coast of Australia during the autumn–winter months and south in spring–early summer (Bruce et al. 2006). However, satellite tracking of white sharks tagged in southern Australia showed broad-scale movements consistent with mixing of the population across their entire Australian range, as well as across the Tasman Sea to New Zealand (Bruce et al. 2006), adding further evidence to indicate that these sharks sometimes move into open ocean waters and cross deep ocean basins (Boustany et al. 2002, Bonfil et al. 2005, Bonfil et al. 2010). Given that the majority of movements of

tagged white sharks in Australia waters are confined to shelf waters, generally in areas of less than 100 m depth (Bruce et al. 2006), it is unlikely that white sharks will be encountered in the survey area.

Seabirds

There are several seabird species that may occur within the survey area due to proximity of islands in the Tasman Sea and Coral Sea that support nesting sites, most notably the Lord Howe and Norfolk Island groups (Figure 5), as well as a series of smaller islands along the NSW coast (DSEWPaC 2012d). These include endangered, vulnerable and migratory albatross and petrel species (order Procellariiformes) that use the region for foraging, feeding or related behaviour. Procellariiformes face a range of threats in the marine environment including direct interactions with fishing operations; ingestion of, and entanglement in, marine debris; contamination from pollutants; and over–fishing of prey species (Baker et al. 2002).

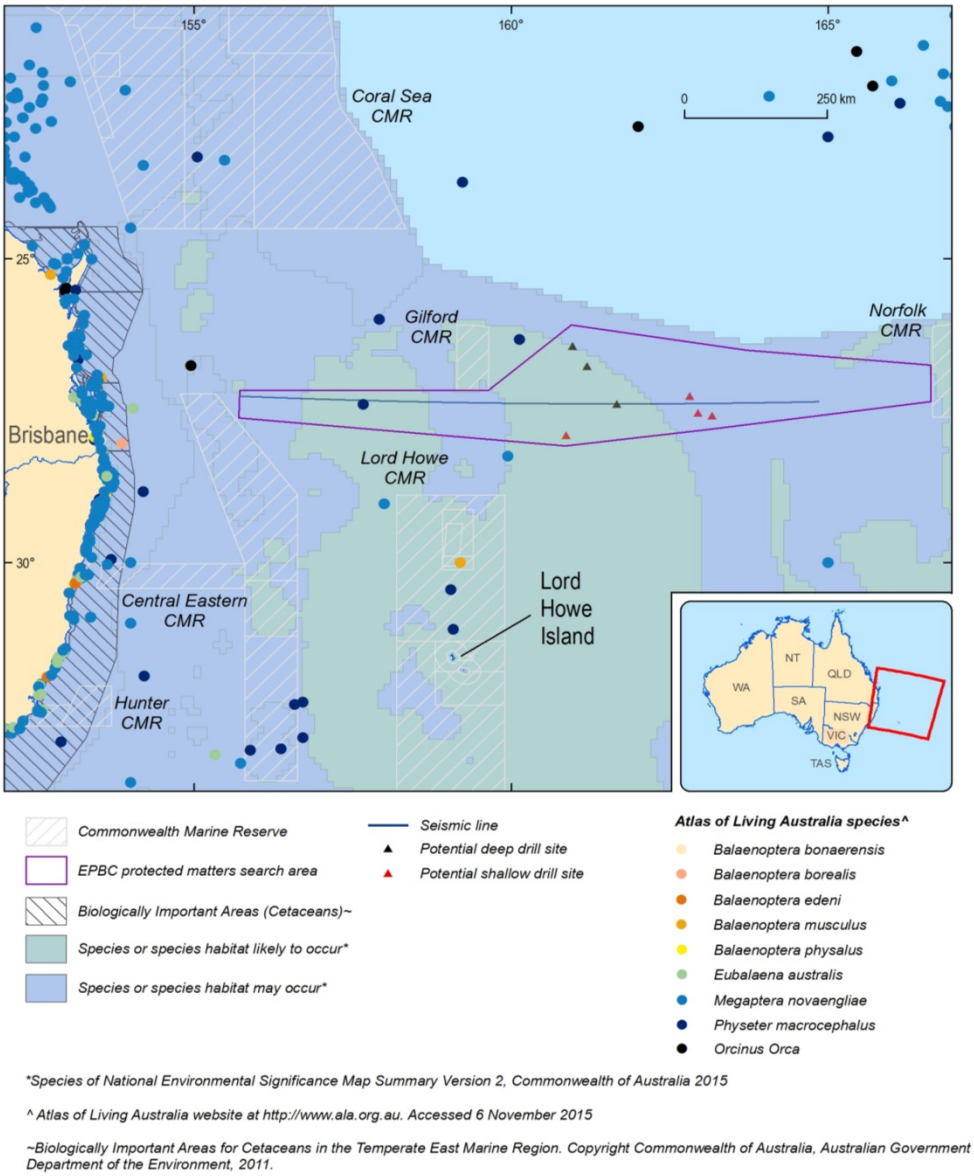

Figure 3: Biologically important areas and sighting records for listed threatened and migratory cetaceans shown in relation to the proposed survey area.

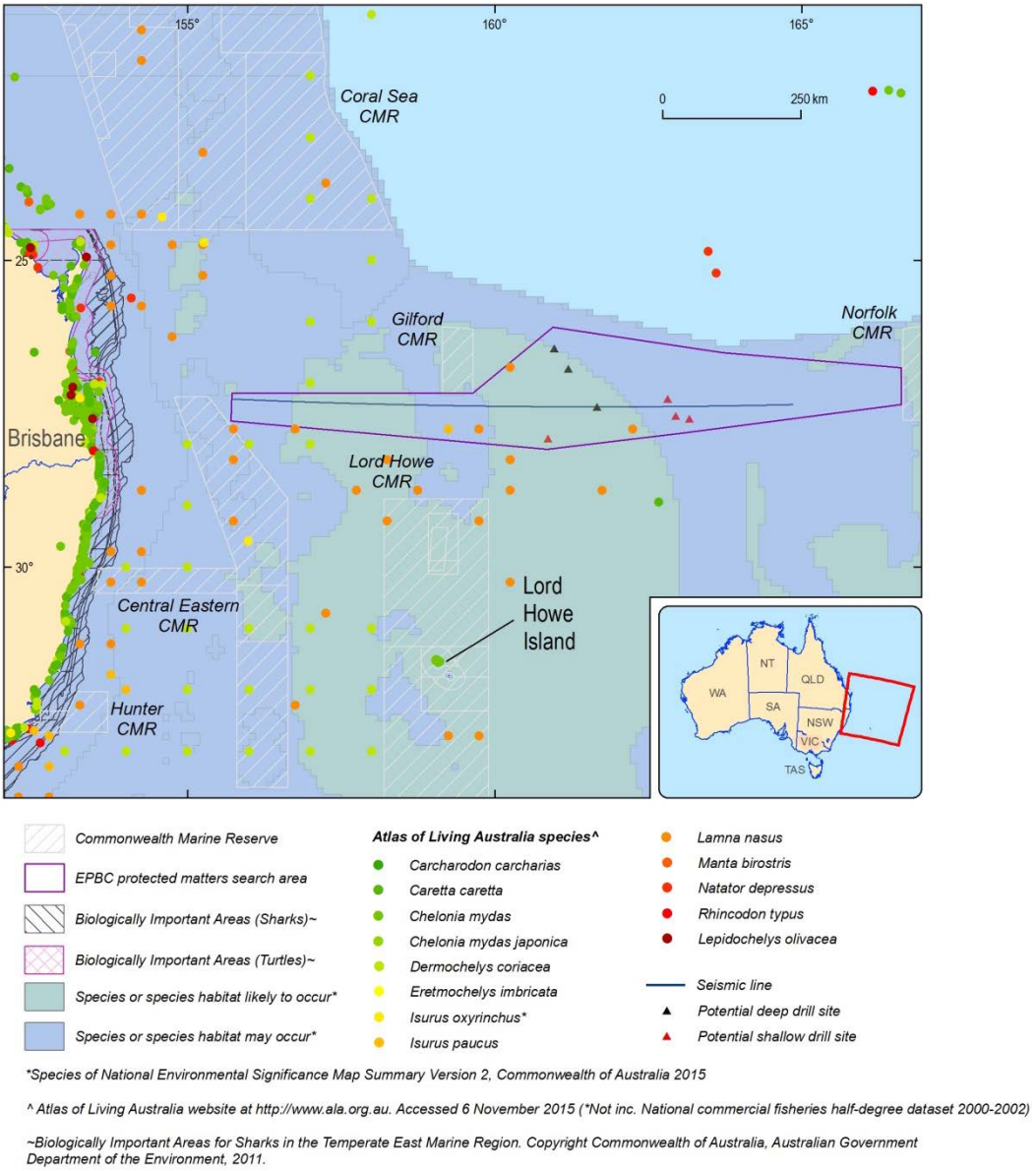

Figure 4: Biologically important areas and sighting records for listed threatened and migratory turtles/sharks shown in relation to the proposed survey area.

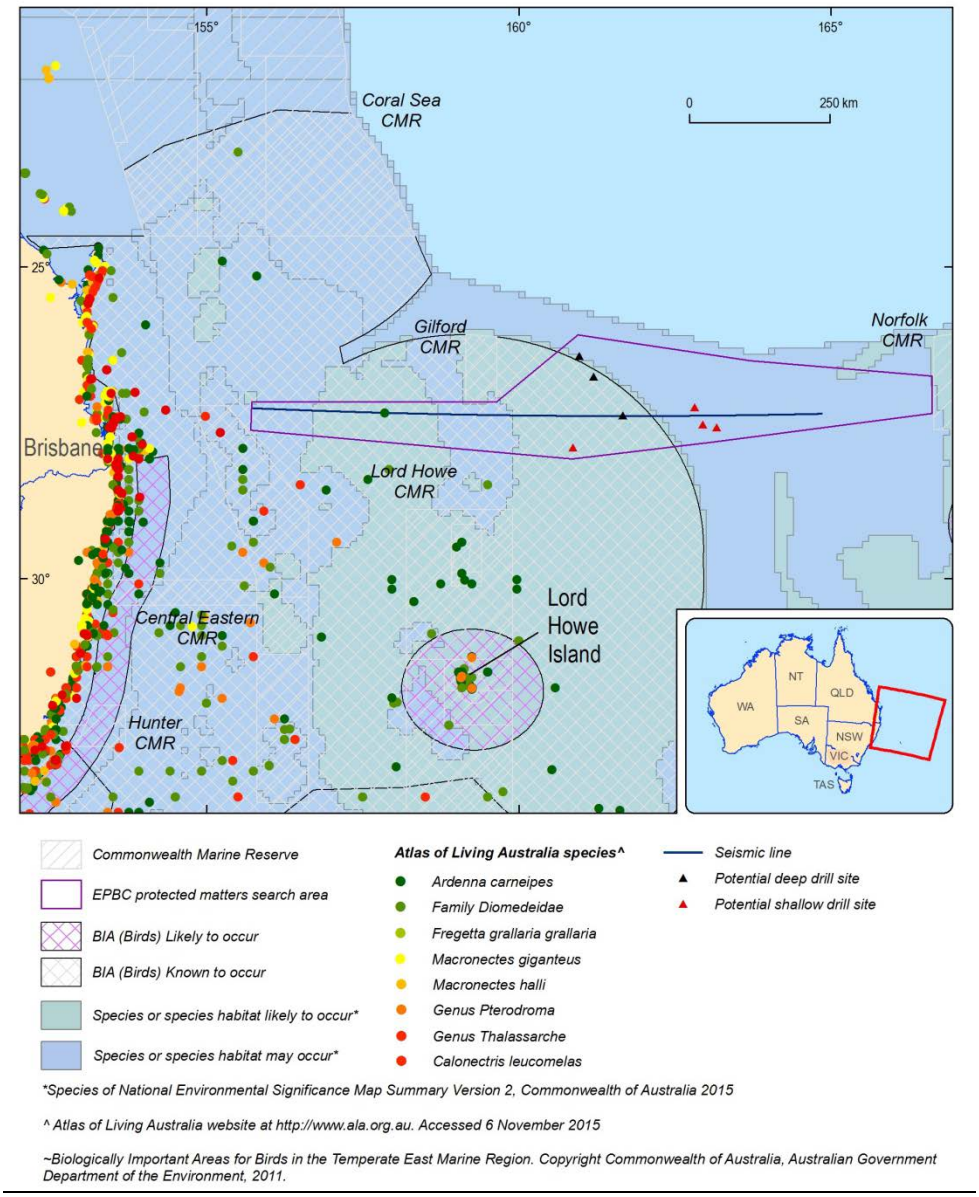

Figure 5: Biologically important areas and sighting records for listed threatened and migratory sea birds shown in relation to the proposed survey area.

Nature and extent of likely impact

The nature and extent of potential impacts on threatened species (described above), as a result of the proposed survey, relate to underwater acoustic disturbance, the physical presence of the marine vessel, light emissions, and seabed disturbance associated with the temporary deployment of Ocean Bottom Seismometers (OBS). Each of these impacts is discussed separately below.

Acoustic disturbance

The main impact to marine life as a result of the proposed survey is acoustic disturbance caused by the discharge of underwater seismic pulses. Marine seismic surveys typically involve the use of airgun arrays which are trailed behind marine vessels and produce high intensity, low frequency impulsive sounds at regular intervals. The optimum frequency range for a particular array is a trade-off between resolution and depth of penetration, with most sound produced between 10–300 Hz and highest levels less than 100 Hz (McCauley et al. 2000a). These sounds are directed towards the seabed and are used to generate detailed descriptions of sub-seabed geological formations (McCauley et al. 2000a, Gausland 2003). The predominant frequency range of seismic airgun emissions is within the detectable hearing range of cetaceans and most fishes and elasmobranchs (Popper et al. 2003, Popper and Fay 2011, Ladich and Fay 2013). It can also elicit a neurological response in cephalopods (Mooney et al. 2010) and decapods (Lovell et al. 2005).

Many marine animals, from small invertebrates to large cetaceans, make extensive use of underwater sounds for important biological activities such as intraspecific communication, predator avoidance, navigation, larval orientation, foraging and reproduction (Montgomery et al. 2006, Vermeij et al. 2010, Mooney et al. 2012). The ability to detect low-frequency sound may have evolved in fish, cephalopods, and other mobile marine invertebrates to avoid predators (Mooney et al. 2010). Anthropogenic noise can interfere with the ability of an animal to detect and/or use its 'acoustic' or 'auditory' scene and potentially decrease its fitness and chance of survival (Popper and Hastings 2009). Potential effects of intense anthropogenic sound sources on marine animals range from disturbance that may lead to displacement from feeding or breeding areas, to auditory damage and potential mortality (Popper and Hawkins 2012). Alternatively, some marine species may experience no effect of exposure to intense sources, particularly if the received level of sound does not exceed hearing thresholds (Popper and Hastings 2009). The area over which seismic noise may adversely impact marine species therefore depends on multiple factors, including the extent of sound propagation underwater, its frequency characteristics and duration, its distribution relative to the location and movements of organisms, and the absolute sensitivity and range of spectral hearing among species (Slabbekoorn et al. 2010, Popper and Hawkins 2012).

Impact on Cetaceans

Potential biological effects of air gun noise on marine mammals has been extensively reviewed (Gordon et al. 2003, McCauley et al. 2003a, Nowacek et al. 2007, Southall et al. 2007, Richardson et al. 2013) and may include direct physical/physiological effects, behavioural disruption, and indirect effects associated with altered prey availability (Gordon et al. 2003). Physical/physiological effects may include hearing threshold shifts and auditory damage (either permanent or temporary) as well as non-auditory disruption, and can be directly caused by sound exposure or the result of behavioural changes in response to sounds (Gordon et al. 2003).

Baleen whales (e.g., blue, southern right and humpback whales) have been observed displaying a variety of behavioural responses to operating seismic vessels which often vary within and between species (Richardson et al. 1995, McCauley et al. 2000b). For example, McCauley et al (2000b) showed that avoidance of 3D seismic operations by pods of humpback whales (which were involved in resting behaviour in key habitat types), occurred between 7 and 12 km from the survey vessel, whereas migrating individuals were less sensitive in their avoidance behaviour, tending to adjust their course and speed to enable an avoidance range of around 3 km (received sound level in the range of 157 to 164 dB re 1 µPa rms). During experimental exposures, some male humpbacks appeared attracted to the air gun signals and were observed approaching the seismic survey vessels to within 1 to 2 km (McCauley et al. 2000b). McCauley et al (2000b) concluded that given only localised avoidance was seen in migrating whales, any 'risk factor' associated with the seismic survey was confined to a comparatively short period and small range displacement. Odontocetes have also shown mixed behavioural response to seismic survey noise (see Section 3.1 (e)).

Exposure to seismic sound has been shown to alter blue whale acoustic communication. For example, a comparative study of blue whale communication found that calling was more consistent during seismic

acquisition than on non-survey days, and was observed for the discrete, audible calls that are emitted during social encounters and feeding (Di Iorio and Clark 2010). This response was presumed to represent a compensatory behaviour to the elevated ambient noise from seismic survey operations (Di Iorio and Clark 2010). However, as noted above, it is unlikely that foraging or migrating blue whales will be encountered within the Lord Howe Rise survey area. Potential direct or indirect disturbance to blue whales is therefore not expected.

Sound modelling

To assess the range of impact on cetaceans from the proposed seismic survey, Geoscience Australia commissioned Curtin University (Centre for Marine Science and Technology) to undertake acoustic propagation modelling specific to the 7800 in^3 seismic airgun array (see Attachment B and C). Modelling was undertaken at four representative source locations to predict received sound exposure levels (SELs) and peak-to-peak sound pressure levels (SPL $p{-}p$) from the proposed seismic survey at both short (< 5 km) and long (250 km) spatial ranges. An overview of the sampling design, methodology and key results from these studies is provided below.

The geographical distribution of sound exposure levels (SELs) due to a single airgun shot was computed with the seismic source at four representative locations – three along the east-west transect line and one at a high-priority site being considered for stratigraphic drilling (Figure 1 and Figure 2; see also Figure 2 in Attachment B). When plotted relative to the source location, modelled results are considered representative of levels received when the source is located at other locations with similar water depth, seabed slope, and seabed geology. Two different modelling methods were used: long-range modelling, which is computationally efficient and suitable for modelling sound exposure levels at ranges from a few kilometres to hundreds of kilometres; and short-range modelling, which is suitable for computing a variety of signal parameters out to ranges of a few kilometres. Long-range modelling was carried out for all four source locations, whereas short-range modelling was carried out for a single source location that corresponds to one of the high-priority sites being considered for stratigraphic drilling. The short range modelling results are considered to be representative of all the sites at which the source is operated at a depth of 6 m (see Section 2.1).

