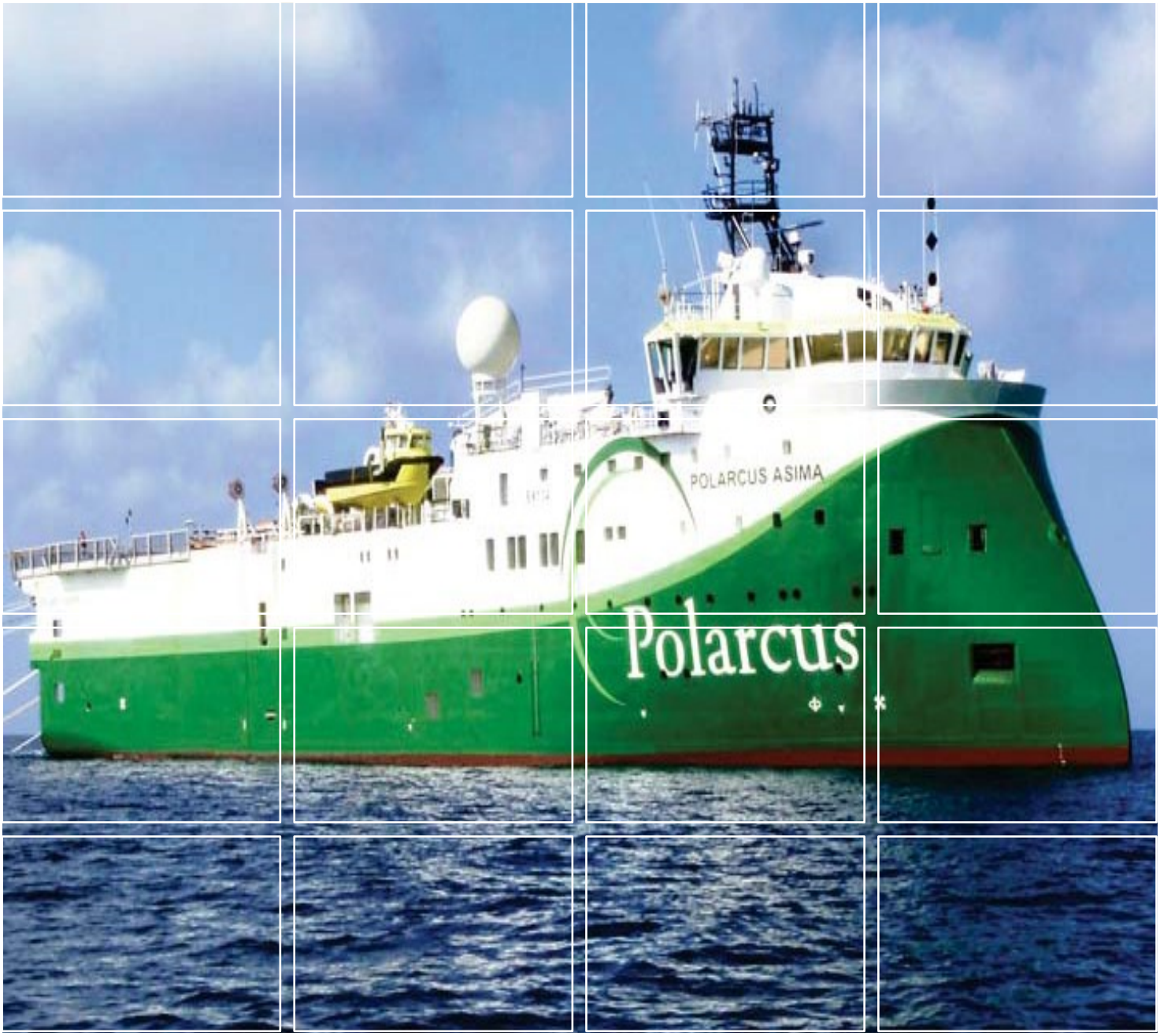

EP Summary for Cygnus 3D Marine Seismic Survey 2015 – 2017 Rev 1

Polarcus Seismic Limited

December 2015

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FINAL REPORT

Polarcus Seismic Limited

Environment Plan Summary for Cygnus 3D Marine Seismic Survey 2015 – 2017 Rev 1

December 2015

Reference: 0306660

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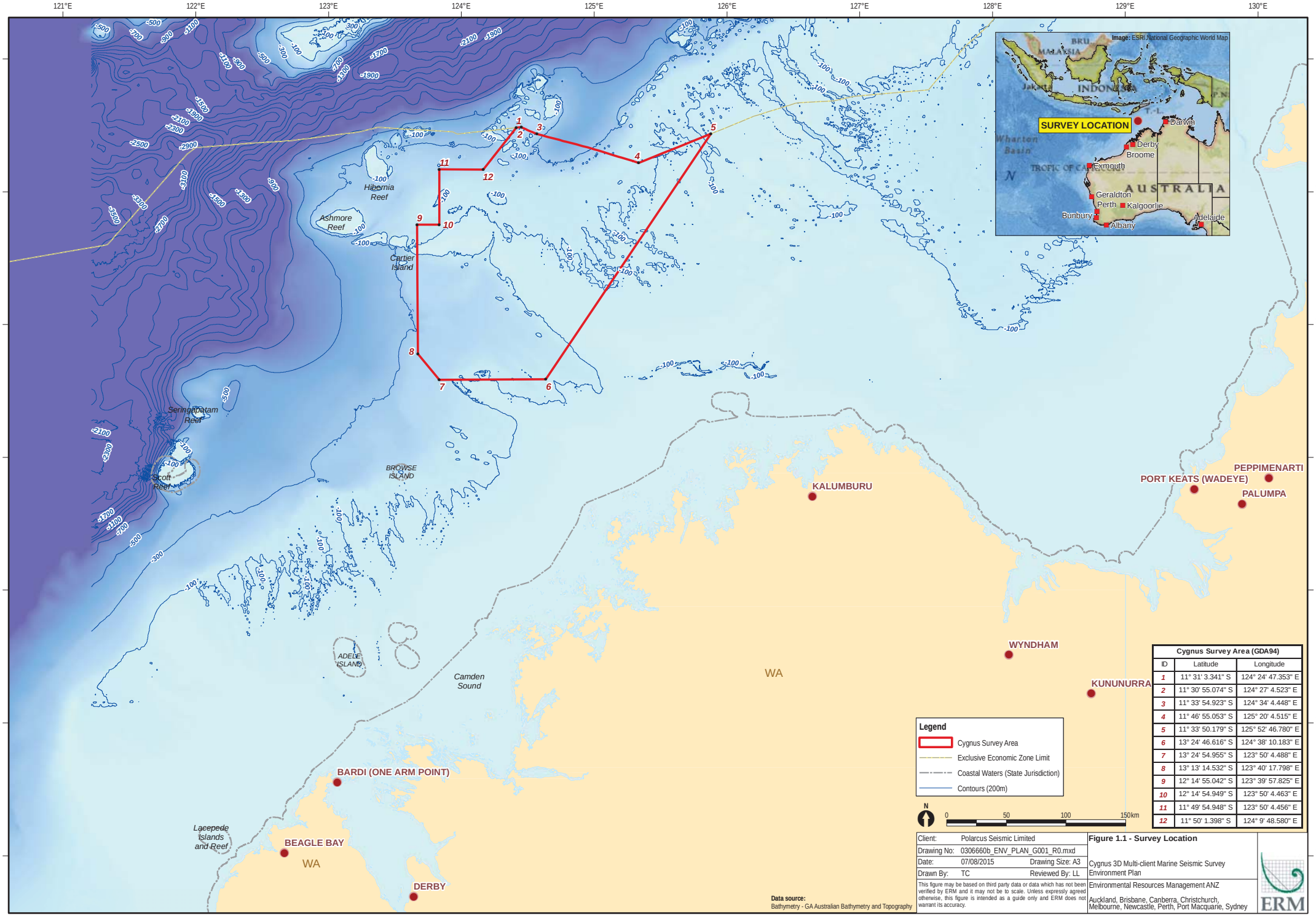
1 INTRODUCTION

Polarcus Seismic Limited (Polarcus) proposes to undertake a three-dimensional marine seismic survey (Cygnus 3D MSS) in Commonwealth waters of the Vulcan Sub-basin (in the Western Bonaparte Basin), approximately 150 km off the Kimberley coast of northern Western Australia (WA) and 110 km from the Indonesian archipelago and East Timor (*Figure 1.1*). The Cygnus 3D MSS is anticipated to take approximately 12 months starting in December 2015. The survey may be completed in several stages and it is currently proposed that the survey will be completed no later than December 2017.

An Environment Plan (EP) was prepared for the proposed activities to meet the requirements of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act)* and the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS (E) Regulations): Cygnus 3D Marine Seismic Survey 2015-2017 Environment Plan, Document No. 0306660, Revision 1, dated 16 November 2015, NOPSEMA reference A457487 RMS:3292 (the EP). The EP was accepted by NOPSEMA on 14 December 2015 and demonstrates that the Cygnus 3D MSS will be undertaken in a manner consistent with the principles of ecologically sustainable development and carried out such that environmental impacts and risks will be reduced to as low as reasonably practicable (ALARP) and acceptable levels.



Cygnus Survey Area (GDA94)

ID	Latitude	Longitude
1	11° 31' 3.341" S	124° 24' 47.353" E
2	11° 30' 55.074" S	124° 27' 4.523" E
3	11° 33' 54.923" S	124° 34' 4.448" E
4	11° 46' 55.053" S	125° 20' 4.515" E
5	11° 33' 50.179" S	125° 52' 46.780" E
6	13° 24' 46.616" S	124° 38' 10.183" E
7	13° 24' 54.955" S	123° 50' 4.488" E
8	13° 13' 14.532" S	123° 40' 17.798" E
9	12° 14' 55.042" S	123° 39' 57.825" E
10	12° 14' 54.949" S	123° 50' 4.463" E
11	11° 49' 54.948" S	123° 50' 4.456" E
12	11° 50' 1.398" S	124° 9' 48.580" E

Client:	Polarcus Seismic Limited		
Drawing No:	0306660b_ENV_PLAN_G001_R0.mxd		
Date:	07/08/2015	Drawing Size:	A3
Drawn By:	TC	Reviewed By:	LL

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Figure 1.1 - Survey Location

Cygnus 3D Multi-client Marine Seismic Survey
Environment Plan

Environmental Resources Management ANZ

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

ERM

2 TITLEHOLDER'S NOMINATED LIAISON PERSON

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

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3 ACTIVITY DESCRIPTION

3.1 LOCATION

The Survey Area comprises the area within which Polarcus currently anticipate the 3D seismic acquisition to be undertaken (*Figure 1.1)*. The Survey Area covers approximately 31,400 square kilometres (km^2). At its closest, the Survey Area is approximately 425 km north of Derby, Western Australia. The Survey Area incorporates the necessary space for vessel manoeuvring and ancillary activities (i.e. additional area for the purpose of line run-outs, source testing, soft starts and turns etc.).

3.2 ACTIVITY DETAILS

Seismic data acquisition will be undertaken by one purpose-built, state of the art Polarcus-owned and operated seismic vessel. The *Polarcus Naila* (or a vessel of comparable specifications) is expected to be used, although final confirmation of the exact seismic vessel has yet to be made. The *Polarcus Naila* was built in 2010, with the ULSTEIN SX124 design type. The *Polarcus Naila* is considered to be amongst the most environmentally sound seismic vessels in the market with diesel-electric propulsion, double hull and advanced ballast water treatment/bilge water cleaning systems. The seismic vessel carries a maximum of 60 persons on board (POB). The *Polarcus Naila* uses a Marine Gas Oil (MGO) fuel with ultra-low sulphur content (<0.1%) and does not utilise heavy fuel oil. MGO is produced through distillation and as such, it contains a higher proportion of lighter hydrocarbons than other marine fuel types such as intermediate fuel oil or heavy fuel oil.

The planned seismic source has a total capacity of 3,090 cubic inches (in^3), comprising three independent sources. These three sources will be discharged alternately ('flip-flop-flap' source configuration) at 12.5 m intervals along each survey line.

The *Polarcus Naila* will tow the seismic array, comprising the three sources and a total of 10 streamers, along pre-determined north-west to south-east survey lines within the Survey Area. The sources will be towed a short distance behind the seismic vessel at depths of 5 - 10 metres (m).

The ten solid hydrophone streamers, each measuring approximately 8,900 m in length, will be towed at a depth of approximately 15 m below the surface. The hydrophone streamers will be spaced 112.5 m apart.

Tail buoys will be used to maintain position in the water and clearly indicate the streamer ends. As tail buoys are self-inflating, they will return to the surface if they go beyond a certain water depth. In addition, the tail buoys will be fitted with turtle guards. Depth monitor and control devices positioned along the streamers will be used to maintain the preferred tow depth.

The survey will be conducted at a vessel speed of approximately 4.5 knots. For safety reasons, the seismic source will not be operated within 500 m of the 19 m depth contour (referred to as the 'operational exclusion zone'). In addition, to reduce the risk of potential impacts from underwater sound emissions to site-attached fish communities which may be present at banks and shoals within the Survey Area, the seismic source will not be operated within 90 m of the 60 m depth contour (referred to as 'supplementary exclusion zone'). This supplementary exclusion zone extends beyond, and is in addition to, an 'environmental exclusion zone' that Polarcus also agreed to implement and which extends to 85 m from the 30 m depth contour. The multiple layers of exclusions zones all apply.

The survey will also be conducted at least 10 km from any land and 500 m from obstructions (e.g. petroleum production platforms and other industry facilities and infrastructure).

Two support vessels will be engaged for the Cygnus 3D MSS. These comprise:

- One support vessel accompanying the seismic vessel to assist with managing potential interactions with other users of the area; and
- One supply vessel for resupply, refuelling and other support functions.

The support vessels are selected such that they are of sufficient size to tow a seismic vessel in the unlikely event that the seismic vessel loses power.

Refuelling and resupply at sea by a supply vessel is expected to occur approximately every 10 to 14 days during the survey. At-sea refuelling of the seismic vessel will only take place during daylight hours and within strict weather limit guidelines. Crew changes are expected to occur every 35 days by helicopter.

3.3 SCHEDULE

The Cygnus 3D MSS is anticipated to take a total of approximately 12 months to complete, probably over multiple phases of work. The survey has the potential to start as early as December 2015. Exact start and end dates and phasing will be communicated by Polarcus (in accordance with the EP's stakeholder consultation process as described below) based on seasonal restrictions due to environmental sensitivities, availability of vessel and weather conditions; although it is currently proposed that the survey be completed no later than December 2017.

4 EXISTING ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

4.1.1 Meteorology and Oceanography

The Survey Area is characterised by two distinct seasons; a mild, dry winter during the months of April to September and a hot, wet summer during the months of October to March. There are also rapid transitional months between the main seasons generally April and September/October. During the dry winter months, there are steady north-east to south-east winds caused by the occurrence and intensification of anti-cyclones. The prevailing south-east trade winds bring fine conditions with low rainfall. During the wet summer months, there are north-west to south-west winds associated with broad areas of cloud and widespread rainfall.

Tropical cyclones usually form in an active monsoon trough, producing heavy rains, strong wind, large swells and storm surges. On average, about five cyclones occur each year in the region, two of which make landfall and one of which is severe (category 3 or higher having wind gusts of at least 170 km/h) (BOM 2014a). The chance of a severe cyclone occurring is highest in March and April (BOM 2014a).

The Survey Area is dominated by surface currents heavily influenced by both tidal motions and the Indonesian Throughflow, which transports warm waters from the Pacific Ocean into the Indian Ocean through the Indonesian seas. The strength of the Indonesian Throughflow is seasonal with it being weakened during the wet season when the strong south-westerly winds cause intermittent reversals of the currents (Brewer et al. 2007). The strengthening of the Indonesian Throughflow in the dry season coincides with the development of the Holloway Current, which transports waters from the Banda and Arafura seas and the Gulf of Carpentaria southwards along the shelf (DEWHA 2008b).

4.1.2 Bathymetry, Geomorphology and Sedimentology

The Survey Area lies in water depths between approximately 10 and 500 m, with the majority being typically 100 m deep, gradually increasing to 200 m in a south-east to north-west direction. The deepest waters are located in the northernmost portion of the Survey Area where depths increase to 500 m.

