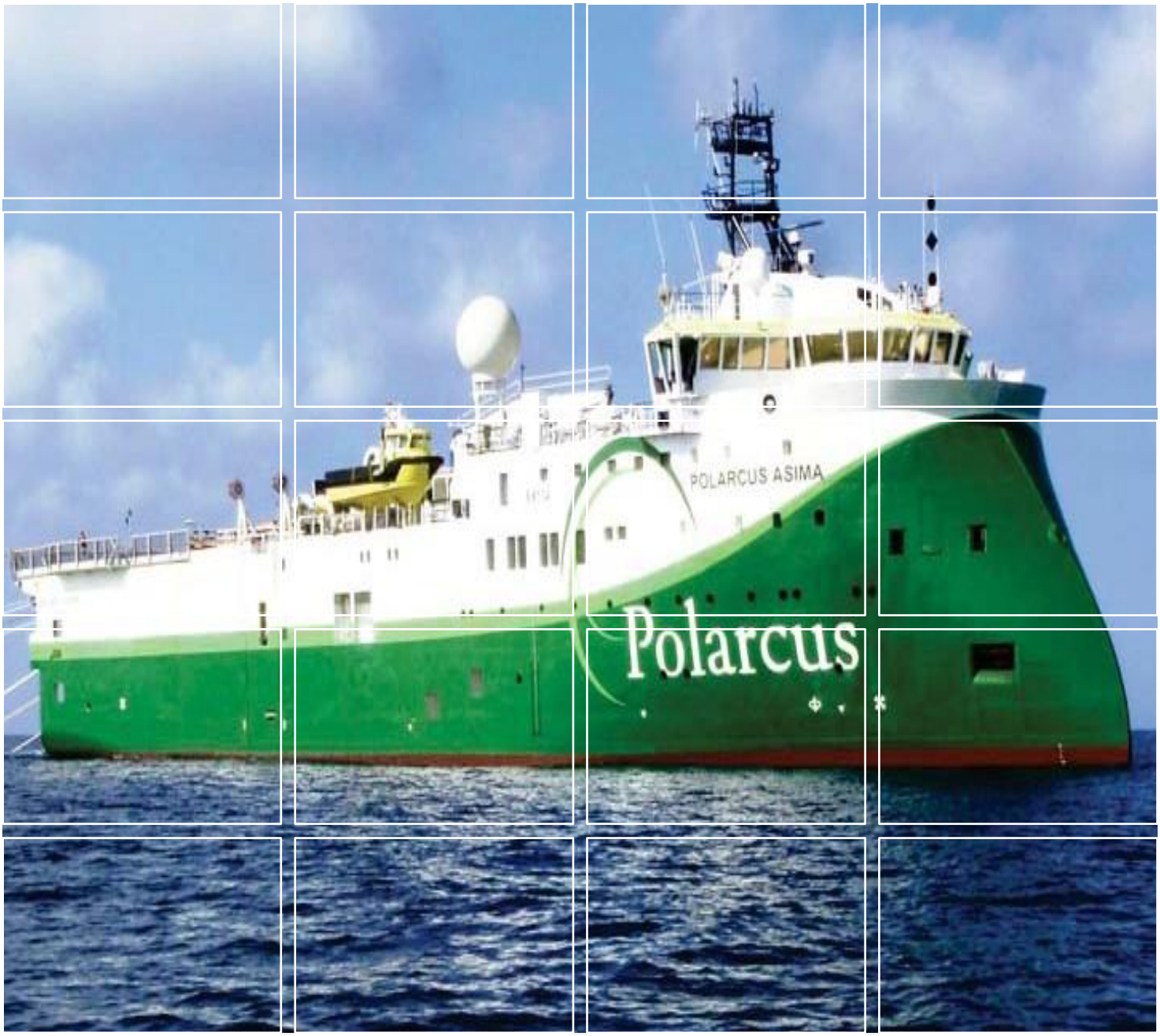

Environment Plan Summary for the Capreolus Phase II 3D Multi-Client Marine Seismic Survey

Polarcus Seismic Limited

5 August 2016

0331032

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FINAL REPORT

Polarcus Seismic Limited

Environment Plan Summary for the Capreolus Phase II 3D Multi-Client Marine Seismic Survey

5 August 2016

Reference: 0331032

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1 INTRODUCTION

The Capreolus Phase II three-dimensional (3D) Multi-Client Marine Seismic Survey (MSS) is proposed to be undertaken by Polarcus Seismic Limited (Polarcus) in Commonwealth waters of the Offshore Northern Carnarvon Basin and Roebuck Basin, approximately 135 kilometres (km) northwest of Port Hedland, 258 km north-northeast of Exmouth and 410 km west of Broome in Western Australia.

The Capreolus Phase II 3D MSS will encompass two distinct survey areas (where seismic data acquisition will be collected) within a larger Operational Area (which encompasses additional areas where vessel manoeuvring and ancillary activities will occur). The approximate Capreolus Phase II survey areas and larger Operational Area are presented in *Figure 1.1*.

The Environment Plan (EP) for the proposed activities (Capreolus Phase II 3D Multi-client Marine Seismic Survey Environment Plan, Revision No. 1, Reference No. 0331032) was accepted by NOPSEMA on the 26th July 2016. In accordance with sub-regulations 11(3) and 11(4) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations), this EP Summary provides a summary of the accepted EP, including the management measures that will be implemented to reduce potential environmental impacts and risks from the activity to as low as reasonably practicable (ALARP) and acceptable levels.

Survey Coordinates (GDA94z50)		
ID	Easting	Northing
1	116.33841	-16.50170
2	117.24934	-16.50259
3	117.26014	-17.14192
4	117.77564	-17.14060
5	117.77903	-17.35607
6	117.16320	-17.36231
7	117.16334	-17.51316
8	117.00612	-17.51562
9	117.00114	-17.83646
10	116.33868	-17.83295
11	115.33256	-18.50189
12	115.83180	-18.50324
13	115.83379	-18.57985
14	117.00114	-18.58346
15	117.00365	-18.36798
16	118.22972	-18.36641
17	118.23395	-18.60814
18	118.17874	-18.61089
19	118.17702	-18.72580
20	117.44911	-18.99230
21	117.53528	-19.18119
22	117.34147	-19.27501
23	117.33194	-19.54793
24	115.33724	-19.54776
25	116.21241	-16.35818
26	118.37863	-16.36277
27	118.37317	-18.79696
28	117.64516	-19.07561
29	117.72621	-19.25845
30	117.48549	-19.36608
31	117.47839	-19.68658
32	115.19083	-19.67048
33	115.20481	-18.37381
34	116.19572	-18.38058

Legend
- Operational Area
- Southern Survey Area
- Northern Survey Area
- Bathymetry (m)
- Coastal Waters (State Jurisdiction)

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Drawing No:	0331032b_Phase2EP_G001_R0.mxd	
Date:	20/01/2016	Drawing Size: A3
Drawn By:	DR	Reviewed By: CR

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Figure 1.1 - Survey Location

Polarcus Capreolus Phase II

Environmental Resources Management ANZ

Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney

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2 TITLEHOLDER'S NOMINATED LIAISON PERSON

The titleholders nominated liaison person, who can be contacted for further information about the Capreolus Phase II 3D MSS, is:

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Polarcus Seismic Ltd
c/o Polarcus DMCC, Almas Tower, Level 32, Jumeirah Lakes Towers
PO Box 283373, Dubai, United Arab Emirates
Tel: +971 4 43 60 959
Email: nina.neshpor@polarcus.com

3 ACTIVITY DESCRIPTION

3.1 LOCATION

The Operational Area and the two survey areas (including boundary coordinates) within which the Capreolus Phase II 3D MSS will be undertaken are shown in *Figure 1.1*. The survey areas will target areas included in a Special Prospecting Authority (SPA), for which Polarcus has submitted an application to the National Offshore Petroleum Titles Administrator (NOPTA).

3.1.1 Survey Areas

The survey areas comprise the areas within which Polarcus anticipate acquiring 3D seismic data. At the closest point, the survey areas are approximately 157 km northwest of Port Hedland and approximately 427 km west of Broome. The northern survey area covers approximately 14,620 square kilometres (km^2) in water depths ranging from approximately 1,566 to 5,505 metres (m). The southern survey area covers approximately 29,520 km^2 in water depths ranging from approximately 22 to 1,697 m. An environmental exclusion buffer of 1km around the Glomar Shoal Key Ecological Feature (KEF) will be applied so that seismic data acquisition does not occur near this seafloor feature, identified for its increased biological productivity and as being of significance for commercial fisheries in the region.

3.1.2 Operational Area

The wider Operational Area incorporates the planned survey areas (above) and additional space where vessel manoeuvring and ancillary activities (i.e. additional area for the purpose of line run-outs, source testing, soft starts and turns etc.) may occur.

3.2 ACTIVITY DETAILS

The Capreolus Phase II 3D MSS will be undertaken by one or two purpose-built, state of the art Polarcus-owned and operated seismic survey vessels. Each seismic vessel will acquire seismic data by towing a seismic source (an array of 'airguns' which discharge compressed air underwater to create a sound pressure wave that reflects off the rock formations beneath the seabed) and the receivers (one or more 'streamers' containing 'hydrophones' to detect the returning sound signal and transmit it back to the vessel). Processing, analysis and interpretation of these returned signals allows a broad picture of subsurface rock formations to be established and potential accumulations of hydrocarbons to be identified.

The total volume of the planned seismic source is 3,480 cubic inches (in^3) and this will be towed a short distance behind each seismic vessel at 5 to 10 m depth. The source will be discharged at approximately 12.5 m intervals along predetermined east-west survey lines. A total of 12 hydrophone streamers each measuring between approximately 8 and 9 km in length will be towed at a depth of between 10 and 20 m below the surface and will be spaced 100 m apart. The survey will be conducted at a speed of approximately 4.5 knots.

Only one seismic survey vessel will acquire seismic data in each survey area at any one time (therefore there will always be a minimum 40 km separation distance between vessels), although the two areas may be acquired either consecutively or concurrently.

In addition to the seismic survey vessel(s), a support vessel will accompany each seismic vessel to assist with managing potential interactions with other users of the area, and between one and two supply vessels will be used for resupply, refuelling and other support functions. Refuelling and resupply at sea by supply vessel is expected to occur approximately every 35 days during the survey. At-sea refuelling of the seismic and support vessels will only take place during daylight hours and within strict weather limit guidelines. Crew changes are also expected to occur approximately every 35 days by helicopter.

3.3 SCHEDULE

The Capreolus Phase II 3D MSS is scheduled to commence during the second half of 2016 and may be completed in multiple stages of work. The Capreolus Phase II 3D MSS is expected to be completed by 30th June 2018.

The exact scheduling and phasing of the survey over the two survey areas is yet to be confirmed. Exact scheduling is subject to weather conditions, vessel availability, timing restrictions due to environmental sensitivities, and the final survey work scope.

3.4 ENVIRONMENTAL DESIGN CHARACTERISTICS

The Polarcus vessels meet stringent Det Norske Veritas (DNV) CLEAN-DESIGN and BWM-T notations that regulate emissions to air and water. The Polarcus fleet also carries the International Maritime Organization (IMO) Green Passport that regulates environmental and occupational health and safety risks through the life of the vessel, from shipbuilding to eventual recycling.

A number of measures have been taken by Polarcus to provide additional protection for vessel integrity, including double hulls on all vessels and the additional requirements for compliance that enable the vessels to meet the DNV 2008 SPS notation for controlled stability and floatability. The Polarcus vessels also have the DNV NAUT-AW class notation for enhanced nautical safety, incorporating a grounding avoidance system. The Polarcus vessels have multiple main engines, independent propeller shafts and split switchboards and additionally all carry the DNV notation DYNPOS-AUTR that warrants the vessels have a redundant dynamic positioning system and an independent joystick system back-up. Taken together these features substantially reduce the risk of loss of control of the vessel.

In addition to complying with the applicable local regulatory requirements for the protection of marine mammals in or around seismic operations, Polarcus follows standard industry practices for soft start procedures across all seismic operations. Polarcus also has a Passive Acoustic Monitoring (PAM) system, designed to detect the presence of marine mammals by listening for their calls, available on board its vessels.

Tail buoys will be used to clearly indicate the streamer ends. The buoys will be fitted with turtle guards to protect against potential entanglement of turtles in the buoys.

4 EXISTING ENVIRONMENT

The Capreolus Phase II 3D MSS Operational Area lies within the Northwest Shelf Province and the Northwest Transition of the North-west Marine Region, as defined in the North-west Marine Bioregional Plan (SEWPaC 2012). The survey areas target sedimentary formations within the Northern Carnarvon Basin and Roebuck Basin.

The following provides a description of the receiving environment relevant to the Capreolus Phase II 3D MSS and Zone of Potential Impact (ZPI; where potential impacts from unplanned events such as a hydrocarbon spill have been considered), including particular values and sensitivities protected under the Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).

4.1 PHYSICAL ENVIRONMENT

Water depths across the Operational Area range from less than 30 m in the vicinity of Glomar Shoal on the continental shelf to over 5,000 m on the Argo Abyssal Plain. Seismic acquisition is only expected to take place in water depths of approximately 67 m or greater. The Operational Area overlaps the continental shelf, continental slope, and the deeper Argo Abyssal Plain.

Notable seafloor features on the continental shelf in the southern part of the Operational Area include seafloor terraces, escarpments and areas of hard ground associated with the 'Ancient coastline at 125 m depth contour', 'Continental slope demersal fish communities' and Glomar Shoal Key Ecological Features (KEFs). The deeper central and northern parts of the Operational Area include rises, ridges and canyons of the continental slope, as well as aprons/fans of the Argo Abyssal Plain.

Sediments in the Operational Area are mostly dominated by sands with the exception of the deeper continental slope sediments and the Argo Abyssal Plain in the northern portion of the Operational Area, which are dominated by muds (DEWHA 2008a).

The Operational Area is dominated by surface currents heavily influenced by both tidal motions and the Indonesian Throughflow current, which transports warm waters from the Pacific Ocean into the Indian Ocean through the Indonesian seas. Tides in the operational area are semi-diurnal (i.e. two high tides and two low tides per day).

Rankin Bank is located approximately 6 km south of the Operational Area. The Rowley Shoals are located approximately 52 km east of the Operational Area.

4.2 ECOLOGICAL ENVIRONMENT

4.2.1 *Key Ecological Features*

Components of the Commonwealth marine area are defined as Key Ecological Features (KEFs) when they are deemed to be of regional importance for either the region's biodiversity or ecosystem function and integrity (Commonwealth of Australia 2012). KEFs that are relevant to the Capreolus Phase II 3D MSS Operational Area and ZPI are summarised in *Table 4.1* and shown in *Figure 4.1*.

Table 4.1 Key Ecological Features relevant to the Capreolus Phase II 3D MSS

Key Ecological Feature	Values	Description
Ancient coastline at 125 m depth contour	Unique seafloor feature with ecological properties of regional significance	Parts of the ancient coastline (predominantly where it occurs as a rocky escarpment) provide areas of enhanced biological productivity with associated Biologically Important Areas (BIAs) in areas otherwise dominated by soft sediments.
Glomar Shoal	Unique seafloor feature; high biodiversity	Contains highly fractured molluscan debris, coralline rubble and coarse carbonate sand with increased biological productivity which attracts fish such as Rankin Cod which are caught in large numbers by commercial fisheries in the area.
Continental Slope Demersal Fish Communities	Communities with high species biodiversity and endemism	The continental slope between North West Cape and the Montebello Trough has more than 500 fish species (76 endemic), making it the most diverse slope bioregion in Australia. The slope of the Timor Province and the Northwest Transition also contains more than 500 species of demersal fish (64 endemic).
Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals	High productivity and aggregations of marine life	The reefs of the Rowley Shoals (including Mermaid Reef) are areas of enhanced productivity that contribute to species richness through the mixing and re-suspension of nutrients from water depths of 500–700 m.

4.2.2 Ecological Communities

The benthic habitats and communities found within the Operational Area are typical of those observed throughout the North West Marine Region. The southern part of the Operational Area (<200 m water depth) is predominantly characterised by the sandy substrates of the Northwest Shelf Province and is considered to support low density benthic communities of bryozoans, molluscs and echinoids (DEWHA 2008a). Sponge communities are also sparsely distributed on the shelf in areas of hard substrate (DEWHA 2008a), such as the rocky escarpments associated with the 'Ancient coastline at 125 m depth contour' KEF. There is a strong correlation between benthic and demersal fish communities, benthic habitats and depth across the Northwest Shelf (Brewer *et al*. 2007).

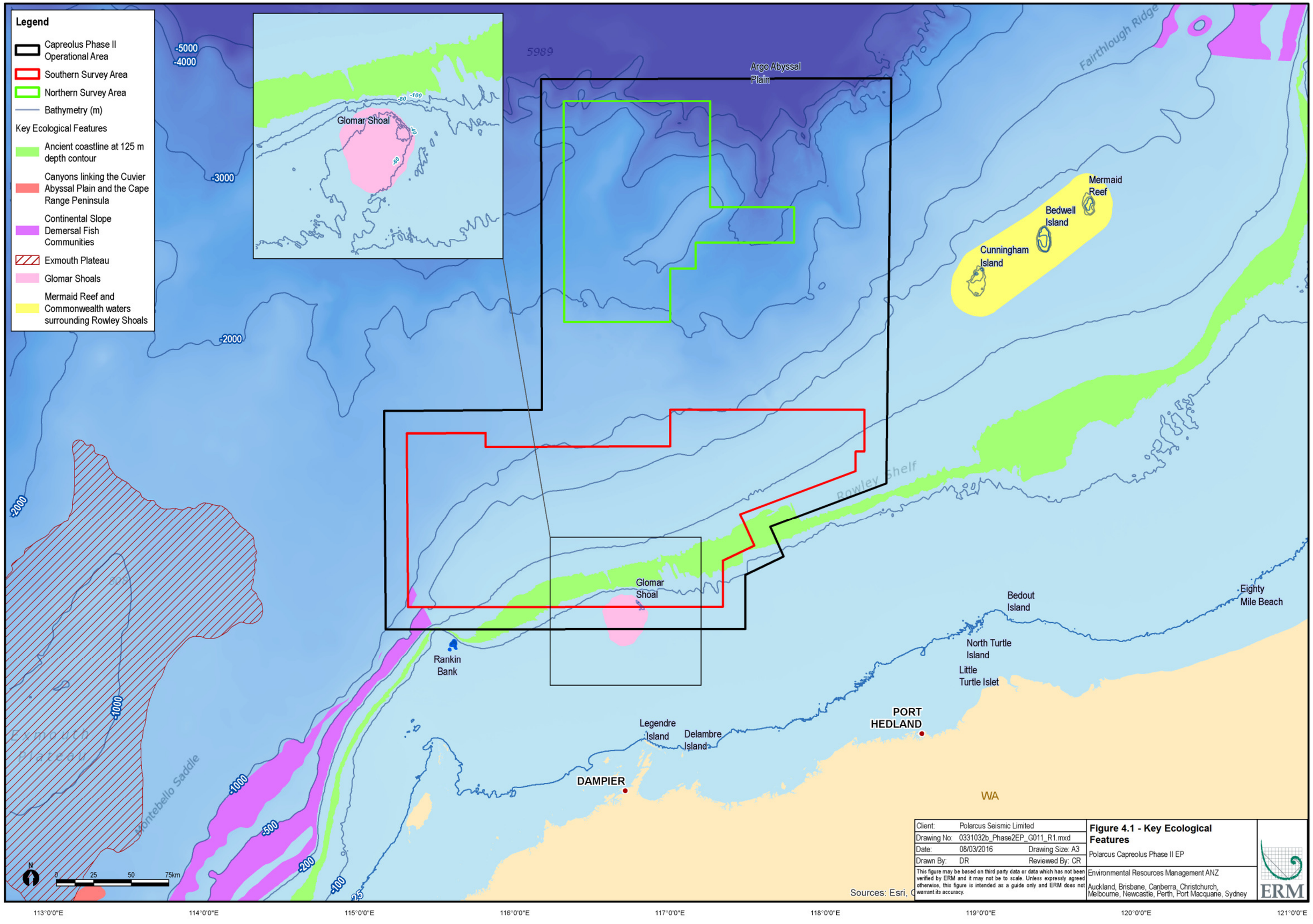

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Figure 4.1 - Key Ecological Features

Polarcus Capreolus Phase II EP

Environmental Resources Management ANZ

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Sources: Esri, C

Glomar Shoal and Rankin Bank are two large and complex bathymetrical features located on the Northwest Shelf. Glomar Shoal is located within the Operational Area and Rankin Bank is located approximately 6 km to the south of the Operational Area (*Figure 4.1*). Glomar Shoal is approximately four times the size of Rankin Bank (215 km^2 compared to 54 km^2); together these two remote shallow water features represent regionally significant habitats which provide unique areas of "hard ground" in a shelf setting that provide local enhancements in regional biological productivity and diversity, and support commercial fish species such as rankin cod, red emperor, crimson snapper and bream, as well as coral reef fish in shallower areas.

The central and northern parts of the Operational Area include the continental shelf break, continental slope and the Argo-abyssal plain of the Northwest Transition. The shelf break and continental slope are dominated by sandy substrate while the abyssal plain and deep ocean floor are dominated by muddy sediments (DEWHA 2008a). The region's continental slope habitats support demersal fish assemblages (DEWHA 2008a) and deep water crustacean species such as scampi.

The deeper ocean areas support meiofauna (microscopic animals living between grains of sediment on the seabed), infauna (ability to burrow in sediment) and sparsely distributed epibenthic communities (live on the surface of the seabed) (Brewer *et al*. 2007). Mobile benthic species (e.g. deepwater sea cucumbers, crabs and polychaetes) are presumed to be associated with the seafloor and sparse populations of bentho-pelagic fish and cephalopods are supported in low densities (DEWHA 2008a). Highly mobile pelagic fish species, such as migratory southern bluefin tuna, also occur in the wider region (DEWHA 2008a).