Potential ranges of impact due to sound produced during the proposed seismic survey are based on the susceptibility of cetaceans to permanent and temporary threshold shift (PTS and TTS, respectively) in hearing sensitivity, and behavioural responses. Cetaceans were split into three general categories – low-frequency, mid-frequency, and high-frequency cetaceans – based on similarities in their hearing range (auditory sensitivity at different frequencies) and corresponding generalized frequency-weighting ("M-weighting") functions (Southall et al. 2007). "Low-frequency" cetaceans (7 Hz to 22 kHz) include the mysticetes (baleen whales), "mid-frequency" cetaceans (150 Hz to 160 kHz) include most odontocetes (toothed whales), and "high-frequency" cetaceans (200 Hz to 180 kHz) include those odontocetes specialised in using high frequencies (of which, relevant species likely to occur in the survey area include sperm whales and beaked whales) (Southall et al. 2007). Levels for which the onset of behavioural responses can be expected vary widely among the limited number of studies that have been undertaken. For example, for mid-frequency cetaceans exposed to multiple, consecutive pulses, expected received levels as low as 100 dB re 1 µPa rms to as high as 160–180 dB re 1 µPa rms, can result in a behavioural response (Southall et al. 2007). PTS and TTS were based on single pulses, while behavioural response was based on multiple pulses. This is because estimating potential ranges based on multiple pulses, such as those produced during seismic surveys, requires the number and sound levels of pulses that animals are exposed to, to be known with certainty. For PTS and TTS, the required levels are higher, and so the corresponding ranges from the source are smaller.

Instantaneous physiological damage is only likely to occur to cetaceans if received peak sound levels exceed 265–275 dB re 1 µPa (Parvin et al. 2007). These levels are unlikely to be exceeded beyond approximately 50 m from a typical seismic source (Parvin et al. 2007). Results from the acoustic sound modelling show that the rate at which received SELs decrease with increasing range varied with bathymetry and source depth, but for all four source locations, the maximum levels were predicted to be between 130 dB re 1 μPa^2.s and 140 dB re 1 μPa^2.s at the largest modelled range of 250 km (see Figure 6 and Figure 7). Further reductions in sound exposure levels with increasing range are likely to be quite slow in directions where the sound remains in deep water and would be expected to approach the cylindrical spreading rate of a 10 dB reduction in level for every factor of ten increase in range.

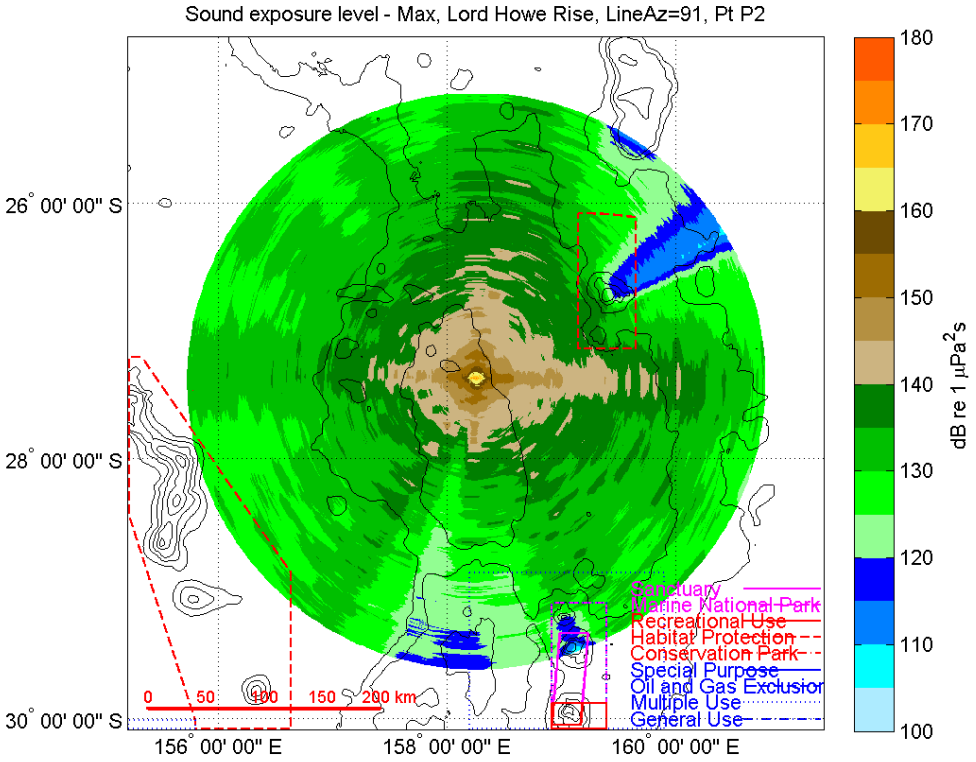

Figure 6: Modelled maximum sound exposure level at any depth due to a 10m deep source at source location P2.

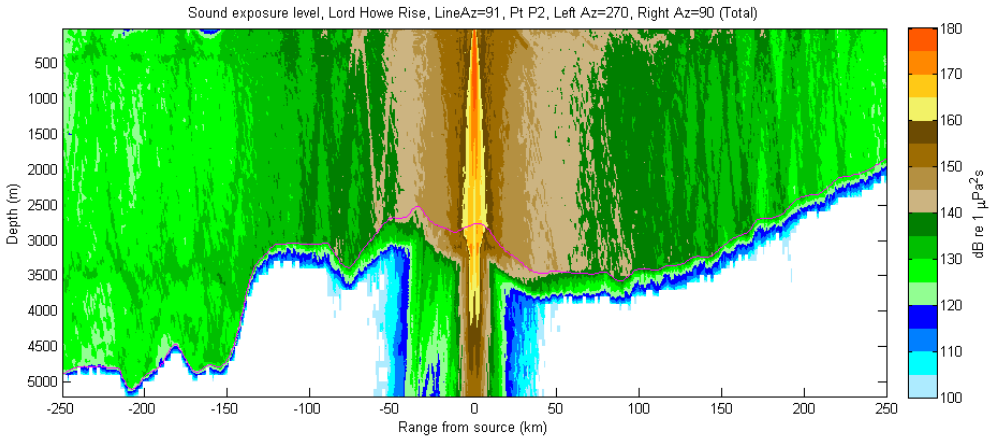

Figure 7: West-east vertical cross-section through the modelled sound exposure level field for a source at P2 (unweighted).

Based on the modelling results above, PTS and TTS are expected to occur for low-frequency cetaceans at ≤66 m distance from the source, and ≤50 m for mid- and high-frequency cetaceans. Ranges for TTS are predicted to be ≤390 m for low-frequency, and ≤224 m for mid- and high frequency cetaceans. The low-frequency PTS and TTS ranges were determined by the M-weighted sound exposure level criteria, whereas the mid-frequency and high-frequency cetacean ranges were determined by the peak-to-peak sound level criteria in Southall et al. (2007). The assessment study recommended that these results be applied with caution for sections of the survey where the source is being operated at a depth of 10 m (refer Section 2.1), as levels are expected to increase with increasing source depth.

Behavioural responses in cetaceans were predicted to occur at 400 m from the source for high-frequency cetaceans and 1.4 km for low and mid-frequency cetaceans, but potentially extending to >250 km. Because seismic surveys require multiple pulses normally undertaken over extended periods, cumulative exposure can reach PTS and TTS thresholds across larger distances. Measures to reduce the impact of the seismic source on cetaceans are detailed in Section 5.

Impact on Turtles

There are very few studies on the effects of seismic airgun activity on sea turtles and turtle audition is fairly poorly studied to date. However, existing data suggest that turtles hear best between about 100 Hz and 1 kHz, and should thus be able detect low-frequency, high-amplitude pulses from airgun arrays (DeRuiter and Doukara 2012). Given the current lack of comprehensive data on turtle hearing sensitivity, it is difficult to predict the sound exposure levels that would be required to cause temporary or permanent hearing loss. However, marine turtles, including the loggerhead turtle (*Caretta caretta*) have displayed avoidance behaviour to air-gun arrays (O'Hara and Wilcox 1990, McCauley et al. 2000b, DeRuiter and Doukara 2012). McCauley et al. (2000b) estimated that a typical airgun array operating in 100–120 m water depth could impact marine turtles behaviour at a distance of about 2 km (at received levels around 166 dB re 1µPa rms) and cause avoidance at around 1 km (at 175 dB re 1µPa rms). Modelled sound exposure levels generated by the proposed survey do not exceed guidelines for recoverable injury and mortality of turtles (see Table 7.4 in Popper et al. 2014b). Turtles present in the region at the time of the survey are likely to display avoidance behaviour in response to the approaching seismic noise. It is therefore unlikely that turtles will be impacted at an individual or population level.

Impact on Fish

Although marine fish typically have less acute hearing than marine mammals, many are more sensitive than odontocetes in the range 100–500 Hz where most seismic sound is produced (Gordon et al. 2003). While there is little information available on permanent hearing loss in fish resulting from exposure to high-intensity sounds, there is a growing body of literature which shows that anthropogenic sounds that exceed normal ambient noise may result in a temporary change in hearing sensitivity from which the animal will recover over time (Popper and Hastings 2009, Popper et al. 2014a). This loss of hearing (also referred to as temporary threshold shift (TTS)), is a temporary reduction in hearing sensitivity caused by exposure to intense sound. The level and duration of exposure that causes TTS varies widely and can be affected by factors such as repetition rate, frequency and duration of the sound, SPL, as well as the health condition of the exposed organisms (Popper and Hastings 2009).

The presence of gas bladders, and their anatomical location within the body, make fish particularly susceptible to pressure-mediated injury to the ears and body tissues (Popper et al. 2014a). There are few data on the effects of seismic airguns on fish mortality and damage to organ systems, and of these none have shown mortality (Popper et al. 2007, McCauley and Kent 2012, Miller and Cripps 2013). McCauley et al. (2003b) demonstrated that exposure to repeated single air-gun shots (1m of 222.6 dB re 1µPa (peak to peak) or 203.6 dB re 1µPa RMS) caused extensive damage to the sensory hair cells of the saccule of the inner ear of caged pink snapper (*Pagrus auratus*), while other studies have demonstrated no damage in several other species (Popper et al. 2005, Song et al. 2008). Fish have been shown to recover from temporary reductions in hearing sensitivity resulting from exposure to seismic sound (Popper and Hastings 2009, Popper et al. 2014a).

Behavioural effects are the most studied variable in assessments of low-frequency sound on fish, although few studies have observed the behaviour of fish exposed to a seismic survey directly (Popper and Halvorsen 2014). Airgun discharges have been reported to elicit varying degrees of startle and alarm responses and changes in schooling patterns, position in the water column and swimming speeds in fish (e.g. Pearson et al. 1992, Santulli et al. 1999, Wardle et al. 2001, Boeger et al. 2006, Fewtrell and McCauley 2012).

Potential habituation to repeated airgun exposure has been demonstrated for some fish. During air gun activity, some captive rockfish returned to pre-exposure behavioural patterns late in the exposure period, suggesting habituation to the air-gun sounds (Pearson et al. 1992). Similarly, behavioural observations of three coral reef fish species (*Lutjanus synagris*, *Lutjanus apodus*, *Chaetodipterus faber)* in field enclosures before, during and after exposure to air guns showed that repeated exposure resulted in increasingly less obvious startle responses (Boeger et al. 2006). Temporary habituation to airgun discharges was observed in schooling whiting when they returned to pre-exposure depth range following continual exposure to airgun sound over one hour, but again ascended to greater depths when airgun discharges recommenced after a period of non-shooting (Chapman and

Hawkins 1969).

A number of studies have shown that seismic airguns have an impact on fish catch and abundance, presumably due to changes in fish behaviour and distribution (reviewed by Hirst and Rodhouse 2000, McCauley et al. 2000a, Popper and Hastings 2009). Peña et al. (2013) investigated the real-time behaviour of herring schools exposed to a full-scale 3D seismic survey and observed changes in swimming speed, swimming direction, or school size that could be attributed to the transmitting seismic vessel as it approached from a distance of 27 to 2 km, over a 6 h period (Peña et al. 2013). Miller and Cripps (2013) investigated the effects of a 3D seismic survey on a shallow-water fish community at six locations at Scott Reef, before and after the survey. No significant effect was found on the overall abundance or species richness of species belonging to the family Pomacentridae (a group that exhibit a high degree of site fidelity) or non-Pomacentridae families (which comprised larger, more mobile roaming demersal species) (Miller and Cripps 2013).

Hearing sensitivities among sharks are poorly understood. This lack of knowledge makes it difficult to evaluate the potential effects that could be associated with exposure to seismic noise. Hearing abilities among sharks have demonstrated highest sensitivity to low frequency sound (40 Hz to approximately 800 Hz), which is sensed solely through the particle-motion component of an acoustical field (Myrberg Jr 2001). Sharks do not possess swim bladders and are therefore perceived to be less sensitive to underwater noise and trauma. The Temperate East Bioregional Plan species report card assesses noise pollution from seismic exploration as 'not of concern' for all shark species identified in the EPBC protected matters search. Impacts of the proposed seismic activity on sharks are therefore insignificant.

Although modelled sound exposure levels do not exceed guidelines for recoverable injury and mortality of fish (see Table 7.4 in Popper et al. 2014b), it is anticipated that some behavioural impacts on fish may occur within close range to the seismic source. Sharks and the vast majority of other fish likely to occur within the proposed survey area are highly-mobile pelagic species, and are therefore more likely to move away from the approaching sound source which will reduce the likelihood of any direct pathological damage. The survey vessel will be constantly moving and therefore any given location will only be affected for a relatively short period of time, thereby reducing the risk of population impacts. The use of soft starts prior to firing the airguns (see Section 5) will also act as a warning signal to fish in the nearby region.

Impact on Seabirds

Direct impacts of the proposed survey on seabirds identified in Section 3.1 (d) are unlikely to occur to a significant level. While it is possible that seismic emissions may affect some diving seabirds, these affects are considered to be short in duration given the brief periods of time seabirds spend underwater. Few studies have been done on the potential impacts of seismic activities on seabirds, which makes it difficult to assess the potential effects on movements and diving behaviour (e.g. Lacroix et al. 2003). However, indirect effects may occur as a result of the potential displacement of the seabirds prey fish species (see above).

Vessel presence and light emissions

In addition to noise produced by the seismic airguns, vessel noise also represents a potential source of underwater acoustic disturbance. Analysis of noise from ships revealed that their propulsion systems are a dominant source of radiated underwater noise at frequencies <200 Hz (Hildebrand 2009). Acoustic masking from anthropogenic noise, including ship noise, is increasingly being considered as a potential threat to marine mammals, especially low-frequency specialists such as baleen whales (Clark et al. 2009), as it may prevent foraging and communication. Some marine mammals have been found to sing longer songs (e.g. Fristrup et al. 2003), increase their call levels (e.g. Holt et al. 2009) and/or change their call rates (e.g. Lesage et al. 1999, Miksis-Olds and Tyack 2009) when exposed to high-level boat or shipping noise (Parks et al. 2011). Baleen whales, such as the humpback, sei, and fin whales are not expected to be encountered during the survey, which is scheduled to occur outside of known peak migratory activity. Several studies have also demonstrated that noise from boat traffic may reduce the effective range of communication signals and therefore the signalling efficiency between individual fish (Amoser et al. 2004, Vasconcelos et al. 2007, Codarin et al. 2009), due to reduced detection distances through masking (Codarin et al. 2009) and/or diminished auditory sensitivity of receivers (Vasconcelos et al. 2007). Picciulin et al. (2012) found that the mean vocalization pulse rate of brown meagres (*Sciaena umbra*) was higher following repeated, though not single, boat passes compared with ambient conditions, and suggested that the observed vocal enhancement may have occurred as a result of an increased density of callers, or from an increased acoustic output by those individuals already calling. Shipping traffic routes that occur within the proposed survey area (see Section 3.3) have the potential to result in

acoustic masking of some species. The presence of the survey vessel (RV *Kairei*) will be temporary, so if additional masking occurs it is unlikely to impact significantly on existing masking in the region.

The physical presence of the survey vessel represents a physical hazard to marine fauna similar to commercial shipping in the area (see Section 3.3 (l)). Potential impacts include short-term behavioural changes, such as avoidance, or wounding and/or mortality in the event of a collision. Cetaceans that are known to be at-risk of collision include fin whales, humpback, gray, minke, southern right and sperm whales (Laist et al. 2001, Jensen et al. 2004). Far fewer reports of strikes exist for blue, Bryde's, sei and killer whales (Laist et al. 2001, Jensen et al. 2004). Certain areas, namely continental shelf and slope, are considered hotspots for collision (Laist et al. 2001). Of the collision-risk species listed above, the sperm whales and killer whale are likely to occur in the research area at the time of proposed survey. Other odontocete species, including beaked whales, are also likely to occur in the area (see Attachment D). Large cetaceans demonstrate a variety of behaviours in response to approaching vessels (attributed to vessel noise), including moving away from the vessel's path with increased swimming speed and longer dive times (Baker and Herman 1989, Scheidat et al. 2004). These behavioural responses are likely to reduce the risk of vessel strike. Research has also shown that most lethal or severe injuries involve ships over 80 m in length and travelling 14 kn or faster (Laist et al. 2001). The RV *Kairei* will be acquiring seismic data on the proposed survey at an average speed of 4–5 kn, which will dramatically reduce the risk of collision with marine fauna. If required, and safe to do so, evasive action may be taken to avoid collisions with marine mammals while the vessel is in transit. In addition to potential physiological impacts as a result of acoustic noise, marine turtles may potentially collide with or become entangled in the towed seismic array, leading to possible injury or death from physical damage or drowning. However, the likelihood of collision or entanglement is considered low given the avoidance behaviour demonstrated for turtles in response to seismic surveys (discussed above). Furthermore, the slow speed of the survey vessel combined with mitigation measures to minimise potential effects (see section 5 for details on soft-start procedures; early detection of turtles by MMOs) will further reduce the risk of collision and/or entanglement.