Several banks and shoals exist within and surrounding the Survey Area. Shoals and banks in the Survey Area are abrupt geological features that typically rise to within 5 to 30 m from the sea surface and extend along the continental shelf in a north-east/south-west direction (PTTEP 2013). Initially the shoals rise steeply from depths of 100-200 m on the continental shelf and begin to plateau at around 40 to 50 m depth (PTTEP 2013). The plateau area of each shoal is typically oval in shape and covers approximately 10 - 15 km^2 at depths of 20 - 30 m, with occasional higher ground rising to within approximately 10 m of the sea surface (Heyward et al 2010). Where available (National Imagery and Mapping Agency (2004)) shallowest depths at the shoals are presented in *Table 4.1*. The banks/shoals of the Survey Area on average display a gradient of 0.1 (one vertical metre for every ten horizontal metre). Those banks and shoals within the Survey Area cover an estimated 3% of the total Survey Area.

The north-eastern corner of the Survey Area overlaps with the western edge of the Sahul Shelf system, a Key Ecological Feature (KEF) that is regionally important in enhancing productivity in the region (Commonwealth of Australia 2012). Only approximately 10% of the Sahul Shelf system overlaps with the Survey Area. This western edge of the Sahul Shelf system is characterised by a hard substrate plateau of approximately 100 m depth that abruptly (almost completely vertically) rises from the surrounding 150 - 200 m depths to the north-west. The southern portion of the Survey Area includes the ancient coastline along the 125 m depth contour (also a KEF), characterised by several terraces and steps that reflect a gradual increase in sea level over geological timescales.

The region comprises large areas of seabed that are dominated by soft sediments. The soft sediments typically consist of sandy and muddy substrate, occasionally made up of patches of coarser sediments (DEWHA 2008b). Parts of the ancient coastline along the 125 m contour consist of rocky escarpments while other parts are dominated by soft sediments (DEWHA 2008a). Both the identified banks/shoals and the Sahul Shelf system provide a variety of carbonate substrates (Heyward et al 2010) compared to the surrounding sandy and muddy substrate in deeper (>150 m) waters covering the majority (approximately 95% per above) of the Survey Area.

Table 4.1 Banks and Shoals in and near the Survey Area

Bank/Shoals	Within Survey Area	Approximate shallowest depth (m) (Heyward et el 1997; National Imagery and Mapping Agency 2004)
Vulcan Shoal	Yes	9.5
Goeree Shoal	Yes	Not available
Eugene McDermott Shoal	Yes	11.1
Heywood Shoal[2]	No	Not available
Barracouta Shoal	Yes	10.3
Southern portion of Sahul Bank (several unnamed shoals)	Yes	5-29.5
Jabiru Shoals	Yes	Not available
Pee Shoal	Yes	10.3
Mangola Shoal	No	9.0
Barton Shoal	No	13.7
Dillon Shoal	No	13.1
Echuca Shoal[2]	No	Not available
Basset Smith Shoal	No	4.8
Penguin Shoal[1]	No	9.7
Gale Bank[1]	No	22.0
Baldwin Bank[1]	No	15.5
Favell Bank[1]	No	22.0
Fantome Shoal	No	7.3
Vee Shoal	No	13.4
Johnson Bank	No	8.5
Woodbine Bank	No	11.5
Big Bank Shoals	No	16.0

4.2 ECOLOGICAL ENVIRONMENT

4.2.1 Benthic Assemblages

The sandy and muddy substrates that predominantly cover the Survey Area (approximately 95% of the area) support relatively little sea bed structure or sessile epibenthos. They are sparsely covered by sessile filter-feeding organisms (e.g. gorgonians, sponges, ascidians and bryozoans) and mobile invertebrates (e.g. echinoderms, prawns and detritus feeding crabs) (Brewer et al. 2007; DEWHA 2008b). Scattered throughout the Survey Area are shoals with a relatively high diversity of organisms (e.g. hard and soft corals, sponges and associated fish communities).

Shoals

The bank and shoal systems in and around the Survey Area support diverse biological communities including corals, sponges, seagrasses and a variety of reef fish, with dominant organisms ranging from the macroscopic alga *Halimeda* to soft and hard coral communities (Heyward et al 1997). Shoals in the region may also provide feeding habitats for macrofauna such as marine turtles and dugongs, particularly where the seabed rises to a depth of less than 20 m (Whiting 1996).

Due to the remoteness of the area most of these shoals are either understudied or poorly characterised, although the benthic environments of two shoals within the Survey Area, the Barracouta and Vulcan shoals, have been surveyed previously. These therefore provide an indication of shoal habitats present in the region.

Surveys of areas down to 40 m have revealed bare sand and rubble as a ubiquitous component of the benthos, interspersed with abundant primary producers, dominated by algae, corals and seagrass. The shoals studied had a large proportion of seabed covered with life (25 – 42%) with the remainder composed of sand/silt or unconsolidated rock (Heyward et al 2013).

The study identified a correlation between the depth of the shoals and live coral cover, with diverse and abundant coral found on the shallower areas of each shoal (Heyward et al 2010). Most major coral families were represented across the shoals studied, *Acroporidae* and *Poritidae* were the dominant coral families (Heyward et al 2011a and b, Heyward et al 2013). The soft coral cover identified during the study in 2013 was higher at the Barracouta Shoal, while the cover of ascidians was higher at Vulcan Shoal (Heyward et al 2013). Seagrass was only present on Vulcan Shoal, while encrusting forms of sponges were relatively common across all shoals (Heyward et al 2013).

Studies in 2011 and 2013 found that the submerged shoals in the Survey Area supported many of the same species that are common with the emergent coral reefs of the region such as Ashmore Reef and Scott Reef (Heyward et al 2011a and b; Heyward et al 2013). The study identified that the biota on the shoals were typical of shallow reef systems in the region, mirroring regional coral and algal species (Heyward et al 2011a and b).

4.2.2 Threatened and Migratory Species Overview

A search of the EPBC Act Protected Matters Database was undertaken to identify the likelihood of occurrence of listed fauna within and around the Survey Area (including a 10 km buffer). The search identified 16 threatened species and 25 migratory species (which is inclusive of the aforementioned threatened species) (*Table 4.2*). No Threatened Ecological Communities were identified. The following sections describe the identified listed threatened and migratory species.

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

	Scientific Name	Common Name	Status
Birds	*Anous tenuirostris melanops*	Australian lesser noddy	Vulnerable
	Calonectris leucomelas	Streaked shearwater	Migratory
	Fregata ariel	Lesser frigatebird	Migratory
	Fregata minor	Great frigatebird	Migratory
	Phaethon lepturus	White-tailed tropicbird	Migratory
	Sula sula	Red-footed booby	Migratory
Reptiles	*Caretta caretta*	Loggerhead turtle	Endangered, Migratory
	Chelonia mydas	Green turtle	Vulnerable, Migratory
	Dermochelys coriacea	Leatherback turtle	Endangered, Migratory
	Eretmochelys imbricata	Hawksbill turtle	Vulnerable, Migratory
	Lepidochelys olivacea	Olive ridley turtle	Endangered, Migratory
	Natator depressus	Flatback turtle	Vulnerable, Migratory
	Aipysurus apraefrontalis	Short-nosed sea snake	Critically Endangered
	Aipysurus foliosquama	Leaf-scaled sea snake	Critically Endangered
Mammals	*Balaenoptera musculus*	Blue whale	Endangered, Migratory
	Megaptera novaeangliae	Humpback whale	Vulnerable, Migratory
	Balaenoptera bonaerensis	Antarctic minke whale	Migratory
	Balaenoptera edeni	Bryde's whale	Migratory
	Orcinus orca	Killer whale	Migratory
	Physeter macrocephalus	Sperm whale	Migratory
	Orcaella brevirostris	Irrawaddy dolphin	Migratory
	Tursiops aduncus	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	Migratory
	Dugong dugon	Dugong	Migratory
Sharks and Rays	*Carcharodon carcharias*	Great white shark	Vulnerable, Migratory
	Rhincodon typus	Whale shark	Vulnerable, Migratory
	Glyphis garricki	Northern river shark	Endangered
	Pristis pristis	Largetooth sawfish	Vulnerable
	Pristis zijsron	Green sawfish	Vulnerable
	Isurus oxyrinchus	Shortfin mako	Migratory
	Isurus paucus	Longfin mako	Migratory
	Manta birostris	Giant manta ray	Migratory

4.2.3 Birds

Many migratory shorebirds (including those frequenting offshore islands) and seabird species are known to occur in the region. Migratory shorebird species forage and rest in the region on their way between Northern Hemisphere breeding grounds and Northern Australian feeding grounds, known as the East Asian–Australasian Flyway. Seabird species spend the majority of their lives foraging across large distances over the open ocean and many also breed within the region. Important areas for seabirds and migratory shorebirds in proximity to the Survey Area include (DEWHA 2008b):

- Ashmore Reef Commonwealth Marine Reserve (CMR) and Cartier Island CMR (approximately 45 km and 5 km away respectively), which support some of the most important seabird rookeries in the region. Ashmore Reef and Cartier Island are also important staging points and feeding areas for many migratory shorebirds. Studies carried out at Ashmore Reef have identified an increase in the number of migratory seabirds, from 75,000 in 2010 to 107,000 in 2013 (PTTEP 2013). Ashmore Reef CMR and Cartier Island CMR and surrounding waters are designated breeding and foraging biologically important areas (BIAs) for a number of bird species. The Survey Area overlaps with some of these BIAs.

- Scott Reef is an important staging area for migratory shorebirds and foraging area for seabirds (approximately 200 km away).

One threatened and five migratory bird species were identified by a search of the EPBC Act Protected Matters Database as potentially occurring in the Survey Area through foraging, feeding, breeding or other related behaviours (*Table 4.2*). Through a search of the National Conservation Values Atlas (Commonwealth of Australia 2012), five additional bird species were identified as having BIAs in close proximity to the Survey Area.

4.2.4 Reptiles

Marine Turtles

Marine turtles have similar life cycle characteristics which include migration from foraging areas to mating and nesting areas. All species with the exception of flatback turtles have an oceanic pelagic stage before moving to nearshore waters to breed. The region is considered to be significant for supporting large feeding and nesting turtle populations. There are several key locations for turtle species throughout the region, including along the coastline and offshore islands in close proximity to the Survey Area.

The following areas in proximity to the Survey Area are considered to be particularly important for turtle nesting (DEWHA 2008b):

- Ashmore Reef and Cartier Island CMRs (approximately 45 km and 5 km away, respectively), are critical habitats for breeding and feeding marine turtles and support large populations of marine turtles (Commonwealth of Australia 2002). Approximately 11,000 marine turtles are estimated to forage at Ashmore Reef (DOE 2015b). Ashmore Reef CMR and Cartier Island CMR and surrounding waters are designated BIAs for a number of marine turtles to highlight breeding, inter-nesting and foraging behaviours in the area. The Survey Area overlaps with portions of these BIAs. Genetic studies of the WA green turtle population reveal there are five discrete genetic stocks (management units) in the eastern Indian Ocean. Ashmore Reef and Cartier Island form a distinct management unit for green turtles.

- Sandy Islet at Scott Reef is a known green turtle nesting site (approximately 200 km away); and

- Lacepede Islands is a critical nesting and inter-nesting habitat for green turtles. The islands comprise the largest green turtle rookeries in WA (approximately 415 km away).

- The Sahul Shelf system is a foraging area for loggerhead, olive ridley and flatback turtles (Commonwealth of Australia 2012). A portion of the Sahul Shelf system overlaps with the eastern portion of the Survey Area.

Given that Ashmore Reef, Cartier Island and the Sahul Shelf system support a large number of foraging turtles (approximately 11,000), the shoals and banks in and around the Survey Area may also provide foraging habitat for turtles.

Sea snakes

Most sea snake species tend to be found in the shallower parts of the region to allow for increased benthic foraging time (DEWHA 2008b). Sea snakes that inhabit coral reefs in the region live out their lives within a few hectares with little movement between the reefs; once a species becomes a resident on a reef, the active dispersal and migration between reefs ceases (Guinea 2013; PTTEP 2013). The distance between reefs in the region and the deep water between reefs inhibits migration and supports the concept that sea snakes at each reef form a discrete 'management unit' for each species and prevents species from occupying all reefs (PTTEP 2013).

At least 19 species of sea snake occur within the region (DEWHA 2008b). Amongst these species, two threatened and 17 listed marine sea snake species were identified to be listed on the EPBC Act Protected Matters Database search as potentially occurring in the Survey Area (*Table 4.2).* The two threatened species identified, namely the short-nosed sea snake and the leaf-scaled sea snake, are endemic to WA.

Surveys conducted at Ashmore Reef have recorded a notable decline in sea snake numbers over recent years, with sightings of sea snakes becoming rare since 2003 (Guinea 2013; PTTEP 2013).

4.2.5 Marine Mammals

Several species of marine mammals are known to occur in the region and have wide distributions that are associated with feeding and migration patterns linked to reproductive cycles. There are 26 species of marine mammals that occur regularly in the waters of the region. This includes two threatened/migratory, seven migratory and 17 listed marine mammals, which were identified by a search of the EPBC Act Protected Matters Database as potentially occurring in and around the Survey Area (*Table 4.2*). There are no known important breeding and foraging habitats for listed marine mammals within the Survey Area, with the exception of a minor portion of the pygmy blue whale migration BIA.

Cetacean species such as the pygmy blue whale and humpback whale are known to transit between Southern Ocean feeding grounds and tropical water breeding grounds. However, some cetacean species (e.g. bottlenose dolphin, Indo-Pacific humpback dolphin and sperm whale) are thought to be resident in the region throughout the year (DEWHA 2008b).

Dugongs are also present in the region, preferring shallow waters along the coast and around shoals where seagrass habitat is available (DEWHA 2008a). Ashmore Reef CMR (approximately 45 km away) supports a small population of dugongs. DNA studies indicate that this population may be genetically distinct from other Australian populations (Whiting 1999). The ranges of these genetically distinct dugongs are thought to possibly extend to Cartier Island and other submerged in the area (Whiting 1999).

Several biologically important areas for species have been identified within and around the Survey Area as follows:

- The pygmy blue whale migration BIA passes along the shelf edge at depths between 500 m and 1,000 m. The Survey Area overlaps with a very small (less than 0.02%) portion of the BIA, along the northern boundary;

- The humpback whale migration BIA extends along the length of the coast of Western Australia, to its northernmost extent offshore of the Kimberley region. The northern boundary of the BIA is approximately 130 km south-west from the Survey Area. As part of the BIA, Camden Sound (approximately 275 km away) is recognised as the main humpback whale breeding and calving ground (DSEWPaC 2012a); and

- Ashmore Reef and surrounding waters (approximately 60 km away) form the designated BIA for dugongs to highlight breeding and foraging behaviours in the area (DOE 2015f).

4.2.6 Fish

The region contains a diverse range of fish of tropical Indo-west Pacific affinity that are characterised by high levels of endemism and species diversity (Allen et al 1988; Commonwealth of Australia 2012; DEWHA 2008a). The continental slope of the Timor Province and the North-west Transition Bioregion supports more than 418 and 505 species of demersal fish respectively, of which 64 species are considered endemic (Last et al 2005). The diversity of the continental slope demersal fish communities in the Timor Province Bioregion has been identified as a KEF (DEWHA 2008a). The Survey Area only overlaps with approximately 0.05% of the continental slope demersal fish KEF.

The shoals in and around the Survey Area are thought to host diverse fish communities. Although there has been little study of the majority of the shoals within the Survey Area, it is assumed that fish assemblages described for the Barracouta and Vulcan shoals are broadly representative of shoals in the wider region of the Survey Area in the absence of shoal-specific information. A survey carried out in 2011 at Barracouta and Vulcan shoals found that the fish community structure was characterised by six assemblages of fishes determined by depth, amount of reef substrate and size of the shoal plateau (Heyward et al 2011a and b). The highest levels of fish species richness and total abundance were generally observed at shallow depths (less than 30 m) (Heyward et al 2011a and b). It is noted that less than 1% of the Survey Area includes depths less than 30 m depth. In 2013, Barracouta, Vulcan and Goeree shoals were surveyed and 262 species of fish and sharks from 43 families were identified (Heyward et al 2013). The Barracouta and Vulcan shoals were found to have a median fish abundance and species richness between 1.25 to three times higher than equivalent shoals, banks and reef edges in the Great Barrier Reef Marine Park (PTTEP 2013).

Site-attached fish communities are typically associated with small, isolated patches of coral reef (Ault and Johnson 1998). Since the banks/shoals within the Survey Area (including those of the Sahul Shelf system) are known or expected to host coral reef communities, it is considered possible that some of these banks/shoals will support site-attached fish communities. This is especially the case in the portions of those banks/shoals occurring in waters shallower than 30 m (comprising less than 1% of the Survey Area per above), where the highest abundances of coral cover and associated fish species are expected. Minimal to no coral cover is expected at depths greater than 60 m (Heyward et al 2011a and b), and subsequently the presence of site-attached fish at those depths is not expected.