Intertidal and subtidal coral reef communities are a key habitat of the Rowley Shoals, approximately 52 km to the east of the Operational Area.

4.2.3 Marine Fauna

The Operational Area and surrounding waters support species of marine mammal (whales and dolphins), reptiles (marine turtles and sea snakes), fish, sharks and rays, and migratory and/or foraging birds. Species listed as threatened and/or migratory under the EPBC Act are presented in *Table 4.2*.

Table 4.2 Threatened and Migratory Species that may occur within and around the Operational Area

	Species Name	Status
Marine mammals	Pygmy blue whale	Endangered, Migratory
	Humpback whale	Vulnerable, Migratory
	Sperm whale	Migratory
	Sei whale	Vulnerable, Migratory
	Antarctic minke whale	Migratory
	Bryde's whale	Migratory

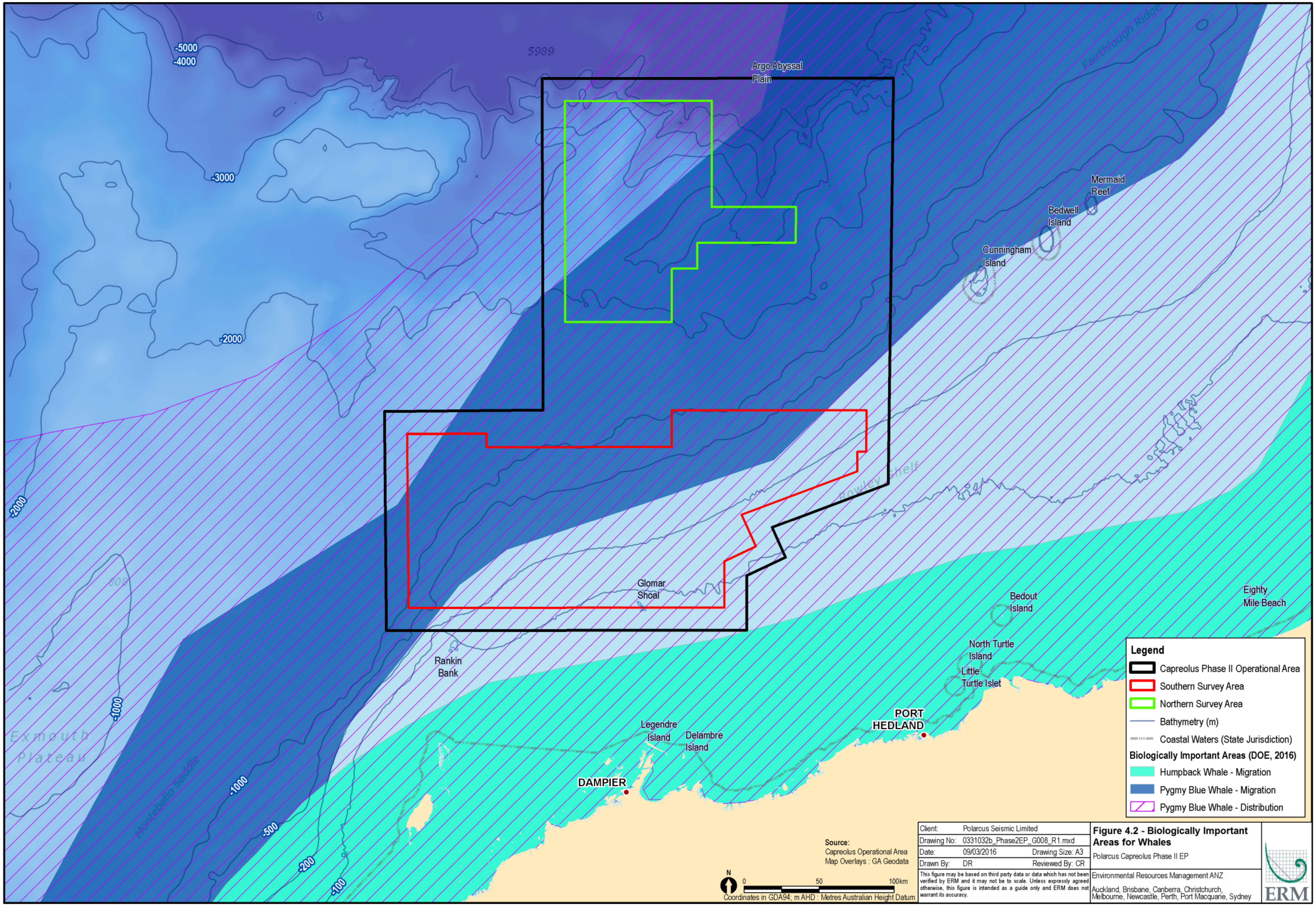
	Species Name	Status
	Killer whale	Migratory
	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	Migratory
Reptiles	Flatback turtle	Vulnerable, Migratory
	Leatherback turtle	Endangered, Migratory
	Loggerhead turtle	Endangered, Migratory
	Green turtle	Vulnerable, Migratory
	Hawksbill turtle	Vulnerable, Migratory
	Short-nosed sea snake	Critically Endangered
Fish, Sharks and Rays	Whale shark	Vulnerable, Migratory
	Great white shark	Vulnerable, Migratory
	Grey nurse shark	Vulnerable
	Shortfin mako	Migratory
	Longfin mako	Migratory
	Dwarf sawfish	Vulnerable
	Green sawfish	Vulnerable
	Giant manta ray	Migratory
	Reef manta ray	Migratory
Birds	Lesser frigatebird	Migratory
	White-tailed tropicbird	Migratory
	Osprey	Migratory

Marine Mammals

Eight EPBC Act listed threatened and/or migratory marine mammals potentially occur in proximity to the Operational Area.

Several of the listed whale and dolphin species are known to transit between Southern Ocean feeding grounds and tropical water breeding grounds, including migratory humpback whales and pygmy blue whales, for which BIAs have been identified (*Figure 4.2*).

Pygmy blue whales travel alone or in small groups (McCauley 2011, Gilmour *et al.* 2013) and are expected to occur in low numbers. The pygmy blue whale migration BIA and distribution BIA overlap with the Operational Area. The northern migration along the coast of WA occurs between April and August, with numbers expected to peak in the Operational Area between June and August. A shorter southern migration period occurs between October and December (Double *et al.* 2014; McCauley 2011; McCauley & Jenner 2010; McCauley & Salgado-Kent 2008), with numbers expected to peak in the Operational Area between October and November.



Argo Abyssal Plain
Fairthlough Ridge
Mermaid Reef
Bedwell Island
Cunningham Island
Rowley Shelf
Glomar Shoal
Rankin Bank
Bedout Island
Eighty Mile Beach
North Turtle Island
Little Turtle Islet
PORT HEDLAND
Legendre Island
Delambre Island
DAMPIER
Exmouth Plateau
Montebello Saddle
Legend
Capreolus Phase II Operational Area
Southern Survey Area
Northern Survey Area
Bathymetry (m)
Coastal Waters (State Jurisdiction)
Biologically Important Areas (DOE, 2016)
Humpback Whale - Migration
Pygmy Blue Whale - Migration
Pygmy Blue Whale - Distribution
Source:
Capreolus Operational Area
Map Overlays : GA Geodata
Coordinates in GDA94; m AHD : Metres Australian Height Datum

Client:	Polarcus Seismic Limited
Drawing No:	0331032b_Phase2EP_G008_R1.mxd
Date:	09/03/2016 — Drawing Size: A3
Drawn By:	DR — Reviewed By: CR

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Figure 4.2 - Biologically Important Areas for Whales

Polarcus Capreolus Phase II EP

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Humpback whales typically migrate along the coast between July and October (Jenner *et al.* 2001). The migration tends to be in water depths less than 200m. The humpback migration BIA is located to the south of the Operational Area, although humpback whales are also expected to occur in deeper waters including the Operational Area.

Other whale and dolphin species (e.g. bottlenose dolphin and sperm whale) are understood to be resident in the region throughout the year (DEWHA 2008a). Sei, Bryde's and Minke whales are not expected to be common in the Operational Area.

Reptiles

The Operational Area does not overlap with the BIAs for green, hawksbill or loggerhead turtles and no regionally important nesting sites are in the immediate vicinity. However, the southern part of the Operational Area overlaps slightly with the flatback turtle internesting BIA. Leatherback turtles may also occur occasionally in the Operational Area during their migration to waters in south-east Asia from December to January. Foraging loggerhead turtles are a conservation value of the Argo Rowley Terrace Commonwealth Marine Reserve (CMR). Generally however, marine turtles are expected to occur in low numbers in the offshore waters of the Operational Area.

Sea snakes may occur within the Operational Area, but tend to be found in the shallow waters around coral reefs. Sea snakes are not expected to be common in the Operational Area.

Sharks and Rays

The region within and around the Operational Area experiences high species richness of cartilaginous fish, including sharks, sawfish and rays (Commonwealth of Australia 2012). A Whale shark foraging BIA has been defined along the edge of the continental shelf in the south of the Operational Area. Other shark and ray species include makos and manta rays. Species of sawfish are unlikely to be present in the Operational Area given the species preference for coastal waters, embayments and estuaries.

Commercial Fish and Shellfish Species

Commercial (and recreational) fish species that may occur in the Operational Area include demersal fish species (living close to or in association with the seabed) on the continental shelf and slope. Demersal species tend to aggregate around seabed features and hard, rocky areas of seabed including Glomar Shoal, Rankin Bank, and rocky escarpment and slope habitats associated with the 'Ancient coastline at 125 m depth contour' KEF and the 'Continental Slope Demersal Fish Communities' KEF.

Demersal fish species may include snappers and breams (e.g. goldband, crimson, saddletail, red, ruby, and brownstriped snapper, as well as red emperor and rosy threadfin bream); emperors (e.g. spangled emperor and blue-spot emperor); and groupers and rock cods (e.g. Rankin cod and eightbar grouper). Shark species such as sandbar shark and blacktip shark may also occur in the Operational Area.

Pelagic fish species, such as mackerels and tunas (e.g. Spanish mackerel, grey mackerel, southern bluefin tuna, yellowfin tuna, skipjack tuna) and billfish (marlin and swordfish) may occur over large areas in the open offshore waters.

Shellfish species include deep-water scampi which inhabit deep continental shelf and slope waters and are usually found on firm, shelly substrates at depths of 420 to 500 m (AFMA 2015), various species of prawns in shallow waters, and pearl oysters in shallow coastal waters outside of the Operational Area.

Consultation with the Department of Fisheries (DOF) indicates that the spawning periods of some fish species may coincide with Capreolus Phase II 3D MSS. However, many species are broadcast spawners, spawning multiple times and releasing numerous batches of eggs over an extended spawning period in shallow continental shelf waters. Suitable spawning and nursery habitats for demersal species are usually in shallow and sheltered waters, such as coastal embayments, inshore reefs, estuaries, seagrass beds and mangroves (DOF 2004; Kailola *et al*. 1993; Prokop 2006; Castro 1996; Grubbs *et al*. 2007; DL 2015; Bray 2011). While the Operational Area overlaps with the habitat and range of some species, the preferred spawning habitats for the majority of these species are not commonly found within the deep offshore waters of the Operational Area. Pelagic species spawn over large areas of coastal and offshore waters. Southern bluefin tuna spawning is known to occur between northern WA and Java, however, consultation with the Australian Southern Bluefin Tuna Industry Association indicated that the Operational Area is outside areas where southern Bluefin tuna are known to breed.

Birds

Migratory shore bird and seabird species are known to occur in the region. The majority of migratory bird species forage and rest in the region on their way between Northern Hemisphere breeding grounds and Northern Australian feeding grounds (i.e. East Asian–Australasian Flyway). Key sites in the region that support significant populations of migratory birds are Eighty Mile Beach (approximately 178 km southeast of the Operational Area) and the Montebello, Lowendal and Barrow islands (approximately 74 km south of the Operational Area). Seabird species (including terns, shearwaters, tropicbirds, frigatebirds and boobies) spend significant periods foraging across large distances over the open ocean.

Commonwealth and coastal waters, as well as the Argo-Rowley Terrace Commonwealth Marine Reserve, provide foraging habitat for a number of migratory shorebird and seabird species. A foraging BIA for wedge-tailed shearwaters overlaps the southern portion of the Operational Area. Waters surrounding the Rowley Shoals are designated as a foraging BIA for white-tailed tropicbirds (DOE 2015) and overlap with the eastern part of the Operational Area.

4.3 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

4.3.1 Protected Areas

Commonwealth Marine Reserves and State reserves relevant to the Capreolus Phase II 3D MSS and ZPI are listed below:

- Argo-Rowley Terrace Commonwealth Marine Reserve (overlaps Operational Area);
- Mermaid Reef Commonwealth Marine Reserve;
- Rowley Shoals State Marine Park;
- Dampier Commonwealth Marine Reserve; and
- Montebello Commonwealth Marine Reserve.

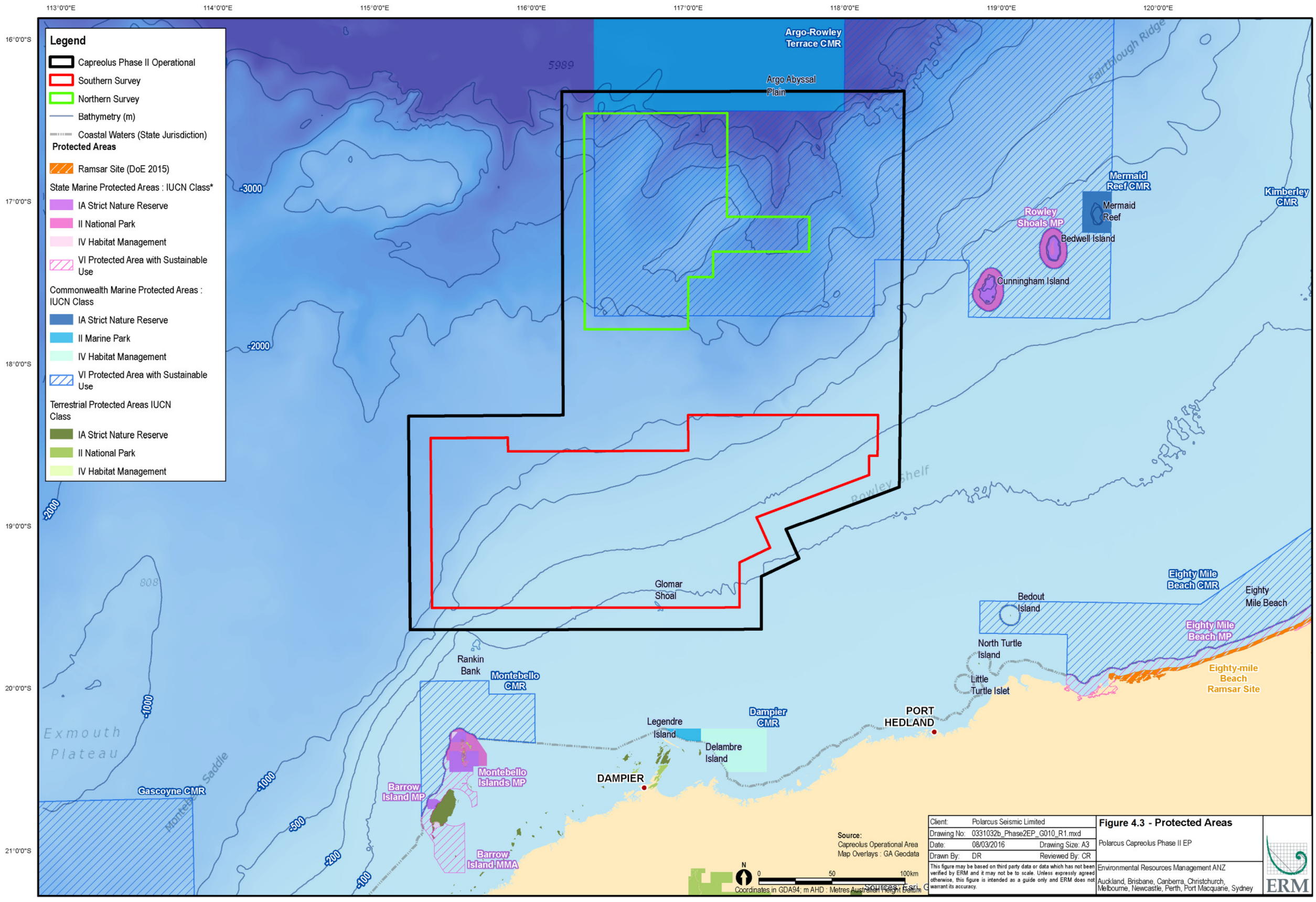
These protected areas are shown in *Figure 4.3*.

4.3.2 Commercial Fisheries

The key Commonwealth and State managed commercial fisheries that intersect the Operational Area and have the potential to interact with the Capreolus Phase II 3D MSS include:

- Pilbara Fish Trawl Fishery, which uses trawling techniques;
- Pilbara Trap Managed Fishery, using trap methods;
- Pilbara Line Fishery, which uses line methods;
- Mackerel Managed Fishery, which uses trolling or handline methods;
- North West Slope Trawl Fishery, which uses trawling techniques; and
- Western Tuna and Billfish Fishery, which uses line methods.

Other fisheries licence areas were also identified but are not expected to experience a significant interaction with the Capreolus Phase II 3D MSS, including the Southern Bluefin Tuna Fishery, the Western Skipjack Fishery and the Northern Shark Fisheries (not currently operational), as well as the North Coast Prawn Managed Fishery, Marine Aquarium Fish Managed Fishery, Specimen Shell Managed Fishery, Pearl Oyster Managed Fishery, Pilbara Developing Crab Fishery, Abalone Managed Fishery, Beche-de-mer Fishery, and West Coast Deep Sea Crustacean Managed Fishery (operate in shallow coastal waters away from the Operational Area).


Legend
Capreolus Phase II Operational
Southern Survey
Northern Survey
Bathymetry (m)
Coastal Waters (State Jurisdiction)
Protected Areas
Ramsar Site (DoE 2015)
State Marine Protected Areas : IUCN Class*
IA Strict Nature Reserve
II National Park
IV Habitat Management
VI Protected Area with Sustainable Use
Commonwealth Marine Protected Areas : IUCN Class
IA Strict Nature Reserve
II Marine Park
IV Habitat Management
VI Protected Area with Sustainable Use
Terrestrial Protected Areas IUCN Class
IA Strict Nature Reserve
II National Park
IV Habitat Management
113°0'0"E
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118°0'0"E
119°0'0"E
120°0'0"E
121°0'0"E
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21°0'0"S
Argo-Rowley Terrace CMR
Argo Abyssal Plain
5989
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-2000
-1000
-500
-200
-100
Fairbrough Ridge
Mermaid Reef CMR
Mermaid Reef
Rowley Shoals MP
Bedwell Island
Cunningham Island
Kimberley CMR
Rowley Shelf
Glomar Shoal
Bedout Island
Eighty Mile Beach CMR
Eighty Mile Beach
Eighty Mile Beach MP
North Turtle Island
Little Turtle Islet
Eighty-mile Beach Ramsar Site
PORT HEDLAND
Dampier CMR
Legendre Island
Delambre Island
DAMPIER
Rankin Bank
Montebello CMR
Montebello Islands MP
Barrow Island MP
Barrow Island MMA
Gascoyne CMR
Montebello Saddle
Exmouth Plateau
808
Source:
Capreolus Operational Area
Map Overlays : GA Geodata
N
0
50
100km
Coordinates in GDA94; m AHD : Metres Australian Height Datum
Sources: Esri
Client: Polarcus Seismic Limited
Drawing No: 0331032b_Phase2EP_G010_R1.mxd
Date: 08/03/2016
Drawing Size: A3
Drawn By: DR
Reviewed By: CR
This figure may be based on third party data or data which has not been verified by ERM and it may not be to scale. Unless expressly agreed otherwise, this figure is intended as a guide only and ERM does not warrant its accuracy.
Figure 4.3 - Protected Areas
Polarcus Capreolus Phase II EP
Environmental Resources Management ANZ
Auckland, Brisbane, Canberra, Christchurch, Melbourne, Newcastle, Perth, Port Macquarie, Sydney
ERM

4.3.3 Commercial Shipping

Commercial shipping is currently a major activity in the region, transporting goods between Australian and international ports, primarily resulting from growth in the resources sector (Commonwealth of Australia 2012).

Local vessel movements include vessels travelling to and from the ports at Dampier and Port Hedland. Shipping fairways from Port Hedland, Roebourne and Karratha run through the Operational Area and Southern Survey Area.

4.3.4 Petroleum Exploration and Production

The region supports a number of petroleum exploration and production licences and infrastructure within or adjacent to the Operational Area.

Other seismic survey activities may occur in the region at the same time as the Capreolus Phase II 3D MSS. Polarcus will liaise with the proponents of other seismic activities accepted by NOPSEMA, which have the potential to overlap with the Capreolus Phase II 3D MSS or that may come within 40 km of the Operational Area.

4.3.5 Tourism and Recreation

Recreation and tourism activities in the region typically peak during the dry season and include recreational fishing, diving, snorkelling, wildlife watching and boating (Commonwealth of Australia 2012). These activities predominantly occur in State waters.

A distinct peak in recreational fishing activity in the region occurs between September and December (Parks and Wildlife 2013). Recreational fishing within the Operational Area may occur around the Glomar Shoal and Rankin Bank, however, due to water depths and the distance offshore, recreational fishing and charter boats are not expected to be common. Recreational fishing also occurs at Rowley Shoals (52 km east) and Bedout Island (109 km southeast).

4.3.6 Defence Activities

The Operational Area does not overlap with any Australian Department of Defence (DoD) training or exercise areas (DoD 2011) and no concerns have been raised by the DoD during the stakeholder consultation process.

4.3.7 World and National Heritage Sites

There are no World Heritage or National Heritage Sites within or near to the Operational Area.