Lighting on vessels operating offshore may affect light sensitive marine fauna, such as marine turtles, fish and seabirds. Given the distance of the survey area from known biologically important areas for marine turtles (e.g. significant turtle nesting sites along the eastern coast of Australia), significant impacts to marine turtles are not expected. Studies have shown that nocturnally migrating birds may die or lose a large amount of their energy reserves during migration as a result of encountering and being attracted to artificial light sources of the many offshore platforms in the North Sea (Marquenie et al. 2008, Poot et al. 2008). Artificial light fields around offshore petroleum platforms have also been shown to provide an enhanced foraging environment for larval, juvenile and adult fishes by providing sufficient light to locate and capture prey, as well as by attracting and concentrating positively phototaxic prey taxa (Keenan et al. 2007). As these examples relate to permanent offshore structures, rather than a constantly moving vessel, the potential effects of light emissions from the survey on fish and birds are likely to be less pronounced. Furthermore, the Temperate east Bioregional Plan species report card assesses light pollution from shipping vessels as either 'of less concern' or 'not of concern' for the majority of seabird species identified in the EPBC protected matters search (DSEWPaC 2012d). In sum, the impacts of the proposed seismic activity on turtles, fish and seabirds are insignificant.

Lighting is required for safety and navigational purposes on the vessel 24 hours a day during the proposed survey. For intermittent periods, spot lighting will be required for in-sea equipment inspection, deployment and retrieval. The use of such equipment will be minimised as far as practicable and workplace lighting will be directed inboard where possible to minimise direct light fall on water.

Seabed disturbance

The temporary deployment of Ocean Bottom Seismometers (OBSs) will occur on areas of gently sloping seabed typically characterised by soft sediment (pelagic mud). Any impact from the presence of OBS on the benthic environment will therefore be short-term in nature and highly localised. The steel anchors that will be left on the seabed following recovery of OBS will slowly corrode but may also be colonised by epibenthic fauna and/or flora.

Summary

Given the location and timing of the survey, continual movement of the vessel and the control measures to be adopted during the seismic activities (refer Section 5), the proposed action is unlikely to have a significant impact on listed threatened species, as identified in the EPBC protected matters search (Attachment D); or on their habitat. The proposed survey is therefore unlikely to cause any of the significant impacts as defined for

threatened species in *Significant Impact Guidelines 1.1, Matters of National Environmental Significance* (DoE 2013; see Section 6).

3.1 (e) Listed migratory species

Description

A search of the Department of the Environments (DoE) Protected Matters Search Tool database (Attachment D) identified 38 migratory species or species habitat that may occur in the survey area. These species and their current conservation status are shown in Table 3.1.2. Note: threatened and migratory species as highlighted in Table 3.1.1 have been described in in Section 3.1 (d) above. Species listed as Migratory only are described in the section below.

Table 3.1.2. Listed migratory species or species habitats that may occur within the proposed study area

Listed Migratory Species		
Migratory Marine Species		
Scientific name	Common name	Status
Calonectris leucomelas	Streaked Shearwater	
Diomedea antipodensis	Antipodean Albatross	Vulnerable*
Diomedea dabbenena	Tristan Albatross	Endangered*
Diomedea epomophora (sensu stricto)	Southern Royal Albatross	Vulnerable*
Diomedea exulans (sensu lato)	Wandering Albatross	Vulnerable
Diomedea gibsoni	Gibson's Albatross	Vulnerable*
Macronectes giganteus	Southern Giant-Petrel	Endangered
Macronectes halli	Northern Giant-Petrel	Vulnerable
Phoebetria fusca	Sooty Albatross	Vulnerable
Puffinus carneipes	Flesh-footed Shearwater	
Thalassarche cauta (sensu stricto)	Shy Albatross, Tasmanian Shy Albatross	Vulnerable*
Thalassarche eremita	Chatham Albatross	Endangered
Thalassarche impavida	Campbell Albatross	Vulnerable*
Thalassarche melanophris	Black-browed Albatross	Vulnerable
Thalassarche salvini	Salvin's Albatross	Vulnerable*
Thalassarche steadi	White-capped Albatross	Vulnerable*
Balaenoptera bonaerensis	Antarctic Minke Whale, Dark-shoulder Minke Whale	
Balaenoptera borealis	Sei Whale	Vulnerable
Balaenoptera edeni	Bryde's Whale	
Balaenoptera musculus	Blue Whale	Endangered
Balaenoptera physalus	Fin Whale	Vulnerable
Carcharodon carcharias	Great White Shark	Vulnerable
Caretta caretta	Loggerhead Turtle	Endangered
Chelonia mydas	Green Turtle	Vulnerable
Dermochelys coriacea	Leatherback Turtle, Leathery Turtle	Endangered
Eretmochelys imbricata	Hawksbill Turtle	Vulnerable
Eubalaena australis	Southern Right Whale	Endangered
Isurus oxyrinchus	Shortfin Mako, Mako Shark	
Isurus paucus	Longfin Mako	
Lagenorhynchus obscurus	Dusky Dolphin	
Lamna nasus	Porbeagle, Mackerel Shark	
Lepidochelys olivacea	Olive Ridley Turtle	Endangered
Manta birostris	Giant, Chevron, Pacific, Pelagic, Oceanic Manta Ray	
Megaptera novaeangliae	Humpback Whale	Vulnerable
Natator depressus	Flatback Turtle	Vulnerable
Orcinus orca	Killer Whale, Orca	

Physeter macrocephalus	Sperm Whale	
Rhincodon typus	Whale Shark	Vulnerable
Migratory Marine Birds		
Scientific name	Common name	Status
Calonectris leucomelas	Streaked Shearwater	
Diomedea antipodensis	Antipodean Albatross	Vulnerable*
Diomedea dabbenena	Tristan Albatross	Endangered*
Diomedea epomophora (sensu stricto)	Southern Royal Albatross	Vulnerable*
Diomedea exulans (sensu lato)	Wandering Albatross	Vulnerable
Diomedea gibsoni	Gibson's Albatross	Vulnerable*
Macronectes giganteus	Southern Giant-Petrel	Endangered
Macronectes halli	Northern Giant-Petrel	Vulnerable
Phoebetria fusca	Sooty Albatross	Vulnerable
Puffinus carneipes	Flesh-footed Shearwater	
Thalassarche cauta (sensu stricto)	Shy Albatross, Tasmanian Shy Albatross	Vulnerable*
Thalassarche eremita	Chatham Albatross	Endangered
Thalassarche impavida	Campbell Albatross	Vulnerable*
Thalassarche melanophris	Black-browed Albatross	Vulnerable
Thalassarche salvini	Salvin's Albatross	Vulnerable*
Thalassarche steadi	White-capped Albatross	Vulnerable*

(*Species is listed under a different scientific name on the EPBC Act - Threatened Species list).

Mammals

In addition to the five listed threatened species of baleen whale described in section 3.1 (d), Bryde's whales and Antarctic minke whales are listed Migratory species that may occur in the proposed survey area (Table 3.1.2; Figure 3). Three odontocete species, the sperm whale, killer whale and dusky dolphin, are also listed Migratory species that may occur in the region (Table 3.1.2; Figure 3).

Bryde's whales (*Balaenoptera edeni*) are small balaenopterids found in pelagic temperate to tropical waters, both oceanic and inshore (DoE 2015c). Due to uncertainty regarding inshore and offshore forms of Bryde's Whales, their life history and migratory movements are difficult to ascertain. However, no evidence exists for large-scale movements for the inshore form, while seasonal migrations to tropical waters during winter are possible for offshore forms of Bryde's Whales (DSEWPaC 2012b, DoE 2015c). Insufficient information exists as to how Australian Bryde's whales use their habitat, as no specific feeding or breeding grounds have been documented off Australia (DoE 2015c). While the recognised range of Bryde's whales extends into the Tasman Sea, the likelihood of the survey vessel encountering this species is low.

Antarctic Minke Whales (*Balaenoptera bonaernsis*) often occupy offshore and pelagic waters to >600 m depths within cold temperate Antarctic waters between 21° and 65° (DoE 2015a). Their distribution along the west coast of Australia is currently unknown; however, they are known to occur north to 21° S off the east coast (Bannister et al. 1996). Mating periods occur between June and December, and the gestation period lasts approximately 10 months (late May-June) within the warmer waters north of the Antarctic Convergence (ca 50°S). This species migrates between the summer Antarctic feeding grounds and winter sub-tropical to tropical breeding grounds (DoE 2015a). They have been reported up to 350 km south of the ice edge during winter, suggesting that some portions of the population may over-winter in higher latitudes (Thiele and Gill 1999, Perrin and Brownell Jr 2002). The likelihood of the survey vessel encountering or coming within close proximity to Antarctic Minke whales is low given the known migration patterns of this species.

Sperm whales (*Physeter macrocephalus*) are a cosmopolitan species commonly found in deep, pelagic, offshore waters and have been recorded offshore from all Australian states (Bannister et al. 1996). Key localities include: the area between Cape Leeuwin and Esperance, WA, close to the edge of the continental shelf (averaging 20 to 30 nautical miles offshore); south-west of Kangaroo Island, SA; off the Tasmanian west and south coasts; off New South Wales, including Wollongong; and off Stradbroke Island, Queensland (Bannister et al. 1996). The area of occupancy of sperm whales remains uncertain due to the paucity of records for pelagic waters off Australia and the Australian subantarctic and Antarctic territories (DoE 2015i). Female and young male sperm whales appear to be restricted to warmer waters north of about 45° S in the Southern Hemisphere, while adult males travel to and

from colder waters of Antarctica (Bannister et al. 1996, Lyrholm et al. 1999). Sperm whales feed on a variety of large squids (Evans and Hindell 2004) and fishes and tend to inhabit the offshore continental margin where canyons are present or the seabed rises steeply resulting in high concentrations of prey due to upwelling (Bannister et al. 1996). Although no biologically important habitat for sperm whales has been identified within the vicinity of the study area, canyon features on the eastern continental slope and the Tasmantid seamount chain provide feeding grounds for this species and sighting records obtained from the Atlas of Living Australia confirm their presence in the region (Figure 3). Given this, and given that the proposed seismic line intersects this key ecological feature, it is likely that sperm whales will be encountered in the survey area.

Killer whales (*Orcinus orca*) are found throughout the world's oceans and are widely recognised as predators of other marine mammals, including large sperm and baleen whales (Jefferson et al. 1991, Forney and Wade 2006). In Australia, killer whales have been recorded from all state waters, with concentrations around Tasmania (Bannister et al. 1996), frequent sightings in South Australia and Victoria (Ling 1991) and in the Antarctic south of 60° (Bannister et al. 1996, Pitman and Ensor 2003). The species is distributed from the equator to polar waters, and is generally more common at higher latitudes in highly-productive, near-shore areas (DSEWPaC 2012b). Killer whales forage in the Temperate East Marine Region and are likely to breed in and migrate through the region (DSEWPaC 2012b). It is possible that this species may be encountered during the survey, although numbers are not anticipated to be high.

Dusky dolphins (*Lagenorhynchus obscurus*) are widely distributed in southern cool temperate waters from about 55° to 26°S, but with extensions north of this latitudinal range in association with cold currents (Bannister et al. 1996). They are distributed across southern Australian waters from Western Australia to Tasmania (Gill et al. 2000) and are listed as Migratory under the EPBC Act (Table 3.1.2). This cetacean species is known to occur in the Temperate East Marine Region on an infrequent basis (DSEWPaC 2012b). It is unlikely that this species will be encountered in large numbers within the proposed study area.

Sharks

In addition to the aforementioned white shark and whale shark (see Section 3.1d), shortfin and longfin Mako and Porbeagle sharks are also listed as Migratory under the EPBC Act (Table 3.1.2). These sharks are wide-ranging, highly migratory, pelagic species, found predominately in deeper offshore oceanic waters where they utilise productivity hotspots generated by currents and eddies as key foraging sites (DSEWPaC 2012e; Figure 4). The Temperate East Marine Region and its adjacent state waters are known to play an important role for these species, providing key breeding, feeding and aggregation rounds.

The shortfin Mako (*Isurus oxyrinchus*) is an epipelagic shark known to occur in both tropical and temperate waters >16 °C (Last and Stevens 2009). It is normally oceanic and cosmopolitan in its distribution and is widespread occurring from the surface to water depths of at least 888 m (Stevens 2010, Abascal et al. 2011). It is widely distributed in Australian waters, with the exception of the Arafura Sea, Gulf of Carpentaria and Torres Strait, and is occasionally found close inshore (Last and Stevens 2009). Shortfin Mako feed mainly on teleost fish and cephalopods, with larger individuals (>3m) known to take larger prey such as billfish and small cetaceans (Last and Stevens 2009). Litters of 4–16 pups are born off New South Wales around November (Stevens 1983). The targeted commercial take of shortfin Mako is prohibited in Commonwealth waters; however, individuals can be retained (as byproduct) if they are dead upon capture (DSEWPaC 2012e).

The longfin Mako (*Isurus paucus*) is a widely-distributed epipelagic shark (Reardon 2006). This species is deep-dwelling (usually between 120 and 240 m) and appears to be cosmopolitan in tropical and warm temperate waters; however its distribution within Australia remains unclear and it is often confused with the more common shortfin Mako (DSEWPaC 2012e). Sighting records obtained from Atlas of Living Australia confirm their wide-ranging migratory movements (Figure 4). It is therefore highly likely that both species of Maki may transit the survey area and surrounding waters.

The porbeagle shark is a wide-ranging, oceanic species found in subtropical and temperate of the North Atlantic and Southern Hemisphere (1 to 18°C), although it is more commonly found on continental shelves. In Australia, it occurs from southern Queensland to south-west Australia (Last and Stevens 2009). Porbeagle sharks have been shown to occupy a broad depth range (0 – 552 m), diving frequently from the surface to near the seabed in shelf areas and making extended dives in shelf-edge habitats >300 m (Pade et al. 2009), while mature female porbeagles have also been shown to migrate up to 2356 km through the winter, at depths down to 1360 m (Campana et al. 2010). Little data exists for Southern Hemisphere populations, although they are thought to give birth off New Zealand and Australia in winter (Francis and Stevens 2000).

The giant manta ray (*Manta birostris*) is usually found offshore, often around oceanic islands, sometimes coastal, and most commonly in tropical waters. They are large filter-feeding elasmobranch fishes that have a circumglobal distribution (Last and Stevens 2009) and like other large planktivorous elasmobranchs (e.g. *Rhincodon typus*), they exhibit long-distance migrations. However, little is known about its distribution and movement patterns along Australia's east coast (Couturier et al. 2011). Although this species may transit through the survey area and surrounding waters (see Figure 4), it is unlikely to be encountered in large numbers within the survey area.

Turtles

The five species of marine turtle likely to occur within the proposed survey area are also classified as Threatened species, and have been described in Section 3.1 (d).

Seabirds

The majority of vulnerable and endangered albatross and petrel species (order Procellariiformes) listed as Threatened species (Table 3.1.1) are also listed as Migratory (Table 3.1.2) in the EPBC Act. Additional migratory species likely to occur in the study area include the Streaked Shearwater (*Calonectris leucomelas*) and Flesh-footed Shearwater (*Puffinus carneipes*). The streaked shearwater is known to occur in the Temperate East Marine Region on an infrequent basis (DSEWPaC 2012d). The world's largest population of Flesh-footed Shearwaters on Lord Howe Island in eastern Australia has been declining for more than two decades as a result of bycatch in long-line fisheries (Baker and Wise 2005) and loss of nesting habitat (Lavers et al. 2014). This species mainly forages offshore over continental shelves, where it feeds on fish and squid and may therefore be encountered during the survey.

Nature and extent of likely impact

The potential impacts to listed migratory marine species are the same as those described for listed threatened species in Section 3.1 (d). As summarised above, the proposed survey will be temporary and short in duration and managed to mitigate impacts to as low as reasonably practicable (see Section 5). To this end, the proposed survey is unlikely to cause significant impacts as defined for migratory baleen whales, turtles, fish or seabirds. Additional discussion on potential acoustic-related impacts to high-frequency cetaceans is provided below.

Mid- and high-frequency cetaceans are all odontocetes (toothed whales) which have an auditory bandwidth range between 150 Hz and 180 kHz. Unlike the mysticetes, all odontocete cetaceans appear to have highly advanced echolocation (biosonar) systems that use intermediate to very high frequencies (Southall et al. 2007). Sperm whales are the largest odontocetes and are thought to have better low frequency hearing than smaller odontocetes and may thus be more vulnerable to potential disturbance from seismic surveys (Gordon et al. 2003). However, the reactions of sperm whales to seismic noise vary among studies. Mate et al. (1994) found a negative correlation between seismic surveys and the presence of sperm whales in the Gulf of Mexico, and Bowles et al. (1994) reported that sperm whales ceased clicking, possibly as a response to seismic survey pulses, with received levels some 15 dB above background noise levels. In contrast, Stone and Tasker (2006) reported that sighting rates of sperm whales did not differ significantly with seismic surveys and Madsen (2002) demonstrated that exposure to the seismic survey pulses did not elicit observable avoidance or changes in vocal patterns during feeding dives. Moreover, examination of the behaviour of sperm whales before, during and after five separate 1–2 h controlled sound exposures of airgun arrays in the highly-exposed Gulf of Mexico, showed that sperm whales did not exhibit avoidance reactions to airguns (Miller et al. 2009). Small odontocetes have shown strong lateral spatial avoidance and there is some evidence to suggest that killer whales may demonstrate localised spatial avoidance of seismic sounds (Stone and Tasker 2006).

Observations of beaked whale strandings coincident with mid-frequency naval sonar (e.g. Jepson et al. 2003) have focused attention on the potential impact of such sounds on beaked whales (particularly Cuvier's beaked) (reviewed in Barlow and Gisiner 2006, Cox et al. 2006, Tyack et al. 2011). The potential impacts of anthropogenic noise, including seismic airgun emissions, on beaked whales remain poorly understood, partly due to their elusive nature (Cato et al. 2009, Tyack et al. 2011). Some marine mammals show strong avoidance responses when evading predators and sounds from tactical mid-frequency sonars somewhat resemble, in frequency band and modulation, the social signals of one of the only predators of large marine mammals, the killer whale (Southall et al. 2007). However, it remains unknown as to whether beaked whales in certain conditions mistake tactical mid-frequency sonar signals for killer whales and consequently change their behaviour in a way that injures them (Southall et al. 2007).