The survey period overlaps with the spawning seasons for certain commercial fishery target species that occur in the Survey Area. A desktop review of the ecological characteristics of these species suggests that the preferred spawning habitats for the majority of these species include hard/rocky substrates, reefs, and/or shallow coastal waters (DL 2015).

Significant numbers of spawning adults are not expected to be encountered during the Cygnus 3D MSS given that:

- The Survey Area is located away from shallow coastal waters (approximately 150 km from the coastline);
- Water depths in the Survey Area are predominantly greater than 100 m with hard/rocky substrates and reefs not commonly found in the Survey Area; and
- Polarcus will implement three depth-determined exclusion zones (*Table 6.3*) and these minimum distances from shallow areas are expected to avoid interaction with preferred spawning habitats.

4.2.7 Sharks and Rays

The region experiences high species richness of shark, sawfish and rays stemming from the diversity of marine environments (Commonwealth of Australia 2012). There are approximately 500 shark and sawfish species globally, with 94 of these found in the region (i.e. 19% of the world's shark species) (DEWHA 2008b). Eight species of threatened and/or migratory sharks and rays were identified by a search of the EPBC Act Protected Matters Database as potentially occurring in and around the Survey Area. The Survey Area overlaps with 9% of the whale shark foraging BIA which extends across northern Western Australia.

4.3 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT

The Ashmore Reef CMR has two types of zoning: IUCN Category Ia – Sanctuary Zone and IUCN Category II – Recreational Use Zone (DOE 2015b). The Survey Area does not overlap with the reserve, but lies approximately 45 km east of the outer boundary of the reserve. The Cartier Island CMR has one type of zoning; IUCN Category Ia – Sanctuary Zone (DOE 2015b), which extends to the whole of the reserve. The Cartier Island CMR (and thus the Cartier Island Sanctuary Zone), is at its closest approximately 5 km from the western boundary of the Survey Area. Cartier Island itself is located approximately 12 km away.

There are no World Heritage or National Heritage Sites within the Survey Area. A search of the National Native Tribunal Register did not identify any Native Title areas within the Survey Area. The Survey Area is located approximately 5 km from the nearest historic shipwreck (*the Ann Millicent*) as listed on the Australian National Shipwreck Database (DOE 2015f). The *Ann Millicent* is located within Cartier Island CMR (DOE 2015a).

Trading vessels may pass through the Survey Area on occasion, however a low density of shipping is expected. Interactions between tourism activities and the survey are considered unlikely as the majority of activities are carried out within WA State waters. The Australia-Indonesia Memorandum of Understanding Box (MOU Box) is an area of Australian water in the Timor Sea where Indonesian traditional fishers, using traditional fishing methods only, are permitted to operate. Although a small component of the Survey Area overlaps the MOU Box, the Survey Area is not located within the typical route for traditional Indonesian fishermen from Indonesia to Ashmore Reef to Scott Reef. Access within the Cartier Island Defence Practice Area (10 km radius from the island) is prohibited and no Cygnus 3D MSS activity (including vessel/equipment presence or anchoring) will occur within that area.

Due to low efforts or location of principal commercial fishing, the Cygnus 3D MSS is not expected to interfere with most of the 13 commercial fisheries with which the Survey Area overlaps. It is considered that the survey has the potential to interact with the following three WA-managed fisheries:

- Northern Demersal Scalefish (primarily trap with some line fishing);
- Kimberley Prawn (trawl); and
- Mackerel (trolling or handline).

There are two other potential seismic surveys accepted by NOPSEMA due to be completed during the scheduled acquisition period of the Cygnus 3D MSS which overlap to some degree with the Survey Area. These include:

- the PGS Forge Multi-Client 3D Marine Seismic Survey; and
- the CGG Gravis Multi Client 3D Marine Seismic Survey.

5 STAKEHOLDER CONSULTATION

5.1 CONSULTATION APPROACH

Consultation has been planned and undertaken with the aim of:

- informing relevant stakeholders of the Cygnus 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 Survey Area. The survey activities, timing, and potential environmental impacts and risks of both planned activities and potential unplanned events were also taken into account during the stakeholder identification process.

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*.

Relevant stakeholders were then reviewed to understand how the survey activities may affect the person or the organisation's functions, interests and activities and the most appropriate method of consultation to be utilised. 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, these stakeholders will be contacted, provided with information about the survey and invited to comment. Evidence of additional stakeholder consultation will be documented in the EP's Consultation Log.

The Consultation Log is a "living document" which will be updated throughout the survey and will be used during the post-survey review of environmental performance.

5.3 *CONSULTATION METHOD*

Information sheets, each including a map, were prepared and distributed by email to relevant stakeholders as listed in *Table 5.1* on 28 July 2015. Three versions of the information sheet were developed based on the following themes:

- a general overview of the survey including location, extent, survey design, environmental setting, proposed management strategy and management measures related to interactions with marine fauna, interactions with other users of the Survey Area and potential for cumulative effects from concurrent seismic surveys;
- a general overview (as per above), including further details on the environmental setting related to fisheries; and
- a general overview (as per above), including further details on the environmental setting related to identified ecological sensitivities (e.g. marine mammals, whale sharks and turtles).

Each identified stakeholder was sent the information sheet most relevant to their identified interests. Identified interests captured in each information sheet were based on feedback typically received during stakeholder consultation undertaken for previous seismic surveys and anticipated potential concerns from identified stakeholders. Stakeholders were asked to respond and provide initial feedback to a dedicated email address (ermaustraliapolarcus@erm.com) by 7 August 2015. 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. Follow-up phone calls as required were completed following the distribution of the information sheets. Consultation records and responses were logged in the Consultation Log.

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 trigger for further consultation with relevant stakeholders, will be managed through the Polarcus Management of Change Procedure and, where relevant, in accordance with the provisions of Regulations 11A, 16 and 17 of the OPGGS (E) Regulations.

5.4 CONSULTATION RESULTS

A summary of key issues and concerns raised by stakeholders during consultation for this EP is provided in *Table 5.1*. Consultation with these stakeholders commenced in July 2015. Of the 77 stakeholders, Polarcus received responses from 27, all of which were addressed with fair consultation prior to the submission of the EP to NOPSEMA. Stakeholders that engaged in consultation with Polarcus during the consultation period were representative of all categories targeted as relevant persons, as follows:

- Commonwealth government
  Out of 15 stakeholders identified and contacted, nine responses were received.

- Western Australian government
  Out of 9 stakeholders identified and contacted, five responses were received.

- Fisheries and associations
  Out of 16 stakeholders identified and contacted, eight responses were received.

- Recreation operators, tourism operators and ports
  Out of 12 stakeholders identified and contacted, two responses were received.

- Environmental non-governmental organisations and land councils
  Out of 9 stakeholders identified and contacted, one response was received.

- Industry
  Out of 16 stakeholders identified and contacted, two responses were received.

For stakeholders that did not respond, at least three communication attempts were completed (i.e. information sheet provided by email and two follow-up calls), with the exception of fishery license holders for which only mailing addresses are available from the Department of Fisheries. Since the initiation of the stakeholder consultation, no further responses have been received from those stakeholders for which a response had not been received at the time of EP submission. Polarcus deems this sufficient time for consultation, given the extent of follow up engagement provided to these stakeholders.

It is also noted that since submission of the EP, Polarcus has liaised with the operators of the two other potential seismic surveys meant to be completed during the scheduled acquisition period of the Cygnus 3D MSS which overlap the Survey Area. The notifications from Polarcus about Cygnus 3D MSS to PGS (Forge survey) and CGG (Gravis survey) were received.

Polarcus, PGS and CGG will keep each other informed of the timings and locations of the corresponding seismic surveys. Should simultaneous operations be identified, Polarcus will work with operator(s) to minimise the potential for interaction (e.g. by applying a minimum separation distance of 40 km between seismic vessels).