4.3.8 Marine Archaeology

Shipwrecks and relics older than 75 years are protected under the Commonwealth Historic Shipwrecks Act 1976. Based on a search of the Australian National Shipwreck Database and Western Australian Museum Shipwreck Database, there are no *historic* shipwrecks or relics confirmed within the Operational Area. There is one recent shipwreck within the Operational Area, the *Haw Kiet*, which was wrecked in 2003. The closest confirmed historic shipwreck (older than 75 years) is the *Trial* which was a sailing vessel wrecked in 1622 approximately 66 km south of the Operational Area (DOE 2016).

4.3.9 Aboriginal Heritage

No aboriginal heritage sites occur in the Operational Area given its offshore location.

4.3.10 Native Title

A search of the National Native Tribunal Register did not identify any Native Title areas within the Operational Area given its offshore location.

5 STAKEHOLDER CONSULTATION

5.1 CONSULTATION OBJECTIVES

Consultation has been planned and undertaken with the aim of:

- informing relevant stakeholders of the Capreolus Phase II 3D MSS;
- gathering information about the stakeholders' interests and activities in the Survey Area during the period over which the survey is proposed to be conducted; and
- providing stakeholders with the opportunity to raise issues and concerns about the survey.

The consultation approach has been informed by recognised guidance material, including:

- NOPSEMA's Information Paper: Consultation Requirements under the OPGGS (E) Regulations 2009;
- AFMA's Guidelines for Petroleum Industry Consultation with AFMA (AFMA 2015);
- The Western Australian Department of Fisheries' Guidance Statement for oil and gas industry consultation with the Department of Fisheries (Department of Fisheries, 2013); and

- Contacts for the Department of Industry and Science (DOIS) general and special notifications regarding the acreage areas offered for petroleum exploration in the 2015 Offshore Petroleum Exploration Acreage Release (DOIS 2015).

5.2 RELEVANT STAKEHOLDERS

Relevant stakeholders were identified by considering interests and activities that occur within or around the Operational Area. Relevant stakeholders were identified as:

- Departments and agencies of the Commonwealth to which the activities to be carried out may be relevant;
- Departments and agencies of the State of Western Australia to which the activities to be carried out may be relevant;
- Persons or organisations whose functions, interests or activities may be affected by the activities to be carried out; and
- Any other person or organisation that Polarcus consider relevant.

The identified relevant stakeholders are listed in *Table 5.1*.

Polarcus understand that the list of relevant stakeholders is not exhaustive and additional stakeholders may be identified as part of ongoing consultation. Should additional stakeholders be identified prior to, or during the survey, they will be provided information about the survey and invited to comment.

5.3 CONSULTATION METHOD

Information sheets, each including a map, were initially prepared and distributed by email or post to relevant stakeholders as listed in *Table 5.1* on 21 January 2016. The information sheet included a general overview of the survey including location, extent, survey design, environmental setting, and proposed management measures.

Stakeholders were asked to respond and provide initial feedback to a dedicated email address (ermaustraliapolarcus@erm.com) by 26 February 2016. The dedicated email address also aided in the tracking and recording of stakeholder and titleholder communication. Where stakeholders could only be contacted via post (e.g. individual State managed fishery license holders) or phone (e.g. land councils and tourism charter groups), the appropriate communication channels were used, whereby those parties were either sent hard copies of the information sheet or contacted via phone to relay the corresponding details of the information sheet. Where additional stakeholders were subsequently identified to Polarcus, these stakeholders have also been contacted with the above information.

5.4 CONSULTATION RESULTS

A summary of key issues and concerns raised by stakeholders during consultation for this EP and how these have been addressed is provided in *Table 5.1*.

Table 5.1 Summary of Consultation Results

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Commonwealth Government				
Department of Immigration and Border Protection formerly the Australian Customs and Border Protection Service	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016. Email resent on 4 February 2016. Email received 5 February 2016 advising of Dampier District office area contact details. Stakeholder consultation letter emailed on 12 February 2016.	Email received 12 February confirming no environmental concerns, but inquiring regarding border matters for vessels and crew.	Email acknowledgement sent on 19 February. Email forwarded to Polarcus for vessel and crew matters. Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Australian Fisheries Management Authority (AFMA)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	Stakeholder suggested verbally that they do not foresee any issues and will respond if any issues identified.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Australian Hydrographic Service	Stakeholder consultation letter emailed on 21 January 2016.	Email received on 25 January 2016 acknowledging receipt of letter and stating that AHS will issue relevant notice to mariners and request works details to be forwarded to them 2/3 weeks prior to commencement.	Email acknowledgement sent 2 February 2016. Fair consultation completed to date.	Survey information to be provided to AHS for inclusion in Notice to Mariners.
Australian Marine Safety Authority (AMSA) Marine Operations and Emergency Response Divisions	Stakeholder consultation letter emailed on 21 January 2016	Email received from AMSA Nautical Advice on 28 January 2016, providing chart of October 2015 AIS data, and stating: - seismic vessel must display appropriate shapes, lights and tail buoys; and - visual and radar watches to be maintained at all times. Request for vessel to notify AMSA's Joint Rescue Coordination Centre (JRCC) 24-48 hours before commencement. Request to contact AHS at least 4 weeks prior to commencement to NtM.	Email Response sent 19 February 2016, confirming that vessels will comply with requirements of COLREGS, as implemented through the Navigation Act 2012 and associated Marine Orders. Requirement to notify JRCC and AHS also acknowledged. Reply acknowledged by AMSA on 24 February 2016. Fair consultation completed to date.	AMSA JRCC and AHS to be kept informed as requested.
Department of the Environment – Marine Protected Areas – Parks Australia	Previously advised by Department of the Environment they did not need to be consulted regarding EPs under the assessment of NOPSEMA. Stakeholder consultation letter emailed to general Department of the Environment email address on 19 February 2016 (following advice from the WA Office of Environmental Protection Authority).	Department of the Environment acknowledged receipt of the email on 22 February 2016. Email received from Marine Protected Areas – Parks Australia asking whether the survey is proposed to overlap any Commonwealth Marine Reserves and requesting they be consulted during the ongoing development of the EP.	Email response sent 15 July 2016 confirming correct contact details for Marine Protected Areas – Parks Australia. Confirmation provided that northern survey area overlaps the Argo-Rowley Terrace CMR Multiple Use Zone (IUCN category VI area) and is located 1 km to the south of the Marine National Park Zone (IUCN category II area) at its closest point. Details of assessment of impacts and risks to values of the CMR were provided. A summary of the control measures proposed in the EP to manage the risks and ensure management of the activity is consistent with the management principles of each IUCN area were also provided. Marine Protected Areas – Parks Australia acknowledged receipt of email on 27 July and confirmed that management plans for all reserves currently under transitional management arrangements will be in place within the next 12 months and that mining operations (including petroleum exploration and recovery) are not consistent with IUCN categories other than Category VI (Multiple Use). When future management plans come into effect, the Director of National Parks expects titleholders to consider the need to revise and amend environment plans accordingly. Fair consultation completed to date.	Impacts and risks to values of the Argo-Rowley Terrace CMR were assessed in the EP and control measures proposed that are consistent with IUCN management principles, as confirmed by Marine Protected Areas – Parks Australia (refer to *Section 6.2*). Stakeholder will be kept informed of the survey.
National Native Title Tribunal	Stakeholder consultation letter emailed on 21 January 2016	Email received 29 January 2016, with attached Native Title database search results showing overlap between the survey areas and the Representative Aboriginal and Torres Strait Islander Body Area, represented by the Kimberley Land Council Aboriginal Corporation.	Email acknowledgement sent 3 February 2016, confirming that details have been sent to the Kimberley Land Council Aboriginal Corporation. Fair consultation completed to date.	Stakeholder will be kept informed of the survey.

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Department of Defence	Stakeholder consultation letter emailed on 21 January 2016	Email received on 21 January 2016 stating that the DOD is not a stakeholder for the survey and requesting they be removed from the distribution list.	Fair consultation completed to date.	No further action required.
Department of Communications	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Department of Industry and Science	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Department of Foreign Affairs and Trade (DFAT)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016. Email re-sent 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Western Australia Government				
WA Department of Environment Regulation	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	Email received 4 February 2016 confirming that the activity is not considered under DER's regulatory functions and requesting that DER is removed from the mailing list.	Fair consultation completed to date.	No further action required.
Department of Mines and Petroleum (DMP)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	Email received 25 February 2016 confirming that DMP does not require any further information at this stage and that the activity will be assessed by NOPSEMA. Request pre-start and completion notifications to be sent to DMP. Link provided for DMP's Consultation Guidance Note regarding reportable incidents.	Email reply sent 28 March 2016, confirming that pre-start and completion notifications will be provided to DMP, and that reportable incident notifications and reports will be completed in accordance with the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009. Fair consultation completed to date.	Stakeholder will be kept informed of the survey as requested.
Department of Fisheries (DOF)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	Email reply received 16 February 2016 with letter response (dated 12 February 2016) attached. DoF noted letter was valid for 6 months and requested that, if the survey has not commenced within 6 months, Polarcus contact DoF again 3 months prior to commencement. Letter response included: 1) Consultation - Request for Polarcus to contact WAFIC, Pearl Producers Association, Recfishwest, and individual licence holders, and to identify mitigation strategies. 2) Fishing activities in the area - Table of commercial fishery licences and interests in the region. 3) Fish Spawning - Table of commercially important fish species' known spawning periods in the North Coast Fisheries Bioregion, and request to identify strategies to minimise impacts on spawning. 4) Oil Pollution Emergency Plans - Details of DoF spill response officer provided. 5) Biosecurity - Risk assessment, mitigation and reporting recommendations and requests. 6) Expectation/Implementation - Request for written response detailing impacts and mitigation strategies.	Email reply sent 28 March 2016, including: 1) Consultation - Confirmation of consultation undertaken and commitment to ongoing consultation. 2) Fishing activities in the area - Confirmation that commercial fishery licences and interests listed had been consulted and that the Pilbara Developing Crab Fishery had been added to the consultation list. Confirmation of controls that will be implemented to minimise interactions with fishing activities. 3) Fish Spawning/Aggregation - Confirmation that spawning periods have been accounted for in the EP, but spawning habitat is limited in the Operational Area. Confirmation that the Glomar Shoal KEF will be excluded from the survey, and that minimum source and soft-start controls will be implemented and therefore localised and temporary behavioural impacts are expected. Southern part of survey to be excluded between July and October to avoid Humpback whale migration; therefore avoids shallowest area during Rankin cod and mackerel spawning. 4) Oil Pollution Emergency Plans - Confirmation that details of DoF spill response officer have been noted. 5) Biosecurity - Confirmation of mitigation and reporting measures that will be implemented. 6) Closing Remarks on DoF Expectations/ Implementation - Confirmation that details will be included in the EP. Acknowledged request for further consultation if survey not commenced within 6 months of letter and confirmed that Polarcus will make reasonable efforts to provide timely notifications. Fair consultation completed to date.	Potential impacts and risks to fish and commercial fisheries, as well as biosecurity risks have been assessed in the EP and appropriate control measures provided to reduce risks to ALARP and acceptable levels (refer to Section 6). Stakeholder will be kept informed of the survey.
WA Department of Transport (Maritime Environmental Emergency Response)	Stakeholder consultation letter emailed on 21 January 2016.	Email received 21 January 2016 acknowledging receipt Email received 27 January 2016 stating that the survey is outside of DoT jurisdiction and advising we contact AMSA.	Email acknowledgement sent to DoT on 2 February 2016, confirming consultation will continue with AMSA. Fair consultation completed to date.	Stakeholder will be kept informed of the survey as requested.

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Department of Parks and Wildlife (DPAW)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	Email received 5 February, recommending consideration of pygmy blue whales and capacity to deal with oiled wildlife should a spill occur.	Email sent 19 February 2016 confirming that the EP will consider risks to pygmy blue whales and will include an OPEP aligning with the National Plan for Maritime Environmental Emergencies, and Operational and Scientific Monitoring arrangements. Fair consultation completed to date.	Potential impacts and risks to pygmy blue whales have been assessed and appropriate control measures provided to reduce risks to ALARP and acceptable levels (refer to Section 6). The EP includes an OPEP and other control measures to prevent and reduce the impacts from a hydrocarbon spill. Stakeholder will be kept informed of the survey.
Office of the Environmental Protection Authority	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016. Email re-sent on 4 February 2016.	Email received 10 February 2016 acknowledging receipt and forwarding the email to appropriate branch in the EPA. Email received 12 February 2016 confirming that the EPA do not consider themselves to be a relevant stakeholder, but suggesting we liaise with the Commonwealth Department of the Environment.	Email acknowledgement sent 19 February 2016 and stating that a copy of the stakeholder letter has been sent to the Department of the Environment. Fair consultation completed and closed.	No further action required.
Member for Pilbara	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	Email received 04 February 2016 acknowledging receipt of stakeholder information and advising that they have no concerns regarding the survey.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Member for Derby West Kimberly	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Shire of Broome	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Town of Port Hedland	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016. Email re-sent 4 February 2016.	Email received 04 February 2016 acknowledging receipt.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Shire of Wyndham East Kimberley	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016. Email re-sent 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Federal Member for Durack	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Commercial Fisheries & Associations				
Australian Fisheries Management Authority (AFMA) on behalf of the Commonwealth fisheries: • North West Slope Trawl Fishery • Western Tuna and Billfish Fishery • Western Skipjack Tuna Fishery • Southern Bluefin Tuna Fishery	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	Stakeholder suggested verbally that they do not foresee any issues and will respond if any issues identified.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Nickol Bay Prawn Managed Fishery	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Onslow Prawn Managed Fishery	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Specimen Shell Managed Fishery	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Pilbara Demersal Scalefish Fishery (incl. Pilbara Line Fishery, Pilbara Fish Trawl fishery, Pilbara Trap Managed Fishery)	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Mackerel Managed Fishery	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Marine Aquarium Fish Managed Fishery	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Pearl Oyster Managed Fishery (Pearl Producers Association)	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Beche-De-Mer Fishery	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
West Coast Deep Sea Crustacean Managed Fishery	Information sheet and map sent by mail to individual licence holders on 22 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Pilbara Developmental Crab Fishery	Information sheet and map sent by mail to individual licence holders on 18 March 2016 following recommendation from DoF.	No response received.	Fair consultation completed to date.	No response received. Stakeholders will be kept informed of the survey.
Western Australian Fishing Industry Council (WAFIC)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 4 February 2016 and confirmed email was received and forwarded to individual stakeholders.	No response received, although Polarcus is engaging with WAFIC generally regarding potential future improvements in consultation with fisheries.	No response received, although Polarcus is engaging with WAFIC generally regarding potential future improvements in consultation with fisheries. Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Australian Southern Bluefin Tuna Industry Association	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 12 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Australian Council of Prawn Fisheries	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made to Jim on 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Australian Fishing Trade Association	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Pearl Producers Association	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Western Australian Northern Trawl Owners Association	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
WA Seafood Exporters	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call attempted 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Westmore Seafoods	Stakeholder consultation letter emailed on 21 January 2016	Email received 1 February 2016 with details of fishing vessels with towed gear and fish traps expected in survey area and requesting the survey avoids fishing vessels. Also expressed concern about the impacts of seismic on migratory schooling fish in the Pilbara fisheries and Scampi habitat in the North West Slope Fishery.	Email Response sent 19 February 2016, confirming the measures that will be implemented to minimise potential interactions and explaining that the seismic vessel will be a 'vessel restricted in its ability to manoeuvre', as defined in AMSA Marine Order 30 (Prevention of collisions). Reassurance provided on potential effects to fish and scampi, but invited further comment if still concerned. Fair consultation completed to date.	Potential impacts to fish, scampi and commercial fisheries have been assessed in the EP and appropriate control measures provided to reduce risks to ALARP and acceptable levels (refer to Section 6). Stakeholder will be kept informed of the survey.
Northern Wildcatch Seafood Australia (NWSA)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Tuna West Indian Ocean Tuna Association (TWIOTA)	Stakeholder consultation letter emailed on 21 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
A Raptis and Sons	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 and 12 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Traditional Fisheries	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	Stakeholder verbally confirmed they have no specific concerns and they forwarded the letter to AFMA and the northern prawn fishery.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Australian Recreational Fishing Foundation	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Recreational Fishing, Charters, Marine Tourism Operators				
RecfishWest	Stakeholder consultation letter emailed on 21 January 2016	Email received 27 January 2016, confirming receipt and Cc'ing Karratha and Dampier Fishing Club Presidents.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Karratha Fishing Club	Email forwarded from RecfishWest on 27 January 2016. Polarcus email of acknowledgement sent 27 January 2016, inviting Karratha Fishing Club to comment.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Dampier Fishing Club	Email forwarded from RecfishWest on 27 January 2016. Polarcus email of acknowledgement sent 27 January 2016, inviting Dampier Fishing Club to comment.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Broome Fishing Club	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 4 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Western Australian Game Fishing Association	Stakeholder consultation letter emailed on 4 February 2016 following confirmation of contact details with Broome Fishing Club.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Absolute Ocean Charters	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Arrow Pearl Co. and vessel provider	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Broome Billfish Charters	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Broome Whale Watching (Sentosa Charters)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
North Star Cruises Australia	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016. Email re-sent 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Reel Teaser Charters	Stakeholder consultation letter emailed on 21 January 2016.	Email received 23 January 2016 acknowledging receipt of letter and stating that their vessel does travel between Broome and Exmouth a couple of times a year and may travel through the proposed survey area, however they do not see any issues that will affect their operations.	Email acknowledgement of receipt sent 2 February 2016. Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
The Great Escape Charter Company	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	Verbally confirmed no issues expected.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Diversity Charter Company	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 and 12 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Kimberly Marine Tourism Association	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	Verbally confirmed no issues expected.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Derby Visitor Centre	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 11 February 2016.	Verbally confirmed email received, but activity is not near Derby and therefore not concerned about the activity.	Fair consultation completed and closed.	No further action required.
Odyssey Expeditions	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
One Tide Charters	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016. Email re-sent 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Kingfisher Tours	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	Verbally advised that they do not operate in the Dampier or the Port Hedland area.	Fair consultation completed and closed.	No further action required.
Aviair	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Peregrine Bird Tours	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	Verbally advised that they operate out of Victoria. No tours operated recently in WA and none expected.	Fair consultation completed and closed.	No further action required.
Kimberley Bird Watching	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	Verbally advised that they do not operate in the area.	Fair consultation completed and closed.	No further action required.
Kimberley Air Tours	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Kimberley Whale Watching	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Kimberley Outback Tours	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Ports and Shipping				
Kimberley Port Authority	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 11 February 2016. Email re-sent 11 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Pilbara Ports Authority	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made on 11 February 2016. Email re-sent 11 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Environmental Non-Governmental Organisations				
Australian Marine Conservation Society	Stakeholder consultation letter emailed on 21 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Australian Conservation Foundation	Stakeholder consultation letter emailed on 21 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Conservation Council of WA	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 11 February 2016. Contact details provided for PEW TRUST (see below).	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Pew Trust	Stakeholder consultation letter emailed on 11 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
World Wildlife Fund	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 12 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Wilderness Society	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 11 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
International Fund for Animal Welfare (IFAW)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 12 February 2016. Email re-sent 12 February 2016.	Email received 15 February 2016 stating IFAW does not have the capacity to respond in detail at this time. If capacity becomes available at a later date IFAW will endeavour to send detailed feedback.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Save the Kimberley	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 11 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Environs Kimberley	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 11 and 12 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Centre for Whale Research (CWR)	Stakeholder consultation letter emailed on 21 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Australian Marine Mammal Centre	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 12 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Land Councils				
Northern Land Council	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 11 February 2016. Email resent on 11 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Kimberley Land Council Aboriginal Corporation	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 11 February 2016. Email resent on 11 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Industry				
Broome Chamber of Commerce and Industry	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Port Hedland Chamber of Commerce	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
APPEA	Stakeholder consultation letter emailed on 21 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Carnarvon Petroleum Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Shell Development (Australia) Pty Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Woodside Energy Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Finder Exploration Pty Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Karoon Gas Australia Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Eni Australia Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
BHP Billiton Petroleum (Australia) Pty Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Exxon Mobil	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Statoil	Polarcus notified and sent pre-funding proposal letter on 13th April 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Quadrant Energy Pty Ltd	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
BP Australia	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Santos	Polarcus notified and sent pre-funding proposal letter on 13th April 2016. Follow up meeting completed 12th May 2016.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Cue Exploration Pty Ltd	Stakeholder identified. Stakeholder to be engaged during Access Authority (AA) / Special Prospecting Authority application process.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Tap Oil Limited	Stakeholder identified. Stakeholder to be engaged during Access Authority (AA) / Special Prospecting Authority application process.	No response received concerning the EP.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Telecommunications cable operators				
Telstra	Stakeholder consultation letter emailed on 21 January 2016.	Email received 09 February 2016 acknowledging receipt and advised that the proposed survey is in the vicinity of an out-of-service submarine telecommunications cable and to please take care to avoid entanglement with the cable.	Email acknowledgement sent 19 February 2016 and information forwarded to Polarcus. Fair consultation completed to date.	Stakeholder will be kept informed of the survey.
Nextgen	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Sinopec Oil and Gas Australia (Puffin) Pty Ltd	Stakeholder consultation letter emailed on 21 January 2016.	No response received.	Fair consultation completed to date.	No response received. Stakeholder will be kept informed of the survey.
Oil Spill Response Organisations				
Australian Marine Oil Spill Centre (AMOSC)	Stakeholder consultation letter emailed on 21 January 2016. Follow-up call made 10 February 2016.	Email received 10 February 2016 thanking Polarcus for keeping them informed and advised no concerns regarding the survey.	Fair consultation completed to date.	Stakeholder will be kept informed of the survey.