While the survey area does not overlap with any known biologically important areas for sperm whales or beaked whales, it is likely that these species may be encountered due to the presence of suitable habitat for foraging (see Section 3.1 (e)). Sound modelling results indicate that seismic pulses with received levels of 180 dB re 1 µPa or more are restricted to a radius of approximately 300 m around the seismic airgun array, therefore the potential for PTS and TTS is low as a whale would need to be less than one kilometre from the airgun array and remain within this range for a period of time to sustain this level of hearing impairment. PTS and TTS were predicted to occur in mid- and high-frequency cetaceans at ≤50 m and the ranges for TTS in mid- and high frequency cetaceans were predicted to be ≤224 m (see Attachment B and C). It is possible that these whales may exhibit avoidance behaviour in response to the seismic source, but such a response is likely to be temporary and localised and unlikely to lead to significant impacts at the population level.

Due to the likelihood of encountering sperm whales (see Section 3.1e) and/or beaked whales (see Section 3.3a), increased precaution and buffer zones, in conjunction with adaptive management procedures, will be implemented (see Section 5). The vocalisations of *Ziphius cavirostris* (Cuvier's beaked whale) and *Mesoplodon densirostris* (Blainville's beaked whale) are distinctively different in several acoustical characteristics from those of other toothed whales, providing a reliable means of detection and identification (Cato et al. 2009). The planned use of Passive Acoustic Monitoring (PAM) may therefore provide an effective means of mitigation. Given the ability of cetaceans to avoid vessels and the acoustic source and the adoption of proposed mitigation measures (see Section 5), it is highly unlikely that cetaceans will be exposed to sound levels that may cause pathological damage or permanent threshold shifts in hearing. In addition, the short duration and transient nature of the survey will mean that it is unlikely to cause long-term disturbance to or displacement of marine mammals that may be present in the survey area.

Summary

Given the location and timing of the survey, continual movement of the vessel and the control measures to be adopted during the seismic activities (refer Section 5), the proposed action is unlikely to have a significant effect on any listed migratory species as identified in the EPBC protected matters search (Attachment D); or on their habitat. The proposed survey is therefore unlikely to cause any of the significant impacts as defined for migratory species in *Significant Impact Guidelines 1.1, Matters of National Environmental Significance* (DoE 2013; see Section 6).

3.1 (f) Commonwealth marine area

(If the action is in the Commonwealth marine area, complete 3.2(c) instead. This section is for actions taken outside the Commonwealth marine area that may have impacts on that area.)

Description

The action is in the Commonwealth Marine Area; refer to Section 3.2 (c)

Nature and extent of likely impact

The nature and extent of likely impacts to Commonwealth marine areas is provided in Section 3.2 (c).

3.1 (g) Commonwealth land

Description

The proposed survey is strictly a marine operation and will therefore not be taking place on Commonwealth land.

Nature and extent of likely impact

Not applicable.

3.1 (h) The Great Barrier Reef Marine Park

Description

The proposed action will not be undertaken in the Great Barrier Reef Marine Park.

Nature and extent of likely impact

Due to the geographic distance between the proposed study area and the Great Barrier Reef Marine Park (>400 km), no direct or indirect impacts from the survey are considered likely to occur.

3.1 (i) A water resource, in relation to coal seam gas development and large coal mining development

Description

Not applicable.

Nature and extent of likely impact

Not applicable.

3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

3.2 (a)	**Is the proposed action a nuclear action?**	**X**	No

		Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment

3.2 (b)	**Is the proposed action to be taken by the Commonwealth or a Commonwealth agency?**		No
		X	Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment

Refer to Section 3.2 (c) below.

3.2 (c)	**Is the proposed action to be taken in a Commonwealth marine area?**		No
		X	Yes (provide details below)

If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f))

The proposed action is located within two Commonwealth marine areas; the EEZ/Territorial Sea and the Extended Continental Shelf, with water depths ranging between ~1,300 and 4,800 m. The study area falls within the Temperate East Marine Region, which comprises Commonwealth waters from the southern boundary of the Great Barrier Reef Marine Park to Bermagui in southern New South Wales, and includes the waters surrounding Lord Howe and Norfolk Islands. The Temperate East Marine Region is characterised by a narrow continental shelf, significant variation in sea-floor features (including seamount chains and canyons), dynamic oceanography, and a unique mix of tropical and cold water reef systems (DSEWPaC 2012a).

The main physical features of the region include:

- three seamount chains that run parallel to the East coast—the Tasmantid and Lord Howe seamount chains and the Norfolk Ridge;
- the East Australian Current, which dominates the oceanography of the region;
- the Tasman Front, which forms between 20 and 30 degrees south and represents the meeting point for two distinct bodies of water—the warm, nutrient-poor Coral Sea and the cold, nutrient-rich Tasman Sea; and
- the canyons of the eastern continental slope, which add critical habitat diversity to the region.

Key ecological features of the Temperate East Marine Region include:

- Shelf rocky reefs;
- Canyons on the eastern continental slope;
- Tasman Front and eddy field;
- Upwelling off Fraser Island;
- Tasmantid seamount chain;
- Elizabeth and Middleton reefs;
- Lord Howe seamount chain; and
- Norfolk Ridge.

The proposed seismic survey intersects two of these key ecological features – the Tasmantid and Lord Howe seamount chains. The Tasmantid seamount chain is a prominent chain of underwater volcanic mountains, plateaux and terraces that contain a range of habitats from deep sea sponge gardens to near-pristine tropical coral reef systems (DSEWPaC 2012a). These habitats are considered biological hotspots with high species diversity and are known feeding and breeding grounds for a number of open ocean species (e.g. marine turtles, marine mammals) and have high species endemism. The Lord Howe seamount chain extends for approximately 1000 km along the western margin of the Lord Howe Rise and supports tropical shallow coral reefs and deep cold water corals.

Given the restricted spatial extent and timing of the survey, and the control measures to be adopted to reduce any short term effects, the proposed action is unlikely to have significant impact on the environment as a whole or cause any of the significant impacts as defined for Commonwealth marine areas in *Significant Impact Guidelines 1.1, Matters of National Environmental Significance* (DoE 2013).

Specifically, the proposed survey is not likely to:

- Result in any known or potential pest species becoming established in the Commonwealth marine area;
- Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results;
- Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution;
- Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health;
- Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected; or
- Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

3.2 (d)	**Is the proposed action to be taken on Commonwealth land?**	**X**	No
			Yes (provide details below)
If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g))			

3.2 (e)	**Is the proposed action to be taken in the Great Barrier Reef Marine Park?**	**X**	No
			Yes (provide details below)
If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h))			

3.3 Other important features of the environment

3.3 (a) Flora and fauna

Threatened and migratory species identified by the EPBC Act Protected Matters Search Tool as likely to occur in the survey area are discussed in Sections 3.1(d) and 3.1(e). This search also identified a number of other cetacean species that may occur in the study area, including *Ziphius cavirostris* (Cuvier's beaked whale) and *Mesoplodon densirostris* (Blainville's beaked whale) (see Attachment D). Beaked whales (family Ziphiidae) are small- to medium-sized toothed whales ranging in length between species from about 3.5 to 13 m. They generally inhabit deep waters offshore and are very elusive and rarely sighted (Cato et al. 2009). Consequently, little is known about their biology and distributions (Cato et al. 2009). A combined visual and acoustic survey for beaked whales in the Coral Sea off the east Australia resulted in 75 sightings of more than 500 individuals of a range of cetacean species including several species of dolphins, pilot whales, sperm whales, humpback whales, minke whales, and six sightings of 12 individual beaked whales of unidentified species (Cato et al. 2009). Thousands of clicks typical of beaked whales were recorded, with higher density of detections found in areas of steep bathymetric slopes than over the deep plains (Cato et al. 2009). The Tasmantid seamount chain in particular is therefore likely to provide important habitat for these species (see Section 3.2 (c)).

3.3 (b) Hydrology, including water flows

Not applicable.

3.3 (c) Soil and Vegetation characteristics

Not applicable.

3.3 (d) Outstanding natural features

Section 3.2(c) provides details regarding the key ecological features in the temperate east, as documented in the Marine Bioregional Plan for the Temperate East Marine Region (DSEWPaC 2012a). These key ecological features link into the 'major conservation values' identified for the Central Eastern, Gifford, Lord Howe and Norfolk Commonwealth Marine Reserves, as outlined in the Temperate East Commonwealth Marine Reserves Network Management Plan 2014-24 (DNP 2013).

3.3 (e) Remnant native vegetation

Not applicable.

3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

The marine survey will be conducted in water depths ranging from ~1,300 to 4,800 m.

3.3 (g) Current state of the environment

Not applicable.

3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

There are no Commonwealth Heritage Places within the proposed survey area. A search of the Australian national shipwreck database found no historic shipwrecks located within the area of operations. Four ship wrecks are located to the south and another two ship wrecks are located to the south east of the operational area. The HMS *Sirius*, wrecked in 1790, is listed on the Commonwealth Heritage List. It is located to the south east of the area at Norfolk Island on the outer reef at Slaughter Bay, -29° 3' 37"S, -167° 57'18"E.

3.3 (i) Indigenous heritage values

There are no known Indigenous heritage values within the proposed survey area or immediate surrounds.

3.3 (j) Other important or unique values of the environment

Five Commonwealth Marine Reserves are located within close proximity to the proposed survey area and four Key Ecological Features occur in the region. See Section 3.2(c) for details.

3.3 (k) Tenure of the action area (e.g. freehold, leasehold)

Not applicable.

3.3 (l) Existing land/marine uses of area

Fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA), with Commonwealth fisheries operating from 3 nm of baseline out to 200 nm (the extent of the Australian Fishing Zone). The proposed survey area has the potential to overlap the following Commonwealth fishing zones:

- Eastern Tuna and Billfish Fishery;
- South and Eastern Scalefish and Shark Fishery;
- Southern Bluefin Tuna Fishery;
- Southern Squid Jig Fishery; and
- Small Pelagic fishery.

Geoscience Australia is in the process of consulting all potentially-affected fisheries in the proposed survey area and will consult with these fisheries leading up to and throughout the proposed survey activities to ensure any interactions are minimised. A brief description of these fisheries is provided below.

The Eastern Tuna and Billfish Fishery extends from Cape York in Queensland to the South Australian/Victorian border. Fishing occurs in the Australian Fishing Zone and adjacent high seas and targets yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*), albacore tuna (*T. alalunga*), broadbill swordfish (*Xaphias gladius*) and striped marlin (*Tetrapturus audax*). Fish are caught using pelagic longlines or minor lines, and vessels are likely to operate in the open ocean, particularly around raised features such as seamounts and ridges, if not restricted by marine protected areas. Total catch and values for 2012-13 were 3915 tonnes and $23.9 million (http://www.afma.gov.au/fisheries/eastern-tuna-and-billfish-fishery-page/).

The Southern and Eastern Scalefish and Shark Fishery operate south from Fraser Island in southern Queensland, around Tasmania, to Cape Leeuwin in southern Western Australia (almost half of the Australian Fishing Zone). The estimated value of the sector in 2013-14 was $72.2 million. The fishery is managed under five sectors of which the East Coast Deepwater Trawl Sector (ECDTS) and Scalefish Hook Sector (SHS) operate within the study region. The ECDTS targets Alfonsino (*Beryx splendens*), a deep-water fish that is often found over seamounts and underwater ridges, using bottom and midwater trawls. Principal species caught in the SHS, include gummy shark (*Mustelus antarcticus*), blue-eye trevalla (*Hyperoglyphe antarctica*) and pink ling (Genypterus blacodes). A variety of fishing gear is used in this fishery (e.g. bottom longline and dropline, gillnet; see http://www.afma.gov.au/fisheries/southern-eastern-scalefish-shark-fishery/).

The Southern Bluefish Tuna Fishery operates throughout the Australian EEZ. Nationally, the Southern Bluefin Tuna (*Thunnus maccoyii)* Fishery was valued at $27.1 million in 2012-13. *T.maccoyii* is a highly-migratory pelagic species that is captured using pelagic longline and oceanic purse seines. After capture, live tuna are transported to Port Lincoln in southeastern Australia where fish are grown in fish-pens to increase their value on the Japanese market, providing an estimated national value of up to $115 million in some years (http://www.afma.gov.au/fisheries/southern-bluefin-tuna-fishery/).

The Southern Squid Jig Fishery is a single method, single species fishery that operates throughout southeast Australia. Most activity occurs off the coasts of Victoria and Kangaroo Island, although some historical peak activity occurred in Tasmanian waters. The main species targeted is the arrow squid (*Nototodarus gouldi*), which is caught using lights to attract the squid. Squid are most abundant over shelf and slope waters at depths of 50–200 m, with the fishery operating at depths between 60 and 120 m. Most of the jig catch is taken January – June each year, although some squid are caught continuously as by-catch in trawl fisheries throughout the year (Lynch, 2005). Annual catch of squid in 2012-13 was 166 tonnes valued at $1.34 million (http://www.afma.gov.au/fisheries/southern-squid-jig-fishery/).

The Small Pelagic Fishery covers nearly 3 million square kilometres, from Western Australia to Southern Queensland. Small pelagic fish live in open sea water which is not near the seafloor or shore. The species targeted by commercial fishers in the Small Pelagic Fishery are Australian sardine (*Sardinops sagax*), Blue mackerel (*Scomber australasicus*), Jack mackerel (*Trachurus declivis, T. murphyi*) and Redbait (*Emmelichthys nitidus*). Fish are mainly caught using midwater trawl and purse seine gear. Total fishery value is confidential due to the small number of fishers. Although this is a small industry, small pelagic fishes are a critical component of mid-trophic food webs, and are therefore fundamental to the functioning of pelagic ecosystems http://www.afma.gov.au/fisheries/small-pelagic-fishery-faqs-3/).

Shipping

Consultation with Australian Maritime Safety Authority (AMSA) indicated that vessel traffic transiting between Sydney and Noumea will pass close to the seismic survey areas (see Figure 8; Appendix A). Traffic transiting between Brisbane, other major Queensland ports and New Zealand is also likely to be encountered when undertaking operations along the east–west oriented seismic line.

The RV *Kairei* will be towing a 6 km seismic streamer cable when undertaking 2D seismic operations. Vessel manoeuvrability will be restricted and at low speed in comparison to commercial vessels traffic. All vessels will be advised of the seismic survey vessel's movements through notice to mariners and radio communication. The vessel will maintain active communication with any commercial shipping encountered. Logs will be kept of vessel interactions. The vessel will comply with maritime standards; maintaining navigation aids and lighting to ensure safe operations.

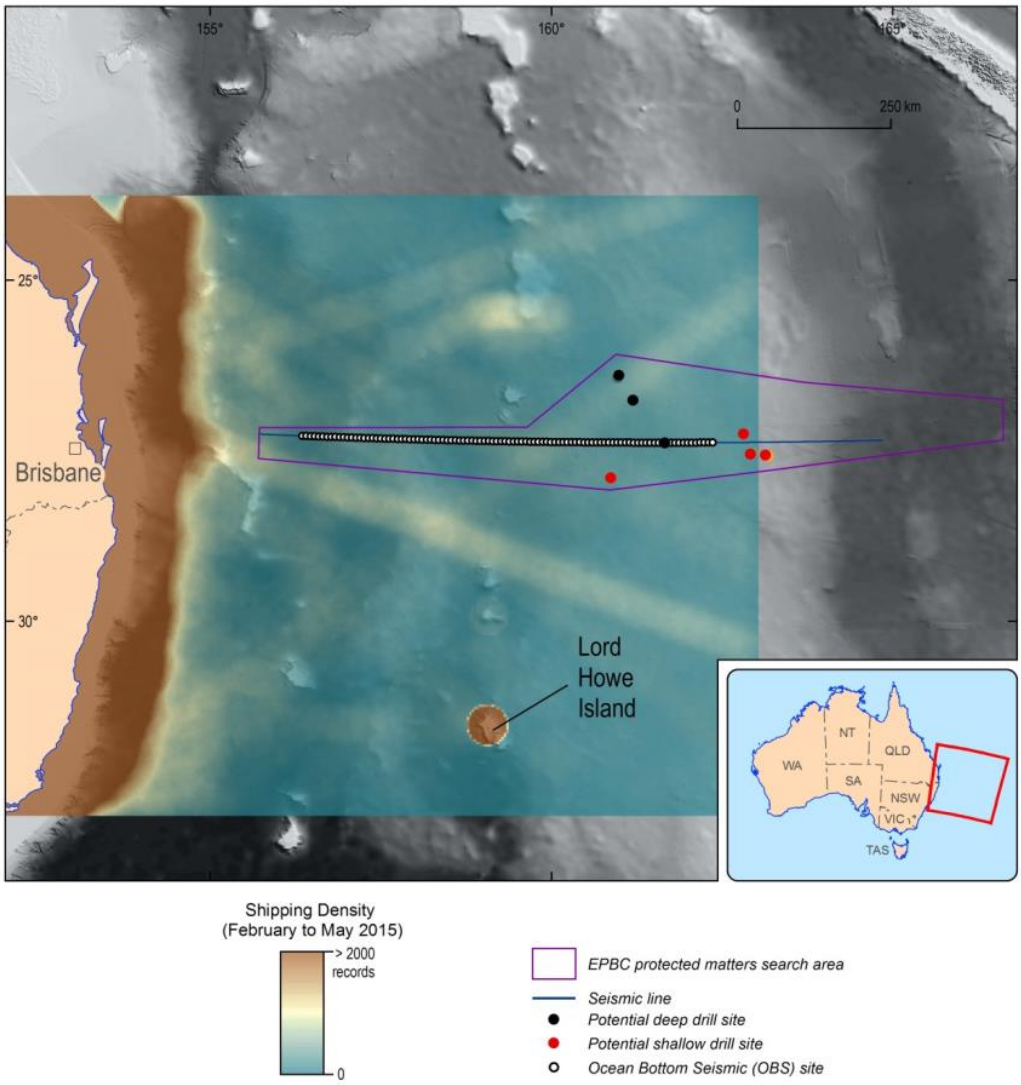

Figure 8: Vessel traffic routes within the proposed survey area shown as shipping density for the period February to May 2015.

Military Exercise areas

Annual Australian Notices to Mariners for 2016 will be checked against the survey area in early 2016 to ensure there are no military exercise areas or other notices of concern. Monitoring of fortnightly notice to mariners will also occur in 2016. Military Flying Exercise area R650B is listed in the Annual Australian Notices to Mariners for 2015 offshore of Brisbane to Longitude 158°E overlapping the survey area. The Department of Defence is engaged in the stakeholder consultation process (see Appendix A).