Table 5.1 Summary of Consultation Results

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Commonwealth Government				
Australian Fisheries Management Authority (AFMA)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 with message left requesting call-back. Follow-up email to secondary contact made on 4 August 2015. Follow-up call made on 13 August 2015 during which it was relayed that the Environment Section contact was on leave until the following week, but that a reminder message will be left with him to reply as soon as possible. It was also relayed over the phone that AFMA typically replied promptly if an issue was identified in a consultation letter.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Australian Recreational Fishing Foundation	Phone call made on 4 August 2015 with message left requesting call-back. Follow-up message of information sheet details made through the organisation's online contact form. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Australian Hydrographic Office (AHO)	Email with information sheet and map sent on 28 July 2015	Email from AHO on 29 July 2015 acknowledging information sheet and request for final details prior to commencement of survey.	Polarcus replied on 3 August 2015 to confirm such information will be supplied as requested. Fair consultation completed and closed.	AHO to be kept informed as requested.
Australian Marine Safety Authority (AMSA) Marine Operations and Emergency Response Divisions	Email with information sheet and map sent on 28 July 2015	Email from AMSA on 3 August 2015 providing vessel traffic plot within the Survey Area and noting that extra caution must be taken where the Survey Area overlaps with the Osborne Passage and the charted Preferred Route. AMSA advised the survey to be conducted in accordance with exceptional communications and certain navigational controls (e.g. lights and streamers, reflective tail buoys, visual and radar watches, etc). AMSA requested that AMSA's Joint Rescue Coordination Centre (JRCC) be contacted for Auscoast warning broadcasts before operations commence. Additionally, the Australian Hydrographic Service must be contacted no less than 4 working weeks for the promulgation of related Notices to Mariners. AMSA also requested notification of survey end. The Cygnus 3D MSS must be conducted in accordance with MARPOL Convention requirements regarding discharges and the Marine Order '90' series. Finally, AMSA assumed that the Department of Agriculture was being consulted.	Polarcus replied to AMSA on 3 August 2015 acknowledging receipt of their email and information (including the vessel traffic plot) for subsequent review and incorporation into the EP. It was relayed to AMSA that the EP will include controls to minimise significant disruption or interference with other users of the Survey Area during the survey. Such controls include the navigational measures listed in AMSA's email as well as adherence with requirements of the International Regulations for Preventing Collisions as Sea 1972 (COLREGS), Chapter 5 of Safety of Life at Sea as implemented in Commonwealth Waters through the Navigation Act 2012 and associated Marine Orders Parts 21, 30, 59. Polarcus confirmed that the Cygnus 3D MSS will be conducted in compliance with MARPOL and the Marine Orders. Polarcus also confirmed that the Department of Agriculture is being consulted regarding the Cygnus 3D MSS. AMSA replied on 10 August 2015 thanking Polarcus for their response. Fair consultation completed and closed.	AMSA JRCC and AHO to be kept informed as requested.
Maritime Border Command (MBC) formerly Border Protection Command (BPC)	Email with information sheet and map sent on 28 July 2015	MBC replied on 29 July 2015 stating they had no comment, but would appreciate being kept informed of any further developments.	Polarcus replied on 3 August 2015 to confirm that the MBC will be kept informed of the Cygnus 3D MSS. Fair consultation completed and closed.	MBC to be kept informed as requested.
Department of Agriculture (ABARES)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 with message left requesting call-back.	Email received on 4 August 2015 from ABARES relaying that they do not respond to queries relating to seismic testing and referred Polarcus to AFMA for further consultation.	Polarcus replied on 4 August 2015 thanking ABARES for their email and confirming that AFMA were being consulted with regard to the Cygnus 3D MSS. Fair consultation completed and closed.	No further action required.
Department of Communications	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 during which the Department of Communications relayed that they were drafting up a response and would be sending it through as soon as they heard back from the Australian Communications & Media Authority. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Department of Defence • Defence estate management and offshore training areas • Australian Defence Force Airspace Cell • Defence Headquarters Air Command	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary contact sent on 4 August 2015. Follow-up call made on 4 August 2015.	Follow-up call made on 4 August 2015 during which the Department of Defence relayed that they did not have any comments at this time. Email from the Department of Defence (Estate & Infrastructure Group) received on 17 August 2015. The attached letter relayed that the Department of Defence has no objection to the proposed activities and reminds Polarcus of the requirement for advanced notice to AHS. Polarcus replied on 17 August 2015 noting no objection from the Department of Defence and confirming that advanced notice to AHS will be completed for Cygnus 3D MSS.	The Department of Defence had no objection to the survey. Fair consultation completed and closed.	No further action required.
Department of the Environment	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 13 August 2015 with message left requesting call-back.	Call from the DOE was received on 17 August 2015 during which the DOE relayed that they do not need to be consulted regarding EPs under the assessment of NOPSEMA.	The DOE do not consider themselves a relevant stakeholder for Cygnus 3D MSS. Fair consultation completed and closed.	No further action required.
Australian Marine Mammal Centre	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 with message left requesting call-back. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Department of Foreign Affairs and Trade (DFAT)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 during which the DFAT relayed that they will review the information sheet provided and respond should they have any feedback. Follow-up call made on 13 August 2015 during which DFAT requested that the information sheet be resent to another email address and that a reply will be made should DFAT have any feedback to provide. The information sheet was subsequently resent as requested immediately following the call.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Department of Industry and Science (DOIS)	Email with information sheet and map sent on 28 July 2015. Follow-up email and phone-call on 4 August 2015.	Email received on 4 August 2015 from the DOIS in which they relayed that they had no feedback to make related to the survey's EP. The DOIS provided the background and steps for the Special Prospecting Authority application that will need to be made to the National Offshore Petroleum Titles Administrator (NOPTA), as well as notification requirements for any work to be conducted within the Perth Treaty Area.	The DOIS confirmed they had no feedback to provide other than the process to follow to obtain authorisation to operate within the Perth Treaty Area. Polarcus confirmed with the DOIS that the supplied information has been taken into consideration for survey planning. Fair consultation completed and closed.	No further action required.
Department of Immigration and Border Protection formerly the Australian Customs and Border Protection Service	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015.	Follow-up call made on 5 August 2015 during which the department relayed that their main concern would be for ships entering Australian borders, not those that are already within the borders. They did not identify any potential concerns. Email received on 5 August stating that the Australian Border Force has no input to offer in relation to the survey.	Polarcus replied confirming that vessels for the Cygnus 3D MSS will comply with applicable Australian border protection requirements, including making the relevant declarations for entering and exiting Australian waters. Fair consultation completed and closed.	No further action required.
National Native Title Tribunal (NNTT)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015.	Email received on 6 August 2015 stating that the Survey Area is currently not subject to a native title application. The NNTT relayed that the Survey Area does appear to fall within the Representative Aboriginal Torres Strait Islander Body Area of the Northern Land Council and the NNTT recommended that Polarcus seek their feedback on the proposed survey.	Polarcus replied on 6 August 2015 confirming Survey Area overlaps with areas of the Northern Land Council and the Kimberley Land Council Aboriginal Corporation. The two parties were added to the stakeholder list and consultation began on 7 August 2015 (per below). Fair consultation completed and closed.	Consultation initiated with the Northern Land Council and the Kimberley Land Council Aboriginal Corporation (as per below).
Federal Member for Durack	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015 during which it was relayed by staff that they will remind the Federal Member to respond by email. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Western Australia Government				
Department of Environmental Regulation (DER)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015 with message left requesting call-back. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Department of Mines and Petroleum (DMP)	Email with information sheet and map sent on 28 July 2015	Email received on 5 August advising that significant populations of loggerhead turtles may also occur in Ashmore/Cartier and recommending that the survey timing also account for loggerhead turtle peak nesting periods (if different to green and hawksbill turtles). DMP requested pre-start notifications confirming the start date(s) for the survey approximately one week prior to commencement and cessation notifications to inform DMP upon completion of acquisition (i.e. for the year). Polarcus replied via email on 17 August 2015. The reply included a detailed description of the sporadic nesting of loggerhead turtles in the region of the Survey Area. Polarcus has committed to not acquiring seismic data within a 30 km radius of Cartier Island during the peak nesting periods for green and hawksbill turtles (October to February, which coincides with the peak nesting period of the loggerhead turtle, i.e. December). Polarcus' commitment to not operate the seismic vessel from October to February within the identified BIAs is anticipated to reduce interaction with nesting marine turtles. Polarcus also included the various management measures proposed to be implemented to reduce the number of encounters with foraging turtles (including loggerhead turtles). Such controls include the 500 m exclusion zone from the 19 water depth contour, the 500 m shut-down zone for turtles and the speed restriction within 300 m of a turtle. It is therefore anticipated that the risk of significant impacts from the Cygnus 3D MSS to breeding and foraging marine turtles, including loggerhead turtles, is low.	The DMP's queries on loggerhead turtles have been addressed, with no impacts to the species expected. The DMP will be notified as requested. DMP replied via email on 17 August 2015 relaying that they are satisfied Polarcus have considered the risks and impacts to loggerhead turtles and note the commitments and controls outlined, as to why those risks have been assessed as low. Fair consultation completed to date.	Stakeholder will be kept informed of the survey as requested.
Department of Fisheries (DOF)	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary contact and follow-up phone call with message left requesting call-back made on 4 August 2015. Follow-up call made on 5 August 2015 during which the DOF relayed that they were drafting a response to the information sheet and expect to send out soon.	Email with attached letter received from the DOF on 10 August 2015. The DOF noted the potential to affect fish populations and the operations of fishers who harvest these resources. It was recommended that the Western Australian Fishing Industry Council (WAFIC), Recfishwest, the Pearl Producers Association and individual licensed fishers be consulted. The DOF requested that a full range of mitigation strategies be implemented, including using the minimum required acoustic capacity to achieve its objectives. The DOF noted that Polarcus identified a number of commercial fisheries in their consultation package, but that the Marine Aquarium Managed Fishery, Beche de Mer Fishery and the Specimen Shell Managed Fishery were not included in that list. The DOF requested that any potential impact to charter, recreational and/or customary fishing is specifically identified in the EP. The DOF requested that Polarcus specifically include strategies in the EP to minimise the impacts of survey activities on fish spawning (e.g. soft starts, sound and exposure time minimisation). Alternately, it is preferable if seismic activities do not occur during the times of the year that key fish species listed in the letter that may be spawning within the Survey Area. The DOF requested that Polarcus demonstrate it has taken reasonable measures to minimise the chance of biosecurity impacts and included recommendations for such. A reply letter to DOF was sent on 13 August 2015. Polarcus confirmed that the majority of the fisheries listed in the DOF's letter (as well as relevant recreational and charter fishing stakeholders) have been included in the stakeholder consultation process.	The DOF's queries on consultation, fishing activities in the Survey Area, fish spawning and biosecurity have been addressed. Based on the information provided, the risk of Cygnus 3D MSS affecting fish populations and the operations of fishers who harvest these resources has been reduced to ALARP. Fair consultation completed to date.	Stakeholder will be kept informed of the survey and ongoing consultation may be required if any further concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
		No concerns had been raised to Polarcus by fishery licence holders at the time of Polarcus' response. The Marine Aquarium, Beche de Mer and the Specimen Shell Managed Fisheries have subsequently been added to the list of relevant stakeholders for the Cygnus 3D MSS. Copies of the information sheet were sent to the licence holders of these three fisheries on 11 August 2015. Due to low effort or location of the majority of commercial fishing activities away from the Survey Area, the Cygnus 3D MSS is not expected to interfere with most of the nine State managed commercial fisheries which operational zones overlap with the Survey Area (including the three newly added fisheries). The letter included a description of the several management measures being proposed in the Cygnus 3D MSS EP so as to reduce the risk of potential impacts to fish and fishing operations to both ALARP and acceptable levels. Due to the location and environmental setting of the Survey Area, significant numbers of spawning adults are not expected to be encountered during the survey. Given the survey design and observed fish behaviour related to sound emissions, behavioural changes to fish are expected to be localised and temporary, with fish (including those during spawning and pre-spawning periods) expected to rapidly return to normal behaviour once the seismic vessel has passed. A description was provided of the biofouling management measures for all vessels during the survey.		
Department of Transport (DOT) (Maritime Environmental Emergency Response)	Email with information sheet and map sent on 28 July 2015. Follow-up emails to secondary contacts sent on 4 and 7 August 2015. Follow-up call made on 13 August 2015 with message left requesting call-back.	DOT replied on 28 July 2015 confirming receipt and intent to reply in a timely manner. No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Department of Parks and Wildlife (DPAW)	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary contact and follow-up phone call made on 4 August 2015 with message left requesting call-back. Follow-up call made on 12 August 2015 with message left requesting call-back.	Email received from DPAW on 17 August 2015 relaying that DPAW had reviewed the information sheet and they did not wish to make any further comments.	DPAW have no comments to make. Fair consultation completed and closed.	No further action required.
Office of the Environmental Protection Authority (OEPA)	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary contact sent on 4 August 2015. Follow-up call made on 5 August 2015 during which it was relayed that the information sheet had been forwarded to the Marine Branch and that they will respond if they have any feedback to provide. Follow-up call made on 13 August 2015.	Follow-up call made on 13 August 2015 during which the Marine Branch manager relayed that they had no feedback to provide given the Survey Area is located outside of State waters. He also referred Polarcus to the EPA Advice for the Woodside Torosa Subsea Development: http://www.epa.wa.gov.au/News/Publicadvice/Documents/CMS14397-TorosaSubsea-s39A-160215.pdf The advice document provides details on the values of various atolls and shoals in the region. It was confirmed to OEPA during the call that benthic communities and habitat were being considered in the assessments of the Cygnus 3D MSS EP. OEPA had no further response to provide.	OEPA relayed that they had no response to make. Fair consultation completed and closed.	No further action required.
Member for Kimberley	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary contact sent on 4 August 2015. Follow-up call made on 5 August 2015 with message left requesting call-back. Follow-up call made on 12 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Shire of Derby West Kimberley	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015.	Follow-up call made on 5 August 2015, during which the Shire expressed that the information sheet had been circulated internally and that they have no response.	The Shire of Derby West Kimberley relayed that they had no response to make. Fair consultation completed and closed.	No further action required.
Shire of Wyndham East Kimberley	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015 with message left requesting call-back. Follow-up call made on 12 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Commercial Fisheries & Associations				
Commonwealth Fisheries (AFMA): • North West Slope Trawl Fishery • Western Tuna and Billfish Fishery • Western Skipjack Tuna Fishery • Southern Bluefin Tuna Fishery	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015.	Follow-up call made on 4 August 2015 during which the AFMA representative relayed that consultation letters for Commonwealth Managed Fisheries related to seismic surveys should be submitted to petroleum@afma.gov.au It was confirmed during the follow-up phone call that the information sheet had indeed been supplied to the referenced email address (refer to AFMA above).	AFMA satisfied that the right AFMA branch is being contacted as part of this stakeholder consultation process. Fair consultation completed and closed.	No further action required.
State Fisheries (licence holders): • Kimberley Prawn Managed Fishery • West Coast Deep Sea Crustacean Managed Fishery • Northern Demersal Scalefish Fishery • Northern Shark Fishery • Mackerel Managed Fishery • Pearl Oyster Managed Fishery	Information sheet and map mailed on 8 August 2015	Email received on 13 August 2015 from Doug Gibson, Managing Director of Old Brown Dog Fishing Co. (OBD), which operates a vessel the FV Ashburton Road in the Northern Demersal Scalefish fishery. OBD takes issue with your assumption that fishing vessel operators will assume the burden of ceasing fishing activities in the event of an interaction. It is a policy position adopted by WAFIC that when an incoming proponent proposes a disruption to the activities of a pre-existing activity then the onus shall be on the incoming proponent to take steps to mitigate or compensate the disruption. It is an offence under the *Fish Resources Management Act 1994*, for any vessel other than a licensed fishing vessel to interfere with fishing gear. Polarcus replied via email on 17 August 2015. Polarcus acknowledged OBD's issue and WAFIC's policy regarding interactions between fishing vessels and other vessels. Polarcus described the various controls proposed to be implemented to reduce the risk of disruption or interrupting with other users of the area (including fishery operators) to both ALARP and acceptable levels. Polarcus confirmed that they will be complying with legislation relevant to the interaction between vessels, including the AMSA Marine Orders and Fish Resources Management Act 1994. It was noted that under Marine Order 30 Rule 18(c), a vessel engaged in fishing when underway shall, so far as possible, keep out of the way of a vessel restricted in her ability to manoeuvre (including an active seismic survey vessel).	Issue raised by OBD and Polarcus has provided a response including a description of Polarcus' proposed survey management to reduce the risk of disruption or interrupting with other users of the area (including fishery operators) to both ALARP and acceptable levels. Fair consultation completed to date.	Stakeholders will be kept informed of the survey as requested and ongoing consultation may be required if any further concerns or issues are raised.
Traditional Fisheries (AFMA's MoU Box Manager)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 with message left requesting call-back.	Email from AFMA MOU Box Manager received on 13 August 2015 which relayed that the Survey Area overlaps with a portion of the MOU and warns about the likelihood of encounters with Indonesian traditional fishermen. It would be possible for AFMA to assist Polarcus to pass any printed material to the fisheries authorities on Rote Island where nearly all the traditional vessels originate. To be useful any printed material must be translated to Indonesian. Polarcus replied via email on 14 August 2015 confirming their agreement to prepare the translated information sheet to be distributed prior the start of the survey acquisition.	Polarcus has accepted AFMA's offer to assist with the consultation with Indonesian traditional fishermen. Fair consultation completed to date.	Stakeholder will be kept informed of the survey and ongoing consultation may be required if any further concerns or issues are raised.
Commonwealth Fisheries Association (CFA)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015.	Follow-up call made on 4 August 2015 during which the CFA relayed that they have no response to provide besides advising to contact the relevant fisheries operators and associations directly.	It was confirmed during the follow-up phone call that the relevant fisheries operators and associations were indeed being contacted directly. The CFA relayed that they had no response to make. Fair consultation completed and closed.	No further action required.
Western Australian Fishing Industry Council (WAFIC)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 during which WAFIC requested the information sheet to be resent to the reception email address. WAFIC will respond should they have any feedback to provide. Follow-up call made on 12 August 2015.	Follow-up call made on 12 August 2015 during which WAFIC relayed that they had passed the information sheet on to the relevant fishers in the area. They mentioned that if they received any feedback from the fishers, they would forward that along to Polarcus. However, they had no feedback to provide at the moment.	WAFIC will forward along any feedback they may receive from fishers in the area.	Stakeholder will be kept informed of the survey and ongoing consultation may be required if any further concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015.	Follow-up call made on 4 August 2015 during which ASBTIA relayed that they had no feedback to provide given the Survey Area is located outside of the known southern blue fin tuna spawning ground.	The ASBTIA relayed that they had no response to make. Fair consultation completed and closed.	No further action required.
Australian Council of Prawn Fisheries (ACPF)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015.	Follow-up call made on 5 August 2015 during which the ACPF relayed that they did not foresee any issues for anyone within the area except for Westmore Seafoods, Australia Bay Seafoods or the North West Slope Trawl Fisheries. ACPF had no response other than to check with those potential stakeholders.	Australia Bay Seafoods operate outside of the Survey Area in the Northern Territory and Gulf of Carpentaria and are thus not considered to be a relevant stakeholder. The North West Slope Trawl Fisheries were confirmed to be included in the Cygnus 3D MSS stakeholder consultation process. Westmore Seafoods was added to the stakeholder list per below. Fair consultation completed and closed.	No further action required.
Australian Fishing Trade Association (AFTA)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 during which AFTA relayed that the information sheet had been forwarded to their CEO and should they wish to provide a response they will do so. Follow up call made on 14 August 2015 with message was left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Pearl Producers Association (PPA)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015.	Follow-up call made on 5 August 2015 during which it was discussed that due to the Survey Area location, interference with the Pearl Oyster Managed Fishery and impacts from sound emissions from the seismic survey on pearl oysters are not expected. The PPA made a query regarding the potential impacts of seismic sound resulting from the Cygnus 3D MSS on food sources for pearl oysters within the Survey Area, and associated effects on the fishery's pearl oysters. Polarcus replied via email on 13 August 2015 describing how according to scientific literature, phytoplankton is not known to be affected by seismic sound emissions. Even if phytoplankton were conservatively assumed to be affected by seismic sound emissions as zooplankton can be, information was provided to demonstrate that the proportion of plankton affected by sound from the seismic source at distances sufficient to cause physiological effects (5 - 6 m) would be extremely small in comparison to the overall population in the Survey Area. Thus, impacts to feeding pearl oysters (including those commercially cultured along the Kimberley coastline) are not expected.	Discussed with PPA that due to the Survey Area location, interference with the Pearl Oyster Managed Fishery and impacts from sound emissions from the seismic survey on pearl oysters are not expected. The PPA's query on potential impacts on food sources for pearl oysters was answered. Fair consultation completed to date.	Stakeholder will be kept informed of the survey and ongoing consultation may be required if any further concerns or issues are raised.
Western Australian Northern Trawlers Owners Association (WANTOA) / WA Seafood Exporters	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary contact sent on 4 August 2015. Follow-up call made 5 August 2015. Follow-up call made on 12 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Westmore Seafoods	Phone call made on 13 August 2015 during which an email address was provided and it was requested that the Information Sheet be sent to that email. Should the corresponding contact have any feedback to provide they will respond. The information sheet was emailed as requested that same day.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Recreational Fishing, Charters, Marine Tourism Operators				
RecfishWest	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary contact sent on 4 August 2015. Follow-up call made 5 August 2015 with message left requesting call-back. Follow-up call made on 12 August 2015 during which it was confirmed the correct contact had been emailed.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
One Tide Charters	Email with information sheet and map sent on 28 July 2015. Follow-up calls made 5 and 12 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Unreel Adventure Safaris	Email with information sheet and map sent on 28 July 2015. Follow-up calls made 5 and 12 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
KAS Helicopters	Email with information sheet and map sent on 28 July 2015. Follow-up call made 5 August 2015 with message left requesting call-back. Follow-up call made on 12 August 2015 during which it was relayed that they will review the information sheet and reply as soon as possible.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Kingfisher Tours	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015 and advised to call the next day. Follow-up call made on 6 August 2015 during which the information sheet was asked to be resent. Follow-up call made on 12 August 2015 during which it was relayed that the information sheet was being circulated within the organisation and that they will reply should they have any feedback to provide.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Aviair	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015.	Follow-up call made on 5 August 2015 during which Aviair relayed that they consider that Cygnus 3D MSS will not have any impact on their operations.	No concerns raised by Aviair. Fair consultation completed and closed.	No further action required.
Peregrine Bird Tours	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 5 August 2015.	Follow-up call made on 5 August 2015 during which Peregrine Bird Tours relayed that they consider that the Cygnus 3D MSS will not have any impact on their operations.	No concerns raised by Peregrine Bird Tours. Fair consultation completed and closed.	No further action required.
Kimberley Bird Watching	Email with information sheet and map sent on 28 July 2015. Follow-up call made 5 August 2015 with message left requesting call-back. Follow-up call made on 12 August 2015.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Kimberley Air Tours	Email with information sheet and map sent on 28 July 2015. Follow-up call made 5 August 2015 during which it was relayed that the information sheet had been forwarded to the manager. Kimberley Air Tours will respond should they have any feedback to provide. Follow-up call made on 12 August 2015 during which it was relayed that the information sheet was being circulated within the organisation and that they will reply should they have any feedback to provide.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Kimberley Whale Watching	Email with information sheet and map sent on 28 July 2015. Follow-up call made 5 August 2015 with message left requesting call-back. Follow-up call on 12 August 2015 during which it was relayed that the information sheet will be reviewed and that they will reply should they have any feedback to provide.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Kimberley Outback Tours	Email with information sheet and map sent on 28 July 2015. Follow-up call made 5 August 2015 during which it was requested for the information sheet to be sent to a secondary email contact. The information sheet was resent as requested the following day. Follow-up call on 12 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Ports and Shipping				
Port of Broome	Email with information sheet and map sent on 28 July 2015. Follow-up call on 13 August 2015 during which another email address was provided and the information sheet was requested to be resent to that email. The information sheet was resent that same day.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Environmental Non-Governmental Organisations				
The Wilderness Society	Email with information sheet and map sent on 28 July 2015. Follow-up call made 6 August 2015 during which it was requested for the information sheet to be sent to secondary email contacts. The information sheet was resent as requested that same day. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Save the Kimberley	Email with information sheet and map sent on 28 July 2015. Follow-up call made 6 August 2015 during which it was requested for the information sheet to be sent to a secondary email contact. The information sheet was resent as requested that same day. Follow-up call made on 12 August 2015.	Follow-up call made on 12 August 2015 during which it was relayed that Save the Kimberley do not have any concerns regarding the Cygnus 3D MSS.	No concerns raised by Save the Kimberley. Fair consultation completed and closed.	No further action required.
Environs Kimberley	Email with information sheet and map sent on 28 July 2015. Follow-up call made 6 August 2015 with message left requesting call-back. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Australian Conservation Foundation	Email with information sheet and map sent on 28 July 2015. Follow-up call made 6 August 2015 during which it was requested for the information sheet to be sent to a secondary email contact. The information sheet was resent as requested that same day. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
The Conservation Council of WA	Email with information sheet and map sent on 28 July 2015. Follow-up calls made on 6 and 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
World Wildlife Fund	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 4 August 2015 during which WWF requested the information sheet to be resent. The information sheet was resent as requested that same day. They relayed that they will respond should they have any feedback. Follow-up call on 13 August 2015 during which another email address was provided and the information sheet was requested to be resent to that email. The information sheet was resent that same day.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
International Fund for Animal Welfare (IFAW)	Email with information sheet and map sent on 28 July 2015. Follow-up call made 4 August 2015 during which it was requested for the information sheet to be sent to a secondary email contact. The information sheet was resent as requested that same day. Follow-up call made on 12 August 2015 with message left requesting call-back. Follow-up call made on 24 September 2015 confirming that the contact person is appropriate, but not available at the time.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Land Councils				
Northern Land Council	Phone call made on 7 August 2015 during which it was requested that the information sheet be emailed to their reception email address provided over the phone. The land council relayed that should they have any feedback they will get in contact. Information sheet was emailed following the phone call. Follow-up call made on 13 August 2015 with message left requesting call-back.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Kimberley Land Council Aboriginal Corporation	Phone call made on 7 August 2015 during which it was requested that the information sheet be emailed to their reception email address provided over the phone. The land council relayed that should they have any feedback they will get in contact. Information sheet was emailed following the phone call. Follow-up call made on 13 August 2015 during which the organisation requested for the information sheet to be resent. The information sheet was resent that same day.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Industry				
APPEA	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 14 August 2015 during which APPEA mentioned that the email had been received and forwarded on to the respective people within APPEA. APPEA will respond if they have any concerns.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Telecommunication cable operators: Telstra Nextgen	Email with information sheet and map sent on 28 July 2015. Follow-up email to secondary Telstra contact sent on 4 August 2015. Follow-up call made to Nextgen on 13 August 2015 with message left requesting call-back. Follow-up call made to Telstra on 14 August 2015 during which Telstra mentioned that the email had been received and forwarded on to the respective people within Telstra. Telstra will respond if they have any concerns.	No response received from Telstra at the time of EP submission. Call received from Nextgen on 17 August 2015 relaying that Nextgen have no objection to Cygnus 3D MSS, but identify themselves as a stakeholder for survey and request to be kept informed. This is due to Nextgen's plans to lay down a fiber optic cable from Darwin to Port Hedland starting in early 2016. The cable route may overlap with the Survey Area. Polarcus agreed to keep Nextgen informed of the survey.		Stakeholders will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Approved and Prospective Petroleum Development Activities near or within the Survey Area: Sinopec Oil and Gas Australia (Puffin) Pty Ltd INPEX – Ichtys PTTEP AA Cash-Maple Shell Development Australia - Prelude Conoco Phillips Greater - Poseidon Hunt Oil - Schooner Woodside - Browse FLNG	Email with information sheet and map sent on 28 July 2015. Received confirmation from INPEX on 30 July 2015 that the information sheet had been forwarded to the relevant team.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Broome Chamber of Commerce and Industry	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 13 August 2015 during which the organisation requested for the information sheet to be resent. The information sheet was resent that same day.	Email from the Broome Chamber of Commerce received on 17 August 2015. The email relayed that they have no issues or concerns with Cygnus 3D MSS.	No concerns raised by Save the Kimberley. Fair consultation completed and closed.	No further action required.
Port Hedland Chamber of Commerce	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 13 August 2015 during which the organisation requested for the information sheet to be resent. The information sheet was resent that same day.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.
Oil Spill Response				
Australian Marine Oil Spill Centre (AMOSC)	Email with information sheet and map sent on 28 July 2015. Follow-up call made on 14 August 2015 during which AMOSC mentioned that the email had been received and forwarded on to the respective people within AMOSC. AMOSC will respond if they have any concerns.	No response received at the time of EP submission.		No response received. Stakeholder will be kept informed of the survey and ongoing consultation may be required if concerns or issues are raised.