Stakeholder	Initial Consultation Undertaken	Stakeholder Response	Polarcus Reply and Status Assessment	How Issue / Concern Addressed
Potential Concurrent Seismic Surveys				
TGS Canning-Northern Carnarvon Multi Client Marine Seismic Survey PGS Titan Multi Client 3D Marine Seismic Survey Searcher Seismic Bilby 2D Phase 3 Multi-client Marine Seismic Survey CGG Davros Phase II MultiClient 3D Marine Seismic Survey Plus others, if identified.	Polarcus will liaise with other seismic operators prior to and during the survey.	N/A	N/A	Consultation with operators of seismic surveys potentially occurring concurrently within the Survey Area will be conducted prior to and during the Capreolus Phase II 3D MSS. If concurrent seismic activities actually occur, simultaneous operations management measures will be agreed and implemented including a minimum separation distance of 40 km between seismic vessels.

5.5 ONGOING CONSULTATION

Polarcus will continue to engage with relevant stakeholders (as identified during the course of the consultation described here) prior to and during the Capreolus Phase II 3D MSS, as appropriate. This includes ongoing engagement to inform stakeholders about key milestones and activities and any other relevant information. The schedule for ongoing consultation with stakeholders is given in *Table 5.2*.

Should any additional concerns be raised, or new information provided by existing or new stakeholders prior to, or during the survey, these concerns and/or information will be assessed for their merits and a response provided. As required, follow-up actions, including triggers for further consultation with relevant stakeholders, will be managed through the Polarcus Management of Change Procedure.

Table 5.2 Schedule for Ongoing Consultation

Stakeholder	Ongoing communication schedule
All relevant stakeholders with the exception of those requesting no further consultation.	Provide advance notice of commencement of each stage of the survey, including final survey location and timing, to other marine users (including relevant commercial fisheries licence holders) via Notice to Mariners. Provide update should any details of area or timing change during the course of the survey. Provide notice of survey completion following completion.
AHS	To be contacted through hydro.ntm@defence.gov.au no less than 4 working weeks prior to the commencement of each stage of the survey for the promulgation of related Notices to Mariners,
AMSA	AMSA's Joint Rescue Coordination Centre (JRCC) to be contacted through rccaus@amsa.gov.au for Auscoast warning broadcasts before operations commence. JRCC to be provided vessels details and area of operation and need to be advised when the survey starts and ends.
NOPSEMA	Provide notice of start and end of each stage of the Capreolus Phase II 3D MSS at least 10 days before commencement and within 10 days after completion, respectively using Regulation 29 Notification Form. Provide monthly and incident reports during the survey and Environmental Performance Report within 2 months of completing each stage of the survey, as detailed in *Section 9.6* of this EP.
DMP	Provide pre-start notifications confirming the start date(s) for the each stage of the survey approximately one week prior to commencement and cessation notifications to inform upon completion of acquisition.
DoF	Contact DoF for further consultation if the survey has not commenced within six months of the date of their letter (dated 12th February 2016). If practicable, taking into account survey timing restrictions such as those caused due to vessel availability, environmental sensitivities, and weather conditions, re-consultation with DoF is requested to occur 3 months prior to commencement of the survey.

6 ENVIRONMENTAL IMPACTS AND RISKS

6.1 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHOD

The risk assessment was undertaken in accordance with the Polarcus Risk Assessment Procedure, Risk Management Procedure and the Polarcus Risk Matrix (*Figure 6.1*). The Polarcus Risk Assessment and Risk Management procedures are aligned with the *Australian Standard/New Zealand Standard (AS/NZS) ISO 31000:2009 Risk Management* and *Handbook 203:2012 Managing Environment-related Risk* (Standards Australia/Standards New Zealand 2009 and 2012, respectively). The risk assessment process followed the following steps:

- Identification of potential environmental hazards associated with the seismic survey's planned activities and credible unplanned events;
- Identification of physical, biological, and socioeconomic receptors within the environment that may be affected by the activities (planned and unplanned), as well as identification of particular environmental values and sensitivities;
- Evaluation of the potential consequences of these hazards to the identified receptors with legal compliance in place but without other control measures, and determination of the 'inherent' risk;
- Identification of appropriate control measures (i.e. those in addition to legal requirements) if the inherent risk is not deemed low and acceptable;
- Evaluation of the residual risk with control measures in place;
- Determination of whether the environmental impacts and risks have been reduced to levels that are demonstrably ALARP and whether they are acceptable; and
- Development of environmental performance outcomes, performance standards, and measurement criteria.

A risk assessment was undertaken for the Capreolus Phase II 3D MSS by way of an environmental risk assessment workshop conducted on 16 February 2016, to identify and assess the risks associated with the survey. The workshop was supported by background literature, predictive modelling (e.g. for sound emissions and oil spills) and discussions with relevant seismic operations personnel, vessel management personnel and environmental specialists. The identification of risks and the selection of appropriate controls for these risks were also informed by Polarcus' experience in conducting other seismic surveys in Australia and elsewhere.

The risks were determined using the Polarcus Risk Matrix (*Figure 6.1*) and interpreted in accordance with *Table 6.1* (further descriptions of consequence) and *Table 6.2* (interpretation of risk). Where several potential impacts were identified for an activity, the consequence and likelihood categories were determined based on the worst credible potential impacts.

Further controls were considered to reduce the likelihood of the impact occurring (i.e. preventative) and/or reduce the consequence of the impact (i.e. mitigation) and in turn reduce the risk to ALARP.

6.2 SUMMARY OF IMPACTS, RISKS AND CONTROL MEASURES

A summary of the environmental hazards, impacts and controls determined through the risk assessment is provided in *Table 6.3*.

Further detail on the environmental impacts and risks, as included in the EP, is provided in *Section 6.3* (planned activities) and *Section 6.4* (unplanned events).

People	Environment	Property Value Technical	Reputation	Security	Severity	Never Heard Of "A"	Rarely Occurs "B"	Occasionally Occurs "C"	Regularly Occurs "D"	Occurs All the Time "E"
No health effect. No Injury	No Discharge	Less than $ 5K	No Impact	No Harm	0					
Slight work related illness FAC	Slight Discharge <5 liters	Less than $ 50K.	Slight Impact	Slight Breach Handled Internally	1					
Minor work related illness RWC or MTC	Minor Discharge >5 liters - <100	Less than $500K	Minor Impact Limited Exposure	Minor breach Local Authorities	2					
Extensive work related illness. LTI	Extensive Discharge >100 liters - <1m³	Less than $5M.	Extensive Impact National Exposure	Extensive Breach Threat to Operations	3					
Fatality or Major illness	Major Discharge >1m³ - <10m³	Less than $10M	Major Impact Regional Exposure	Major Breach Loss of Operations	4					
Fatalities or Major Illnesses (multiples)	Massive Discharge >10m³	Exceeding $10M.	Massive Impact International Exposure	Massive Breaches Company Lockdown	5					

Manage for Continuous Improvement	Incorporate Risk Reduction Measures	Intolerable Risk – All Stop

Figure 6.1 Polarcus Risk Matrix

Table 6.1 Further Descriptions of Environmental Consequences

Severity Ranking	Severity Label	Description
0	None	No environmental consequences
1	Slight	Slight environmental damage where restoration can be handled internally and no breaches of legislative requirements have been made
2	Minor	Large-scale damage to the environment with no lasting effects, restoration can be handled internally and a single breach of legislative requirements
3	Extensive	Environmental damage requiring external resources for restoration and involving many breaches of legislative requirements
4	Major	Severe environmental damage requiring extensive measures for restoration and involving widespread breaches of legislative requirements
5	Massive	Persistent severe environmental damage resulting in ongoing breaches of legislative requirements and major financial consequences

Table 6.2 Interpretation of Risk

Risk Conclusion	Interpretation	Explanation
LOW RISK	Acceptable	No additional controls are required. Consideration may be given to effective solutions or improvements that impose no significant cost burden. Monitoring is required to ensure that the controls are maintained.
MEDIUM RISK	Acceptable if ALARP	Efforts should be made to reduce the risk, but the cost of prevention should be measured and limited. Risk reduction methods should be implemented within a defined time period.
HIGH RISK	Not acceptable / intolerable	Work should not be started or continued until the risk has been reduced to an acceptable level. If it is not possible to reduce the risk even with unlimited resources, work has to remain prohibited.

Table 6.3 Summary of Environmental Impacts, Risks and Control Measures

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Planned Activities										
Physical Presence	Entanglement or collision between marine fauna and vessels or towed equipment.	Marine fauna (i.e. marine mammals, turtles, whale sharks).	A collision between a vessel and marine fauna, or entanglement in towed seismic equipment has the potential to cause injury or death.	Extensive (3)	Rarely occurs (B)	**Low**	• At least one MFO will be present on the seismic vessel supported by trained crew. The MFO will detect the presence of marine fauna in the vicinity of the survey vessel(s) for the duration of the survey and will ensure approach distances required by EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans are implemented when survey vessels are in transit at all times when visibility allows visual detection. • Requirements of Part 8 Division 8.1 of the EPBC Regulations 2000, applicable to cetaceans, will also be implemented for whale sharks and turtles. • Turtle guards will be fitted on tail buoys to prevent any individual turtles becoming trapped. • Seismic survey activities will be conducted at least 50 km away from the Humpback whale migration BIA during the peak Humpback whale migration periods (July to October) to minimise physical presence in areas expected to have the greatest numbers of migrating Humpback whales. • If safe and practicable to do so, any fauna found to be entangled in wet equipment shall be returned to the ocean immediately and subsequent required reporting to the Department of the Environment will be undertaken.	Extensive (3)	Rarely occurs (B)	**Low**
Physical Presence	Disruption/interference with other users in the Operational Area.	Other users in the Operational Area (i.e. commercial and recreational fishing, commercial shipping vessels, petroleum operations).	Disruptions to other users and activities are expected to be localised and temporary.	Minor (2)	Occasionally occurs (C)	**Low**	• Vessels will maintain appropriate lighting, shapes, navigation and communication at all times to inform other users of the position and intentions of the vessel, in compliance with the Navigation Act 2012 and associated Marine Orders. • A 24 hour visual, radio and radar watch will be maintained for vessels in the vicinity of the Operational Area. • Other users who may be present in the Operational Area will be advised of survey activities through pre-mobilisation consultation; Notice to Mariners issues by the AHS prior to survey mobilisation and following demobilisation; and Daily reports provided to the AMSA JRCC. • Seismic vessels, support vessels and associated equipment will only operate within Petroleum Safety Zones around petroleum production facilities within the Survey Area if facility titleholder / operator approval has been confirmed; and operations are undertaken in accordance with close-pass procedures. • During operation of the seismic source, a minimum separation distance of 40 km shall be maintained between the Capreolus Phase II 3D MSS seismic vessels and other operating seismic survey vessels. • At least one support vessel will be present with each seismic survey vessel in a survey area when the seismic vessel is in operation and when safe to do so (e.g. outside of inclement weather periods). • Each streamer will be clearly marked with a tail buoy	Minor (2)	Rarely occurs (B)	**Low**
Sound Emissions from the Seismic Source	High intensity impulsive sound emitted from seismic sources has the potential to impact cetaceans in the following ways: • Changes to hearing as a result of high sound	Cetacean species that may potentially be impacted include: • Migrating pygmy blue whales • Migrating humpback whales	Physiological impacts may occur to a small number of individuals in the unlikely event they remain in close proximity to the seismic source. Temporary behavioural changes in transient animals for up to several kilometres from the	Extensive (3)	Occasionally occurs (C)	**Medium**	• Minimum source size selected (3,480 in^3) to acquire survey data and meet the geophysical objectives of the survey • Part A of EPBC Policy Statement 2.1 will be applied in full, including: o Observation zone: 3+ km horizontal radius from the seismic source; o Low power zone: 2 km horizontal radius from the seismic source; o Shut-down zone: 500 m horizontal radius from the seismic source; o Pre-Start-up Visual Observations; o Soft-start Procedures; o Start-up Delay Procedures;	Extensive (3)	Rarely occurs (B)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
	levels at close range to the seismic source, including: o temporary threshold shift (TTS); or o permanent threshold shift (PTS); • Behavioural impacts resulting from disturbance, or masking or interfering with biologically important sounds.	• Other cetacean species	seismic source. Stronger avoidance behaviours may occur within a few kilometres.				o Operational Shut-down and Low-power Procedures; o Night-time and Low Visibility Procedures; o Sighting Reports • No operation of the seismic source within 50 km of the humpback migration BIA during the migration period (July to October). A 50 km exclusion buffer around the humpback whale migration BIA will be generated based on the humpback whale migration GIS shapefile, sourced from the Department of the Environment, and will be uploaded onto the seismic survey vessels' electronic navigation system. • A MFO will be on board the seismic vessel and on duty during daylight hours during the survey. • During operation of the seismic source, a minimum separation distance of 40 km shall be maintained between the Capreolus Phase II 3D MSS seismic vessels and other operating seismic survey vessels. • PAM will be available on board the seismic vessels and will be used during night-time and low visibility data acquisition (night-time and low visibility conditions to be determined by the MFO) • A PAM operator will be on board the seismic vessel and on duty during night time and low visibility conditions during the survey. • If three whale sightings occur within the 3 km Observation Zone within a 24 hour period (commencing from the time of the first sighting): o Shut-down Zone will be extended from 500 m to 2 km and normal procedures will only resume after a period of 24 hours has elapsed with less than three whale sightings within the 3 km Observation Zone; or o The seismic vessel will relocate to an alternative survey line (taking into account the whale's travel direction and speed) and will not return within 24 hours. • If three whale instigated power-down or shut-down situations occur during a 24 hour period (commencing from the time of the first whale instigated shut-down): o The seismic vessel will relocate to an alternative survey line (taking into account the whale's travel direction and speed) and will not return within 24 hours; or o If the seismic vessel is unable to relocate to an alternative survey line, seismic acquisition will only continue with the 2 km shut-down zone applied and night-time/low visibility operations will cease until there has been a 24 hour period, which included seismic operations during good visibility conditions, during which no shut-downs/power-downs have occurred for whales. • If three consecutive instances of moving to another survey line occur: o The seismic vessel will relocate to another area (minimum separation distance of 20 km from the position where the last whale instigated shutdown occurred, taking into account the whale's travel direction and speed) and will not return within 24 hours; or o If the seismic vessel is unable to relocate more than 20 km away, seismic acquisition will only continue with the 2 km shut-down zone applied and night-time/low visibility operations will cease until there has been a 24 hour period, which included seismic operations during good visibility conditions, during which no shut-downs/power-downs have occurred for whales. • Crew, survey personnel, MFO's and PAM operators will be briefed in the marine fauna observation, separation distance estimation, controls and reporting requirements relevant to this EP, including adaptive management measures.			