Submarine communications cables

Several submarine communications cables either cross the proposed survey area or are located within the study region (see Figure 9). The Australian regulator, Australian Communications and Media Authority (ACMA), and companies that operate these cables were contacted as part of GA's stakeholder engagement process. The

locations of cables crossing the proposed seismic line were determined to inform the proposed placement of the Ocean Bottom Seismometers.

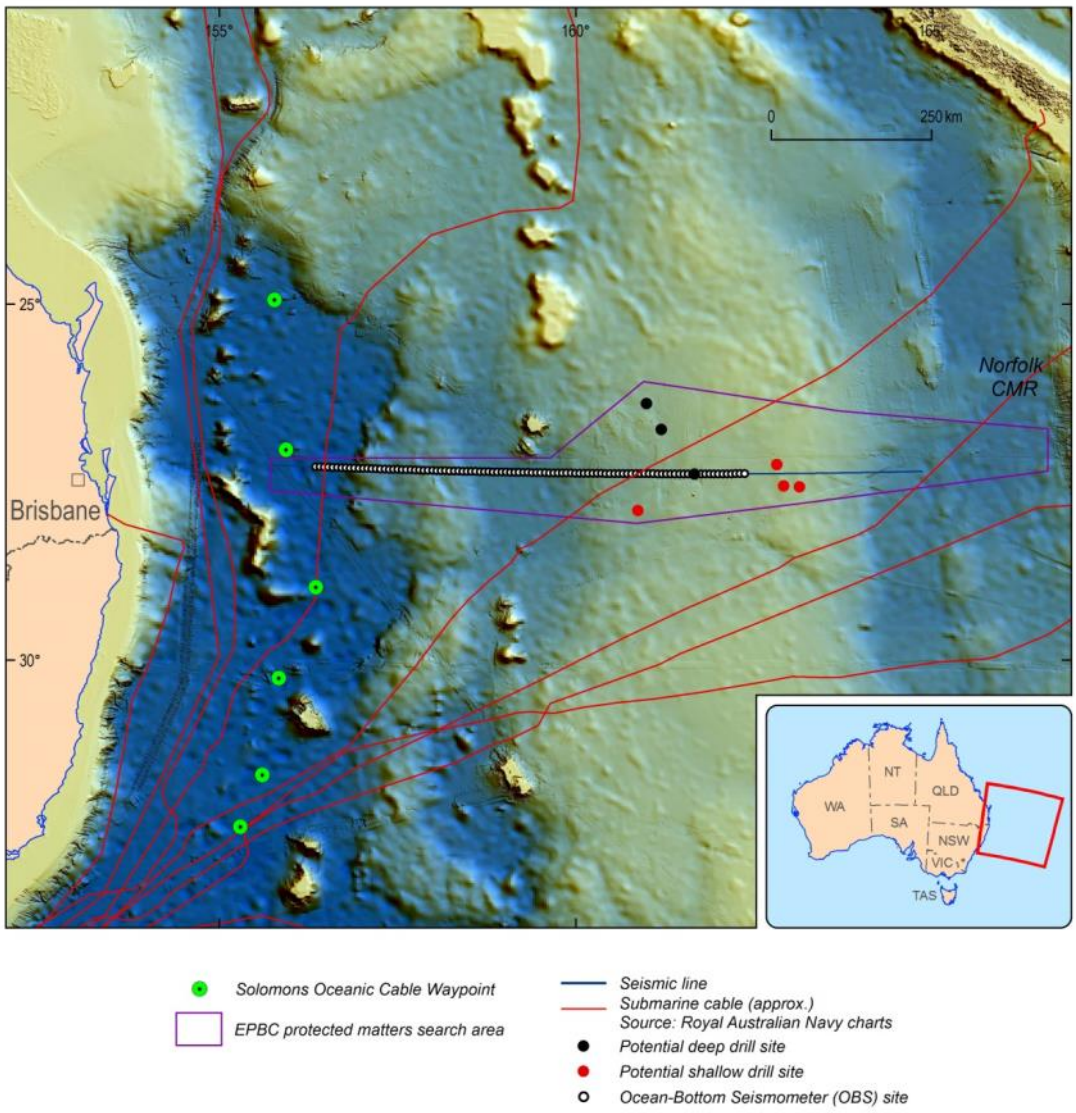

Figure 9: Existing and proposed submarine cables within and outside the proposed survey area. Note that OBS units will be spaced 6 km apart.

Gondwana 1 submarine communications cable network connects New Caledonia and Australia. The landing points are at Narrabeen Beach, Sydney NSW and three landing points in New Caledonia. The fibre optic cable was brought into service in 2008. The cable was laid in conjunction with Alcatel and is operated by the Post & Telecommunications Office (OPT) of New Caledonia. The cable crosses the proposed east–west oriented 2D seismic line at approximately -27° 22' 8.4"S, 160° 52' 51.6"E (-27.369, 160.881), towards the eastern end of the line.

The Australia Japan cable network has been operating since 2001. The submarine fibre optic cable network was established by private company, Australia Japan Cable. It connects Tamarama Beach, Sydney, Australia to Maruyama, near Tokyo, Japan via Guam. The cable crosses the western end of the east–west oriented 2D seismic line at approximately -27° 14' 24"S, 160° 27' 7.2E" (-27.24, 156.452).

The Southern Cross Cable network was commissioned in 2000. The network is almost 30,500 km in length, including 28,900km of submarine cable incorporating around 500 optical repeaters (placed every 40-70km), and 1,600km of terrestrial cable. There are nine cable stations (two each in Australia, New Zealand, Hawaii and

the US mainland, and one in Fiji) and an access point in San Jose, California. The submarine cable crosses the survey area to the east of the proposed seismic lines.

Other submarine cables located in the area that do not cross the proposed survey area include:

- Telstra Endeavour submarine cable connecting Sydney and Hawaii, operated by Telstra since 2007.
- Australian Papua New Guinea cable system (APNG-2 cable) connecting Sydney, Australia and Port Moresby, Papua New Guinea via the Coral Sea, operating since 2006 in collaboration between Telikom, PNG, Telstra, Australia and Telecom New Zealand.
- PIPE Networks' PPC-1 fibre optic cable connecting Cromer, Sydney, Australia to Piti, Guam, via Madang, PNG, operating since 2009.

3.3 (m) Any proposed land/marine uses of area

Proposed seafloor cables

The Solomon's Oceanic Cable Company proposes to install a fibre optic submarine cable linking Honiara, Solomon Islands with Sydney Australia (details provided in EPBC referral 2015/7502). The referral was assessed as "not a controlled action decision if undertaken in a particular manner" dated 22 October 2015. The first stage of the project is scheduled to commence in early 2016, with an initial 103 days of marine route surveying, followed by landing site operations and marine cable laying. The cable route will pass west of the proposed east–west oriented 2D seismic line (see Figure 9). The Solomon's Oceanic Cable Company was contacted by Geoscience Australia for stakeholder consultation and any response by the company will be managed through the consultation process. Any potential interactions between the seismic vessel and the cable survey or cable laying vessels will be managed by standard international and Australia maritime procedures.

4 Environmental outcomes

The proposed action poses potential impacts on threatened and migratory species, including cetaceans, turtles, sharks and seabirds. However, with the implementation of control and mitigation measures (described in Section 5) the environmental outcome will be that there are no significant impacts on threatened and migratory species in the survey area. Specific measures against the environmental outcome for this project can only be broadly addressed, due to a lack of baseline data for many species. A precautionary approach will therefore be adopted. In addition, a project-specific environmental management plan will be prepared prior to the commencement of the survey based on measures detailed in Section 5 (see Table 5.1). The plan will include compliance documentation against the mitigation measures in the form of a compliance register, and specific guidance for survey participants. This will include commitments adopted from *EPBC Act Policy Statement 2.1*.

5 Measures to avoid or reduce impacts

The Lord Howe Rise seismic survey is scheduled during the annual period of low cetacean activity in the region, especially for baleen whales (see Section 3.1). However, the survey area and the modelled impact range intersect with an important habitat for some cetaceans, including sperm whales and beaked whales. To mitigate against the possible impacts this survey may have on these or other cetaceans, precaution zones and management procedures will be implemented in a manner that is consistent with the *EPBC Act Policy Statement 2.1 – 'Interaction between offshore seismic exploration and whales.*' (Part A – Standard Management Procedures and Part B – Additional Management Procedures). Part B of the policy specifies Marine Mammal Observers (MMO), Passive Acoustic Monitoring (PAM) and shutdown and low-power zones as recommended measures for seismic surveys where the likelihood of encountering whales is moderate to high. While the likelihood of encountering whales in the proposed survey area is low, these additional measures will be adopted for the proposed seismic survey to improve the detection of applicable species.

Specifically, the survey will include:

- A team of experienced and independent Marine Fauna Observers (MFOs) (4 persons);
- A Passive Acoustic Monitoring (PAM) system with experienced and independent operators (2 persons). The PAM system will comprise a towed hydrophone array (range 2–200 kHz) and real-time tracking software;
- A commitment to a low power zone of 2 km from the acoustic source and to adaptive management procedures.

These additional measures will help the detection of cetaceans and other marine fauna during periods of low visibility (including night operations) across the survey area and provide for better-informed operational decisions in the event that whales, in particular, are encountered. A full description of operational procedures for the seismic system and for other potential impacts associated with survey activities is listed in Table 5.1.

Table 5.1. Specific measures to avoid and/or reduce potential impacts from the proposed survey

Environmental aspect	Potential environmental effect	Proposed controls/mitigation measures
Acoustic emissions from seismic source (airguns 7,800 cubic inches)	Disturbance or injury to whales and other marine fauna	To minimise the risk of acoustic disturbance from the seismic source on cetaceans, as well as other marine fauna, the following management measures will be implemented: • The propose marine seismic survey will comply with mitigation measures consistent with *EPBC Act Policy Statement 2.1, Interaction between Offshore Seismic Exploration and Whales*, including implementation of Part A Standard Management Procedures, as follows: o **Pre-start visual observations**: During daylight hours, visual observation to 3 km from the acoustic source (i.e. 'the observation zone') will be undertaken for at least 30 minutes prior to the commencement of the soft-start procedure; o **Soft-start (ramp-up) procedure:** If no whales have been sighted within 2 km of the acoustic source (i.e. 'low power zone') then acoustic power will be gradually increased to full power over a 30 minute period; o **Start-up delay procedures:** If a whale is detected within 3 km of the acoustic source during soft-start an additional MMO or trained crew member will be brought to the bridge to continuously monitor the whale. If a whale is then observed to enter the low-power zone (<2 km from the acoustic source) the source will be powered down to lowest possible setting. If a whale is sighted within, or about to enter, the shutdown zone (<500 m from the source) the source will be shut down completely. Soft start procedures will only re-commence after the whale has been observed outside the low power zone, or if 30 minutes have elapsed since the last sighting. o **Operations procedure:** During daylight hours, trained MMOs will maintain continual observations for whales. The acoustic source will be reduced to minimum power when not collecting seismic data (e.g. during line turns). If the source is shut down or on low power for operational reasons (e.g. maintenance, line turns) the soft-start procedure and start-up delay procedure will be followed provided no whales were observed during the shutdown or low-power period. If whales were observed then the pre-start visual observations procedure will be followed. o **Stop work procedure:** If a whale is sighted within the 3 km observation zone, an additional MMO or trained crew member will be brought to the bridge to continuously monitor the whale. If a whale enters the low-power zone, the acoustic source will be reduced to minimum power. If a whale is observed within the shutdown zone, the acoustic source will be shut down. Soft-start procedures will only resume after the whale has been observed to move outside the low-power zone or if the whale has not been sighted for 30

		minutes. o **Night-time and low visibility procedure**: During periods of low visibility (e.g., fog, periods of high winds and night-time operations) start-up and then operational procedures will commence in accordance with the following conditions: ▪ There have not been three (3) or more whale instigated power-down or shut-down situations during the preceding 24-hr period; or ▪ If operations had not been underway during the preceding 24 hours but the vessel has been in the vicinity (approximately 10 km) of the proposed start-up position for at least 2 hours (under good visibility conditions) within that 24-hour period and during those 2 hours no whales have been detected through visual observations or PAM. • Sighting reports completed and returned to the Department of Environment and to the Australian Marine Mammal Centre, using the Cetacean Sightings Application (CSA) software, within two months of survey completion. • Additional management measures consistent with Part B: Additional Management Procedures of *EPBC Act Policy Statement 2.1, Interaction between Offshore Seismic Exploration and Whales* that will be adopted for whales include: o Provision of at least two dedicated and experienced Marine Mammal Observers (MMO), and up to two standby MMO, will be on-board during the proposed survey, with at least one MMO on duty during all daylight hours; o Provision of a Passive Acoustic Monitoring (PAM) system and at least two dedicated and experienced PAM operators to maintain 24 hour monitoring when the seismic source is active; and o MMO/PAM operators will use PAM to supplement visual observations to help achieve Part A Standard Management Procedures, including pre-start observations, operation, stop work and night-time and low-visibility procedures. • Adaptive management procedures: the shutdown zone will be increased to 2 km if three or more whale-instigated shut downs have occurred in the previous 24 hours. • If whale sightings are more frequent or greater than anticipated during the survey planning, Geoscience Australia will contact the Department of the Environment to discuss appropriate measures for night-time operations.
Underwater noise from Multibeam Echo Sounder (MBES) and Sub-bottom Profiler	Disturbance or injury to whales and other marine fauna	To minimise the risk of acoustic disturbance / harm to cetaceans, as well as other marine fauna, the following management measures will be implemented (adapted from the 'Prescribed Manner to be followed for Multibeam and Sub-bottom Profiler Surveys' developed jointly by Geoscience Australia and Department of Sustainability, Environment, Water, Population and Communities):

(SBP)		• Pre-start visual observations for whales will be undertaken by a MMO or trained crew for at least 10 minutes prior to commencement of MBES and SBP operations. Start procedures may commence only if a whale is not observed within 300 m. • During MBES and SBP operations visual observations will be maintained continuously during daylight to identify if there are any whales present. • If a whale is sighted within 3 km an additional MMO or trained crew will be brought to the bridge to continuously monitor the whale in sight. • If a whale is sighted within 300 m, the acoustic source must be shut down. • The acoustic source may be restarted when the whale is observed to have moved out of the 300 m zone or when 10 minutes have elapsed since the last sighting. • During periods of low visibility and night operations where visual observations cannot be clearly undertaken out to 3 km, the acoustic source may be used: o If there have not been more than 3 whale instigated shutdowns in the previous 24 hours; or o If the vessel has been in the vicinity (~10km) and, in the previous 24 hours, no whales were sighted during a 2 hour period of continual observations in good visibility.
Collision / entanglement with marine fauna	Injury to or death of marine fauna	To minimise the risk to marine fauna caused by the physical presence of the survey vessel the following management measures will be implemented: • Survey vessel to comply with relevant sections of Part 8 of the *EPBC Regulations 2000*, when there is no trailing equipment deployed. • During daylight hours at least one MMO or trained crew member will be on watch to ensure that any risk of collision is avoided, particularly during transiting or at any time the vessel is travelling at increased speed. • If a whale is detected within the 3 km observation zone an additional trained crew member or MMO should be brought to the bridge to continuously monitor the whale. • If any marine mammal or turtle is sighted in the vicinity ahead of the vessel and if judged by the MMO to be not responsive (i.e. resting, feeding, socialising), the vessel's course will be altered—provided safe navigation allows—to avoid collision with the animal. • Within the caution zone of 150 m for a dolphin and 300 m for a whale, the vessel must operate at a constant speed of less than 6 knots: o The vessel should take action to avoid approaching closer than 100 m to a whale and 50 m for a dolphin;

		○ The vessel should not restrict the path of the cetacean; ○ If a whale comes within these limits, the vessel must reduce speed and continue on a course away from the whale; and ○ If a dolphin approaches the vessel or comes within the limits the vessel speed and course must not change suddenly. • Death of or injury to a listed species will be reported to the DoTE within seven days. • Entangled marine fauna to be recovered and returned to the ocean immediately.
Routine Discharges: (Oily Water, Sewage Grey Water)	Localised reduction of water quality and nutrient enrichment or chronic/acute toxic effects	To minimise the risk to marine water quality, the RV *Kairei* will be fully MARPOL 73/78 compliant, including • Annex I (Regulations for the Prevention of Pollution by Oil) • Annex IV (sewage). The vessel will also adhere to the Commonwealth *Protection of the Sea (Prevention of Pollution by Ships) Act 1983.*
Non-routine Discharges: (hydrocarbon and chemical spills)	Acute or toxic effects to marine flora and fauna.	To minimise the risk of vessel collision and consequential release of hydrocarbons and chemicals to the marine environment, the RV *Kairei* will be fully MARPOL 73/78 compliant (as above). The following management measures will also be implemented: • GA will continue to consult and notify stakeholders to advise them of survey timing, areas and activities; • The survey vessel will adhere to the *Commonwealth Navigation Act and subordinate Marine Orders*, including (but not limited to): Part 21, Safety of Navigation and Emergency Procedures; Part 27, Radio Equipment; Part 28, Operations Standards and Procedures; Part 30, Prevention of Collisions, and Part 91 Marine pollution prevention - oil; Protection of the Sea (Prevention of Pollution from Ships) Act 1983–Section 9 Prohibition of discharge of oil or oily mixtures into the sea; • Navigation safety aids (e.g., radio, radar, automatic identification system and navigation lights) will be available on-board; • Ship Oil Pollution Emergency Plan (SOPEP) on board with suitable crew training; • Vessel masters qualified and competent in the safe navigation and control of marine vessels to prevent collisions with other vessels; • Competent crew trained to required maritime safety standards; • Crews will maintain 24/7 bridge watch for third-party vessels in proximity to the survey; • All other vessels not participating in the survey activities will be requested to give the seismic vessel safe clearance; • The Australian Hydrographic Service will be informed prior to survey commencement and will issue a Notice to