Stakeholder	Consultation Undertaken	Stakeholder Response	Status Assessment	How Issue / Concern Addressed
Potential Ongoing Seismic Surveys				
Forge Multi-Client 3D Marine Seismic Survey, PGS Australia Pty Ltd Quoll 3D Marine Seismic Survey, Searcher Seismic Pty Ltd Gravis Multi Client 3D Marine Seismic Survey, CGG Services (Australia) Pty Ltd	Consultation commenced in late August 2015.	Searcher advised that the Quoll survey was completed on 16 August 2015, and thus no overlap will occur. The notifications from Polarcus about Cygnus 3D MSS to PGS (Forge survey) and CGG (Gravis survey) were received. Polarcus, PGS and CGG will keep each other informed of the timings and locations of the corresponding seismic surveys.	Should simultaneous operations be identified, Polarcus will work with the operator(s) to minimise the potential for interaction (e.g. minimum separation distance of 40 km between seismic vessels).	Consultation with operators of seismic surveys potentially occurring concurrently within the Survey Area will be conducted prior to and during the Cygnus 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 the applicable Commonwealth and Western Australian authorities and other relevant stakeholders (as identified during the course of the consultation described here) prior to and during the Cygnus 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 as part of the Cygnus 3D MSS is given in *Table 5.2*.

The Consultation Log prepared to support consultations for the EP will be kept live and used as a tool to trigger and record ongoing consultation. Additional stakeholders may be identified throughout the course of the survey, thus, these new stakeholders will be contacted and given the opportunity to provide feedback as relevant. Polarcus understand that feedback or concerns regarding the survey may be raised by stakeholders, over the two year EP validity period. As required, such further consultation with relevant stakeholders, will be managed through the Polarcus Management of Change Procedure and, where relevant, in accordance with the provisions of Regulations 11A, 16 and 17 of the OPGGS (E) Regulations.

Table 5.2 Schedule for Ongoing Consultation

Stakeholder	Ongoing communication schedule
All relevant stakeholders as listed in *Table 5.1* with the exception of those requesting no further consultation.	Provide advance notice of survey commencement, including final survey location and timing. Provide update should any details of area or timing change during the course of the survey. Provide notice of survey completion following completion.
Commonwealth Government	
AHO	To be contacted through hydro.ntm@defence.gov.au no less than 4 working weeks 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. Provide an information sheet about the survey (also translated into Indonesian) to AMSA's MOU Box Manager prior to survey commencement. The AMSA MOU Box Manager will forward the information sheet to relevant port authorities in Indonesia for their subsequent distribution to Indonesian traditional fishermen.
NOPSEMA	Provide notice of start and end of the Cygnus 3D MSS at least 10 days before survey 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 the survey, as detailed in the EP.
State Government	
DMP	Provide pre-start notifications confirming the start date(s) for the survey approximately one week prior to commencement and cessation notifications to inform upon completion of acquisition (i.e. for the year)
Fisheries	
Individual fisheries licence holders	Advise of the final survey location and timing prior to survey commencement, reminding them of the limited manoeuvrability of the survey vessel, and asking them to respond if they may be operating in the Survey Area during the survey. Depending on the responses received, provide further information to licence holders who indicate they may be operating in the Survey Area during the survey, such as survey location reports, progress status and activity look-ahead reports.

6 ENVIRONMENTAL IMPACTS, RISKS AND CONTROLS

6.1 RISK ASSESSMENT APPROACH AND 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 controls, and determination of the 'inherent' risk;
- Identification of appropriate controls (i.e. those in addition to legal requirements) if the inherent risk is not deemed low and acceptable;
- Evaluation of the residual risk with planned safeguards 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 Cygnus 3D MSS by way of an environmental risk assessment workshop conducted on 16 July 2015, 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). In addition to the descriptions of consequence presented in the Polarcus Risk Matrix, further descriptions were developed to cover other environmental impacts besides those related to discharges volumes. Where several potential impacts were identified for an activity, the consequence and likelihood categories were determined based on the worst credible potential impacts. Those categories took into account experience of workshop participants and industry history.

For those hazards for which the inherent risk was not deemed low, further controls were developed to reduce the likelihood of the impact occurring (i.e. preventative) and/or reduce the consequence of the impact (i.e. mitigation) to in turn reduce the risk to ALARP. In accordance with the Polarcus Risk Management Procedure, the following hierarchy of controls was applied:

- **Eliminate:** Redesign the activity or substitute a substance so the hazard is removed or eliminated;
- **Reduce:** Replace the material or process with a less hazardous one and one which does not introduce another hazard;
- **Isolate:** Measures to prevent the hazard escalating;
- **Control:** Identifying and implementing procedures, administrative controls, competency and training;
- **Personal protective equipment**: Implementing this last line of defence only after all previous measures have been tried and found to be ineffective;
- **Discipline:** Ensuring that all controls are monitored, reviewed and enforced.

Controls were required to be reasonable and practicable where both the cost of implementation and the potential effect(s) on the technical scope of the survey were acceptable. Controls were identified during the environmental risk assessment workshop drawing on the experience of personnel involved in seismic survey design and execution. Where necessary, controls were then refined as part of the ALARP demonstration process.

The following criteria were used to determine whether impacts and risks were ALARP:

- No reasonably practicable alternatives/substitutes to the activity are available that could eliminate, isolate or provide a net reduction in the risk to environmental values or sensitivities; and
- No reasonably practicable additional controls (e.g. engineering, administrative or procedural controls) are available that could provide a net reduction in the risk to environmental values or sensitivities.

In making this determination, consideration was given to trade-offs of implementing the alternatives or additional controls in terms of cost, technical, environmental, safety and logistical implications.

The following criteria were then used to determine whether impacts and risks were acceptable:

- The impact and risk was demonstrably ALARP;
- The activities and/or the identified impact and risk is compliant with applicable legislation, relevant regulatory or industry guidelines and standards and corporate policies, standards and procedures; and
- The level of risk is determined to be low or medium (*Table 6.1*).

A summary of the environmental hazards, impacts and controls determined through the risk assessment is provided in *Table 6.3*. In order to demonstrate the range of issues considered and provide additional detail on those aspects of the seismic survey considered to be of greatest interest to stakeholders, further detail on impacts associated with physical presence and sound emissions has been provided thereafter.

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 Environmental Impacts, Risks and Controls

Activity	Environmental Impact	Inherent Risk			Controls	Residual Risk		
		Cons	Like	Risk		Cons	Like	Risk
Seismic and support vessels in Survey Area	Collision/entanglement with large marine fauna resulting in injury/death	Extensive (3)	Occasionally occurs (C)	Medium	• Part A of EPBC Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (including procedures around trained crew; observation, lower power and shut-down zones; soft start; start-up delay; night-time and low visibility) • One MFO will be present on the seismic vessel supported by trained crew. • Vessel movements will comply with EPBC Regulations 2000 – Part 8 Division 8.1 'Interacting with cetaceans' and will be applied to cetaceans, whale sharks and dugongs (requirements applicable to whales will also be implemented for dugongs and whale sharks) • Vessels will not travel at speeds greater than 6 knots within 300 m of a turtle • No seismic acquisition within a 30 km radius from Cartier Island during the green and hawksbill turtle peak nesting period (October-February) • No operation of the seismic source within 500 m of the 19 m depth contour (operational exclusion zone) • No operation of the seismic source within 85 m of the 30 m depth contour (environmental exclusion zone) • No operation of the seismic source within 90 m of the 60 m depth contour (supplementary exclusion zone) • No operation of the seismic source within 90 m of the 100 m depth contour associated with the outer boundary of the carbonate banks and terraces system of the Sahul Shelf KEF • Turtle guards installed on tail buoys. • The seismic vessel will operate at low speeds (approximately 4.5 knots). • If possible and safe to do so, any entangled fauna will be returned to sea, with subsequent required reporting. • No recreational fishing.	Extensive (3)	Rarely occurs (B)	Low

	Disruption / interference with other users in the area	Minor (2)	Occasionally occurs (C)	Low	• Stakeholders who may be present in the Survey Area (as determined during consultation for this EP – see *Section 5*) are consulted prior to the survey commencing and on survey completion.
					• Ongoing consultation between Polarcus and fisheries licence holders relevant to the Survey Area (refer to *Section 5*).
					• Notice to Mariners issued prior to commencement of survey activities.
					• No activity (including vessel/equipment presence or anchoring) within the Cartier Island Defence Practice Area (10 km radius from the island).
					• Daily reporting to AMSA JRCC.
					• Adherence with requirements of the International Regulations for Preventing Collisions as Sea 1972 (COLREGS) and Chapter 5 of Safety of Life at Sea as implemented in Commonwealth Waters through the Navigation Act 2012 and associated Marine Orders Parts 21, 30, 59 - navigation, collision, support vessels, including:
					  o Appropriate lighting, navigation and communication to inform other users.
					  o Use of radar and 24/7 watch.
					• There will be at least one support vessel with the seismic vessel when the seismic vessel is in operation and when safe to do so (e.g. outside of inclement weather periods).
					• Minimum 40 km separation between the Cygnus 3D MSS seismic vessel and other operating seismic vessels of potential concurrent seismic surveys in the region of the Survey Area during data acquisition activities.
					• Streamer ends marked with tail buoys.
					• Exclusion zone of 500 m from the outermost point of petroleum production platforms and other industry facilities and infrastructure.
						Minor (2)	Rarely occurs (B)	Low

Activity	Environmental Impact	Inherent Risk			Controls	Residual Risk		
		Cons	Like	Risk		Cons	Like	Risk
Planned / routine discharge of domestic wastes (treated sewage, grey water, putrescible waste)	Temporary and localised reduction in water quality (increase in nutrient levels) resulting in localised, minor and temporary ecological impacts (e.g. changes in the availability of light, certain nutrients and/or dissolved oxygen)	Slight (1)	Rarely occurs (B)	Low	• Discharges in accordance with MARPOL 73/78 Annexes IV and V and Protection of the Sea (Prevention of Pollution from Ships) Act 1983 - Section 26D • Approved sewage treatment plant, sewage comminuting and disinfecting system or a sewage holding tank, where applicable depending on vessel gross tonnage or people capacity. • Implementation of Vessel Waste Management Plan • Marine Orders – Part 95 (Marine pollution prevention — garbage); and Part 96 (Marine pollution prevention — sewage)	Slight (1)	Rarely occurs (B)	Low
Deck drainage and bilge wastes	Temporary and localised reduction in water quality resulting in localised, minor and temporary toxicity impacts on marine biota	Slight (1)	Rarely occurs (B)	Low	• Discharges in accordance with MARPOL 73/78 Annex I • Approved oil-in-water separator used prior to discharge (oil less than 15 ppm) • Preventative/Planned Maintenance System • Current International Oil Pollution Prevention (IOPP) Certificate	Slight (1)	Rarely occurs (B)	Low
Routine disposal of solid hazardous and non-hazardous waste	Solid hazardous and non-hazardous wastes will not be discharged to sea, thus no impacts to the marine environment are expected	None (0)	Never heard of (A)	Low	• No discharge overboard to sea • Waste segregation on board • Recycling of non-hazardous waste where possible • Use of appropriate waste transfer, management and disposal companies	None (0)	Never heard of (A)	Low
Seismic source in operation	Physiological damage to marine fauna Disruption to behaviour patterns of marine fauna	Extensive (3)	Occasionally Occurs (C)	Medium	• EPBC Policy Statement 2.1 (Part A) will be applied in full (including procedures around trained crew; observation, lower power and shut-down zones; soft start; start-up delay; night-time and low visibility). The following precaution zones will be implemented: • Observation zone: 3+ km horizontal radius from the seismic source. • Low power zone: 2 km horizontal radius from the seismic source. • Shut-down zone: 500 m horizontal radius from the seismic source. • The 500 m shut-down zone applicable to whales under EPBC Act Policy Statement 2.1 will be extended to whale sharks, dugongs and turtles. • One MFO will be present on the seismic vessel supported by trained crew. • No seismic acquisition within a 30 km radius from Cartier Island during the peak green and hawksbill turtle peak nesting period (October-February). • No operation of the seismic source within 500 m of the 19 m depth contour (operational exclusion zone) • No operation of the seismic source within 85 m of the 30 m depth contour (environmental exclusion zone) • No operation of the seismic source within 90 m of the 60 m depth contour (supplementary exclusion zone) • No operation of the seismic source within 90 m of the 100 m depth contour associated with the outer boundary of the carbonate banks and terraces system of the Sahul Shelf KEF • Minimum 40 km separation between the Cygnus 3D MSS seismic vessel and other operating seismic vessels of potential concurrent surveys in the region of the Survey Area during data acquisition activities. • Adaptive management approach to be implemented in response to multiple whale sightings and associated shut-downs: • If three whale-instigated shut-downs occur within 24 hours, the seismic vessel will shut down and move to another survey line. • If three consecutive instances of moving to another survey line occur, shut down and move to another area (minimum separation distance of 50 km from the sighted whales, taking into account their travel direction and speed).	Extensive (3)	Rarely Occurs (B)	Low