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Sound Emissions from the Seismic Source	High intensity impulsive sound emitted from seismic sources has the potential to impact fish in the following ways: • Mortal injury or recoverable injury (including PTS) of fish at very close range to the seismic source. • Temporary changes in hearing (TTS). • Behavioural impacts resulting from disturbance, or masking or interfering with biologically important sounds. • Mortality of eggs and larvae.	Fish receptors that may potentially be impacted include: • Demersal and pelagic fish species • Fish eggs and larvae (spawning)	Temporary behavioural impacts to demersal and pelagic fish. Potential larval mortality limited to the immediate vicinity of the seismic source, though impacts are likely to be minimal given the broadcast nature of spawning by key fish species in the region over the spawning periods.	Minor (2)	Occasionally occurs (C)	**Low**	Consistent with the WA Department of Fisheries' recommended mitigation strategies for the conduct of seismic surveys off the WA coast (DOF 2013), which was reiterated during the consultation process, Polarcus will implement the following controls: • Soft-start procedures to provide fish with advanced opportunity to move away from the source. • Minimum source size selected (3,480 in^3) to acquire survey data and meet the geophysical objectives of the survey • No operation of the seismic source within 1 km of the Glomar Shoal KEF. A 1 km exclusion buffer around the Glomar Shoal KEF will be generated based on the Glomar Shoal KEF GIS shapefile, sourced from the Department of the Environment, and will be uploaded onto the seismic survey vessels' electronic navigation system.	Minor (2)	Occasionally occurs (C)	**Low**
Sound Emissions from the Seismic Source	High intensity impulsive sound emitted from seismic sources has the potential to impact sharks and rays in the following ways: • Physiological injury at very close range to the seismic source. • Behavioural avoidance impacts.	Whale sharks	Whale sharks may show avoidance behaviour to the seismic source but are unlikely to remain close enough to the source to suffer physiological injury.	Extensive (3)	Rarely occurs (B)	**Low**	• Minimum source size selected (3,480 in^3) to acquire survey data and meet the geophysical objectives of the survey • Crew and survey personnel will be briefed in marine fauna observation, separation distance estimation, controls and reporting requirements • A MFO will be on board the seismic vessel and on duty during daylight hours during the survey. • Soft-start procedures to provide sharks with advanced opportunity to move away from the source. • A 500 m shut-down zone from the operating source will be applied to whale sharks as per the shut-down zone for whales in EPBC Act Policy Statement 2.1.	Extensive (3)	Rarely occurs (B)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Sound Emissions from the Seismic Source	High intensity impulsive sound emitted from seismic sources has the potential to modify the behaviour of commercially targeted fish species, which may also affect commercial catches and productivity.	Commercial fisheries	Temporary and localised disruptions to fishing effort may occur, although target fish behaviours are not expected to change long term and the overall productivity of fisheries is not anticipated to be significantly affected.	Minor (2)	Occasionally occurs (C)	**Low**	• Minimum source size selected (3,480 in^3) to acquire survey data and meet the geophysical objectives of the survey • No operation of the seismic source within 1 km of the Glomar Shoal KEF. A 1 km exclusion buffer around the Glomar Shoal KEF will be generated based on the Glomar Shoal KEF GIS shapefile, sourced from the Department of the Environment, and will be uploaded onto the seismic survey vessels' electronic navigation system. • Soft-start procedures to provide fish with advanced opportunity to move away from the source. • During operation of the seismic source, a minimum separation distance of 40 km shall be maintained between the Capreolus Phase II 3D MSS seismic vessels and other operating seismic survey vessels.			
Sound Emissions from the Seismic Source	High intensity impulsive sound emitted from seismic sources has the potential to impact marine turtles in the following ways: • Mortal injury or recoverable injury (including PTS) to marine turtles at very close range to the seismic source. • Temporary changes in hearing (TTS). • Behavioural disturbance impacts.	Internesting, foraging and migrating marine turtles	Physiological impacts at close range to the source are unlikely The behaviour of a small number of turtles may be impacted during the survey, given the survey's offshore location.	Extensive (3)	Rarely occurs (B)	**Low**	• Minimum source size selected (3,480 in^3) to acquire survey data and meet the geophysical objectives of the survey. • Soft-start procedures. • Visual observations and a 500 m shut-down zone will be implemented for marine turtles as per the shut-down zone for whales required under EPBC Act Policy Statement 2.1. • Operation of the seismic source at low power (lowest possible setting) or shut-down within Flatback turtle internesting BIA. The boundary of the flatback turtle internesting BIA will be generated based on the flatback turtle internesting BIA GIS shapefile, sourced from the Department of the Environment, and will be uploaded onto the seismic survey vessels' electronic navigation system. • A suitably experienced MFO will be on board the survey vessel during all activities. • Crew briefing will include marine fauna observation, separation distance estimation, controls and reporting requirements.	Extensive (3)	Rarely occurs (B)	**Low**
Sound Emissions from the Seismic Source	Underwater sound associated with the operation of the seismic source has the potential to cause physiological effects and/or behavioural disturbance to benthic invertebrates.	Benthic and pelagic invertebrates, including: • Sessile benthic invertebrates (e.g. molluscs, echinoids) • Commercially targeted benthic invertebrate species, including Scampi (*Metanephrops australiensis*) • Pelagic invertebrates (e.g. cephalopods and prawns)	Overall, research indicates that the majority of marine benthic invertebrates will only respond to seismic sources at extremely close ranges and more sensitive mobile species, such as Scampi, or pelagic species, such as squid, may demonstrate avoidance of the source.	Slight (1)	Rarely occurs (B)	**Low**	• Minimum source size selected (3,480 in^3) to acquire survey data. • During operation of the seismic source, a minimum separation distance of 40 km shall be maintained between the Capreolus Phase II 3D MSS seismic vessels and other operating seismic survey vessels. • No operation of the seismic source within 1 km of the Glomar Shoal KEF. A 1 km exclusion buffer around the Glomar Shoal KEF will be generated based on the Glomar Shoal KEF GIS shapefile, sourced from the Department of the Environment, and will be uploaded onto the seismic survey vessels' electronic navigation system.	Slight (1)	Rarely occurs (B)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Sound Emissions from the Seismic Source	Underwater sound emissions have the potential to impact the conservation values of the Argo-Rowley Terrace CMR and/or be inconsistent with IUCN management principles.	The conservation values associated with the Argo-Rowley Terrace CMR include: • Important foraging areas for migratory seabirds and loggerhead turtles • Important area for sharks, (found in abundance around the Rowley Shoals) • Representative examples of deep offshore water habitats and communities	• Foraging birds (diving underwater) may be briefly exposed to underwater sound, resulting in a startle response. • Physiological impacts to loggerhead turtles at close range to the source are unlikely. The behaviour of a small number of turtles may be impacted during the survey. • Sharks may show avoidance behaviour to the seismic source. Sharks found in abundance around the Rowley Shoals (the conservation value) will not be impacted. • No discernible or lasting impacts to deep-water benthic communities are expected. • Control measures are proposed that are consistent with the CMR's IUCN management principles.	Extensive (3)	Rarely occurs (B)	**Low**	As per the above control measures, plus: • The seismic source will be reduced to low power (lowest possible setting) or shut-down when within less than 1 km of the Argo Rowley Terrace CMR Marine National Park Zone (IUCN II area). • No operation of the seismic source (at any power level) within the Argo-Rowley Terrace CMR Marine National Park Zone (IUCN II area). • The Argo Rowley Terrace CMR IUCN II area and a 1 km exclusion buffer will be generated based on the Argo Rowley Terrace CMR IUCN II area GIS shapefile, sourced from the Department of the Environment, and will be uploaded onto the seismic survey vessels' electronic navigation system.	Extensive (3)	Rarely occurs (B)	**Low**
Sound Emissions from Vessels and Helicopters	The potential hazard associated with vessel and helicopter noise is the potential to cause behavioural disturbance to marine fauna.	Marine fauna that may potentially be impacted by vessel and helicopter noise include: • Cetaceans • Marine turtles • Whale sharks • Seabirds	Occasional, short term and localised disturbance to marine fauna.	Minor (2)	Occasionally occurs (C)	**Low**	• Vessel activities will be undertaken in accordance with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans. • Helicopter movements will be undertaken in accordance with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans. • Crew induction will include marine fauna observation, separation distance estimation, controls and reporting. • Propulsion systems to be maintained in good working order (manufacturer's specifications). • Requirements of Part 8 Division 8.1 of the EPBC Regulations 2000, applicable to cetaceans, will also be implemented for turtles and whale sharks.	Minor (2)	Occasionally occurs (C)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Liquid Waste Management and Disposal	Potential hazards associated with liquid waste discharge in the Operational Area are: • Temporary and localised reduction in water quality; and • Minor and temporary toxicity impacts on marine biota.	• Water quality • Marine biota – ecological communities and marine fauna	Highly localised and short term changes to water quality and limited impacts to marine biota.	Slight (1)	Rarely occurs (B)	**Low**	• Vessels will hold a current International Sewage Pollution Prevention Certificate (ISPP) Certificate and International Oil Pollution Prevention (IOPP) Certificate. • Sewage will be treated in accordance with MARPOL using an IMO-approved sewage treatment plant, a sewage comminuting and disinfecting system or a sewage holding tank, where applicable depending on vessel gross tonnage or people capacity. • All sewage will be handled, stored and discharged in accordance with the Protection of the Sea (Prevention of Pollution from Ships) Act 1983, including: o No discharge within 12 nautical miles from land; and o No discharge when vessel is travelling at < 4 knots. • Food waste will be macerated to <25 mm and then only discharged when the vessel is en route and is more than 12 Nm from the coastline. • For vessels greater than 100 T (or certified for >15 persons on board), a Waste Management Plan will be developed, and vessels greater than 400 T will have a waste management log book, in accordance with MARPOL 73/78. • Vessels > 400 T will have an oil-in-water separator on board and maintain oil usage management log book, in accordance with MARPOL 73/78. • Oil-in-water separator on board shall be maintained and operated so that the bilge stream is treated to reduce hydrocarbon concentrations below 15 ppm in accordance with MARPOL 73/78 prior to discharge. • Treated bilge water will be discharged only when the vessel is en route and is more than 12 nautical miles from land. • Oil Detection Monitoring Equipment on board the survey vessels will be regularly calibrated to ensure monitoring readings are accurate.	Slight (1)	Rarely occurs (B)	**Low**
Solid Waste Management and Disposal	If solid wastes on board vessels are not managed or disposed of appropriately, small quantities of solid waste (e.g. packaging and other domestic waste products) may be released with the potential to impact the environment. The potential hazards associated with the discharge of solid wastes in the Operational Area are: • Temporary and localised reduction in water quality; and • Interactions with marine biota (e.g. contact, entanglement, ingestion).	• Water quality • Marine biota – ecological communities and marine fauna	Highly localised and short term changes to water quality and limited impacts to individual fauna. No impacts to marine fauna populations.	Slight (1)	Rarely occurs (B)	**Low**	• Vessels >100 T (or certified for >15 persons on board) have a Waste Management Plan, in accordance with MARPOL 73/78. • Vessels >400 T (or certified for >15 persons on board) will have waste management log book, in accordance with MARPOL 73/78. • Bins available for the segregation of waste as per the vessel Waste Management Plan, and bins for potentially wind-blown waste are covered (e.g. using lids or netting). • Solid and hazardous wastes generated during the survey are segregated on board the vessels and are either incinerated (using an IMO-approved incinerator, on survey vessel only) or appropriately disposed of at a licensed onshore facility in accordance with the Vessel Waste Management Plan. • Solid waste generation will be minimised and recycling of non-hazardous solid waste wherever practicable.	Slight (1)	Rarely occurs (B)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Artificial Light Emissions	Artificial light resulting from navigational and safety lighting for seismic survey/support vessels may disrupt marine fauna behaviour.	Marine fauna sensitive to artificial lighting (i.e. turtles, fish and seabirds).	Localised and short term changes in fauna behaviour.	Minor (2)	Occasionally occurs (C)	**Low**	• Survey crews shall be instructed to minimise unnecessary external lighting where practicable during the activity (note that lighting for the purpose of safety or navigation purposes is necessary). • Opportunities to further reduce lighting on vessels used for the survey shall be reviewed prior to the survey commencing.	Minor (2)	Rarely occurs (B)	**Low**
Atmospheric Emissions	Atmospheric emissions have the potential to result in a localised reduction in air quality in the immediate vicinity of the vessel exhaust and to contribute to greenhouse gases (GHG) in the atmosphere.	Air quality in the immediate vicinity of the vessel exhaust and global levels of GHG in the atmosphere.	Short term and localised reduction in air quality. No discernible effect on sensitive receptors is expected. Survey emissions represent a small contribution to overall Australian and global GHG emissions to the atmosphere.	Slight (1)	Regularly occurs (D)	**Low**	• Vessel to have a valid International Air Pollution Prevention (IAPP) certificate. • Vessels will use MGO during the survey, which will have an ultra-low sulphur content of ≤3.5%by mass. • Vessel engines maintained according to manufacturer's specifications. • Incinerator certified and maintained according to manufacturer's specifications. • Fuel usage for the survey recorded.	Slight (1)	Occasionally occurs (C)	**Low**
Introduction of Invasive Marine Species	Introduction of IMS to the Operational Area has the potential to occur through: • biofouling of vessel hull; • exchange of ballast waters; and • biofouling of in-water survey equipment.	Marine ecological communities	If successfully established, IMS may result in: • Competition, predation or displacement of native species. • Alteration of natural ecological processes. • Introduction of pathogens with the potential to impact on ecological health.	Extensive (3)	Rarely occurs (B)	**Low**	• Vessel hull and niches confirmed to be free of IMS prior to mobilisation into Australian waters. • Survey and support vessels will have all necessary Department of Agriculture and Water Resources biosecurity approvals prior to mobilisation, including Quarantine Pre-Arrival Report (QPAR) clearance for vessels entering Australian territorial waters. • All vessels will comply with the requirements of the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009) of which key requirements are: o Maintenance of a Biofouling Record Book outlining marine fouling management actions o Completion of an IMS risk assessment prior to vessel entry into Australian waters which concludes a low risk of IMS presence; and o In-water equipment free of marine fouling prior to the commencement of the survey. • All vessels will maintain a current anti-fouling coating that complies with the requirements of Annex 1 of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships and the requirements of the Protection of the Sea (Harmful Antifouling Systems) Act 2006. • Streamers will be inspected, maintained and cleaned during retrieval prior to deployment in the Operational Area and during retrieval within the Operational Area (e.g. due to transit, crew change, inclement weather) to reduce biofouling. • Exchange of ballast water will occur > 12 nm from land and in water depths of > 50 m in accordance with the Australian Ballast Water Management Requirements (Department of Agriculture and Water Resources 2016). • Ballast water system on board the survey vessel treats water to reduce the risk of any living organisms being present prior to discharge.	Extensive (3)	Rarely occurs (B)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Unplanned Events										
MGO Spill Resulting from Vessel Fuel Tank Rupture	Surface hydrocarbon exposures resulting from an accidental MGO spill from a vessel fuel tank rupture (280 m^3) are expected to result in a localised and short term reduction in water quality with the potential to result in the following adverse effects on the environment: • Toxic effects on marine fauna that come into contact with surface hydrocarbons; • Toxic effects on ecological communities contacted by surface hydrocarbons; • Disruption to other marine users from the presence of the slick.	Marine fauna (e.g. marine mammals, turtles and sea birds), including values of the Argo Rowley Terrace CMR	Sub-lethal and lethal impacts to transient marine fauna from inhalation, ingestion or skin contact are expected to be limited and population level impacts are not expected.	Extensive (3)	Rarely occurs (B)	**Low**	• Vessels utilise MGO which is stored in multiple fuel tanks on board. Fuel tanks can be isolated and contents transferred between them. • Seismic vessel will have a double hull design making a rupture highly unlikely, even in a collision situation. • Radar on board each seismic vessel is fitted with a collision alarm. • Vessels will maintain appropriate lighting, shapes, navigation and communication at all times to inform other users of the position and intentions of the vessel, in compliance with the *Navigation Act 2012* and associated Marine Orders. • A 24 hour visual, radio and radar watch will be maintained for vessels in the vicinity of the Operational Area. • Other users who may be present in the Operational Area will be advised of survey activities through: o Pre-mobilisation consultation o Notice to Mariners issued by the AHS prior to survey mobilisation and following demobilisation; and o Daily reports provided to the AMSA JRCC. • All vessels over 400 t (MARPOL 73/78 Annex I) hold approved and tested SOPEPs and crew are trained in its implementation. • In the event of a spill to the marine environment, the OPEP will be followed.	Extensive (3)	Rarely occurs (B)	**Low**
		Ecological communities (i.e. intertidal corals at Rowley Shoals).	No discernible impacts to ecological communities are expected from surface hydrocarbon exposures, given the potential for limited exposure and distance from the Operational Area.	Slight (1)	Rarely occurs (B)	**Low**		Slight (1)	Rarely occurs (B)	**Low**
		Other marine users (e.g. commercial fisheries, commercial shipping, offshore petroleum activities).	Potential impacts to other marine users include avoidance of the spill to prevent fouling of vessels and equipment, and consequential temporary displacement of vessels and activities from the area.	Minor (2)	Rarely occurs (B)	**Low**		Minor (2)	Rarely occurs (B)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
	Entrained hydrocarbon exposures within the top 20 m of the water column resulting from an accidental MGO spill from a vessel fuel tank rupture (280 m^3) are expected to result in a localised and short term reduction in water quality with the potential to result in the following adverse effects on the environment: • Toxic effects to fish assemblages that contact entrained hydrocarbons; and • Toxic effects on juvenile fish, eggs and larvae that may become entrained with hydrocarbon droplets.	Demersal and pelagic fish assemblages (including juvenile fish, eggs and larvae)	Due to the requirement for relatively long exposure times for concentrations to be significant, the low entrained exposures predicted by the stochastic modelling are only expected to impact juvenile fish, or entrained eggs and larvae which may be entrained with the hydrocarbon droplets. The proportion of juveniles, eggs and larvae that may be affected during the short duration of the spill is expected to be negligible.	Slight (1)	Rarely occurs (B)	**Low**		Slight (1)	Rarely occurs (B)	**Low**
MGO Spill Resulting from Vessel Refuelling failure	An accidental MGO spill during vessel refuelling (up to 25 m3) has the potential to result in the following adverse effects on the environment: • Toxic effects on marine fauna that come into contact with surface hydrocarbons; • Toxic effects to juvenile fish, eggs and larvae from entrained hydrocarbon droplets.	• Marine fauna (e.g. marine mammals, turtles and sea birds) • Demersal and pelagic fish assemblages (including juvenile fish, eggs and larvae)	Localised and short term impacts are predicted to occur to a limited number of marine fauna and fish assemblages in the immediate vicinity of the spill release location following the release in open and dispersive offshore waters.	Minor (2)	Occasionally occurs (C)	**Low**	• Bunkering contractor selection is made in accordance with the contractor selection procedure to ensure the contractor will use dry-break couplings. • All fuel transfer equipment shall be maintained and checked before each use. • No refuelling at sea will be undertaken within 25 km of land, shoals or islands. • Refuelling will only be undertaken during daylight hours and in suitable weather conditions. • Refuelling undertaken in accordance with Polarcus Bunkering Procedure including scuppers being plugged before bunkering commences. • Spill kits and scupper plugs are available on board survey vessels and crew are trained in their use • No refuelling operations will take place within the Argo Rowley Terrace CMR Marine National Park Zone (IUCN II area). • All vessels over 400 t (MARPOL 73/78 Annex I) hold approved and tested SOPEPs and crew are trained in its implementation. • In the event of a spill to the marine environment, the OPEP will be followed.	Minor (2)	Rarely occurs (B)	**Low**

Aspect of the Activity	Hazards	Receptors	Potential Impacts and Risks	Inherent Risk			Control Measures	Residual Risk		
				Con-sequence	Likelihood	Risk		Con-sequence	Likelihood	Risk
Hydraulic Fluid or Chemical Spill Resulting from Single Point Failure	Accidental spills of up to 1 m3 of hydraulic fluids or chemicals are expected to result in a localised and short term reduction in water quality with the potential to result in toxic effects on marine fauna.	Marine fauna and fish	Fluids spilt overboard have the potential to result in toxicity effects to marine fauna and fish in the immediate vicinity of the spill release location, through direct contact or accidental ingestion.	Minor (2)	Occasionally occurs (C)	**Low**	• Hydraulic fluids and chemicals will be selected in accordance with the Polarcus Chemical Control Procedure and will be selected to have the lowest environmental toxicity possible whilst meeting operational performance requirements. • Storage, handling and use of hazardous substances (including hydraulic fluids and chemicals) shall be in accordance with the Material Safety Data Sheet • Spill kits and scupper plugs are available on board survey vessels and crew are trained in their use • Bunded areas, spill kits and drains will be monitored and maintained as necessary. • All vessels over 400 t (MARPOL 73/78 Annex I) hold approved and tested SOPEPs and crew are trained in its implementation. • Spills of hydraulic fluid or chemicals will be cleaned up immediately, reported through the Polarcus Incident Reporting Procedure and waste materials managed in accordance with the vessel Waste/Garbage Management Plan.	Minor (2)	Rarely occurs (B)	**Low**
Accidental Loss of Survey Equipment	Disruption to other users of the Operational Area.	Other marine users (e.g. commercial fisheries)	Temporary and highly localised disruption to other users.	Slight (1)	Occasionally occurs (C)	**Low**	• Streamers will be deployed and retrieved in accordance with the Polarcus Deployment and Recovery of Streamers Procedure, of which key requirements include: o Ensuring weather conditions are appropriate for deployment and retrieval; o Ensuring tail buoy GPS is operational; o Monitoring deployment and retrieval closely; o Checking for physical damage; o Ensuring connection devices are in serviceable condition; o Storing all birds, floats, retrievers and acoustic racks immediately following recovery. • Streamers shall be fitted with redundant retainers, tail buoys and relative GPS. • Solid streamers shall be used for the survey • All lifting gear used for deployment and retrieval of equipment over the vessel shall be load rated for the working load. • AMSA, and other relevant stakeholders known to be in the Operational Area, will be notified in the event of equipment loss. • At least one support vessel will accompany each seismic vessel at all times and will, if necessary, assist in the recovery of lost equipment.	Slight (1)	Occasionally occurs (C)	**Low**
	Disturbance to the seabed.	Benthic habitats and ecological communities	No lasting impacts to benthic habitats and ecological communities are expected.	Slight (1)	Occasionally occurs (C)	**Low**		Slight (1)	Rarely occurs (B)	**Low**
Unplanned Anchoring	Anchoring has the potential to cause damage to seabed communities.	Benthic habitats and ecological communities	Any impacts on benthic habitats and communities would be highly localised and short term. Following removal of anchors, any disturbed areas would likely re-colonise over time.	Slight (1)	Rarely occurs (B)	**Low**	• No anchoring of survey or support vessels in the Operational Area (except during an emergency). • Seismic vessel shall have redundant propulsion available (e.g. thrusters, redundant main engine) • At least one support vessel will accompany each seismic vessel at all times and will, if necessary, assist in the recovery of lost equipment	Slight (1)	Rarely occurs (B)	**Low**

6.3 DETAILS OF ENVIRONMENTAL IMPACTS AND RISKS - PLANNED ACTIVITIES

6.3.1 Physical Presence

The survey may involve up to two seismic survey vessels each towing a seismic source and streamers, and up to four additional support vessels, at any one time. The potential environmental impacts and risks associated with the physical presence of vessels and equipment in the Operational Area are assessed below.

Environmental Impacts and Risks

Physical Presence
Identification of Hazards
The potential hazards associated with the physical presence of vessels and equipment in the Operational Area are: • Entanglement or collision between marine fauna and vessels or towed equipment; and • Disruption/interference with other users in the Operational Area.
Identification of Receptors
• Marine fauna (i.e. marine mammals, turtles, whale sharks) • Other users in the Operational Area (i.e. commercial and recreational fishing, commercial shipping vessels, petroleum operations)
Potential Environmental Impacts and Risks Evaluated in the EP
• A collision between a vessel and marine fauna, or entanglement in towed seismic equipment has the potential to cause injury or death. • Disruptions to other users and activities, expected to be localised and temporary.

6.3.2 Sound Emissions

Underwater sound will be generated by the seismic source, general vessel activities (including engine sound and operation of thrusters) and helicopter movements during crew transfers. As described in *Section 3.2*, there will be up to two seismic survey vessels, which will maintain a minimum separation distance of approximately 40 km when both are operating in the Operational Area. Each survey vessel will be supported by up to two support vessels and helicopters for refuelling, reprovisioning and crew changes.

6.3.3 Sound Emissions from the Capreolus Phase II 3D MSS Seismic Source

During the Capreolus Phase II 3D MSS, the seismic vessel will navigate a series of pre-determined sail lines at a speed of approximately 4.5 knots, emitting a series of acoustic pulses that will be directed down through the water column and seabed. The total volume of the planned seismic source is 3,480 in^3, with an operating pressure of approximately 2,000 psi. This is the minimum source size considered sufficient to achieve the required output to meet the geophysical objectives of the survey due to the water depth and anticipated depth to the geological target.

Seismic sound is characterised by high energy sound pulses of low frequency. Most of the sound energy produced by an airgun is in the range of 10-300 Hz, with the highest levels at frequencies less than 100 Hz (McCauley 1994). The rate of sound attenuation from the seismic source is dependent on local sound propagation characteristics, including seawater temperature and salinity profiles, water depth and seabed properties (McCauley 1994). While seismic sound is directed downwards, horizontal propagation can be detected at considerable ranges due to the high intensity and low frequency properties of the sound source.

Underwater sound can affect marine fauna in the following ways:

- Injury or changes to hearing. Hearing loss may be temporary (temporary threshold shift (TTS)) or permanent (permanent threshold shift (PTS));
- Disturbance and masking or interfering with biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey) leading to behavioural changes or displacement of fauna.

Sound level thresholds above which hearing loss (TTS/PTS), masking or behavioural disturbance may occur and vary widely between species and potentially between individuals of the same species. The occurrence and intensity of behavioural disturbance is highly variable and depends on a range of factors relating to the animal and situation.

The following risk assessments evaluate the potential impacts and risks of underwater sound to a variety of marine fauna, based on acoustic modelling results for the Capreolus Phase II 3D MSS and relevant literature.

Acoustic Modelling

Underwater acoustic modelling of sound propagation from the 3,480 in^3 seismic source was conducted for the Capreolus Phase II 3D MSS to determine the potential magnitude and extent of impacts to key marine fauna receptors.

The seismic source was calculated to have a maximum peak sound pressure level (peak SPL) of approximately 245 dB re 1 µPa at 1 m (source level), which equates to a sound exposure level (SEL) of 222 dB re 1µPa^2.s at 1 m (JASCO 2016). Peak SPL is the maximum absolute value of the instantaneous sound pressure during a specified time interval. It is an appropriate value for determining the risk of physiological impacts caused by intense transient signals.

SEL is a measure of energy and is often used for assessing cumulative exposure to sound over a specified duration and/or from multiple sources. SEL is calculated by summing up the cumulative pressure squared over time and is normalised to a one-second interval.

Modelling was undertaken at two locations considered representative of the water depths within the two survey areas (JASCO 2016). Site 1 is located towards the centre of the Northern Survey Area in water depths of approximately 2,725 m. Site 2 is located on the southern boundary of the Southern Survey Area, approximately 1 km from the Glomar Shoal KEF, in water depths of approximately 77 m (*Figure 6.2)*.

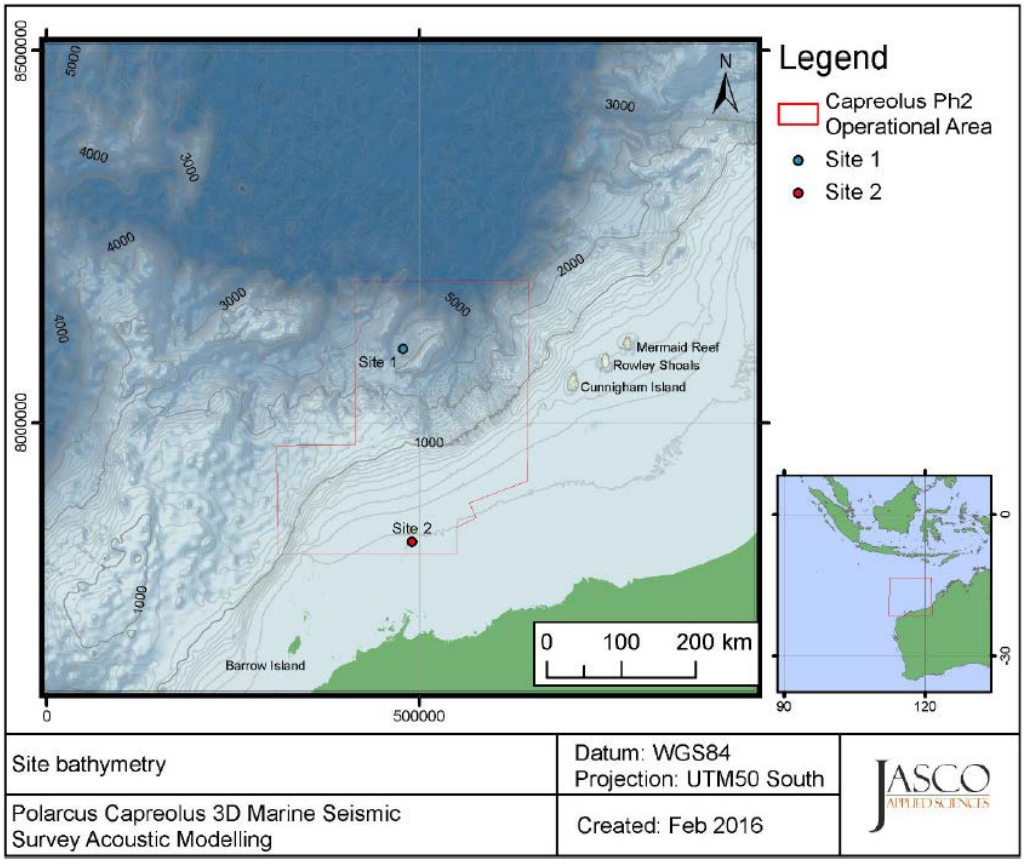

Figure 6.2 ***Acoustic modelling locations for the Capreolus Phase II 3D MSS (JASCO 2016)***

The sound propagation modelling was used to determine the potential spatial extent over which impacts may occur to marine receptors within and adjacent to the two survey areas, based on the acoustic impact criteria outlined below.