		Mariners for the duration of the survey activities; • Mobilisation and demobilisation notifications will be issued to stakeholders within the region, with consultation continuing throughout the survey period as required; • Daily vessel activity reports will be issued to the Australian Maritime Safety Authority Rescue Coordination Centre to minimise the potential for marine activity conflicts; • Vessel to maintain appropriate lighting, navigation and communication at all times to inform other users of the position and intentions of the survey vessel, in compliance with the Navigation Act 2012 and Chapter 5 of the SOLAS Convention; • Spill response equipment is located in accordance with SOPEP; and • Routine drills involving spills are undertaken in accordance with the SOPEP
Solid Wastes: (Garbage Plan, Food Waste)	Negative effects to the marine environment	To minimise the risk to marine water quality, the following management measures for putrescible waste (e.g., food) will be implemented: • Waste will be managed in accordance with MARPOL 73/78 Annex IV and vessel-specific waste management procedures; • The small volumes of non-biodegradable waste and hazardous wastes (e.g., used oils, lithium batteries, chemical and metallic wastes) generated during the proposed survey will be managed in accordance with vessel waste management procedures.
Disposal of Oil waste	Acute or toxic effects to marine flora and fauna.	To minimise the risk to marine water quality, the following management measures for disposal of oil waste will be implemented: • Oil waste will be managed in accordance with MARPOL 73/78 regulations Annex I and SOPEP; and • All oil wastes to be collected and returned to a designated port for recycling and disposal.
Air Emissions	Emission of greenhouse gases to the atmosphere	To minimise the risk to marine fauna caused by emissions of greenhouse gases to the atmosphere, the following management measures will be implemented: • The vessel will comply with MARPOL 73/78 regulations MARPOL Annex VI (Regulations for the Prevention of Air Pollution from Ships) and the Protection of the Sea (Prevention of Pollution from Ships) Act, with regards to sulphur content, namely MGO will contain a concentration of sulphur not exceeding 3.5% by mass; o The vessel holds valid international air pollution certificates; o Incineration is not undertaken onboard the vessel; and o No ozone-depleting substances on the vessel.
Artificial lighting	Disruption to behaviour of light	To minimise the risk to light sensitive marine fauna caused by vessel light emissions, the following management measures will be implemented:

	sensitive marine fauna	• The vessel will operate operates in accordance to MARPOL 73/78 regulations and adhere to the *Commonwealth Navigation Act 1912* and subordinate Marine Orders with respect to navigation and workplace safety (e.g., lighting requirements); No unnecessary external lighting during the activity (note that lighting for the purpose of safety, navigation or operational purposes is excluded). For example, the use of spotlights for in-sea inspections will be minimised as far as practicable; • Workplace lighting will be directed inboard where possible to minimise direct light fall on water; and • Vessel will remain within the survey area for routine survey-related activities.
Anchoring	Localised disturbance to benthos/submarine cables	To minimise the risk of physical disturbance to benthic habitat resulting from anchoring, the following management measures will be implemented: • Commitment of no anchoring except in an emergency.
Ocean Bottom Seismometer (OBS)	Localised disturbance to benthic habitats	To minimise the risk of physical disturbance to benthic habitats resulting from deployment of OBS, the following management measures will be implemented: • Commitment not to deploy OBS units on known sensitive benthic habitats such as in the vicinity of seamounts
Introduced Marine Pests (Ballast water, Anti-fouling certificates, Equipment)	Negative effects on marine species from introduction of disease, predation and competition by alien species	Marine vessels mobilized from international waters will be required to conform to the following requirements to reduce the risk of introduction of marine pests from ballast water or biofouling. To minimise the risk of introduced marine pests, the following management measures will be implemented: • Ballast water exchange will be conducted in accordance with the Australian Ballast Water Management Requirements (DAFF, 2011); • Vessel will have a current Statement of Compliance for International Anti-fouling Systems; • No exchange of ballast water within 12 NM of land, except in emergency situations; and • Trailing and deployed equipment to be cleaned prior to deployment.
Loss of equipment (e.g. streamer)	Localised disturbance to benthic habitat. Hazard to other vessels from floating debris	To minimise the risk of localised disturbance to benthic habitat resulting from the loss of towed seismic equipment, the following management measures will be implemented: • Equipment (bridles and harnesses) to be routinely inspected and maintained for wear and tear and prior to deployment; • Marine notifications in event of loss; • Towed equipment is fitted with radio beacon; and • Reflective tail buoy fitted.

Summary

1. The survey has been timed to avoid whale migration periods so as to minimise any effects of the proposed activity.

2. The use of air-guns during the survey will be fully subject to *'EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales'*. Any potential disturbance and injury to marine mammals from underwater noise produced by the air-gun array will be greatly reduced by the selected timing of the survey and the implementation of monitoring measures (MMOs, PAM).

3. Multibeam sonar and sub-bottom profiling operations will follow procedures to minimise impacts on cetaceans and other marine fauna.

4. The survey will adopt measures in regard to maintaining water quality. The RV *Kairei* is a Japanese vessel and any ballast water used will be taken in Australian waters. Importantly no waste will be discharged from the *Kairei* while at sea. It is pumped or transported ashore at port call.

5. The survey will adopt measures in regard to avoidance of the introduction of pest species through the management of ballast water in accord with Australian requirements. The vessel will also be compliant with international anti-fouling standards.

6. Night operations will be taking place and the survey will adhere to the requirements for the protection of whales (as set out in Table 5.1). The survey will also keep all light spill from the vessel lights to a minimum for safe navigation and operations.

7. A search of the database on the DoE website for historic shipwrecks and the Heritage Places (World, National State and Territory Lists) identified no items in the area of interest.

8. Any impact on the seafloor from the temporary deployment of OBS units will be minimal and highly localised.

6 Conclusion on the likelihood of significant impacts

6.1 Do you THINK your proposed action is a controlled action?

X	No, complete section 6.2
	Yes, complete section 6.3

6.2 Proposed action IS NOT a controlled action.

With reference to the Australian Government Significant Impact Guidelines 1.1 (DoE 2013), the EPBC protected matters search tool, and based on our research into the baseline environment and commitment to mitigation measures, we conclude that the proposed activity will not have a significant impact on any matters of national environmental significance, and will not:

For critically endangered and endangered species

- Lead to a long-term decrease in the size of a population;
- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- Introduce disease that may cause the species to decline; or
- Interfere with the recovery of the species.

For vulnerable species

- Lead to a long-term decrease in the size of an important population of a species;
- Reduce the area of occupancy of an important population;
- Fragment an existing important population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of an important population;
- Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;
- Introduce disease that may cause the species to decline; or
- Interfere substantially with the recovery of the species.

For critically endangered and endangered ecological communities

- Reduce the extent of an ecological community;

- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads
- Adversely affect habitat critical to the survival of an ecological community;
- Fragment an existing important population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water
- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
    - assisting invasive species, that are harmful to the listed ecological community, to become established, or
    - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- Interfere with the recovery of an ecological community.

For listed migratory species

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

6.3 Proposed action IS a controlled action

	Matters likely to be impacted
	World Heritage values (sections 12 and 15A)
	National Heritage places (sections 15B and 15C)
	Wetlands of international importance (sections 16 and 17B)
	Listed threatened species and communities (sections 18 and 18A)
	Listed migratory species (sections 20 and 20A)
	Protection of the environment from nuclear actions (sections 21 and 22A)
	Commonwealth marine environment (sections 23 and 24A)
	Great Barrier Reef Marine Park (sections 24B and 24C)
	A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E)
	Protection of the environment from actions involving Commonwealth land (sections 26 and 27A)
	Protection of the environment from Commonwealth actions (section 28)
	Commonwealth Heritage places overseas (sections 27B and 27C)

7 Environmental record of the responsible party

		Yes	No
7.1	**Does the party taking the action have a satisfactory record of responsible environmental management?** Geoscience Australia is the Australian Commonwealth Government's national geoscience agency with responsibility for providing fundamental geoscience information for Australia's Commonwealth waters to support government policy. In this capacity, Geoscience Australia has conducted numerous marine scientific surveys using a variety of research vessels. All surveys have been completed in accordance with EPBC environmental requirements at the time. The marine surveys conducted by Geoscience Australia include regional seismic surveys, marine environmental and biodiversity surveys, and coastal and estuarine studies. Marine surveys have been conducted by Geoscience Australia for >20 years. The data acquired by Geoscience Australia has been used for the management of the Commonwealth marine areas and has been used to inform the design and management of Commonwealth and State marine protected areas.	✓	
7.2	**Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?** **If yes, provide details**		✓
7.3	**If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?** **If yes, provide details of environmental policy and planning framework**	**N/A**	

7.4 **Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?** ✓

Provide name of proposal and EPBC reference number (if known)

2014/7191 Geoscience Australia/Science and research/Davis Station, Antarctica/Antarctica/Infrasound Monitoring Station (ISO3), Antarctica 28 Apr 2014

2012/6343 Geoscience Australia/Commonwealth/Browse Basin 100kms northwest of the Dampier Peninsular/Commonwealth Marine/marine survey to acquire data to assist assessment of CO2 storage potential 12 Feb 2013

2012/6343 Geoscience Australia/Science and research/Offshore SW Fremantle/WA/CO2 3D Seismic Survey Vlaming Sub-Basin 11 Apr 2012

2012/6310 Geoscience Australia/Exploration (mineral, oil and gas - marine)/Petrel Sub-Basin (Joseph Bonaparte Gulf) /Commonwealth Marine/Marine Environmental Survey 2012 08 Mar 2012

2012/6295 Geoscience Australia/Exploration (mineral, oil and gas - marine)/Geosequestration Permits PTRL-01 and PTRL-02/Commonwealth Marine/Bonaparte Seismic and Bathymetric Survey 28 Feb 2012

2012/6275 Geoscience Australia/Exploration (mineral, oil and gas - marine)/Vlaming Sub-Basin /Commonwealth Marine/Marine Environmental Survey 10 Feb 2012

2012/6245 Geoscience Australia/Exploration (mineral, oil and gas - marine)/Vlaming Sub-Basin in the Indian Ocean/Commonwealth Marine/3D Seismic Survey 11 Jan 2012

2011/6067 Geoscience Australia/Exploration (mineral, oil and gas - marine)/Waters offshore from Geraldton/WA/North Perth Marine Survey 05 Aug 2011

2010/5517 Geoscience Australia/Science and research/Van Diemen Rise west of Bathurst Island Timor Sea/Commonwealth Marine/Joseph Boneparte Gulf Seabed mapping survey 31 May 2010

2009/4951 Geoscience Australia/Science and research/Bonaparte Gulf/Commonwealth Marine/Bonaparte Basin Seabed Mapping Survey 22 Jun 2009

2008/4493 Geoscience Australia/Science and research/Mentelle, Perth, Northern & Southern Carnarvon Basins & Wallaby Plateau regions offshore WA/Commonwealth Marine/2D seismic survey 02 Oct 2008

2008/4466 Geoscience Australia/Science and research/Wallaby Plateau, Perth Basin, Southern & Northern Carnarvon Basins/Commonwealth Marine/Marine reconnaissance survey 18 Sep 2008

2007/3636 Geoscience Australia/Exploration (mineral, oil and gas - marine)/Tasman Sea/Commonwealth Marine/Faust-Capel Basins & Gifford Guyot Seismic Survey 15 Aug 2007

2007/3390 Geoscience Australia/Science and research/West Island/Cocos Keeling Island/Infrasound Monitoring Station 03 Apr 2007

2007/3301 Geoscience Australia/Science and research/Lord Howe Island/NSW/Seismic Station 16 Feb 2007

2006/3137 Geoscience Australia/Science and research/Great Australian Bight/Commonwealth Marine/Bight Basin Geological Survey 07 Nov 2006

2006/3026 Geoscience Australia/Science, research and investigations/Commonwealth Marine/NSW/Continental slope research 31 Aug 2006

2006/2844 Geoscience Australia/Exploration (mineral, oil, gas)/Capel and Faust Basin/Commonwealth Marine/Seismic Data Survey for GA Oil Exploration Program, Capel and Faust Basins (700km East of Brisbane) 02 Jun 2006

2005/2069 Geoscience Australia/Science, research and investigations/Indian Ocean/Commonwealth Marine/Geo-science Investigations 06 Apr 2005

2005/2004 Geoscience Australia/Science, research and investigations/Arafura Sea/Commonwealth Marine/Geo-scientific survey 17 Feb 2005 2004/1700 Geoscience Australia/Exploration (mineral, oil, gas)/Offshore/WA/Seismic Survey, Bremer Basin, Mentelle Basin and Zeewyck Sub-basin 04 Aug 2004 2002/613 Geoscience Australia/Science, research and investigations/Shannon National Park/WA/CTBT Infrasound Monitoring Station 19 Mar 2002 2001/424 AGSO Geoscience Australia/Other/Bucklands Military Training Area/TAS/Infrasound Monitoring Station (ISO5) 30 Aug 2001		

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8.2 Reliability and date of information

- Information on matters of national environmental significance was obtained from the Protected Matters Search Tool on the Australian Government's EPBC website (http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf).
- Information on listed threatened species and ecological communities was obtained from the Department of Environments web site:
    - General information www.environment.gov.au/biodiversity/threatened/index.html
    - Copies of recovery plans and threat abatement plans www.environment.gov.au/biodiversity/threatened/recovery.html
    - www.environment.gov.au/biodiversity/threatened/tap/index.html
    - Species profile and threats database www.environment.gov.au/sprat
- All other information presented in this referral is based on peer-reviewed scientific research articles and publicly-available and government-approved environmental approval submissions.

8.3 Attachments

Indicate the documents you have attached. All attachments must be less than three megabytes (3mb) so they can be published on the Department's website. Attachments larger than three megabytes (3mb) may delay the processing of your referral.

		✓ attached	Title of attachment(s)
You must attach	figures, maps or aerial photographs showing the project locality (section 1)	✓	
	GIS file delineating the boundary of the referral area (section 1)	✓	
	figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3)	✓	
If relevant, attach	copies of any state or local government approvals and consent conditions (section 2.5)	N/A	
	copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6)	N/A	
	copies of any flora and fauna investigations and surveys (section 3)	N/A	
	technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4)	✓	
	report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3)	✓	

9 Contacts, signatures and declarations

Project title: Lord Howe Rise Marine Seismic Survey

9.1 Person proposing to take action

Name and Title:	Dr Irina Borissova
Organisation:	Geoscience Australia
EPBC Referral Number:	
ABN:	80 091 799 039
Postal address	GPO Box 378, Canberra, ACT, 2601
Telephone:	02 6249 9658
Email:	Irina.borissova@ga.gov.au
Name of designated proponent (if not the same person at item 1 above): ACN/ABN of designated proponent (if not the same person named at item 1 above):	As above

I qualify for exemption from fees under section 520(4C)(e)(v) of the EPBC Act because I am:

- ☐ an individual; OR
- ☐ a small business entity (within the meaning given by section 328-110 (other than subsection 328-119(4)) of the *Income Tax Assessment Act 1997*); OR
- ☐ not applicable.

I would like to apply for a waiver of full or partial fees under Schedule 1, 5.21A of the EPBC Regulations. Under sub regulation 5.21A(5), you must include information about the applicant (if not you) the grounds on which the waiver is sought and the reasons why it should be made:

- ☑ not applicable.

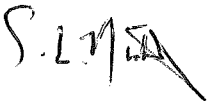
Declaration

I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.
I understand that giving false or misleading information is a serious offence.
I agree to be the proponent for this action.
I declare that I am not taking the action on behalf of or for the benefit of any other person or entity.

Signature I Borissova Date 11/12/2015

9.2 Person preparing the referral information (if different from 9.1)
Individual or organisation who has prepared the information contained in this referral form.

Name	Scott Nichol
Title	Dr
Organisation	Geoscience Australia
ABN	80 091 799 039
Postal address	GPO Box 378, Canberra, ACT, 2601
Telephone	02 6249 9346
Email	scott.nichol@ga.gov.au
Declaration	I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct. I understand that giving false or misleading information is a serious offence.

Signature  Date 11/12/15

Alternate contact: Dr Andrew Carroll
email Andrew.carroll@ga.gov.au
Tel 02 6249 9848

Appendix A: Stakeholder Consultation

Australian Government
Geoscience Australia

Cnr Jerrabomberra Avenue
and Hindmarsh Drive,
Symonston ACT 2609

GPO Box 378,
Canberra, ACT 2601 Australia

Phone: +61 2 6249 9111
Facsimile: +61 2 6249 9999

Web: www.ga.gov.au

ABN 80 091 799 039

30 October 2015

Re: International Ocean Discovery Program
Lord Howe Rise Marine Seismic Survey

Invitation to Comment

Dear Sir/Madam,

The Australian Government, through Geoscience Australia, is proposing to conduct a scientific seismic survey on the Lord Howe Rise (Tasman Sea) in 2016. The survey will be conducted in collaboration with the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and is part of a larger research project proposed under the International Ocean Discovery Program (IODP Proposal 871-CPP) titled "First Deep Stratigraphic Record for the Cretaceous Eastern Gondwana Margin: Tectonics, paleoclimate and deep life on the Lord Howe Rise high-latitude continental ribbon".

The proposed survey is scheduled to take place between 22 March and 11 May 2016 and will involve the operation of a multi-channel towed seismic system and the temporary deployment of ocean bottom seismometers on the seafloor to map the deep geological structure of the Lord Howe Rise. Further information regarding the survey is provided in the attached summary sheet.

Geoscience Australia is currently preparing a referral report for the proposed survey that will address the potential impacts of the seismic study on matters of environmental significance (including Threatened and Migratory species) protected under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999. This EPBC referral process involves public consultation with relevant stakeholders.

To assist us with compiling a thorough referral, we welcome the submission of any comments or concerns you may have about the proposed survey. To ensure timely submission of the EPBC Referral to the Australian Government's Environment Minister, we would greatly appreciate your responses by **23 November 2015**. Please don't hesitate to contact me with any questions you may have regarding the proposal.

Sincerely,

Jessica Gurney
Project Manager, Lord Howe Rise Survey
Geoscience Australia
P: (02) 6249 9043
E: Jessica.Gurney@ga.gov.au

Australian Government
Geoscience Australia

International Ocean Discovery Program
Lord Howe Rise Marine Seismic Survey

Information Sheet for Stakeholders

Introduction

Geoscience Australia (GA) and the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) have initiated a collaborative project with involvement of the international science community to examine the geological and climatic history of the Lord Howe Rise in the Tasman Sea. The project comprises four main activities:

1. Deep Seismic Survey for Crustal Structure and Tectonic Framework (March–May 2016)
2. Detailed Site Survey at Proposed IODP Drilling Site (early/mid 2017)
3. Deep Stratigraphic Drilling (proposed late 2018/early 2019) (if funded)
4. Processing and storage of data and samples

Information from the surveys and drilling will provide a globally-significant record of the evolution of the Earth's crust and of climatic and environmental change during the Mesozoic (250–66 million years ago). The drilling stage of the project will be conducted through the International Ocean Discovery Program (IODP Proposal 871-CPP).