Activity	Environmental Impact	Inherent Risk			Controls	Residual Risk		
		Cons	Like	Risk		Cons	Like	Risk
Vessel thrusters/engine operation	Disruption to behaviour patterns of marine fauna	Slight (1)	Regularly Occurs (D)	Low	• Vessel movements will comply with EPBC Regulations 2000 – Part 8 Division 8.1 'Interacting with cetaceans' and will be applied to cetaceans, whale sharks and dugongs (requirements applicable to whales will be implemented for dugongs and whale sharks) • Vessels will not travel at speeds greater than 6 knots within 300 m of a turtle. • One MFO will be present on the seismic vessel supported by trained crew. • Propulsion systems to be maintained in good working order (manufacturer's specifications)	Slight (1)	Regularly Occurs (D)	Low
Helicopter transfers of crew at sea	Disruption to behaviour patterns of marine fauna	Minor (2)	Occasionally occurs (C)	Low	• Helicopter movements will comply with EPBC Regulations 2000 – Part 8 Division 8.1 'Interacting with cetaceans' and will be applied to both cetaceans and dugongs (requirements for whales will be applied to dugongs) • Helicopters to avoid identified sensitive areas for birds (i.e. bird BIAs, especially Ashmore Reef and Cartier Island).	Minor (2)	Rarely Occurs (B)	Low
Navigational and safety lighting for survey/support vessels	Behavioural effects to marine fauna (marine mammals, turtles, fish and seabirds)	Minor (2)	Occasionally occurs (C)	Low	• Navigational and safety requirements under the Prevention of Collision Convention (Marine Order 30, Issue 7) • Reduce lighting as far as practicable, whilst not jeopardising safety (e.g. non-essential lighting to be turned off when not in use). • Identify opportunities to further reduce lighting during pre-survey environmental checklist	Minor (2)	Rarely occurs (B)	Low
Power generation for vessel and equipment operation	Temporary and localised reduction in air quality	Slight (1)	Occasionally occurs (C)	Low	• Vessel engines and incinerator to be maintained and operated in accordance with manufacturer specification • Vessel has valid International Air Pollution Prevention (IAPP) certificate • Seismic vessel will use low sulphur marine gas oil (MGO) • Marine Orders – Part 97 (Marine pollution prevention - air pollution)	Slight (1)	Rarely occurs (B)	Low
	Limited contribution to global greenhouse gas load	Slight (1)	Occasionally occurs (C)	Low		Slight (1)	Rarely occurs (B)	Low
Waste incineration	Temporary and localised reduction in air quality	Slight (1)	Regularly occurs (D)	Low	• Incinerator MARPOL Annex VI requirements • Vessel has valid IAPP certificate	Slight (1)	Regularly occurs (D)	Low
Biofouling of vessel hull	Introduction and establishment of IMS and displacement of native marine species with potential consequences of threatening biodiversity and reducing overall native species abundance and diversity.	Extensive (3)	Rarely occurs (B)	Low	• IMS risk assessment prior to mobilisation into Australian waters and with vessel confirmed to meet the requirements for entry into Australian waters. • Compliance with the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry guidelines • Valid hull anti-fouling certificate that meets 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*	Extensive (3)	Rarely occurs (B)	Low
Biofouling of in-water survey equipment		Minor (2)	Rarely occurs (B)	Low	• Inspection, maintenance and cleaning of equipment during retrieval	Minor (2)	Rarely occurs (B)	Low
Ballast water exchange		Extensive (3)	Rarely occurs (B)	Low	• Compliance with Australian Ballast Water Management Requirements • Advanced ballast water treatment systems will be on board which eliminate any organisms in ballast water prior to discharge.	Extensive (3)	Rarely occurs (B)	Low

Activity	Environmental Impact	Inherent Risk			Controls	Residual Risk		
		Cons	Like	Risk		Cons	Like	Risk
Fuel tank rupture from vessel collision or grounding leading to release of 280 m^3 of MGO	Acute and chronic toxic effects to marine biota from exposure to surface, entrained and shoreline hydrocarbons Oiling of marine mammals, reptiles and seabirds Oiling of islands and emergent coral reefs/submerged shoals Disruption to commercial and coastal fishing and shipping activities	Extensive (3)	Rarely Occurs (B)	Low	Prevention Controls: • Vessels will not enter exclusion zones around marine conservation areas; • No operation of the seismic source within 500 m of the 19 m depth contour (operational exclusion zone) • No operation of the seismic source within 85 m of the 30 m depth contour (environmental exclusion zone) • No operation of the seismic source within 90 m of the 60 m depth contour (supplementary exclusion zone) • No operation of the seismic source within 90 m of the 100 m depth contour associated with the outer boundary of the carbonate banks and terraces system of the Sahul Shelf KEF • Controls in place to avoid disrupting other marine users also serve to reduce the potential for a collision; • Fuel stored in multiple segregated tanks on-board the seismic vessel; • Seismic vessel double hulled, equipped with a grounding avoidance system; and • Adherence with requirements of the International Regulations for Preventing Collisions as Sea 1972 (COLREGS) and Chapter 5 of Safety of Life at Sea as implemented in Commonwealth Waters through the *Navigation Act 2012* and associated Marine Orders Parts 21, 30, 59 - navigation, collision, support vessels, including: • Appropriate lighting, navigation and communication to inform other users; and • Use of radar and 24/7 watch. Response Measures: • Source control measures in accordance with the vessel SOPEP; • Implement response procedures in accordance with OPEP; • There will be at least one support vessel when the seismic vessel is in operation and when safe to do so (e.g. outside of inclement weather periods)	Extensive (3)	Rarely Occurs (B)	Low
Refuelling spill leading to release of 1.2 m^3 to 25 m^3 MGO	Localised and short term reduction in water quality and toxic effects on marine biota	Minor (2)	Occasionally Occurs (C)	Low	Prevention Controls: • Use of dry-break couplings for refuelling; • No refuelling at sea within 25 km of land or islands • At sea refuelling during daylight hours and in suitable weather conditions as per the Polarcus Matrix of Permitted Operations; • Adherence with the Polarcus Bunkering Procedure, including completion of the Permit to Work Refuelling At Sea Checklist and Bunkering Checklist ensuring that anti-pollution equipment is ready and scuppers plugged before bunkering commences and maintaining good communication; and • Fuel transfer equipment maintained and checked prior to use. Response Measures: • Source control measures in accordance with the vessel SOPEP; and • Implement response procedures in accordance with OPEP.	Minor (2)	Rarely Occurs (B)	Low
Single point failure resulting in the release of < 1 m^3 of hydraulic fluid or chemicals	Localised and short term reduction in water quality and toxic effects on marine biota	Minor (2)	Occasionally Occurs (C)	Low	Prevention Controls: • Storage, handling and use of chemicals in accordance with MSDS; • Bunded areas, spill kits and drains maintained and monitored; and • Hydraulic fluids and chemicals used will be selected to have the lowest environmental toxicity possible whilst meeting operational performance requirements. Response Measures: • Spill kits and scupper plugs available on board; • Implement source control measures in accordance with the vessel SOPEP; • Implement response procedures in accordance with OPEP; and • Spills cleaned up as soon as practicable with contaminated material managed in accordance with vessel Waste Management Procedure.	Minor (2)	Rarely Occurs (B)	Low

Activity	Environmental Impact	Inherent Risk			Controls	Residual Risk		
		Cons	Like	Risk		Cons	Like	Risk
Accidental loss of survey equipment	Potential hazard to navigation, disruption to other users of the area (i.e. fishing operators, or commercial shipping vessels) resulting in a temporary exclusion from users' grounds and/or damage to users' property. Localised seabed disturbance and potential localised damage to benthic habitats (e.g. corals)	Minor (2)	Occasionally occurs (C)	Low	• Procedures for lifting activities and streamer deployment/retrieval • Equipment deployments carried out during appropriate weather conditions • Appropriate storage of equipment on board • Streamers are fitted with additional (redundant) retainers to prevent equipment loss, and have tail buoys fitted with relative GPS to aid recovery • Streamers are fitted with automatic recovery devices • Solid streamers (rather than oil filled) – such that if lost, there is no risk of oil loss • All lifting gear to be load rated as appropriate for the working load • Support vessels available to assist • AMSA notified in the event of equipment loss to provide a warning to shipping • If safe to do so, recovery of lost equipment will be carried out	Minor (2)	Rarely occurs (B)	Low
Accidental loss of solid non-hazardous and hazardous waste	Localised cases of entanglement, ingestion and/or toxicity resulting in injury/death to marine biota	Minor (2)	Occasionally occurs (C)	Low	• No overboard disposal • Waste will be stored, handled and transferred on board in accordance with the vessel Waste Management Plan / Garbage Management Plan which also require compliance with regulatory requirements (i.e. *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Orders – Part 94 (Marine pollution prevention - packaged harmful substances)) • If safe to do so, recovery of lost overboard material will be carried out.	Slight (1)	Rarely occurs (B)	Low
Unplanned anchoring or seabed snagging	Localised seabed disturbance and potential localised damage to benthic habitats (e.g. corals)	Slight (1)	Rarely occurs (B)	Low	• Propulsion redundancy • Support vessels available to assist • No activity (including vessel/equipment presence or anchoring) within the Cartier Island Defence Practice Area (10 km radius from the island) • No operation of the seismic source within 500 m of the 19 m depth contour (operational exclusion zone) • No operation of the seismic source within 85 m of the 30 m depth contour (environmental exclusion zone) • No operation of the seismic source within 90 m of the 60 m depth contour (supplementary exclusion zone) • No operation of the seismic source within 90 m of the 100 m depth contour associated with the outer boundary of the carbonate banks and terraces system of the Sahul Shelf KEF	Slight (1)	Rarely occurs (B)	Low

Cons = Consequence; Like = Likelihood

6.2 PHYSICAL PRESENCE

6.2.1 Entanglement or Collision with Large Marine Fauna

Large marine fauna (i.e. cetaceans, turtles, whale sharks) occurring in the Survey Area have the potential to become entangled in seismic equipment or collide with survey or support vessels, which can lead to injury or death. However, the survey has been scheduled and planned such that none of these marine megafauna are expected to be present in the Survey Area in large numbers at the time of the survey. In particular:

- The Survey Area does not overlap with the known migration route for humpback whales (DOE 2015a).
- Blue whales typically migrate as solitary individuals rather than larger groups (McCauley 2011), and the Survey Area only overlaps with less than 0.02% of the BIA for migrating blue whales (DOE 2015f).
- The Survey Area only overlaps with 9% of the whale shark foraging BIA which extends across northern Western Australia and the closest whale shark aggregation area is at Ningaloo Reef (approximately 1,375 km away (Commonwealth of Australia 2012).
- Significant numbers of turtles and dugongs are not expected due to the size and predominantly deep waters of the Survey Area in the open ocean.

The risk of causing impact to large marine fauna as a result of collision or entanglement was therefore determined to be low given that only individuals are likely to be affected with no population-wide impacts. Polarcus has adopted a number of controls to reduce risks to levels that are demonstrably ALARP (refer to *Table 6.3*), including (but not limited to):

- Compliance with EPBC Policy Statement 2.1 and EPBC Regulations 2000 – Part 8 Division 8.1 with certain requirements extended to turtles, dugongs and whale sharks (refer to *Table 6.3*);
- No seismic acquisition within a 30 km radius of Cartier Island during the green and hawksbill turtle peak nesting period (October-February);
- Implementation of three depth-determined exclusion zones (refer to *Table 6.3*), which will result in the avoidance of shallow waters directly above preferred foraging habitats of dugongs and turtles;
- Turtle guards on tail buoys;
- Operating the seismic vessels at low speeds (approximately 4.5 knots); and
- One MFO on board the seismic vessel.

6.2.2 *Disruption/Interference with Other Users of the Survey Area*

A range of other activities may occur within the Survey Area as summarised in *Section 4.3*.

Prior to commencement of the survey, Polarcus will issue a notice to Mariners to inform stakeholders of survey plans and timeframes. During the survey, Polarcus will report to AMSA JRCC daily to provide updates on the progress of the survey. Consultation with stakeholders will also be continued during the survey as described in *Section 5.5*.

Due to the inherent transient nature of the survey, any deviation from routes or exclusion from the area by other users will be localised and short term.

The likelihood of direct interactions between the seismic vessel and other vessels in the Survey Area will be reduced through the use of appropriate navigational lighting, communication channels and procedures, use of radar and implementation of 24/7 watch on board to keep other users of the area aware of the vessel's position.

Advanced scouting will also be conducted by the support vessel(s) to ensure that other vessels operating in the area are not in the way of the seismic vessel, and are provided with advance notice to move away from the path of the seismic vessel. At least one support vessel will accompany the seismic vessel when in operation and when safe to do so (e.g. outside of inclement weather periods).

No significant disruptions to fishing operations are anticipated due to:

- The fisheries cover wide spatial areas with only a portion of each fishing ground overlapping with the Survey Area.
- Based on current survey design, data acquisition will be limited to approximately 31,400 km^2 and only a small fraction of the Survey Area (less than approximately 0.3%) will be surveyed in any 24 hour period[1], which will thus minimise the time that an area is temporarily unavailable to fishing operations.
- Ongoing consultation with licence holders will enable them to plan fishing activities to avoid disruption.

[1] The seismic acquisition will be conducted in lines, with each line being on average approximately 140 km in length. At a planned acquisition speed of 4.5 knots, each line will take approximately 17 hours to complete. A line turn is then estimated to take approximately 5 hours. This would result in seismic operations over any 24 hour period being undertaken over an area of approximately 110 km^2, representing < 0.3% of the Cygnus 3D MSS Survey Area.

As the seismic vessel will move along the planned seismic lines at a constant speed of approximately 4.5 knots, and with proactive and collaborative management of operational information between Polarcus, other seismic operators in the area and fishers active in the Survey Area, it is expected that disruption to fishing operations through lost fishing time and exclusion from fishing grounds will be reduced to as low as reasonably practicable, with fishers able to rapidly return to the fishing grounds once the vessel has passed.

Polarcus will endeavour to minimise the potential for interaction between simultaneous seismic surveys (should they occur at the same time) to minimise both potential disruptions to operations (as well as potential cumulative sound impacts to the environment). Polarcus has engaged with other previously-mentioned proponents with the aim to develop a management approach for simultaneous operations where necessary. A minimum separation distance of 40 km between seismic vessels will be implemented during data acquisition activities.

Given the above, the risk of disruption/interference with other users of the area as a result of the presence of Cygnus 3D MSS has been assessed to be low.

6.3 SOUND EMISSIONS

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 seismic source has been calculated to have a maximum peak sound pressure level (peak SPL) of 248 dB re 1 µPa at 1 m (source level), which equates to a sound exposure level (SEL) of 227 dB re 1µPa^2.s at 1 m (JASCO 2015).

Impacts and risks associated with noise on key receptors as a result of the Cygnus 3D MSS are summarised below.

6.3.1 Marine Mammals

Marine mammals are considered the receptor most susceptible to impacts from underwater sound generated by seismic activities. *Table* 6.4 presents maximum horizontal distances from the source at which sound levels from a single seismic pulse are predicted to drop below the permanent threshold shift (PTS) and temporary threshold shift (TTS) thresholds (Southall et al. 2007; Wood et al. 2010) at the two sites selected for the acoustic modelling conducted for the Cygnus 3D MSS (JASCO 2015). These distances are considered to be conservative as the model overestimates sound levels within distances of tens of metres of the airgun array (JASCO 2015).

Table 6.4 ***Maximum Horizontal Distances from the Source at which Single Pulse Sound Levels are predicted to Drop below PTS and TTS Thresholds***

Modelled Location	Low frequency cetaceans		Mid frequency cetaceans		High frequency cetaceans	
	Threshold (dB re 1 µPa².s)	Range (m)	Threshold (dB re 1 µPa².s)	Range (m)	Threshold (dB re 1 µPa².s)	Range (m)
Site A	192 (PTS)	48	198 (PTS)	<10	179 (PTS)	90
	177 (TTS)	652	183 (TTS)	74	164 (TTS)	1,250
Site B	192 (PTS)	47	198 (PTS)	<10	179 (PTS)	89
	177 (TTS)	473	183 (TTS)	71	164 (TTS)	901

The following EPBC Policy Statement 2.1 precaution zones will be implemented by Polarcus for the Cygnus 3D MSS:

- Observation zone: 3+ km horizontal radius from the seismic source.
- Low power zone: 2 km horizontal radius from the seismic source.
- Shut-down zone: 500m horizontal radius from the seismic source.