Cetaceans: Sensitivity and Acoustic Modelling Impact Threshold Criteria

Cetaceans are considered to be the most susceptible marine fauna species to impacts from underwater sound generated by seismic activities. Cetaceans in particular utilise their highly sensitive acoustic senses to monitor their environment and for communication, socialising, breeding and (for dolphins) foraging and feeding.

Southall *et al*. (2007) conducted a review of the scientific literature on cetacean hearing and identified three functional hearing categories based on the frequency hearing ranges of cetaceans (low, mid and high-frequency). Low frequency cetaceans (baleen whales such as humpback and blue whales) are considered to be most sensitive to sound from tens of Hz to approximately 10 kHz, which coincides with the frequency range of seismic signals (<500 Hz). Mid and high frequency cetaceans (toothed cetaceans such as dolphins and sperm whales) are considered to be most sensitive to sound greater than 1 kHz and are therefore less sensitive to the low frequency sound from seismic activities. Seismic signals will still be audible to mid and high frequency cetaceans.

Southall *et al*. (2007) and Wood *et al*. (2010) have developed SEL thresholds for injury (PTS) and TTS for cetaceans exposed to seismic sources that are widely accepted and applied across the industry for evaluation of potential impacts. The thresholds are frequency weighted according to the low, mid and high frequency functional hearing categories (m-weighting) (*Table 6.4*). The SEL thresholds are based on cumulative exposure over 24 hours.

Table 6.4 Temporary and Permanent Threshold Shift Criteria for Cetaceans

Functional Hearing Category	TTS (m-weighted SEL)	PTS (m-weighted SEL)
Low frequency cetaceans	177 dB re 1 μPa².s	192 dB re 1 μPa².s
Mid frequency cetaceans	183 dB re 1 μPa².s	198 dB re 1 μPa².s
High frequency cetaceans	164 dB re 1 μPa².s	179 dB re 1 μPa².s

After Southall *et al*. 2007 and Wood *et al*. 2012.

The thresholds developed by Southall *et al*. (2007) were used to determine the single pulse SEL exposure threshold of 160 dB re 1 μPa².s for 95% of seismic pulses at a 1 km range in EPBC Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (EPBC Policy Statement 2.1) (DEWHA 2008a), which has been used since by industry and regulators as best practice for the assessment of impacts from underwater sound generated by seismic activities and has been applied in this EP.

Cetaceans have also been observed to exhibit varying behavioural responses to underwater sounds (ranging from, for example, momentary pauses in vocalisations to changes in travel direction and behavioural avoidance) between rms SPLs of 140 and 180 dB re 1 µPa (Southall *et al*. 2007). Wood *et al*. (2012) proposed thresholds based on a graded probability of response with 10% response likelihood at an rms SPL of 140 dB re 1 µPa, 50% at an rms SPL of 160 dB re 1 µPa, and 90% response likelihood at an rms SPL of 180 dB re 1 µPa for most cetaceans.

These thresholds are consistent with U.S. National Marine Fisheries Service (NMFS) and National Oceanic and Atmospheric Administration (NOAA) behavioural response criteria of 160 dB re 1 µPa (unweighted) rms SPL (NMFS and NOAA 1995; NMFS 2000; NMFS 2014). Therefore, the assessment in this EP uses 160 dB re 1 µPa (unweighted) rms SPL as the threshold for likely behavioural response from cetaceans.

Impact threshold criteria applied during the acoustic modelling for cetaceans are presented in *Table 6.5*.

Table 6.5 Acoustic Modelling Impact Threshold Criteria for Cetaceans

Functional Hearing Category	Unweighted Single-pulse SEL (DEWHA 2008b)	Behavioural Impacts Unweighted rms SPL (NMFS 2014)
Low frequency cetaceans	160 dB re 1 $\mu Pa^2 \cdot s$	160 dB re 1 µPa
Mid frequency cetaceans		
High frequency cetaceans		

Fish: Sensitivity and Acoustic Modelling Impact Threshold Criteria

Fish may use sound to communicate, locate prey, detect predators, and as a cue for orientation (McCauley and Cato 2000). Fish vary widely in their vocalisations and hearing abilities even within families, but generally hear best at low frequencies below 1 kHz (Ladich 2000). Hearing sensitivity in bony fish is a function of the inner ear, specialised auditory structures and, if present, the swim bladder, which provides an indirect route for sound to reach the inner ear (Finneran and Hastings 2000). Some fish have a special connection between the swim bladder and the inner-ear, providing an enhanced indirect route. These fish are considered to be 'hearing specialists' as they are capable of detecting less intense and higher frequency sound waves compared to non-specialised fish ('hearing generalists'), and are therefore considered more sensitive to underwater sound.

Varying levels of hair cell damage in the auditory systems of fish can result in impacts ranging from TTS, recoverable injury, PTS and non-recoverable injury. Fish are also able to repair damaged hair cells and recover from damage that would otherwise cause permanent hearing loss (PTS) in other species; however, the relationship between the level of hair cell damage, hearing loss and cell regeneration is not clearly defined (Au and Hastings, 2008; Popper *et al*. 2014; Smith 2015; Liberman 2015).

Popper *et al*. (2014) reviewed available literature and proposed thresholds for mortal and recoverable injury (including PTS) in fish based on impulsive sound signals. Thresholds were proposed for three types of fish (depending on anatomical susceptibility to impacts from sound) starting at 207 dB re 1µPa (peak SPL) or 203 dB re 1µPa^2.s (24 hour cumulative SEL) for the most sensitive fish. A threshold of 186 dB re 1µPa^2.s (24 hour cumulative SEL) for TTS onset was also proposed for all fish types.

Popper *et al.* (2014) did not propose single pulse peak SPL thresholds for TTS in fish, owing to lack of convergence in available data, and inconsistencies in how TTS was determined in different studies. However, Popper *et al.* (2014) note that sound pressure levels are likely to be directly relevant to the onset of TTS in fish, particularly fish with swim bladders, which have the most sensitive hearing mechanisms.

Popper *et al*. (2005) identified TTS in fish exposed to seismic pulses resulted from peak SPLs between 205-207 dB re 1 µPa in fish with swim bladders, which is consistent with the peak SPL TTS onset threshold of 205-207 dB re 1 µPa applied for impulsive sound sources in the U.S. (Fisheries Hydroacoustic Working Group 2008; Stadler and Woodbury 2009) and recommended by Popper (*Pers. Comm*. 23 February 2016).

Popper *et al.* (2014) also observed that the risk of behavioural impacts to fish is high in the near-field, moderate at intermediate distances, and low in the far-field. Although actual distances are not quoted, these loosely correspond to near-field being in the tens of metres, intermediate being in the hundreds of metres, and the far-field being up to thousands of metres (Popper *et al. 2014*).

Impact threshold criteria applied during the acoustic modelling for fish, based on Popper *et al.* (2014) are presented in *Table 6.6*. Popper *et al.* (2014) also proposed a threshold for mortality of fish eggs and larvae based on available literature and these are also presented in *Table 6.6*.

Table 6.6 ***Acoustic Modelling Impact Threshold Criteria for Fish, Eggs and Larvae (Popper et al. 2014)***

Receptor	Mortal and Potential Mortal Injury	Recoverable Injury
	Peak SPL	
Fish: no swim bladder	213 dB re 1 µPa	213 dB re 1 µPa
Fish: swim bladder not involved in hearing	207 dB re 1 µPa	207 dB re 1 µPa
Fish: swim bladder involved in hearing	207 dB re 1 µPa	207 dB re 1 µPa
Fish eggs and larvae	207 dB re 1 µPa	-

Marine Turtles : Sensitivity and Acoustic Modelling Impact Threshold Criteria

Turtles are not considered to be as sensitive to sound as cetaceans. Marine turtles do not have an external hearing organ but can detect sound through bone-conducted vibration in the skull and by using their shell as a receiving surface (Lenhardt *et al*. 1985). The ear of marine turtles appears to be adapted to detect sound in water, with the retention of air in the middle ear suggesting that they are able to detect sound pressure (Popper *et al*. 2014).

Turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range 100 to 700 Hz (Bartol and Musick 2003), which coincides with the frequency range of seismic signals (<500 Hz).

Popper *et al*. (2014) presents a threshold for potential mortal injury to marine turtles from exposure to seismic pulses of 210 dB re 1 $\mu Pa^2.s$ (24 hour cumulative SEL) and 207 dB re 1 µPa (peak SPL), as presented in *Table 6.7*.

Popper *et al*. (2014) recommend that potential for hearing effects and behavioural disturbance to turtles be assessed qualitatively rather than strictly based on a specific threshold. For hearing effects including PTS and TTS, Popper *et al*. (2014) rated the likelihood as high in the near-field (in proximity to the source) and low in the intermediate to far-field. The likelihood was similarly rated as high in the near-field for behavioural disturbance, moderate in the intermediate-field and low in the far-field. Although specific distances were not ascribed to the near, intermediate and far-field by Popper *et al*. (2014), indicative distances of tens of meters from the source for the near-field, hundreds of meters for the intermediate-field, and thousands of meters for the far-field were provided.

McCauley *et al*. (2000) found that turtles showed behavioural responses (i.e. increase in swimming behaviour) to an approaching low frequency seismic array at received sound levels of approximately 166 dB re 1 µPa (rms SPL), and avoidance at around 175 dB re 1 µPa (rms SPL). Similarly, Moein *et al*. (1995) monitored the behaviour of penned loggerhead turtles to seismic sources operating at 175–179 dB re 1 µPa at 1 m. Avoidance of the seismic source was observed at first exposure but the turtles habituated to the sound over time. Consistent with these findings, a 166 dB re 1 µPa rms SPL has been used as the threshold level for a behavioural disturbance response by NMFS in the U.S. (NSF *et al*. 2011) (see *Table 6.7*).

Table 6.7 Acoustic Modelling Impact Threshold Criteria for Marine Turtles

Receptor	**Mortal and Potential Mortal Injury (Popper *et al.* 2014)** **Peak SPL**	**Behaviour (NSF *et al.* 2011)** **rms SPL**
Marine turtles	207 dB re 1 µPa	166 dB re 1 µPa

Acoustic Modelling Results

Results of modelled underwater sound propagation from Sites 1 (deep water) and 2 (shallow water) based on the described impact threshold criteria for cetaceans, fish (including eggs and larvae), and marine turtles are presented below.

The maximum horizontal distances to exceedance of impact threshold criteria for cetaceans are shown in *Table* 6.8; the maximum horizontal distances to exceedance of impact threshold criteria for fish, fish eggs and larvae are shown in *Table 6.9*; and the maximum horizontal distances to exceedance of impact threshold criteria for marine turtles are shown in *Table 6.10*.

In each case, the underwater sound field predicted by the propagation models was sampled such that the received sound level at each point in the horizontal plane was taken to be the maximum value over all modelled depths for that point. A 3 dB safety factor was applied to all modelled levels to account for variability in sound levels.

Two horizontal distances, relative to the source, are provided by JASCO (2016) for these distances:

- R_{max}, the maximum range at which the given sound level was encountered in the modelled maximum-over-depth sound field; and
- $R_{95\%}$, the maximum range at which the given sound level was encountered after exclusion of the 5% farthest such points. The farthest points are excluded to account for the possibility that the maximum-over-depth sound field footprint and, along a few azimuths, can extend far beyond the main ensonification zone because of environmental variations.

Regardless of the geometric shape of the maximum-over-depth footprint, $R_{95\%}$ is the predicted range that encompasses at least 95% of the area (in the horizontal plane) that would be exposed to sound at or above that level. Only R_{max} is reported for injury thresholds, which occur at distances where the field tends to be more regularly shaped and there are fewer receiver points.

Table 6.8 ***Horizontal Distances from the Source at which Single Pulse Sound Levels are Predicted to Drop Below Criteria for Cetaceans***

Impact Criteria	Distance	
	Site 1 (deep)	**Site 2 (shallow)**
DEWHA (2008b) Criteria 160 dB re 1 µPa².s, Unweighted Single-pulse SEL criterion for 95% of shots	Single-pulse SELs exceed the criterion (>160 dB re 1 µPa².s) at 1 km range at both locations	
Behavioural Impacts 160 dB re 1 µPa, Unweighted Single-pulse rms SPL	$R_{95\%}$ = 5.68 km R_{max} = 6.13 km	$R_{95\%}$ = 10.6 km R_{max} = 14.5 km

Table 6.9 ***Horizontal Distances (R_{max}) from the Source at which Single Pulse Sound Levels are Predicted to Drop Below Criteria for Fish, Eggs and Larvae***

Receptor	Distance	
	Site 1 (deep)	**Site 2 (shallow)**
Mortal and Potential Mortal Injury Impact Criteria		
Fish: no swim bladder	-	30 m
Fish: swim bladder not involved in hearing	2 m	60 m
Fish: swim bladder involved in hearing	2 m	60 m
Fish eggs and larvae	2 m	60 m
Recoverable Injury Impact Criteria		
Fish: no swim bladder	-	30 m
Fish: swim bladder not involved in hearing	2 m	60 m
Fish: swim bladder involved in hearing	2 m	60 m
Fish eggs and larvae	-	-

Table 6.10 ***Horizontal Distances from the Source at which Single Pulse Sound Levels are Predicted to Drop Below Criteria for Marine Turtles***

Impact Criteria	Distance	
	Site 1 (deep)	**Site 2 (shallow)**
Mortal and Potential Mortal Injury 207 dB re 1 µPa Peak SPL	R_{max} = 2.0 m	R_{max} = 60 m
Behavioural Impacts 166 dB re 1 µPa rms SPL	$R_{95\%}$ = 2.96 km R_{max} = 3.10 km	$R_{95\%}$ = 5.48 km R_{max} = 7.20 km

Contour maps of modelled underwater sound propagation at Sites A and B are shown in *Figure 6.3* and *Figure 6.4* respectively. *Figure 6.5* and *Figure 6.6* show predicted sound levels as vertical profiles of the water column along several radial pathways to illustrate the effects of varying bathymetry.

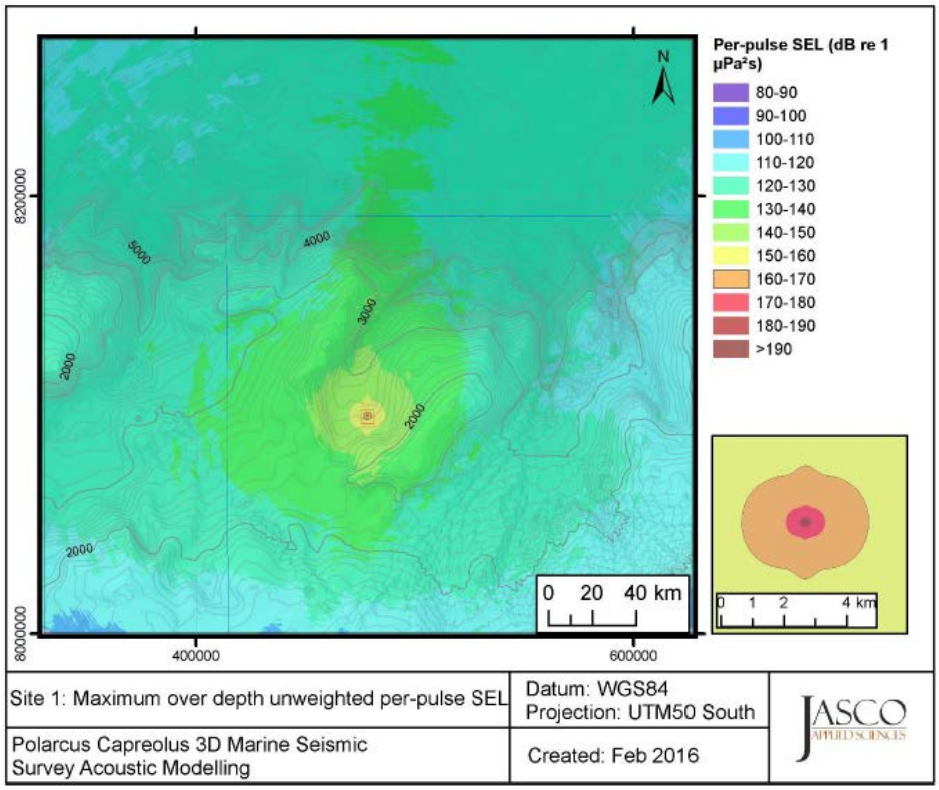

Figure 6.3 ***Site 1 (deep water): Sound level contour map showing per-pulse SEL (JASCO 2016)***

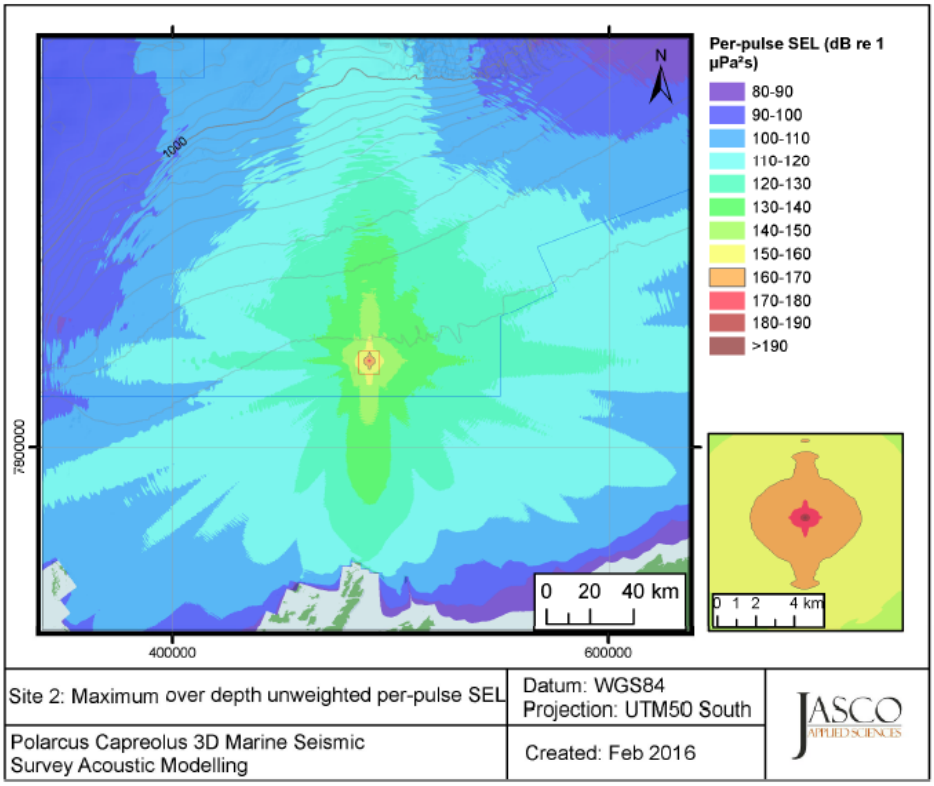

Figure 6.4 *Site 2 (shallow water): Sound level contour map showing per-pulse SEL (JASCO 2016)*

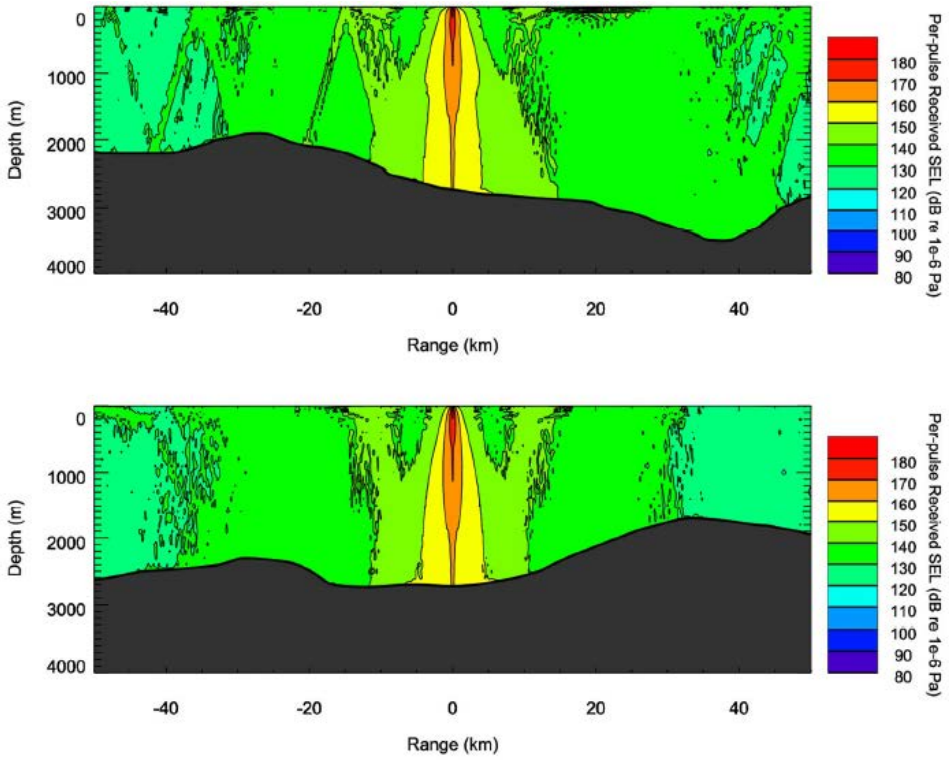

Figure 6.5 *Predicted SELs at Site 1 (deep water) as vertical profiles (JASCO 2016). Levels are shown along broadside (top; south to north) and endfire (bottom; west to east) directions to illustrate the propagation paths and effect of the bathymetry.*