This information sheet describes the timing and location of the 2016 seismic survey and invites comment and enquiries from stakeholders with an interest in the proposed survey area.

Survey Location and Timing

The seismic survey will occur in a remote area of the Tasman Sea with operations across two areas:

- Along a line that extends approximately 700 km in a west-to-east direction (Figure 1). The western end of the line is about 200 km from Brisbane;
- Several potential sites are being considered for drilling on the Lord Howe Rise. At these sites, a grid of seismic lines will be acquired, each 30 km in length and 3 km apart.

The survey is scheduled to take place between 22 March and 11 May 2016.

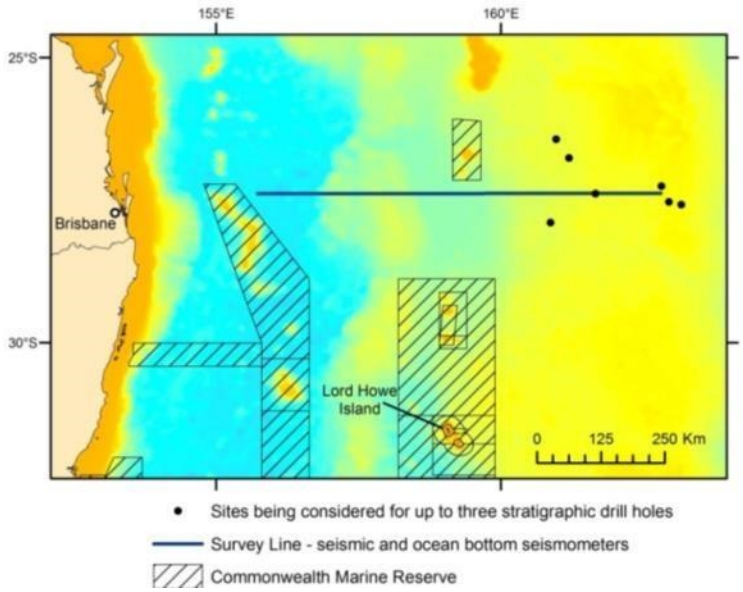


Figure 1. Location map of proposed seismic survey for March to May 2016

Survey Activities

Dates indicated below are subject to change.

- 24 hour operation of a 6-km long towed seismic system (28 March – 15 April; 30 April – 10 May);
- Temporary deployment of ocean bottom seismometers on the seabed (24 March – 29 April);
- Collection of bathymetry (water depth) data along all seismic lines and transit lines.

The seismic array will be used to image the subsurface to a depth of 30 km or more. Ocean bottom seismometers are passive instruments used to record seismic signals that allow measurements of the thickness of the Earth's crust.

Survey Vessel

The survey vessel will be the RV *Kairei*, owned and operated by JAMSTEC. In accordance with requirements for foreign-flagged vessels seeking to undertake scientific research within Australia's Exclusive Economic Zone, an application for Public Vessel Status has been submitted to the Department of Foreign Affairs and Trade.

Environmental Impact

Geoscience Australia is preparing an evaluation of the possible environmental impact of the seismic survey as required under *The Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). This evaluation will include identification of listed Threatened and Migratory species that may occur in, or may relate to, the nominated survey area. Specific focus will be placed on assessing the likely physical, physiological and/or behavioural impacts of the seismic activity on marine fauna (including marine mammals). Sound propagation from the seismic array and acoustic exposure levels will be modelled to inform this assessment.

The use of air-guns during the seismic survey will be fully subject to the *'EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales'*. The risk of potential disturbance and injury to marine mammals from underwater noise produced by the air-gun array is minimal due to the carefully chosen timing of the survey outside of the migration period and the implementation of mitigation measures as outlined in EPBC Act Policy Statement 2.1. These measures will include pre start-up observations and visual monitoring for whales by trained marine mammal observers.

All data collected from the survey will be made freely available, including public release of a post-survey report in 2017.

Stakeholder consultation contact register

Local Administration and Tourism Associations	Contact Date	Comments received by 9 Dec 2015	Outcome/Follow-on Action
Administration of Norfolk Island	Email 3/11/2015 Response 5/11/2015	Consider no impact on Norfolk Island and suggesting progress of the project to be provided via local media.	Ongoing communication.
Lord Howe Island Board	Email 3/11/2015 Phone 24/11/2015 Response 25/11/2015 Email/phone 8/12/2015	Seeking extension for providing comments. Extension agreed. No concerns, email link to be sent to EPBC referral when submitted.	Ongoing communication.
Norfolk Island Tourism Association	Email 3/11/2015	No comments received.	Not applicable.
Lord Howe Island Tourism Association	Email 3/11/2015	No comments received.	Not applicable.
Security and safety services	**Contact Date**	**Comments received**	**Outcome/Follow-on Action**
Department of Defence (Defence Force Australia)	Email 3/11/2015 Email 25/11/2015	No comments received. Comments pending.	Ongoing communication.
Australian Hydrographic Service AHS	Email 3/11/2015 Response 4/11/2015	Notification 3+ weeks prior to the survey with final survey dates	Provide notification 3-4 weeks before the survey
Australian Communications and Media Authority	Email 3/11/2015 Response 12/11/2015	The proposed survey area does not appear to be in the vicinity of existing protection zones but recommending GA to contact relevant submarine cable operators	Submarine cable operators have been contacted.
Australian Border Force/Maritime Border Command	Email 3/11/2015 Response 5/11/2015	Acknowledging receipt of Information. Request for updates on further development.	Provide notification 3-4 weeks before the survey.
AMSA (Australian Maritime Safety Authority)	Email 3/11/2015 Response 12/11/2015	Traffic transiting between Sydney and Noumea will pass close to the proposed drilling sites. Heavy traffic transiting between Brisbane (and other major Queensland ports) and New Zealand will also be encountered when the *RV Kairei* conducts the east/west survey line.	Operational requirement: the seismic vessel must display appropriate day shapes, lights and streamers, reflective tail buoys, to indicate the vessel is towing and is therefore restricted in her ability to manoeuvre. Visual and radar watches must be maintained on the bridge at all times. Ongoing communication: provide AMSA's Rescue Co-ordination Centre (RCC) through rccaus@amsa.gov.au details on vessels details and area of operation and when the survey starts and ends and Australian Hydrographic Service
AMSA Joint Rescue Coordination Centre	Email 3/11/2015	See above	See above
Submarine cables	**Contact Date**	**Comments received**	**Outcome/Follow-on Action**
Solomon's Oceanic Cable Company	Email 3/11/2015 Response 9/11/2015 GA Response 16/11/2015	Advised that an activity planned in April -May 2016 may intersect with the survey lines and querying whether there will be drilling or other bottom encroaching activities in the western end of the survey line. Advised that the proposed cable route is west of the OBS line but does intersect with the east-west	No major issue. Ongoing communication required to coordinate survey activities.

		seismic line.	
Telstra Endeavour Submarine Cable	Email 3/11/2015 Response 23/11/2015	Advised that the proposed survey locations and drill sites are clear of Telstra's active cables.	No action required.
Australia-Japan Cable	Email 4/11/2015 Response 4/11/2015 Response 23/11/2015	Commented that there has been ongoing dialogue between AJCN and JAMSTEC and will review the plan and provide a response. Provided route of AJCN between Australia and Guam and requested seismic survey work avoiding AJCN route and cable, following International Cable Protection Committee (ICPC) guidelines and a notification on final survey dates and locations prior to the survey.	Consultation is ongoing; GA commits to follow ICPC guidelines as applicable.
Southern Cross Cable Network	Email 4/11/2015 Email 12/11/2015 Phone 18/11/2015 GA Response 18/11/2015 Email 25/11/2015	Commented that the Southern Cross cable is located well away from the survey zone and will not be impacted	No action required.
Gondwana-1 New Caledonia OPT and Alcatel	Email 4/11/2015 Follow up email on 17/11/2015	No comments received.	Note: the Gondwana cable crosses the seismic line and will be treated in the same way as the AJCN and Southern Cross Cable.
PIPE Pacific Cable – 1	Email (12/11/2015)	No comments received.	Not applicable.
Local commercial and recreational fisheries	**Contact Date**	**Comments received**	**Outcome / Follow-on Action**
Australian Fisheries Management Authority (AFMA)	Email 3/11/2015 Email 27/11/2015	No comments received. Information provided for fisheries to be contacted	Consultation is ongoing with individual fisheries.
NSW Game Fishing Association (NSW GFA)	Email 26/11/2015	Response pending.	Consultation is ongoing.
Commonwealth Fisheries Association (CFA)	Email 27/11/2015	Response pending.	Consultation is ongoing.
Recreational Fishing Alliance of NSW	Email 26/11/2015	Response pending.	Consultation is ongoing.
Norfolk Island Fishing Association	Email 30/11/2015	Response pending.	Consultation is ongoing.
Recreational Fishing Alliance of NSW (RFANSW)	Email 27/11/2015	Response pending.	Consultation is ongoing.
NSW Game Fishing Association (NSWGFA)	Email 27/11/2015	Response pending.	Consultation is ongoing.
Marine parks and reserves	**Contact Date**	**Comments received**	**Outcome / Follow-on Action**
The Department of the Environment (DoE)	Meeting at DoE 30/10/2015	Discussion on details of survey and seeking feedback.	Clarification of split referral vs. stand-alone referral. Discussion of public consultation.
NGOS and Conservation Groups	**Contact Date**	**Comments received**	**Outcome / Follow-on Action**
Whale and Dolphin Conservation, WDC, Australasia	Email 3/11/2015	No comments received	Not applicable

The Nature Conservation Council of NSW	Email 3/11/2015	No comments received	Not applicable
Wilderness Society	Email 3/11/2015	No comments received	Not applicable
Pew Charitable Trusts	Email 3/11/2015	No comments received	Not applicable
International Fund for Animal Welfare IFAW	Email 23/11/2015 Response 27/11/2015	Requested to be included as a stakeholder and provided feedback on the survey. Comments also provided on the proposed survey and information sheet.	GA responded to IFAW correspondence and committed to ongoing communication.
Save our marine life	Email 3/11/2015	No comments received	Not applicable

D2015-181691

From: Gurney Jessica
To: Cook, Glen MR
Sent: 4/11/2015 11:57 AM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Dear Glen,
Thank you for your comments. We will notify you the survey dates three/four weeks prior to the survey.
Kind regards,
Jessica

Jessica Gurney
Project Manager
Resources Division | **GEOSCIENCE AUSTRALIA**

From: Cook, Glen MR
Sent: Wednesday, 4 November 2015 10:00 AM
To: Gurney Jessica
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Jessica

Project has been noted. Closer to the operation once dates for the survey have been confirmed if you could let us know we will publish a temporary Notice to Mariners. To get the notice out before hand we will need approximately three weeks notice.

Cheers

Glen Cook
A/Manager Nautical Assessment and Maintenance
Australian Hydrographic Service

D2015-183754

From: Gurney Jessica
To: 'MBC Plans Support'
CC: JONES Brad; Maritime Trade Operations (Defence) TURNER Brendan
Sent: 5/11/2015 1:19 PM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Dear Eris,

Thank you for your comments. Your request for updated information is noted.
Kind regards,
Jessica

From: MBC Plans Support
Sent: Thursday, 5 November 2015 12:00 PM
To: Gurney Jessica
Cc: JONES Brad; Maritime Trade Operations (Defence); MBC Plans Support; TURNER Brendan
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Thank you for your email.

Maritime Border Command (MBC) has no comment at this point in time; however, we appreciate being kept informed of any further developments.

Mr Eris Kennedy
Supervisor MBC Planning Support, Maritime Border Command
Border Operations Group
Australian Border Force

D2015-18029

From: Murphy, Philip
To: Gurney Jessica
CC: Costin, Michael
Sent: 4/11/2015 11:27 AM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Dear Jessica,

I now wear two hats, one being Australia-Japan Cable (AJC) and the other being a wider Telstra Marine Operations role.

From the AJC perspective, there has been ongoing dialogue with JAMSTEC for years in the Japan region in terms of consultation for proposed survey work by JAMSTEC which can involve core samples. Basically, JAMSTEC advise where they plan to work and AJC advises if they are near the AJC route, in which case JAMSTEC avoid it.

From the Telstra perspective, I have copied in a colleague Michael Costin (who you may have separately addressed directly).

Thank you for the Invitation to Comment. A review will be undertaken and comments submitted as appropriate.

Regards

Philip Murphy

General Manager, Marine Operations Services
Telstra Network Services / International Operations & Services

D2015-189030
From: Costin, Michael
To: Murphy, Philip; Gurney Jessica Schwarz, Roger Lay, Steven K
CC: Gurdon, Zack
Sent: 4/11/2015 12:30 AM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Jessica,

By way of this email, I'll ask my colleagues, Roger and Steven, to check whether the survey line poses any issues for the route our Endeavour cable that extends from Sydney to Hawaii.

I note the reference to the use of seismic survey equipment. Accordingly, for your reference, I attach a copy of the relevant Recommendation issued by the International Cable Protection Committee.

Best Regards

Michael Costin
General Manager, International Cable Development
Network Services
International Operations & Services, Global Enterprise & Services

D2015-190298
From: Jackie Fam
To: Gurney Jessica
CC: Silvia Superina; Pauline Cooney; Hiscutt, Martin
Sent: 12/11/2015 9:46 AM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Dear Jessica

Thank you for the opportunity to comment on proposed seismic survey activities to be conducted by Geoscience Australia on the Lord Howe Rise (Tasman Sea) in 2016. I note your advice that the survey will be conducted in collaboration with the Japan Agency for Marine-Earth Science and Technology and is scheduled to take place between 22 March and 11 May 2016. I understand that the survey will involve the operation of a multi-channel towed seismic system and the temporary deployment of ocean bottom seismometers on the seafloor to map the deep geological structure of the Lord Howe Rise.

The *Telecommunications Act 1997* provides for submarine cable protection zones to be declared around telecommunications submarine cables that are considered to be of national significance. Certain activities, including exploring for resources and mining are prohibited or restricted in protection zones. There are currently three protection zones: the Northern Sydney Protection Zone, the Southern Sydney Protection Zone and the Perth Protection Zone.

While the proposed survey area does not appear to be in the vicinity of existing protection zones, the protection zone regime does not cover domestic cables or all international cables. There are a number of in situ cables installed along the eastern coast of Australia from Sydney to Papua New Guinea, South East Asia and the USA that may be impacted by the proposed survey activities.

As such, we would encourage you to contact relevant submarine cable operators early in your planning process to ensure your activities do not inadvertently damage telecommunications cables. Contacts for submarine cables in the vicinity of proposed survey activities are:

Telstra Endeavour Cable and APNG-2 Cable
Michael Costin
General Manager
International Networks
Telstra

Pipe Pacific Cable – 1
David Hanly
Operations Manager
TPG Telecom

Australia Japan Cable
Philip Murphy
Head of AJC Engineering & Operations

OPT- Gondawana Cable
Alexis Pastre
Direction Generale

Southern Cross Cable Network
David Clampett
Network Adminstrator

For your information, we have consulted the Commonwealth Department of Communications and the Arts in drafting this response and the Department concurs with this advice.

Please contact me if you have any questions.

Kind Regards

Jackie Fam
Senior Advisor
Networks Section
Australian Communications and Media Authority
www.**acma**.gov.au

communicating | facilitating | regulating

D2015-190299
From: Pugsley, Luke
To: Gurney Jessica
CC: Nautical Advice
Sent: 12/11/2015 11:56 AM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]
Good morning Jessica,

Thank you for providing information on the Lord Howe Rise Marine Seismic Survey.

The attached file shows traffic plots for the area based off of AIS data. It should be noted that traffic transiting between Sydney and Noumea will pass close to the proposed drilling sites. Heavy traffic transiting between Brisbane (and other major Queensland ports) and New Zealand will also be encountered when the RV *Kairei* conducts the east / west survey line.

Given the length of the towed seismic system, the survey vessel will need to be active and maintain exceptional communications with all commercial shipping, should they be encountered, in the survey area noting there will be a considerable speed difference between commercial shipping and the survey vessel whilst the latter is conducting operations. The seismic vessel must display appropriate day shapes, lights and streamers, reflective tail buoys, to indicate the vessel is towing and is therefore restricted in her ability to manoeuvre. Visual and radar watches must be maintained on the bridge at all times.

Please ensure AMSA's Rescue Co-ordination Centre (RCC) is contacted through rccaus@amsa.gov.au for AUSCOAST and NAVAREA warning broadcasts before operations commence. AMSA's RCC will require the vessels details and area of operation and need to be advised when the survey starts and ends. Additionally, the Australian Hydrographic Service must be contacted through hydro.ntm@defence.gov.au no less than two working weeks before operations commence for the promulgation of related Notices To Mariners (NTM).