To ensure that whales are not present in the vicinity of the seismic vessel when the source is powered, pre start-up visual observations and soft start procedures in line with EPBC Policy Statement 2.1 will be implemented.

As identified above, underwater sound levels from a single seismic pulse emitted by the seismic course are predicted to drop below sound levels that may result in PTS, within 100 m of the source, which is well within the 500 m shut-down zone. In addition, mortal injury to marine mammals as a result of sound emissions from the Cygnus 3D MSS is only expected to potentially occur immediately adjacent of the seismic source (McCauley 1994), which is also far within the 500 m shut-down zone. Therefore, the risk of impact to whales from PTS effects or mortal injury is assessed to be low. The acoustic modelling conducted for the Cygnus 3D MSS predicts that sound levels will drop below thresholds for TTS within less than 1.5 km from the source. Implementation of the low power zone at 2 km from the source will therefore protect individuals from potential temporary reduction in hearing sensitivity (TTS).

In addition, Polarcus will implement an adaptive management approach to manage the potential for multiple shut-downs or power-downs due to whale sightings (as described in *Table 6.3*).

Given the location of the Survey Area, the absence of critical habitats (feeding, breeding, calving, resting or confined migratory routes), low presence of marine mammals expected to be in the Survey Area and the control measures proposed, the risk of impacts on marine mammals from underwater sound generated by the Cygnus 3D MSS has been assessed to be low.

6.3.2 Marine Turtles

Popper et al. (2014) presents a threshold for potential mortal injury to marine turtles from exposure to seismic pulses of 207 dB re 1 µPa^2.s (SEL) and 210 dB re 1 µPa (peak SPL). 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, 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.

Sound from the seismic source is predicted to drop below the mortal injury threshold for turtles identified by Popper et al (2014) within less than 10 m and 89 m from the source for the SEL and SPL thresholds respectively (JASCO 2015). Furthermore and based on the modelling undertaken for the Cygnus 3D MSS, sound levels above 170 dB re 1 µPa, associated as presented above with behavioural responses in turtles, will be limited to a few kilometres from the seismic source (less than 5 km) (JASCO 2015).

Ashmore Reef and Cartier Island are known nesting grounds for green and hawksbill turtles. At its closest the Survey Area is located 12 km from nesting beaches at Cartier Island. Furthermore, over the peak turtle nesting season (October to February), Polarcus will maintain a minimum operating distance of 30 km from Cartier Island to minimise disturbance to internesting turtles. At this distance, sound levels are predicted to have dropped below 170 dB re 1 µPa within internesting habitat and are therefore not expected to cause disturbance to nesting or internesting turtles (JASCO 2015).

As described in *Table 6.3*, Polarcus will implement three depth-determined exclusion zones during the Cygnus 3D MSS which will result in the sound source not being operated in, or close to, the shallow (less than 20 m; Whiting 1996) shoal areas that have the potential to provide foraging habitat for turtles. Furthermore, the implementation of soft-start procedures will likely result in any individual turtles in the vicinity of the seismic source actively moving away from the source before entering ranges where sound exposure could cause injury. Furthermore, as a precautionary approach, the 500 m shut-down zone applicable to whales under EPBC Act Policy Statement 2.1 will be extended to turtles (as outlined in *Table 6.3*). Given that turtles are known to be less sensitive to sound compared to marine mammals, and modelling indicating that sound from the seismic source is predicted to drop below the injury threshold within less than 100 m, the extent of this shut-down zone is expected to be very conservative in protecting turtles from mortal injury, hearing damage or other physiological effects.

Some behavioural disturbance may occur up to a few (i.e. less than five) kilometres from the seismic source as described above. However, given the transient nature of the survey, turtles at any one location will only be exposed for a short duration to increased underwater sound levels and would be expected to return to normal behaviour once the seismic vessel has passed.

Given the location of the Survey Area, the distance to nesting habitats and the control measures proposed, the risk of impacts from seismic sound disturbance to turtles as a result of the Cygnus 3D MSS has been assessed to be low.

6.3.3 Pelagic Fish

Table 6.5 presents the thresholds for mortal injury, permanent hearing loss (PTS) and temporary reduction in hearing sensitivity (TTS) in fish based on Popper et al (2014) and Popper et al. (2005).

Table 6.5 Mortality, Mortal Injury, Permanent Hearing Damage (PTS) and Temporary Loss of Hearing Sensitivity (TTS) Thresholds identified by Popper et al (2005; 2014)

Mortality / Mortal Injury		PTS		TTS	
SPL [a] (dB re 1uPa)	SEL [a] (dB re 1 uPa^2.s)	SPL [a] (dB re 1uPa)	SEL [a] (dB re 1 uPa^2.s)	SPL [b] (dB re 1uPa)	SEL [a] (dB re 1 uPa^2.s)
207	207	207	203	205-210	186

a - Popper et al 2014
b - Popper et al 2005

Mainly pelagic species are likely to be found in the open waters of the Survey Area. Although modelling of horizontal dispersion of underwater sound from the seismic source predicts that mortal injury, permanent loss of hearing (PTS), or temporary reduction in hearing sensitivity (TTS) may occur within tens of metres of the seismic source at full power, pelagic species in open waters of the Survey Area are typically highly mobile, and are likely to move away from the source if the received sound levels become uncomfortable (McCauley et al. 2000). In addition, implementation of soft-start procedures will enable pelagic fish to actively avoid waters in proximity of the source as underwater sound levels become increasingly higher. Mortality or mortal injury, PTS or TTS effects are therefore highly unlikely to occur in pelagic fish in the open waters of the Survey Area.

As indicated by the modelling outputs, changes to fish behaviour may be expected within approximately 8 km from the source at full power. However, given the transient nature of the survey and the distance between survey lines (562 m), fish at any one location will only be exposed for a short duration, prior to sound levels returning to background levels as the seismic source moves along the planned seismic line (it takes approximately one hour for the vessel to move 8 km away based on the 4.5 knot speed of the seismic vessel).

It is noted that there is a minor overlap between the Survey Area and the Continental Slope Demersal Fish Communities KEF. However, as the overlap represents a very small fraction of the large area of continental slope within the KEF, any predicted impacts to demersal fish will not be of consequence to the wider KEF.

The risk of impacts to pelagic fish in open waters of the Survey Area is therefore assessed to be low.

6.3.4 Site-Attached Fish

Table 6.6 below provides estimates of the horizontal distances at which sound impact SPL thresholds for fish are likely to occur (JASCO 2015; Popper et al 2005 and 2014). Polarcus has applied the conservative assumption that the sound level will not be attenuated between the seismic source and the seabed.

Table 6.6 Horizontal Distances of Sound Impact Thresholds for Fish

	Mortality and Potential Mortal Injury	PTS and Recoverable Injury	TTS
Peak SPL (dB re 1uPa)	207	207	205 – 210
Horizontal Distance (m)	81 – 89 m	81 – 89 m	Approximately 90 m

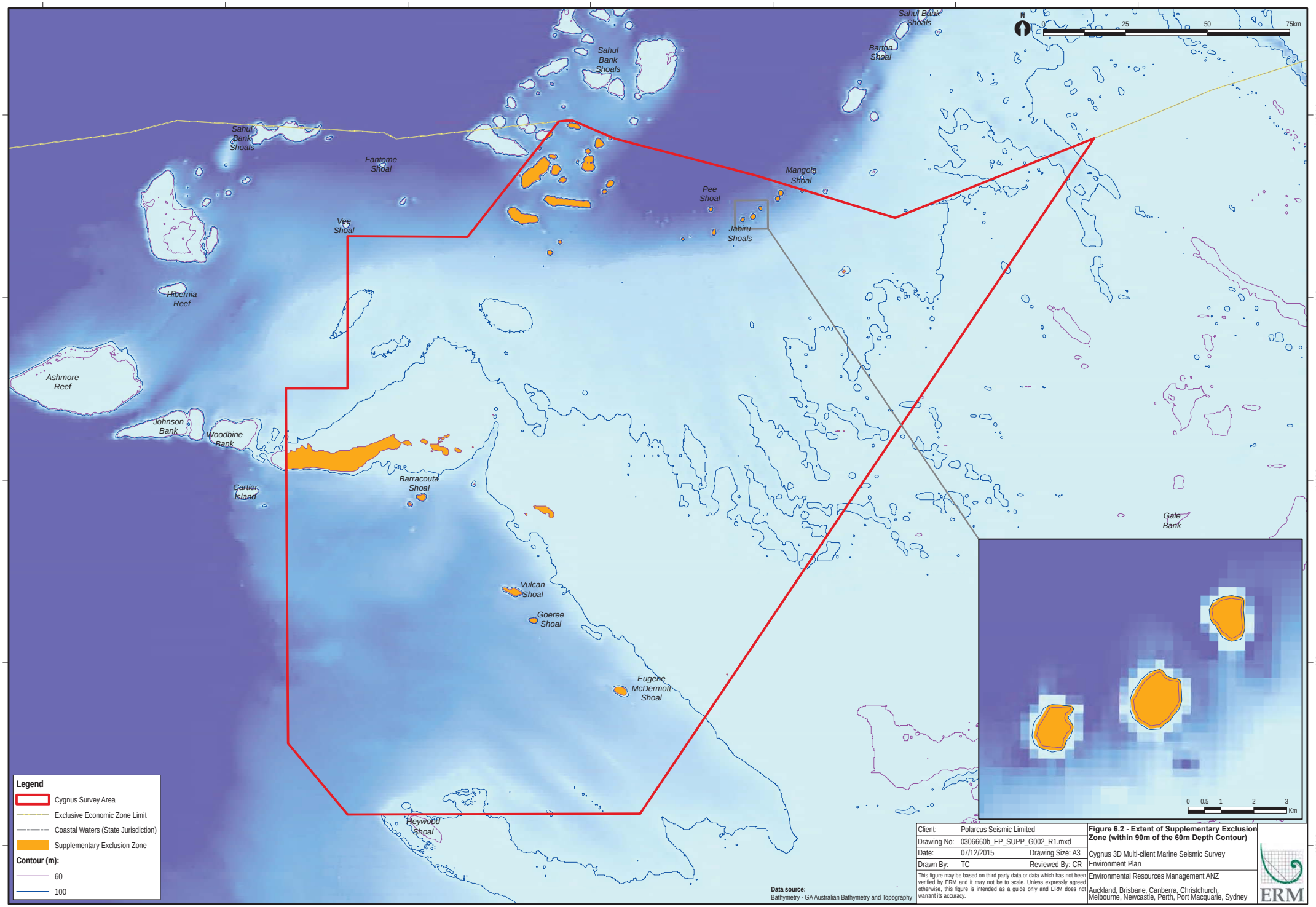
Polarcus confirms that specified exclusion zones will be implemented at all times during seismic acquisition for the Cygnus 3D MSS. No seismic acquisition will be conducted within the areas excluded by those zones (whether operational, environmental or supplementary (see below)). The depths of the outer boundary of the combined operational and environmental exclusion zones range from 31 m to 285 m (mean 112 m, median 102 m). On this basis, no seismic acquisition will occur in waters at least shallower than 30 m and typically shallower than 102 m. The intent of the operational exclusion zone is to provide a safety distance buffer from shallow water areas, while the purpose of the environmental exclusion zones is to provide a lateral offset between the point at which the seismic source is discharged and shallower waters (i.e. less than 30 m) where greater levels of coral cover and associated site-attached fish would be expected to occur. The extent of the combined operational and environmental exclusion zones is presented in *Figure 6.2*.

As described in the EP, site-attached fish communities are associated with coral cover and coral cover is not expected at depths greater than 60 m (Heyward et al 2011), which would indicate that site-attached fish beyond those depths are not expected in any significant number. Given the potential presence of coral cover down to 60 m, Polarcus have further committed to an additional exclusion zone, referred to as the 'supplementary exclusion zone.'

The supplementary exclusion zone will exclude the operation of the seismic source within 90 m of the 60 m depth contour. The depths of the outer boundary of the supplementary exclusion zone range from 61 m to 132 m (mean 89 m, median 87 m). The extent of the supplementary exclusion zone is presented in *Figure 6.3*. The supplementary exclusion zone will be implemented in addition to the operational and environmental exclusion zones, but essentially overlaps with and extends beyond the environmental exclusion zone.

The supplementary exclusion zone has been defined based on sound modelling results, which indicate that sound levels throughout the water column (at any depth) will be lower than the sound impact thresholds for fish within 90 m horizontally of the seismic source (refer to *Table 6.6* above). The implementation of the supplementary exclusion zone will effectively result in the seismic source being at least 90 m away at all times from the potential habitat for site-attached fish (i.e. waters shallower than 60 m).

Thus, the Cygnus 3D MSS seismic source will be operated at distances to minimise mortality, potential mortal injury, PTS, recoverable injury and TTS sound emission impacts to site-attached fish within the Survey Area.



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Drawing No:	0306660b_EP_SUPP_G002_R1.mxd		
Date:	07/12/2015	Drawing Size: A3	
Drawn By:	TC	Reviewed By: CR	

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Figure 6.2 - Extent of Supplementary Exclusion Zone (within 90m of the 60m Depth Contour)

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Environmental Resources Management ANZ

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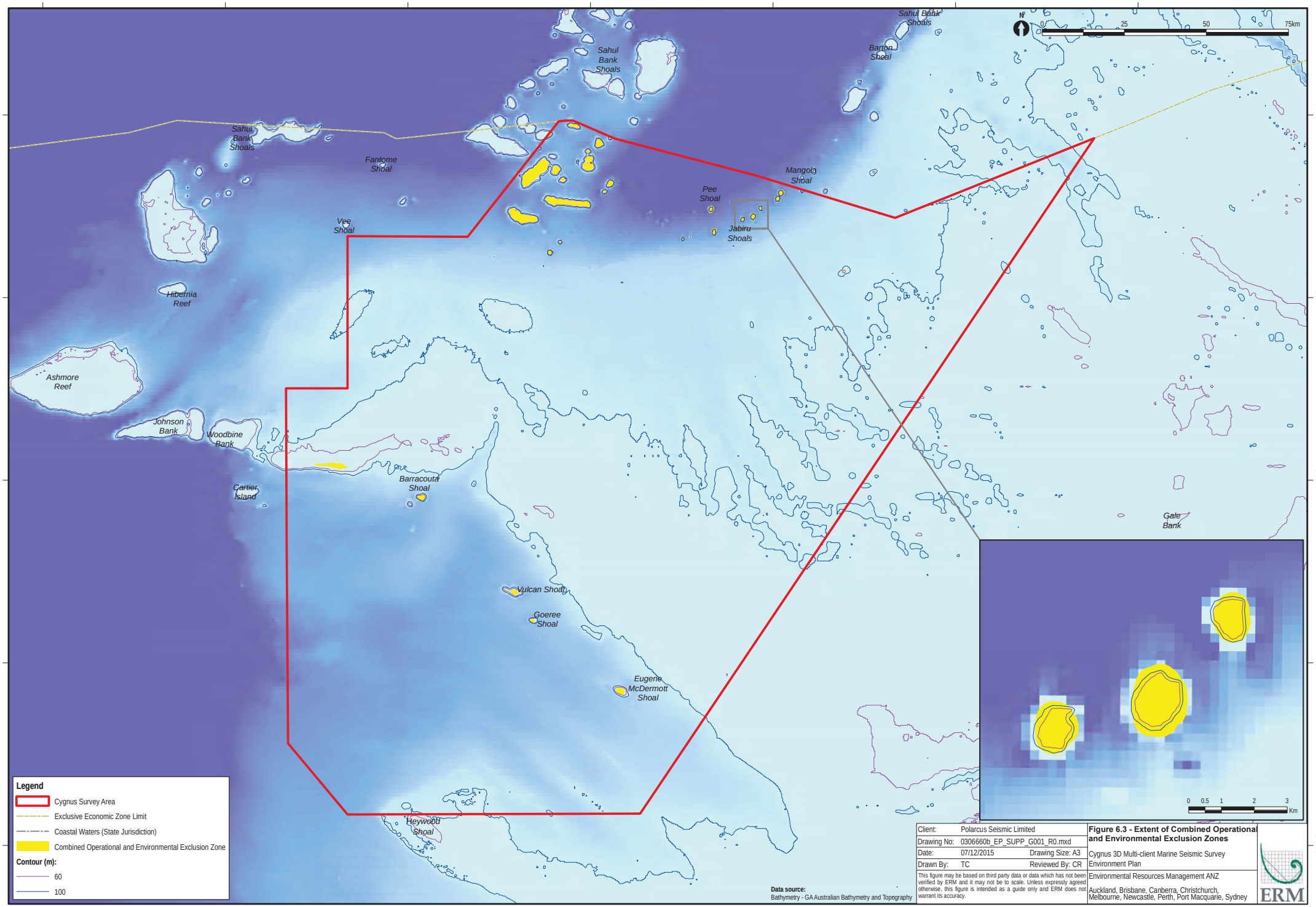

Client:	Polarcus Seismic Limited		
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Date:	07/12/2015	Drawing Size: A3	
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Figure 6.3 - Extent of Combined Operational and Environmental Exclusion Zones

Cygnus 3D Multi-client Marine Seismic Survey Environment Plan

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6.3.1 Benthic Receptors

The risk of sound emission impacts to benthic receptors (i.e. benthic invertebrates such as sponges, corals, crustaceans, marine worms, etc.) is deemed to be low. The seabed of the Survey Area is predominantly (95%) characterised by soft sediment habitats sparsely covered by filter-feeding organisms and mobile invertebrates. The implementation of the three exclusion zones described above results in the operation of the seismic source being over areas expected to have a low presence of benthic invertebrates. Thus, the likelihood of benthic invertebrates being present at the depths which the Cygnus 3D MSS will operate is considered to be low.