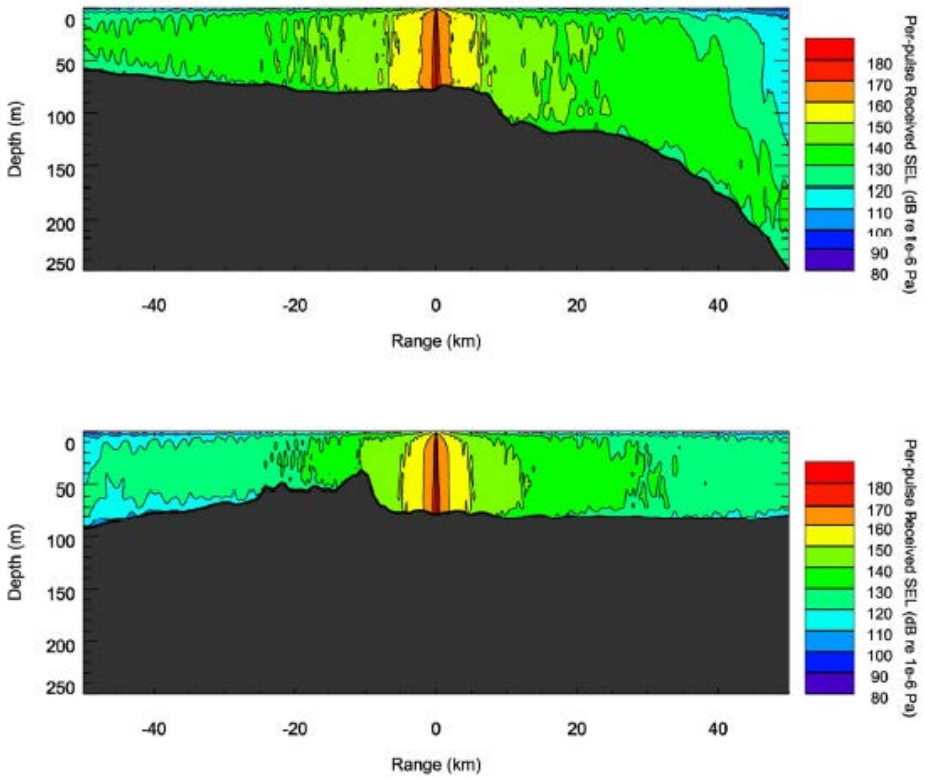

Figure 6.6 ***Predicted SELs at Site 2 (shallow water) as vertical profiles (JASCO 2016). Levels are shown along broadside (top; south to north) and endfire (bottom; west to east) directions to illustrate the propagation paths and effect of the bathymetry.***

Environmental Impacts and Risks

Seismic Sound Emissions - Cetaceans
Identification of Hazards

High intensity impulsive sound emitted from seismic sources has the potential to impact cetaceans in the following ways:
• Changes to hearing as a result of high sound levels at close range to the seismic source, including:
  o temporary threshold shift (TTS); or
  o permanent (permanent threshold shift (PTS);
• Behavioural impacts resulting from disturbance, or masking or interfering with biologically important sounds.

Identification of Receptors
Cetacean species that may potentially be impacted include: • Migrating pygmy blue whales • Migrating humpback whales • Other cetacean species
Potential Environmental Impacts and Risks Evaluated in the EP
• Physiological impacts may occur to a small number of individuals in the unlikely event they remain in close proximity to the seismic source. • Temporary behavioural changes in transient animals for up to several kilometres from the seismic source. Stronger avoidance behaviours may occur within a few kilometres.

Seismic Sound Emissions - Fish
Identification of Hazards
High intensity impulsive sound emitted from seismic sources has the potential to impact fish in the following ways: • Mortal injury or recoverable injury (including PTS) of fish at very close range to the seismic source. • Temporary changes in hearing (TTS). • Behavioural impacts resulting from disturbance, or masking or interfering with biologically important sounds. • Mortality of eggs and larvae.
Identification of Receptors
Fish receptors that may potentially be impacted include: • Demersal and pelagic fish species • Fish eggs and larvae (spawning)
Potential Environmental Impacts and Risks Evaluated in the EP
• Temporary behavioural impacts to demersal and pelagic fish. • Potential larval mortality limited to the immediate vicinity of the seismic source, though impacts are likely to be minimal given the broadcast nature of spawning by key fish species in the region over the spawning periods.
Seismic Sound Emissions – Sharks and Rays
Identification of Hazards
High intensity impulsive sound emitted from seismic sources has the potential to impact sharks and rays in the following ways: • Physiological injury at very close range to the seismic source. • Behavioural avoidance impacts.
Identification of Receptors
• Whale sharks
Potential Environmental Impacts and Risks Evaluated in the EP
Whale sharks may show avoidance behaviour to the seismic source but are unlikely to remain close enough to the source to suffer physiological injury.

Seismic Sound Emissions – Commercial Fisheries
Identification of Hazards
High intensity impulsive sound emitted from seismic sources has the potential to modify the behaviour of commercially targeted fish species, which may also affect commercial catches and productivity.
Identification of Receptors
• Commercial fisheries

Potential Environmental Impacts and Risks Evaluated in the EP
Temporary and localised disruptions to fishing effort may occur, although target fish behaviours are not expected to change long term and the overall productivity of fisheries is not anticipated to be significantly affected.

Seismic Sound Emissions – Marine Turtles
Identification of Hazards
High intensity impulsive sound emitted from seismic sources has the potential to impact marine turtles in the following ways: • Mortal injury or recoverable injury (including PTS) to marine turtles at very close range to the seismic source. • Temporary changes in hearing (TTS). • Behavioural disturbance impacts.
Identification of Receptors
• Internesting, foraging and migrating marine turtles
Potential Environmental Impacts and Risks Evaluated in the EP
• Physiological impacts at close range to the source are unlikely • The behaviour of a small number of turtles may be impacted during the survey, given the survey's offshore location.

Seismic Sound Emissions – Benthic Invertebrates
Identification of Hazards
Underwater sound associated with the operation of the seismic source has the potential to cause physiological effects and/or behavioural disturbance to benthic invertebrates.
Identification of Receptors
• Sessile benthic invertebrates (e.g. molluscs, echinoids) • Commercially targeted benthic invertebrate species, including Scampi (*Metanephrops australiensis*) • Pelagic invertebrates (e.g. cephalopods and prawns)
Potential Environmental Impacts and Risks Evaluated in the EP
Overall, research indicates that the majority of marine benthic invertebrates will only respond to seismic sources at extremely close ranges and more sensitive mobile species, such as Scampi, or pelagic species, such as squid, may demonstrate avoidance of the source.

Seismic Sound Emissions – Commonwealth Marine Reserve Conservation Values
Identification of Hazards
Underwater sound emissions have the potential to impact the conservation values of the Argo-Rowley Terrace CMR and/or be inconsistent with IUCN management principles.
Identification of Receptors
The conservation values associated with the Argo-Rowley Terrace CMR include: • Important foraging areas for migratory seabirds and loggerhead turtles • Important area for sharks, which are found in abundance around the Rowley Shoals relative to other areas in the region • Examples of deep offshore water habitats and communities of the Northwest Transition and Timor Province provincial bioregions • Connectivity between the existing Mermaid Reef Marine National Nature Reserve, the reefs of the Western Australian Rowley Shoals Marine Park, and the deeper waters of the region The conservation values of the CMR also include two KEFs, 'Canyons linking the Argo Abyssal Plain with the Scott Plateau' and 'Mermaid Reef and the Commonwealth waters surrounding Rowley Shoals', which are notable as areas of high biodiversity, enhanced productivity, and feeding and breeding aggregations. However, these KEFs are located approximately 236 km and approximately 40 km from the Operational Area respectively.
Potential Environmental Impacts and Risks Evaluated in the EP
• Foraging birds (diving underwater) may be briefly exposed to underwater sound if they dive near the seismic source when the seismic source is in operation, resulting in a startle response, but this is unlikely. • Physiological impacts to loggerhead turtles at close range to the source are unlikely. The behaviour of a small number of turtles may be impacted during the survey, given the survey's offshore location.
• Sharks may show avoidance behaviour to the seismic source but are unlikely to remain close enough to the source to suffer physiological injury. Sharks found in abundance around the Rowley Shoals (the conservation value) will not be impacted. • No discernible or lasting impacts to deep-water benthic communities are expected. • Control measures are proposed that are consistent with the CMR's IUCN management principles (refer to controls in *Section 6.2*).

6.3.4 Sound Emissions from Vessels and Helicopters

Vessel noise comprises a combination of continuous noise generated by engine and machinery noise, and modulated, broadband noise produced by propeller rotation and cavitations (Richardson *et al*. 1995; Southall 2009; Jensen *et al*. 2009; Wales & Heitmeyer, 2002; Hildebrand, 2009). Vessel noise varies with the size, speed, and engine type and the activity being undertaken. Noise levels for a range of vessels have been measured at 164-182 dB re µPa at 1 m (rms SPL) at dominant frequencies between 50 Hz and 7 kHz (Wyatt 2008; Simmonds *et al*. 2004; McCauley 1998).

For helicopters, the main source of noise is from the main rotor. Dominant tones from helicopters are generally below 500 Hz (Richardson *et al*. 1995). The penetration of noise into the ocean is dependent on the angle of the aircraft and its distance from the sea surface. Noise levels from a Bell 212 helicopter flying at altitudes of 610 to 152 m respectively were measured at 101 – 109 decibels (dB) at 3 m water depth (Richardson *et al*. 1995). This provides an indication of the low received level noise that may be expected from a helicopter.

Environmental Impacts and Risks

Sound Emissions – Vessels and Helicopters
Identification of Hazards
The potential hazard associated with vessel and helicopter noise is the potential to cause behavioural disturbance to marine fauna.
Identification of Receptors
Marine fauna that may potentially be impacted by vessel and helicopter noise include: • Cetaceans • Marine turtles • Whale sharks • Seabirds
Potential Environmental Impacts and Risks Evaluated in the EP
Occasional, short term and localised disturbance to marine fauna.

6.3.5 Liquid Waste Management and Disposal

The seismic survey and support vessels will generate liquid wastes associated with routine activities associated with the survey, including:

- domestic wastes (treated sewage, grey water, putrescible waste); and
- deck drainage and bilge water.

The survey vessel (s) will each have up to 60 persons on board, resulting in up to approximately 9 cubic metres of grey water and sewage discharges per vessel per day from domestic processes such as ablution, laundry and galley activities, and putrescible wastes primarily from food wastes.

Rainwater and wash-down water from deck areas and other open drainage areas on board the vessel may contain minor quantities of chemical residues (i.e. oil, grease, chemicals or detergent), and will require discharge.

The volume of drain discharge required during the survey is dependent on the amount of rainfall received and the frequency of the deck washing activities. Discharge from open drain areas will be conducted directly overboard.

Liquid wastes collected in the bilge consist of a mixture of water, oily residue, lubricants and cleaning fluids from various sources, including engines and machinery areas on board the vessel. The amount of bilge wastes accumulated on board is dependent on vessel characteristics, such as size, engine room design, and preventative maintenance schedule.

Environmental Impacts and Risks

Liquid Waste Management and Disposal
Identification of Hazards
Potential hazards associated with liquid waste discharge in the Operational Area are: • Temporary and localised reduction in water quality; and • Minor and temporary toxicity impacts on marine biota.
Identification of Receptors
• Water quality • Marine biota – ecological communities and marine fauna
Potential Environmental Impacts and Risks Evaluated in the EP
Highly localised and short term changes to water quality and limited impacts to marine biota.

6.3.6 Solid Waste Management and Disposal

Vessel-based activities will contribute to the generation of solid wastes, including non-hazardous wastes (e.g. paper, plastics, waste metal and glass, putrescibles in the form of food waste) and/or hazardous wastes (e.g. used oil, batteries, oil filters). The potential environmental impacts and risks associated with solid waste management and disposal in the Operational Area are assessed below.

Environmental Impacts and Risks

Solid Waste Management and Disposal
Identification of Hazards
If solid wastes on board vessels are not managed or disposed of appropriately, small quantities of solid waste (e.g. packaging and other domestic waste products) may be released with the potential to impact the environment. The potential hazards associated with the discharge of solid wastes in the Operational Area are: • Temporary and localised reduction in water quality; and • Interactions with marine biota (e.g. contact, entanglement, ingestion).
Identification of Receptors
• Water quality • Marine biota – ecological communities and marine fauna

Potential Environmental Impacts and Risks Evaluated in the EP
Highly localised and short term changes to water quality and limited impacts to individual fauna. No impacts to marine fauna populations.

6.3.7 Artificial Light Emissions

During the survey, vessels and survey equipment present in the Operational Area will display artificial lighting to meet navigational and safety requirements under the Prevention of Collision Convention (Marine Order 30, Issue 7). The potential environmental impacts and risks of artificial light emissions in the Operational Area are assessed below.

Environmental Impacts and Risks

Artificial Light Emissions
Identification of Hazards
Artificial light resulting from navigational and safety lighting for seismic survey/support vessels may disrupt marine fauna behaviour.
Identification of Receptors
Marine fauna sensitive to artificial lighting (i.e. turtles, fish and seabirds).
Potential Environmental Impacts and Risks Evaluated in the EP
Localised and short term changes in fauna behaviour.

6.3.8 Atmospheric Emissions

The vessels present in the Operational Area will generate atmospheric emissions from power generation equipment/engine exhaust and waste incinerators. The potential environmental impacts and risks of atmospheric emissions in the Operational Area are assessed below.

Environmental Impacts and Risks

Atmospheric Emissions
Identification of Hazards
Atmospheric emissions have the potential to result in a localised reduction in air quality in the immediate vicinity of the vessel exhaust and to contribute to greenhouse gases (GHG) in the atmosphere.
Identification of Receptors
Air quality in the immediate vicinity of the vessel exhaust and global levels of GHG in the atmosphere.

Potential Environmental Impacts and Risks Evaluated in the EP
Short term and localised reduction in air quality. No discernible effect on sensitive receptors is expected. Given the nature of the activity and the low level of emissions anticipated, survey emissions only represent a small contribution to overall Australian and global GHG emissions to the atmosphere.

6.3.9 Introduction of Invasive Marine Species

The survey will involve seismic data acquisition by one to two seismic vessels with the support of up to four support vessels. The seismic survey vessels will likely be mobilised from a foreign port, currently anticipated to be Singapore.

Vessels transiting from outside of the Operational Area have the potential to introduce invasive marine species (IMS) to the marine environment of the Operational Area. The potential environmental impacts and risks of introducing invasive marine species in the Operational Area are assessed below.

Environmental Impacts and Risks

Introduction of Invasive Marine Species
Identification of Hazards
Introduction of IMS to the Operational Area has the potential to occur through: • biofouling of vessel hull; • exchange of ballast waters; and • biofouling of in-water survey equipment. If successfully established, IMS may result in: • Competition, predation or displacement of native species. • Alteration of natural ecological processes. • Introduction of pathogens with the potential to impact on ecological health.
Identification of Receptors
• Marine ecological communities
Potential Environmental Impacts and Risks Evaluated in the EP
Impacts to marine ecological communities are unlikely given the offshore, deep water location of the Operational Area.

6.4 DETAILS OF ENVIRONMENTAL IMPACTS AND RISKS - UNPLANNED EVENTS

6.4.1 Hydrocarbon and Chemical Spills

Spill Sources and Properties

The following types of hydrocarbons and chemicals are likely to be present on the vessels in varying quantities during the survey:

- Marine Gas Oil (MGO) used to fuel the vessels;
- hydraulic fluids such as engine and synthetic oils required for equipment and engine use; and
- general purpose chemicals used for cleaning and maintenance

The characteristics and general behaviour of these hydrocarbons and chemicals in the event of a spill to the marine environment, are provided below.

Marine Gas Oil

MGO is classified as a Group I non-persistent oil according to the International Tanker Owners Pollution Federation (ITOPF) classifications. It is characterised by light hydrocarbon fractions that are 97.3% volatile to semi- and low-volatile and 2.7% persistent, resulting in rapid weathering and evaporation in the event MGO is spilled to the marine environment.

In the event of a surface release of MGO to the marine environment, the release is expected to spread rapidly and form a thin film on the surface, with the more volatile components and toxic fractions beginning to evaporate immediately following exposure to the atmosphere on the sea surface. Under moderate to strong wind conditions (e.g. >10 knots), some MGO may become entrained into the water column as droplets where it would be subject to dissolution, bacterial biodegradation and decay.

Depending on wind speeds, up to 40% of the MGO spill volume may evaporate in the first 12 to 24 hours. Of the remaining volume, a substantial proportion (e.g. up to 60% at wind speeds of 15 knots where wave action is a direct result of wind speeds) may partition into the water column within this timeframe (RPS APASA 2016).

Hydraulic Fluid

Hydraulic fluid is likely to be present in small quantities on board the seismic and support vessels. A spill of hydraulic fluid resulting in less than 1 m^3 released to the marine environment is considered likely to disperse and weather very rapidly in the open ocean environment of the Operational Area. The Polarcus Hazardous Substances Handling, Storage and Use Procedure guides the selection, and management, of hazardous substances (including hydraulic fluid) on board the seismic vessel.

The procedure explains that environmentally-friendly solutions will be sought out and considered as a replacement for hazardous substances that have been previously used in the industry.

Chemicals

Small quantities of chemicals may also be used and stored on board (e.g. for cleaning and maintenance purposes). If spilled to the marine environment, small volumes (less than 1 m^3) are expected to rapidly disperse naturally and weather in the open ocean environment. The Polarcus Chemical Control Procedure requires chemicals to be selected taking into account their environmental characteristics. Only chemicals approved using this procedure may be used or stored on board the seismic vessel.

Credible Spill Scenarios

Credible hydrocarbon and chemical spill scenarios were identified during the environmental risk assessment undertaken for the EP, taking into account:

- survey activities;
- known volumes of hydrocarbons and chemicals stored on the vessels, as well as material transfer rates and reaction times for spill detection and mitigation;
- design features inherent to the vessel and storage areas (e.g. bunds); and
- proximity to sensitive receptors and features of conservation significance.

The identified credible spill scenarios shown in *Table 6.11* provide a representative range of potential spills associated with the Survey. To understand the fate and trajectory of a potential spill, hydrocarbon spill modelling was undertaken on the identified worst case credible scenario. Given the volumes involved, impacts and risks associated with a single point failure or a vessel refuelling spill would be expected to be considerably less than those described for a vessel fuel tank rupture scenario.

Table 6.11 Hydrocarbon and Chemical Spill Scenarios

Scenario	Spilt Material and Volume	Description
Vessel fuel tank rupture	280 m^3 of MGO	A collision between the seismic vessel, support vessel or a third party vessel has the potential to result in the breach of the hull and subsequent rupture of a fuel tank. A major spill to sea as a result of vessel collision is only likely to occur under exceptional circumstances where these conditions resulted in significant damage to one or more of the fuel tanks in the hull of the vessel. These may include: • navigational error; • vessel loss of power; and • reduced vessel control during adverse weather and sea conditions. If a collision involving the seismic vessel occurred, the worst case credible scenario would be the total loss of the largest single fuel tank volume, which is 280 m^3 of MGO. This scenario was modelled by RPS APASA (2016).
Vessel refuelling failure	1.2 m^3 to 25 m^3 MGO	Vessel refuelling failure may result in the release of MGO to the marine environment. The Polarcus Bunkering Procedure guides refuelling activities. Through the use of dry break couplings (which provide an automatic mechanism to seal off both the hose and the fixed pipe end when the hose is disconnected), the maximum credible spill volume from a refuelling failure is considered to be the maximum typical volume of a transfer hose (1.2 m^3). In the event dry break couplings fail, guidelines indicate the maximum credible spill volume from a refuelling incident with continuous supervision is equivalent to the volume of MGO transferred within a 15 minute period (AMSA 2013), which represents the estimated time required to shut down refuelling operations following discovery of a spill. Based on the known transfer volume of 100 m^3/hr, this may result in a spill volume of 25 m^3. Due to the low volumes involved, and the anticipated rapid dispersal in the marine environment, no modelling was undertaken.
Single point failure (on deck or overboard)	<1 m^3 of hydraulic fluids or general purpose chemicals	A single point failure may occur as a result of mechanical/ structural failure, human error or poor housekeeping. Should a spill occur on deck, controls such as equipment bunds, scupper plugs and on-board clean up should prevent the spilt material reaching the marine environment. However, in the event these controls fail, or are not implemented, spill volumes released to the environment are likely to be less than 1 m^3 based on the inventory used on deck. During rainfall or wash down events, minor quantities of hydraulic fluids or chemicals may also be discharged to the marine environment. Due to the low volumes involved, and the anticipated rapid dispersal in the marine environment, no modelling was undertaken.

The worst case spill scenario (280 m^3 MGO spill from a vessel fuel tank rupture) was modelled using stochastic oil dispersion model SIMAP, based on the inputs summarised in *Table 6.12*.