Kind regards,

Luke

Luke Pugsley
NAUTICAL AND HYDROGRAPHIC ADVISOR
NAUTICAL AND REGULATION
NAVIGATION SAFETY AND INTERNATIONAL RELATIONS

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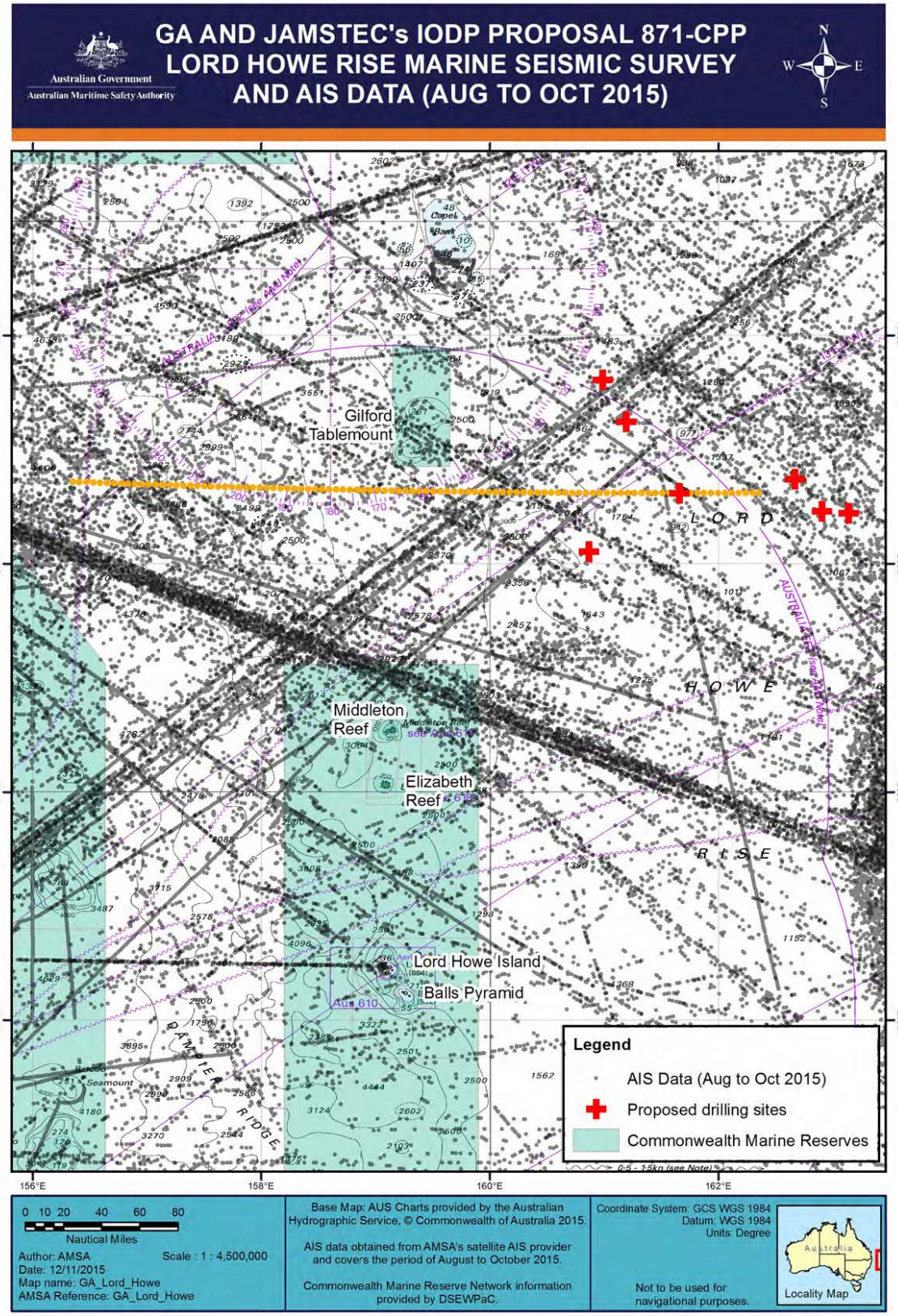
Australian Government
Australian Maritime Safety Authority

Safe and clean seas, saving lives


GA AND JAMSTEC's IODP PROPOSAL 871-CPP
LORD HOWE RISE MARINE SEISMIC SURVEY
AND AIS DATA (AUG TO OCT 2015)
Australian Government
Australian Maritime Safety Authority
N
W
E
S
Gilford Tablemount
Middleton Reef
Elizabeth Reef
Lord Howe Island
Balls Pyramid
Aus 610
Aus 615
L O R D
H O W E
R I S E
BAMFIELD RIDGE
Seamount
AUSTRALIA 200 NM Limit
26°S
28°S
30°S
32°S
156°E
158°E
160°E
162°E
Legend
AIS Data (Aug to Oct 2015)
Proposed drilling sites
Commonwealth Marine Reserves
0 10 20 40 60 80
Nautical Miles
Author: AMSA
Scale : 1 : 4,500,000
Date: 12/11/2015
Map name: GA_Lord_Howe
AMSA Reference: GA_Lord_Howe
Base Map: AUS Charts provided by the Australian Hydrographic Service, © Commonwealth of Australia 2015.
AIS data obtained from AMSA's satellite AIS provider and covers the period of August to October 2015.
Commonwealth Marine Reserve Network information provided by DSEWPaC.
Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree
Not to be used for navigational purposes.
Australia
Locality Map

D2015-191249
From: Gurney Jessica
To: Brett Worrall
Sent: 12/11/2015 11:56 AM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey – SOCC response [SEC=UNCLASSIFIED]

Dear Brett,

Thank you for the information.
The proposed cable route is east of the OBS line but does intersect with the east-west seismic line. Please refer to the map attached.

We see no major issues. However we would like to keep in touch with you regarding timing of your activities in the April-May period.

If you have concerns, please let me know. Thank you.
Kind regards,
Jessica

Jessica Gurney
Project Manager
Resources Division | **GEOSCIENCE AUSTRALIA**

From: Brett Worrall
Sent: Monday, 9 November 2015 4:17 PM
To: Gurney Jessica
Cc:
Subject: Invitation to Comment: Lord Howe Rise Marine Seismic Survey 2016 - SOCC response

Dear Jessica,

Thank you for the information in relation to the international ocean discovery program and the survey works in particular planned for March next year.

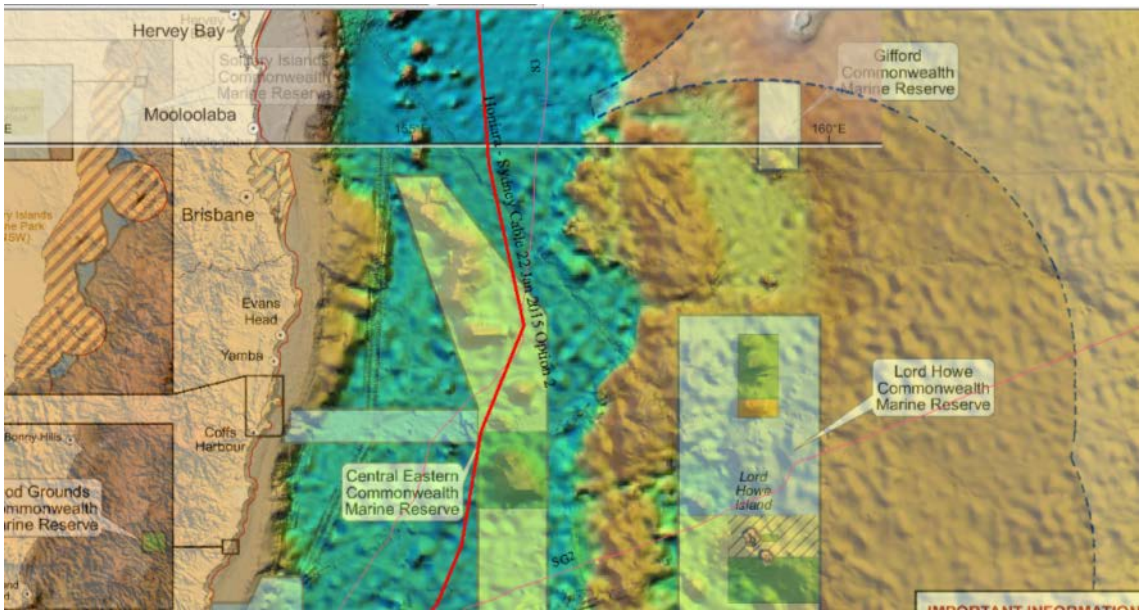
The Solomons Oceanic Cable Company (SOCC) is planning to install a new submarine telecommunications cable between Honiara and Sydney. We are currently at the pre desktop stage so only have a range of routing options we have been discussing with various authorities including the Australian Communications and Media Authority (ACMA) and Environmental Australia/National Parks (EA/Nparks).

I thought it useful to share our current routing proposal (see WGS 84 lat / long list below) and some internal thoughts of where we might route the cable as a function of how the permitting discussions progress with Environment Australia. Refer to attached PDF and figure below for our current thinking. From our initial discussions with EA and NParks seems like we can co-exist in the recently declared marine parks but until we have a final permit from ACMA I would like to keep my options open. The attached file was our attempt to avoid the parks which gives rise to the range of longitudes where we may cross your line.

You will note that we are basically running north south and we will intersect with your planned survey line somewhere between 155 deg 40 min E to 157 deg 24 min E (red line below). Our survey operations are currently envisaged to start no earlier than April 2016 and we would only be in this area for < 1 day sometime in May 2016.

We would of course be very interested to understand if there was ever to be the possibility of drilling or other bottom encroaching activities in the western end of your line. This may impact on our ability to grapple for the cable in the event of a repair so we need to ensure we are aware of each other's plans. The table below is our current proposal for routing with ACMA and the accompanying figures reflects the table.

22	155° 17' 51.4966" E	32° 20' 14.5660" S	-4862.732	85.965 km	505.69 km	19.8°
23	155° 36' 18.2043" E	31° 36' 27.9066" S	-4800.004	152.21 km	591.66 km	8.3°
24	155° 49' 59.6521" E	30° 14' 56.5256" S	-4800.333	149.94 km	743.86 km	19.8°
25	156° 21' 12.9858" E	28° 58' 30.2760" S	-4829.123	217.99 km	893.8 km	349.0°
26	155° 56' 02.0361" E	27° 02' 36.9122" S	-4800.032	233.69 km	1111.8 km	356.1°
27	155° 46' 34.0430" E	24° 56' 20.4863" S	-4600.057	70.489 km	1345.5 km	2.8°



I would be happy to answer any additional questions this email raises.

Kind regards

Brett Worrall
Worrall Consulting Pte Ltd.

On behalf of SOCC

D2015-192723

COMMENTS BY AUSTRALIA-JAPAN CABLE LIMITED ON INVITATION TO COMMENT: LORD HOW RISE MARINE SEISMIC SURVEY

This paper responds to the email from Jessica Gurney dated 4 November 2015 on the subject issue. Australia-Japan Cable Limited (AJCL) operates a submarine cable, namely Australia-Japan Cable (AJC), between Australia, Guam and Japan. The route of AJC between Australia and Guam is shown on Attachment 1.

AJCL makes the following requests:

1. That the subject seismic survey work avoids the AJC route and the AJC cable.
2. That the seismic work be in accordance with relevant guidelines of the International Cable Protection Committee (ICPC)
3. That when final dates and locations for the work are determined that AJC receive notification of these dates and seismic work locations.

Any enquiries related to AJC may be referred to:

Philip Murphy
Head Of AJC Engineering & Operations
Australia-Japan Cable

Philip.Murphy@ajcable.bm

23 November 2015

D2015-191249
From: Collis, Matthew
To: Gurney Jessica
Sent: 23/11/2015 11:53 PM
Subject: FW: Lord Howe Rise Survey

Dear Jessica,

I was forwarded the attached information sheet regarding the proposed Lord Howe Rise seismic survey. Please can you be sure to include IFAW as a stakeholder on this and future such proposals from Geoscience Australia. IFAW's interest is in seeing marine life protected from potential impacts of noise pollution associated with seismic exploration.

In regards to the attached proposal, IFAW would like to submit the following feedback:

- There is no detail about the size/output of the array which will be used. Such information is critical to understand the likely scale and extent of exposure of marine mammals and other marine life to potentially harmful levels of sound. IFAW recommends that the array be reduced to the lowest possible source level to reduce noise and that alternatives to seismic airguns be investigated as these can often significantly reduce the likelihood of impacts on marine life.
- IFAW is pleased to see acoustic modelling will be undertaken. We request that this is shared with stakeholders when finalised and that it looks in particular at received SELs at migratory corridors, biologically important areas and marine reserve boundaries, where these are within or proximate to the survey area.
- IFAW notes that the information sheet says there will be visual observations for whales by trained marine mammal observers, but does not say how many MMOs will be used. It is important that sufficient numbers of MMOs are available throughout daylight hours to ensure sufficient coverage of visual observations.
- IFAW recommends the use of passive acoustic monitoring to supplement MMOs, and for use in periods of low visibility and night-time. We note that the proposed survey area includes some very deep water, which provides potential habitat for beaked whales and other deep diving species like sperm whales. Such animals can stay submerged for significant periods of time and are not always conspicuous when they do surface so PAM can often provide a better chance of detecting these animals. I believe Doug Cato has some information on presence of beaked whales in this region based on (passive acoustic) research he did with the navy, however, I am not sure if it includes the exact areas proposed to be surveyed – I suggest you contact him directly if you haven't already done so. It would also be worth looking at historical sperm whaling records for the area to get an idea of likely sperm whale presence. Neither beaked nor sperm whales are seasonal so altering the proposed timeframe would not work as a mitigation measure for these species.

Kind regards

Matthew Collis | Policy and Campaigns Manager

IFAW - International Fund for Animal Welfare
Oceania Office

D2015-191249
From: Jon Gibbons
To: Gurney Jessica
CC: Jodie Quintal
Sent: 21/11/2015 12:13 PM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Hi Jessica, thank you for the opportunity to comment. Whilst we do not think that this activity would impact Norfolk Island given its distance it may be beneficial to keep the Norfolk Island community informed through the local media on the progress of the project; in particular and when the EPBC Referral is available for comment.

The EPBC Referral would have more information and detail to get a better idea of the location, proximity (or not) to the NI Fishing "Box" and potential extent of any impacts or effects. I guess that you would consult with AFMA and be aware of the Norfolk Island Fishery.
http://www.afma.gov.au/fisheries/norfolk-island-fishery/

We can provide details of the media here if needed.

Regards Jon

Jon Gibbons
Chief Executive Officer
The Administration of Norfolk Island
Kingston

D2015-194304

From: Gurney Jessica
To: Dave Kelly
Sent: 25/11/2015 4:26 PM
Subject: RE: Invitation to Comment: Lord Howe Rise Marine Seismic Survey [DLM=For-Official-Use-Only]

Dear Dave,

Thank you for your message seeking extension for providing comments on the Lord Howe Rise marine seismic survey. I rang your office this afternoon and was instructed to contact you via this email address.

As previously mentioned, Geoscience Australia has prepared an EPBC referral. The document is going through internal approval process and will be submitted to the Australian Government's Environment Minister next Monday.

We understand your situation and are happy to receive a late response from the Lord Howe Island Board. However we might not be able to incorporate your comments in the Referral due to the time constraint and will have to address it separately. Alternatively you could review our EPBC referral when it is published online and contact me if you have further questions or concerns.

Please do not hesitate to contact me if you wish to discuss this further. Thank you.

Kind regards,

Jessica

Jessica Gurney
Project Manager
Resources Division | **GEOSCIENCE AUSTRALIA**

D2015-194304

From: Collis Matthew
To: Gurney Jessica
Sent: 27/11/2015 1:00 PM
Subject: RE: HPRM: FW: Lord Howe Rise Survey [SEC=UNCLASSIFIED]

Thanks Jessica,
That's good to hear about PAM. I look forward to seeing the proposal.
Best wishes,
Matt

From: Gurney Jessica
Sent: Friday, 27 November 2015 12:55 PM
To: Collis, Matthew
Subject: RE: HPRM: FW: Lord Howe Rise Survey [SEC=UNCLASSIFIED]

Dear Matthew,

Thank you for your comments. Yes. I will make sure to include IFAW as a stakeholder on this and future marine survey proposals from Geoscience Australia.

At the time when the information sheet was sent, GA was in the process of finalising the survey plan and considering using passive acoustic monitoring to supplement MMOs. GA has since gone to market procuring contact services for PAM and will finalise the contract next week. It is our intention to have four PAM operators/MMO on the vessel.

GA is currently focusing on finalising the EPBC referral for submission to the Department of the Environment. We have considered comments from stakeholders and have made every effort to address concerns where possible in the EPBC referral.

We expect to submit the Referral document early next week. Once it is published online, I will forward you a link.

Kind regards,

Jessica

Jessica Gurney
Project Manager
Resources Division | **GEOSCIENCE AUSTRALIA**

D2015-194298
From: Petroleum AFMA
To: Gurney Jessica
CC: Ryan Paul, Shanks Steve, Day George
Sent: 27/11/2015 11:53 PM
Subject: FW: Lord Howe Rise Survey

Dear Jessica,

Apologies for the delay in response. Thank you for your request to provide comment on the seismic survey around the Lord Howe Rise in 2016.

Several fisheries potentially coincide with the area that intends to be surveyed, including:

- Southern Bluefin Tuna (SBT) Fishery
- Eastern Tuna and Billfish Fishery (ETBF)
- Southern and Eastern Scalefish and Shark Fishery (including the East Coast Deepwater Trawl Sector and the Commonwealth Scalefish Hook Sector)
- Small Pelagic Fishery (SPF)
- Eastern Skipjack Fishery (no boats are fishing and management arrangements are under review).

In terms of the timeline of the project between March and May next year, all these fisheries are able to fish throughout the year and it can be expected that they will be active during the time of the survey (with the exception of the Eastern Skipjack Fishery).

AFMA recommends that direct consultation with the fishing industry stakeholders occur to determine activities during the time of the survey, despite whatever level of fishing effort that usually occurs during that period. This is because the spatial distribution and intensity of fishing operations can be highly variable over time and the only way to reliably determine future activity is by consulting relevant fishing operators. Low or no effort in recent years may not be indicative of future effort. Fishing may resume in areas where it was not cost effective to do so in the past or in areas that were previously closed.

I have attached a list of fishing industry association contact details for you. This is available on AFMA's website on a webpage designed to guide the petroleum industry on consultation with fisheries stakeholders (http://www.afma.gov.au/sustainability-environment/petroleum-industry-consultation/)

Please note that industry have previously expressed concerns about the impact of seismic surveys on the movements of migratory species, as well as on schools of fish which may disperse for prolonged periods following surveys. AFMA encourages thorough consultation with industry in relation to this issue.

Kind regards,

Bec

Rebecca Gray
Environment Officer, Policy Environment Economics and Research Section
Australian Fisheries Management Authority

From: Gurney Jessica
Sent: Tuesday, 8 December 2015 11:46 AM
To: 'Hank Bower'
Cc: Dave Kelly; Cameron Lay
Subject: RE: LHI rise marine seismic survey [SEC=UNCLASSIFIED]

Hi Hank,

Thank you for your call. I am glad to hear that you have no particular concerns about the survey at this stage.
Yes. I will send you a link when the EPBC referral is published online.
Kind regards,
Jessica

Jessica Gurney
Project Manager
Resources Division | **GEOSCIENCE AUSTRALIA**

From: Hank Bower
Sent: Tuesday, 8 December 2015 11:37 AM
To: Gurney Jessica
Cc: Dave Kelly; Cameron Lay
Subject: LHI rise marine seismic survey

Hi Jessica

Thanks for offering to provide us with a link to the EPBC referral once complete

Please also send through to the emails cc'd

Hank Bower
Manager Environment/World Heritage
Lord Howe Island Board