Table 6.12 Spill Modelling Inputs

Parameters	Modelling inputs
Spill release locations	Five targeted release locations within the Operational Area
Spill volume	280 m^3
Hydrocarbon type	MGO
Spill duration	6 hours
Simulation duration	20 days
Timeframe	Year round, accounting for the following three seasons: • Summer (December – May) • Winter (April to August) • Transitional (March and September to November)

Release Location Selection

Five targeted release locations were selected based on the proximity to sensitive receptors and to provide representative coverage of the Operational Area (*Figure 6.7*). Modelling was undertaken at each location for each season (RPS APASA 2016).

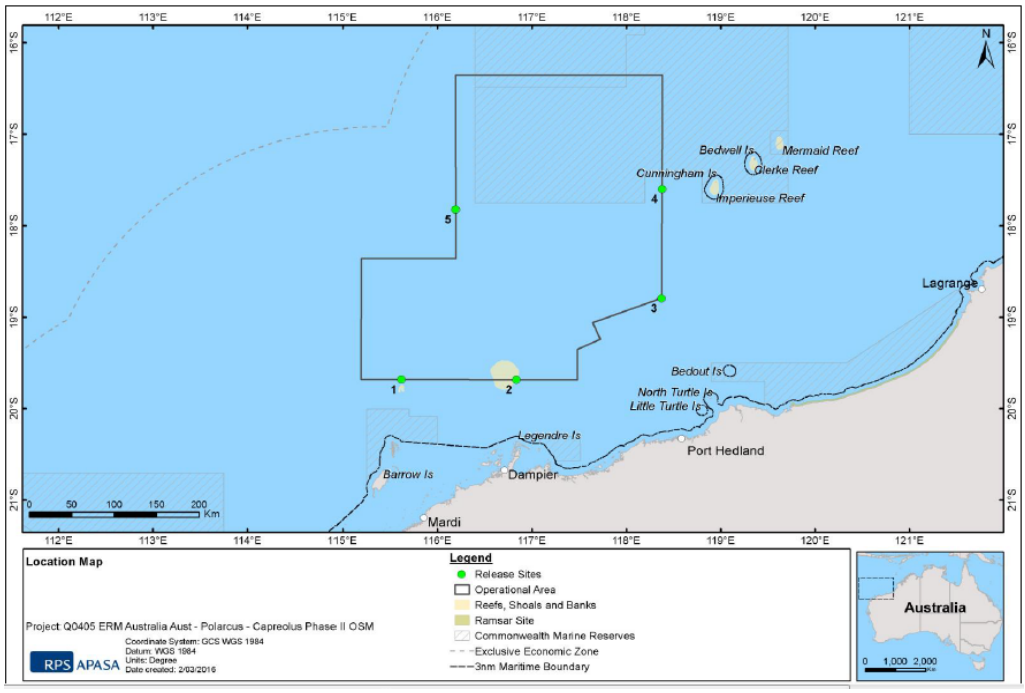

Figure 6.7 Spill release locations within the Capreolus Phase II Operational Area (RPS APASA 2016)

Seasonality

To ensure that modelling results are representative of the range of metocean conditions experienced during the survey period, random start times were selected over the 12 month timeframe to subject each release to different wind and current conditions. As a result, a total of 250 spill trajectories were modelled per season (750 spill trajectories in total), based on 50 individual spill trajectories per season at each release location.

Exposure Thresholds

Based on the modelling outcomes, nearby sensitive locations may be contacted by spilled MGO either at the surface or in the water column. In order to determine the ecological effects of a spill, different thresholds were considered for the risk assessment as follows:

- Surface hydrocarbon thresholds, to assess potential physical effects on sensitive receptors offshore;
- Shoreline accumulation thresholds, to assess potential physical effects on sensitive receptors onshore; and
- Water column exposure thresholds, to assess potential toxicity effects to sensitive receptors offshore from entrained and dissolved aromatic hydrocarbons.

Selected thresholds are summarised in *Table 6.13*. These thresholds were based on accepted thresholds reported in the literature as detailed in the modelling report.

Table 6.13 Summary of Hydrocarbon Exposure Thresholds

Hydrocarbon Concentration	Potential Level of Exposure
Surface Exposure (g/m^2)	
0.5 – 10	Low
10 – 25	Moderate
> 25	High
Shoreline Exposure (g/m^3)	
10–100	Low
100–1,000	Moderate
>1,000	High
Entrained Hydrocarbon Exposure (ppb.hr)	
960 – <9,600	Low
>9,600 – <48,000	Moderate
>48,000	High
Dissolved Aromatic Hydrocarbon Exposure (ppb.hr)	
576 - < 4,800	Low
>4,800 – <38,400	Moderate
>38,400	High

Spill Modelling Results

This section provides an overview of the modelling results for each season for a 280 m^3 release of MGO within the Operational Area. Full details of the modelling undertaken are presented in RPS APASA (2016).

Surface Hydrocarbons

Modelling indicated that, in the event of a 280 m^3 spill of MGO, sea surface hydrocarbons at low (0.5 g/m^2), moderate (10 g/m^2) and high (25 g/m^2) exposure levels may occur up to 268 km, 59 km and 26 km from the spill release locations, respectively. This result does not indicate a continuous slick, but that patches of the surface slick may exceed thresholds out to these distances from the spill release locations. For example, analysis of single slick simulations indicates that a 25 g/m^2 surface slick may extend up to a few kilometres near the release site during the initial 6 hour release duration, but this rapidly disperses and exposures > 25 g/m^2 are not expected to occur after the first 12-18 hours. Similarly, surface exposures > 10 g/m^2 may extend up to several kilometres within the first 12 hours before dispersing (RPS APASA 2016).

The evaporative nature of MGO and environmental conditions experienced during the periods modelled resulted in short-lived surface hydrocarbon exposures. Generally, surface exposures are reduced to less than 10 g/m^2 after approximately 24 hours and sea surface hydrocarbons (the small percentage persistent fractions) become patchy and do not persist beyond 12-14 days (RPS APASA 2016).

Only under summer conditions were patchy surface hydrocarbon exposures above 0.5 g/m^2 predicted to reach the Rowley Shoals (2% probability and a minimum of 62 hours after the release) (RPS APASA 2016).

Entrained Hydrocarbons

No moderate (9,600-48,000 ppb.hr) or high (>48,000 ppb.hr) exposure from entrained hydrocarbons was predicted to result from any of the spill trajectories simulated under the environmental conditions assessed. However, under moderate to high wind conditions, patchy occurrences of low entrained hydrocarbon exposures (< 9,600 ppb.hrs) were predicted in the upper water column (< 20 m depth) (RPS APASA 2016).

The Argo Rowley Terrace CMR and Glomar Shoal had the highest probability of low entrained exposures within the top 10 m of the water column (10% and 6% respectively during winter conditions). There was a 2% probability of low entrained hydrocarbon exposures occurring within the top 10 m of the water column near Rankin Bank, the Rowley Shoals Marine Park and the Montebellos CMR.

There was just 0.4% probability of low entrained exposures extending deeper than 10 m at the Argo Rowley Terrace CMR, Glomar Shoal KEF, Rankin Bank and the Rowley Shoals Marine Park (RPS APASA 2016).

Dissolved Hydrocarbons

Modelling predicted no exposure to dissolved aromatic hydrocarbons at the low, moderate or high threshold levels for any season, as dissolved aromatic components were not predicted to persist long enough in the water column following release. Therefore potential impacts from dissolved aromatics resulting from a 280 m^3 spill of MGO are not discussed further in this EP.

Shoreline Accumulation

No shoreline contact was predicted under any of the seasonal conditions assessed. Therefore, no shoreline accumulation results are presented.

Environmental Impacts and Risks – Vessel Fuel Tank Rupture

MGO Spill Resulting from Vessel Fuel Tank Rupture
Surface Hydrocarbon Exposures
Identification of Hazards – Surface Hydrocarbon Exposures
Surface hydrocarbon exposures resulting from an accidental MGO spill from a vessel fuel tank rupture (280 m^3) are expected to result in a localised and short term reduction in water quality with the potential to result in the following adverse effects on the environment: • Toxic effects on marine fauna that come into contact with surface hydrocarbons; • Toxic effects on ecological communities contacted by surface hydrocarbons; • Disruption to other marine users from the presence of the slick.
Identification of Receptors – Surface Hydrocarbon Exposures
• Marine fauna (e.g. marine mammals, turtles and sea birds). • Ecological communities (i.e. intertidal corals at Rowley Shoals). • Other marine users (e.g. commercial fisheries, commercial shipping, offshore petroleum activities).
Potential Environmental Impacts and Risks Evaluated in the EP
• Surface exposures greater than >10 g/m^2 resulting from a worst-case total fuel tank release are predicted to be limited to several kilometres for a short period (approximately 24 hours). • Given the relatively short-term and localised exposure potential, sub-lethal and lethal impacts to transient marine fauna from inhalation, ingestion or skin contact are expected to be limited and population level impacts are not expected. • No discernible impacts to ecological communities are expected from surface hydrocarbon exposures, given the potential for limited exposure and distance from the Operational Area. • Potential impacts to other marine users include avoidance of the spill to prevent fouling of vessels and equipment, and consequential temporary displacement of vessels and activities from the area.

Entrained Hydrocarbon Exposures
Identification of Hazards – Entrained Hydrocarbon Exposures
Entrained hydrocarbon exposures within the top 20 m of the water column resulting from an accidental MGO spill from a vessel fuel tank rupture (280 m^3) are expected to result in a localised and short term reduction in water quality with the potential to result in the following adverse effects on the environment: • Toxic effects to fish assemblages that contact entrained hydrocarbons; and • Toxic effects on juvenile fish, eggs and larvae that may become entrained with hydrocarbon droplets.
Identification of Receptors – Entrained Hydrocarbon Exposures
• Demersal and pelagic fish assemblages (including juvenile fish, eggs and larvae)
Potential Environmental Impacts and Risks Evaluated in the EP
Due to the requirement for relatively long exposure times for concentrations to be significant, the low entrained exposures predicted by the stochastic modelling are only expected to impact juvenile fish, or entrained eggs and larvae which may be entrained with the hydrocarbon droplets. The proportion of juveniles, eggs and larvae that may be affected during the short duration of the spill is expected to be negligible.

Environmental Impacts and Risks – Vessel Refuelling Failure

MGO Spill Resulting from Vessel Refuelling failure
Identification of Hazards
An accidental MGO spill during vessel refuelling (up to 25 m^3) has the potential to result in the following adverse effects on the environment: • Toxic effects on marine fauna that come into contact with surface hydrocarbons; • Toxic effects to juvenile fish, eggs and larvae from entrained hydrocarbon droplets.
Identification of Receptors
• Marine fauna (e.g. marine mammals, turtles and sea birds) • Demersal and pelagic fish assemblages (including juvenile fish, eggs and larvae)
Potential Environmental Impacts and Risks Evaluated in the EP
Localised and short term impacts are predicted to occur to a limited number of marine fauna and fish assemblages in the immediate vicinity of the spill release location following the release in open and dispersive offshore waters.

Environmental Impacts and Risks – Single Point Failure

Hydraulic Fluid or Chemical Spill Resulting from Single Point Failure
Identification of Hazards
Accidental spills of up to 1 m^3 of hydraulic fluids or chemicals are expected to result in a localised and short term reduction in water quality with the potential to result in toxic effects on marine fauna.

Identification of Receptors
• Marine fauna and fish
Potential Environmental Impacts and Risks Evaluated in the EP
Fluids spilt overboard have the potential to result in toxicity effects to marine fauna and fish in the immediate vicinity of the spill release location, through direct contact or accidental ingestion.

Spill Response Options

Spill response mitigation measures will be implemented as appropriate to reduce the likelihood of impacts to key marine environmental receptors. The objectives of spill response include the protection of human health, environmental values, and the protection of assets. The selection of spill response techniques in any situation will include an assessment of the net environmental benefit of the technique, taking account of priorities for protection and restoration and the sensitivity of the receptors at risk.

Based upon the outcome of the predictive spill modelling and the properties of MGO, the following spill response options are considered applicable for potential MGO spills related to survey:

- source control;
- monitor and evaluate; and
- assisted natural dispersion.

Initial actions for source control are outlined in the vessel SOPEP and would be undertaken in consultation with the relevant statutory Combat Agency (initially AMSA, given the location of the Operational Area in Commonwealth waters).

The above spill response options are not expected to introduce additional hazards to the marine environment or to result in significant additional potential impacts. The response options of source control, monitor and evaluate and assisted natural dispersion will use existing survey and support vessels, and the potential impacts associated with the use vessels is evaluated in *Section 6.3* for planned activities.

6.4.2 Loss of Equipment

Equipment such as the streamers and seismic array has the potential to be lost during the survey as a result of breakage of cables or lifting equipment. While loss of equipment overboard is not a common occurrence, it has occurred in the industry. The design of this equipment means that rapid recovery by the survey or support vessel is facilitated, reducing the risk of lost equipment becoming a long-term hazard to marine environments or other marine users.

Loss of Equipment
Identification of Hazards
The loss of equipment overboard has the potential to: • disrupt other users of the Operational Area; and • result in disturbance to the seabed.
Identification of Receptors
• Other marine users (e.g. commercial fisheries) • Benthic habitats and ecological communities
Potential Environmental Impacts and Risks Evaluated in the EP
• Temporary and highly localised disruption to other users. • No lasting impacts to benthic habitats and ecological communities are expected.

6.4.3 Unplanned Anchoring in an Emergency

None of the vessels associated with the survey plan to anchor on the seabed in the Operational Area. Water depths throughout much of the Operational Area are too deep for anchoring to occur and seismic vessels are expected to use dynamic positioning systems in situations where the vessels are required to maintain position. However, in an emergency, vessels may be required to anchor.

Unplanned Anchoring
Identification of Hazards
Anchoring has the potential to cause damage to seabed communities.
Identification of Receptors
• Benthic habitats and ecological communities
Potential Environmental Impacts and Risks Evaluated in the EP
Any impacts on benthic habitats and communities would be highly localised and short term. Following removal of anchors, any disturbed areas would likely re-colonise over time.

7 IMPLEMENTATION STRATEGY

The Capreolus Phase II 3D MSS will be undertaken in accordance with the NOPSEMA-accepted EP, applicable legislation and the Polarcus Management System. The Polarcus Management System incorporates a number of documented manuals, plans and procedures, registers and work instructions that will be implemented such that identified environmental impacts and risks are continually reduced to ALARP and that monitoring of Polarcus' environmental performance is ongoing.

The Polarcus Environmental Management Procedure, amongst other procedures, provides for the implementation of the commitments in this EP, via for example:

- A pre-survey environmental checklist;
- Project kick-off meeting;
- On-board Daily Meetings
- On-board HSE Committee Meetings
- Toolbox Meetings

Records are produced for each of these activities and meetings.

7.1 ENVIRONMENTAL PERFORMANCE AND COMPLIANCE ASSURANCE

Compliance with the EP will be assured and reviewed via the Daily On-Board Meetings and On-Board HSE Committee Meetings, and via internal audit and monitoring programs described below.

7.1.1 *Environmental Compliance Audits*

Polarcus will maintain a Compliance Register that will serve as an audit tool during the Capreolus Phase II 3D MSS. The register will be sufficiently detailed to enable auditors to determine whether the environmental performance outcomes, standards and measurement criteria for control measures have been met. The register includes:

- The environmental performance outcomes and environmental performance standards relevant to the survey as set out in the EP;
- Measurement criteria to enable an auditor to determine if the survey has complied with the relevant performance standards; and
- The person/party responsible for implementing the performance standard to meet the environmental performance outcome.

Prior to mobilisation of each survey stage and in accordance with the Polarcus Environmental Management Procedure, Polarcus will complete

- A pre-survey environmental checklist with input from the Vessel Manager, Vessel Master and the Party Manager addressing pre-survey planning, preparedness for compliance with regulatory requirements, including the EP.
- An audit of the on-board spill response capability against Vessel SOPEPs to verify spill preparedness.

Polarcus will also conduct a minimum of one compliance audit of the EP per survey stage, to be completed within one month of the stage commencing. This will target:

- Compliance with regulatory requirements detailed in this EP are being achieved;
- Performance outcomes have been monitored, measured and evaluated;
- Emissions and discharges are being monitored, measured and documented; and
- Management strategies and procedures to achieve the environmental performance outcomes are in place and being implemented effectively.

Any required remedial actions will be followed up. A copy of the environmental audit will be forwarded to NOPSEMA upon request. Lessons learnt will be included in an Environmental Performance Report.

7.1.2 Environmental Monitoring

The following aspects will be monitored and recorded during the Capreolus Phase II 3D MSS:

- emission to air (based on fuel consumption figures);
- discharges to water (including oily water discharges, macerated food waste and sewage and grey water discharges);
- waste types and quantities transferred to shore for reuse, recycling or disposal;
- marine fauna sightings; and
- interactions with any third party vessels.

The corresponding parameters, records and responsibilities of such monitoring are detailed in the EP.

7.1.3 Management of Non-conformance

Non-conformances and opportunities for improvement will be identified and corrective actions will be tracked to completion in accordance with the Polarcus Incident Reporting Procedure and Risk Management Procedure, and results logged on the Risk Register.

Polarcus will carry forward non-conformances identified during the Capreolus Phase II 3D MSS for consideration in future surveys to assist with continuous improvement in environmental management controls and performance outcomes.

7.1.4 Review of Environmental Performance

Polarcus will undertake an internal review of the environmental performance of the Capreolus Phase II 3D MSS on completion of each stage of the survey. The review will consider:

- An evaluation of conformance with the Compliance Register;
- Improvements to the implementation strategy included within the EP;
- Compliance with Polarcus' Policies, Manuals and Procedures;
- The management of non-conformances identified during the survey, including reportable and recordable incidents; and
- Concerns identified by stakeholders during and after the completion of the survey, followed by appropriate liaison as required.

The outcomes of the review will be circulated to relevant persons in Polarcus and to other stakeholders as appropriate. The outcomes of the review will be incorporated into environmental management measures applied to future activities to further improve Polarcus' environmental performance, and will be included in an Environmental Performance Report.

7.1.5 Environmental Performance Reporting

Polarcus will maintain a record on the environmental performance of the Capreolus Phase II 3D MSS in relation to the environmental performance outcomes, standards and measurement criteria detailed in the EP and Compliance Register.

A detailed report on environmental performance ('Environmental Performance Report'), including the Compliance Register, will be submitted to NOPSEMA for assessment at the following intervals:

- within two months of completion of the Capreolus Phase II 3D MSS; or
- if the survey is undertaken in multiple stages, within two months of completion of each stage of the Capreolus Phase II 3D MSS; or
- in either case, the interval between reports will not be more than one year.

7.2 *MANAGEMENT OF CHANGE*

In order to ensure that impacts and risks are continually reduced to the residual levels described in the EP and the requirements of legislation will continue to be met, Polarcus will undertake periodic and scheduled verification of the inputs used to inform the evaluation of impacts and risks in the EP, including identifying updates to legislative and regulatory requirements.

Verifications will be undertaken 30 days prior to mobilisation of each survey stage, and repeated upon mobilisation of each survey stage. Periodic verifications will include relevant legislation, guidance, species conservation management plans, protected area management plans, and new stakeholder information.

A record of each verification will document identified changes or new information and an evaluation will be conducted to confirm:

- applicable changes to controls, performance outcomes, standards and measurement criteria; and
- if the information/change results in a new or increased residual risk ranking, as determined in the EP.

Any new or increased impacts or risks that may arise from the verifications will be managed through the Polarcus Management of Change Procedure. This procedure ensures that temporary or permanent organisational, system or operational changes are considered for HSE and quality implications prior to those changes occurring.

7.3 *RESPONSE ARRANGEMENTS IN THE EVENT OF AN OIL SPILL*

In order to encompass the nature and scale of the survey and respond to the identified credible spill scenarios, the overall Oil Pollution Emergency Plan (OPEP) for the survey encompasses multiple levels of planning and response capability. The overall seismic survey OPEP is therefore represented by various levels of emergency plan, which comprise of:

- Vessel(s) SOPEP – for spills contained on the vessel or spills overboard which can be managed by the vessel. Vessel SOPEPs have been prepared in accordance with the IMO guidelines for the development of shipboard oil pollution emergency plans. The Vessel Master is responsible for activating and implementing the vessel SOPEP and the shipboard Oil Pollution Prevention Team is responsible for both prevention and response activities;

- The National Plan for Maritime Environmental Emergencies (National Plan) (AMSA 2014) - AMSA is the jurisdictional authority and control agency for spills from vessels which affect Commonwealth waters i.e. outside of 3 nm from the coast.

For Commonwealth waters initial response actions will be undertaken by the vessel with subsequent actions determined in consultation with the regulatory authorities (AMSA) under the National Plan, having regard to the potential impacts posed by the spill. Upon notification of an incident, AMSA will assume control and will respond in accordance with its Marine Pollution Response Plan as approved by the AMSA Executive; and

- The Western Australian State Emergency Management Plan for Marine Oil Pollution (WestPlan-MOP) and associated Marine Oil Spill Contingency Plan (MOSCP) (DOT) – for spills from vessels which affect WA State waters. If surface slicks appear likely to enter WA State waters (which modelling results shows to be highly unlikely to occur), subsequent actions will be determined in consultation with the DOT under WestPlan–MOP and the MOSCP. The DOT is the designated Combat Agency for oil spills from vessels in WA State jurisdiction.

Notification arrangements have been documented to activate any required involvement from relevant combat agencies.

Given the offshore location of the Operational Area, the preferred strategy for MGO spills will be to allow small spills to disperse and evaporate naturally, and monitor the position and trajectory of any surface slicks. Physical break up by repeated transits through the slick may be considered for larger slicks (following consultation with the Combat Agency – AMSA).

Any further response strategies are unlikely, but will be determined by the Combat Agency (i.e. AMSA or DOT), subject to net environmental benefit analysis (NEBA), response capacity, and logistics, health and safety considerations.

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