Sound impact SPL thresholds for invertebrates are unknown. Because of their physiology, potential effects of seismic sound on marine invertebrates are generally considered to be limited. Thus, sound impact SPL thresholds for invertebrates can be considered to be higher than those for fish. Per *Table 6.6*, the area on the seabed at which sound levels above fish sound impact thresholds would occur comprises of a conservative 90 m radius from the point on the seabed directly below where the seismic was discharged (on the conservative assumption that the seismic signal strength does not degrade at all as it moves vertically through the water column). Thus, it can be deduced that the area of the seabed to receive seismic source sound levels with potential impacts to invertebrates is considerably smaller than this. Based on the low likelihood of benthic invertebrates being present at operating depths; the likelihood of them being present in the small area of seabed directly below the seismic source where potential impacts may occur is even lower (especially for mobile invertebrates). Thus, by also taking into account the transient nature of the survey, any potential impacts will be limited temporally, as well as spatially.

The above assessment is considered to be conservative since potential impacts to invertebrates are understood to be limited to within extremely close range (<15 m) to the seismic source (McCauley 1994). This is further supported by the monitoring of benthic communities following the Maxima 3D MSS conducted at Scott Reef (approximately 200 km away). This MSS used a 2,055 in3 airgun array towed 5 m below the surface in water depths of 30 and 70 m in the southern lagoon at Scott Reef (being immediately adjacent to the reef flat), and following such exposure, benthic receptors such as corals and other benthic invertebrates were found to be unaffected by seismic sound exposure (Hastings et al 2008; Woodside 2011).

It is recognised that the north-eastern corner of the Survey Area overlaps with the western edge (approximately 10%) of the Sahul Shelf system KEF. This western edge of the Sahul Shelf system is characterised by a hard substrate plateau of approximately 100 m depth that abruptly (almost completely vertically) rises from the surrounding 150 - 200 m depths to the north-west.

Given that the Sahul Shelf system is a unique seafloor feature with ecological properties of regional significance, and based on a precautionary approach, Polarcus will also commit to not acquiring seismic data within 90 m of the Sahul Shelf system.

Given that sound impact SPL thresholds for benthic invertebrates are unknown, but understood to be higher than those for fish, the 90 m separation distance to the Sahul Shelf system and associated benthic receptors is a conservative measure being applied by Polarcus to minimise potential impacts from sound emissions (*Table 6.6*).

Given the low likelihood of benthic invertebrates being encountered below the operating seismic source and the exclusion controls to be implemented, the risk of sound emission impacts to benthic receptors is deemed to be low.

6.3.2 Sharks and Rays

Whale sharks may show avoidance behaviour to the seismic source and are unlikely to remain close enough to the source to suffer physiological effects. Given the protected status of the whale shark and the tendency for individuals to be present in surface waters where they may be detected through visual observation, a 500 m shut-down zone will be implemented for whale sharks as per the shut-down zone for whales required under EPBC Act Policy Statement 2.1, thereby reducing the risk of this species being present in close proximity to the powered seismic source.

The risk of impacts from seismic sound disturbance to sharks and rays as a result of the Cygnus 3D MSS has been assessed to be low.

6.3.3 Commercial Fisheries

The overall productivity of fisheries is not anticipated to be affected by underwater sound from the Cygnus 3D MSS and the risk of impact on commercial fisheries has been assessed to be low on the basis that:

- The fisheries cover wide spatial areas with only a portion of fishing areas (and by association stocks) falling within the Survey Area of the Cygnus 3D MSS; and
- Any effects to target species within the Survey Area are expected to only affect a relatively small portion of the WA stock; and
- Ongoing consultation with licence holders will enable them to plan fishing activities to avoid disruption.

Furthermore, Polarcus has engaged with fisheries organisations during the preparation of this EP. The assessments of merit and responses to their concerns are presented in *Section 5*.

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 has:

- Adopted the implementation of soft-start procedures each time the seismic source is initiated gradually increasing power over a 30 minute period; and
- Minimised the sound intensity of the seismic source to the minimum necessary to meet the survey's technical objectives.

6.3.4 Sound Emissions from Simultaneous Operation of Multiple Seismic Sources

While overall sound levels are not expected to be significantly elevated, the result of multiple seismic vessels operating concurrently will represent a wider spatial area of potential exposure to seismic sound for marine fauna. However, the minimum separation distance of 40 km between seismic vessels of potentially concurrent surveys would also not increase the potential for PTS or TTS effects in marine mammals or fish. Cumulative impacts on turtles as a result of other concurrent seismic surveys are not expected given the separation distance of 40 km between vessels and the limited spatial extent over which increased sound levels from each vessel have to potential to affect turtles. Thus, cumulative impacts on marine fauna as a result of other concurrent seismic surveys are not expected.

7 IMPLEMENTATION STRATEGY

The Cygnus 3D MSS will be undertaken in accordance with the NOPSEMA-accepted EP, applicable legislation and the Polarcus Management System. The Polarcus Management System is an integrated system addressing environment, safety and quality management which is based on the International Association of Oil and Gas Producers (IOGP)-IPIECA Report No. 510 (IOGP-IPIECA 2014).

The Polarcus Management System incorporates a number of documented manuals, plans and procedures, registers and tools that will be implemented for the Cygnus 3D MSS 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 the EP. Ongoing monitoring to track environmental performance during the survey includes pre-survey and in-survey environmental inspections, record collection and various scheduled meetings during which any environmental issues that arise are tabled for discussion. Records will be produced for each of these activities that will feed into the Polarcus compliance register (described below) ensuring ongoing compliance with the EP. The compliance register will serve as an audit tool during the survey to establish that environmental performance outcomes and standards are being met in accordance with the EP.

The implementation strategy presented in the Cygnus 3D MSS EP describes the organisational structure, roles/responsibilities and competency/training requirements for all personnel involved in the survey relevant to the controls described in *Table 6.3*. It also further describes the processes in place to meet the monitoring, auditing and reporting requirements defined in the EP and to manage non-conformance, incidents and emergency situations, including oil spills. These processes are underpinned by the Polarcus Management System. The reporting requirements for environmental incidents and reporting on overall compliance of the Cygnus 3D MSS with the EP are also detailed.

7.1 AUDITS

Polarcus will maintain a compliance register that will serve as an audit tool during the Cygnus 3D MSS. The register will be sufficiently detailed to enable auditors to determine whether the environmental performance outcomes for the survey 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 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, operational considerations and on board preparedness. The activity will be documented and corrective actions rectified prior to mobilisation; and
- An audit of the on-board spill response capability against the vessel SOPEP to verify spill preparedness.

Polarcus will then conduct a compliance audit against the EP during the survey. This will target that:

- Compliance with regulatory requirements detailed in the EP is being achieved;
- Performance outcomes have been monitored, measured and evaluated as required;

- Emissions and discharges are being monitored, measured and documented as required; 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 compliance audit will be forwarded to NOPSEMA upon request. Lessons learnt from the environmental compliance audit will be included in the Environmental Performance Report.

Although Polarcus is seeking authorisation to undertake seismic data acquisition operations over a two-year period, the actual acquisition will be undertaken in phases, depending on commercial considerations and interest of relevant titleholders. It is Polarcus' intent to undertake as a minimum one compliance audit per acquisition phase or six month period, whichever is the shortest.

7.2 MONITORING

The following aspects will be monitored and recorded during the conduct of Cygnus 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.

7.3 REVIEW OF ENVIRONMENTAL PERFORMANCE

Polarcus will undertake an internal review of the environmental performance of the Cygnus 3D MSS on completion 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 the Environmental Performance Report.

As stated in *Section 5.5*, the Consultation Log prepared to support consultations for the EP will be kept live and used as a tool to trigger and record ongoing consultation.

7.4 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; DOT, 2010a) and associated Marine Oil Spill Contingency Plan (MOSCP) (DOT, 2010b) – 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 Survey 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).

8 *REFERENCES*

Allen, GR. Swainston, R. and Western Australian Museum 1988. *The Marine Fishes of North-Western Australia: A Field Guide for Anglers and Divers*, Western Australian Museum, Perth, Australia.

Ault TR and Johnson CR. 1998. Spatially and temporally predictable fish communities on coral reefs. Ecological Monographs, 68 (1). pp. 25-50. ISSN 0012-9615

Australian Fisheries Management Authority (AFMA). 2015 The Fisheries, http://www.afma.gov.au/fisheries/ Viewed on 23 July 2015

Australian Fisheries Management Authority (AFMA). 2015. Guidelines for Petroleum Industry Consultation with AFMA, viewed 8 July 2015, http://www.google.com.au/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CCMQFjABahUKEwjd_uXt84vHAhVWgJIKHeBuD7A&url=http%3A%2F%2Fwww.afma.gov.au%2Fwp-content%2Fuploads%2F2012%2F12%2FGuidelines-for-petroleum-industry-consultation-with-AFMA-web-version.docx&ei=Gte-Vd2JJNaAygTg3b2ACw&usg=AFQjCNEby0u5ZCRqv-rgREoRf5ly3zWClg&sig2=atakv1vaidZf7uBQ_LhHtA&bvm=bv.99261572,d.aWw

Australian Maritime Safety Authority (AMSA). 2014. The National Plan for Maritime Environmental Emergencies (National Plan). Australian Maritime Safety Authority, Canberra, Australian Capital Territory.

Brewer, D. Lyne, V. Skewes, T. and Rothlisberg, P. 2007. *Trophic Systems of the Northwest Marine Region*. Report to the Department of the Environment and Water Resources, CSIRO Marine and Atmospheric Research, Cleveland.

Bureau of Meteorology (BOM) 2014a. Climatology of Tropical Cyclones in Western Australia. http://www.bom.gov.au/cyclone/climatology/wa.shtml. Viewed on 23 July 2015

Commonwealth of Australia. 2012. Marine Bioregional Plan for the North-west Marine Region. Canberra: Government of Australia, http://www.environment.gov.au/system/files/pages/1670366b-988b-4201-94a1-1f29175a4d65/files/north-west-marine-plan.pdf. Viewed on 25 June 2015

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2012a. Marine Bioregional Plan for the North-west Marine Region.

Prepared under the Environment Protection and Biodiversity Conservation Act 1999. http://www.environment.gov.au/system/files/pages/1670366b-988b-4201-94a1-1f29175a4d65/files/north-west-marine-plan.pdf. Viewed on 26 June 2015

Department of the Environment (DOE) 2015a. Species Profile and Threats Database, Department of the Environment, Canberra. http://www.environment.gov.au/sprat. Viewed on 29 June 2015

Department of the Environment (DOE) 2015b. Ashmore Reef Commonwealth Marine Reserve http://www.environment.gov.au/topics/marine/marine-reserves/north-west/ashmore. Viewed on 29 June 2015

Department of the Environment (DOE) 2015f. National Conservation Values Atlas http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf. Viewed on 29 June 2015

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008a. Statement 2.1 – Interaction Between Offshore Seismic Exploration and Whales: Industry Guidelines. http://www.environment.gov.au/resource/epbc-act-policy-statement-21-interaction-between-offshore-seismic-exploration-and-whales. Viewed on 29 June 2015

Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008b. North-west Marine Bioregional Plan Bioregional Profile: A Description of the Ecosystems, Conservation Values, and Uses of the North West Marine Region. http://www.environment.gov.au/coasts/mbp/publications/north-west/bioregional-profile.html. Viewed on 29 June 2015

Department of Fisheries, WA (DOF). 2013. Guidance Statement for Oil and Gas Industry Consultation with the Department of Fisheries, viewed 29 October 2014, http://www.fish.wa.gov.au/Documents/occasional_publications/fop113.pdf

Department of Industry and Science (DOIS). 2015. Offshore Petroleum Exploration Acreage Release Special Notices. Viewed 8 July 2015. http://www.petroleum-acreage.gov.au/2015/special-notices

DiscoverLife (DL). 2015. Search, viewed 10 August 2015, http://www.discoverlife.org/search.html

Guinea, M. 2013. Monitoring Program for the Montara Well Release Timor Sea Monitoring Study S6 Sea snakes/Turtles. http://www.environment.gov.au/system/files/pages/bcefac9b-ebc5-4013-9c88-a356280c202c/files/surveys-sea-snakes-turtles.pdf. Viewed on 25 June 2015

Hastings, MC, Reid, CA, Grebe, CC, Hearn, RL and Colman, JG. 2008. The effects of seismic airgun sound on the hearing sensitivity of tropical reef fishes at Scott Reef, Western Australia. Underwater Sound Measurement, Impact and Mitigation, Proceedings of the Institute of Acoustics, vol. 30, iss. 5.

Heyward, AJ. Pinceratto, E. Smith, L.D. 1997. *Big Bank Shoals of the Timor Sea: an environmental resource atlas*. Australian Institute of Marine Science & BHP Petroleum. 115 p.

Heyward, A. Moore, C. Radford, B. and Colquhoun, J. 2010. *Monitoring Program for the Montara Well Release Timor Sea: Final Report on the Nature of Barracouta and Vulcan Shoals*. Prepared by the Australian Institute of Marine Science for PTTEP Australasia (Ashmore Cartier) Pty Ltd.

Heyward, A. Jones, R. Travers, M. Burns, K. Suosaari, G. Colquhoun, J. Case, M. Radford, B. Meekan, M. Markey, K. Schenk, T. O'Leary, RA. Brooks, K. Tinklet P. Cooper T. and Emslie M. 2011a. *Monitoring Study S6B Corals Reefs, Montara: 2011 Shallow Reef Surveys at Ashmore, Cartier and Seringapatam Reefs*. Final Report for PTTEP Australasia (Ashmore Cartier) Pty. Ltd. Australian Institute of Marine Science, Townsville. 163pp. http://www.environment.gov.au/system/files/pages/bcefac9b-ebc5-4013-9c88-a356280c202c/files/2011-shallow-reef-surveys.pdf. Viewed on 21 July 2015

Heyward A, Jones R, Meeuwig J, Burns K, Suosaari G, Radford B, Colquhoun J, Cappo M, Case M, O'Leary R, Fisher R, Meekan M, Stowar M. 2011b. Monitoring Study S5 Banks & Shoals, Montara 2011 Offshore Banks Assessment Survey. Report for PTTEP Australasia (Ashmore Cartier) Pty. Ltd. Australian Institute of Marine Science, Townsville. (253 pp).

Heyward, A. Peed, C. Meekan, M. Cappo, M. Case, M. Colquhoun, J. Fisher, R. Meeuwig, J. and Radford B. 2013 *Montara: Barracouta East, Goeree and Vulcan Shoals Survey 2013.* Prepared by the Australian Institute of Marine Science for PTTEP Australasia (Ashmore Cartier) Pty Ltd

JASCO, 2015. Polarcus Cygnus Marine Seismic Survey Acoustic Modelling. JASCO Document 00993, Version 1.0. Technical report by JASCO Applied Sciences.

Last, P. Lyne, V. Yearsley, G. Gledhill, D. Gomon, M. Rees, T. & White, W. 2005. *Validation of National Demersal Fish Datasets for the Regionalisation of the Australian Continental Slope and Outer Shelf (>40 m Depth)*, Department of Environment and Heritage and CSIRO Marine Research, National Oceans Office, Hobart, Australia, pp. 99.

McCauley, RD, Fertrell, J, Duncan, AJ, Jenner, C, Jenner, MN, Penrose, JD, Prince, RIT, Adihyta, A, Murdoch, J and McCabe, K. 2000. Marine seismic surveys: analysis and propagation of airgun signals, and effects of exposure on humpback whales, sea turtles, fishes and squid. Perth: Prepared for the Australian Petroleum Exploration and Production Association from the Centre for Marine Science and Technology, Curtin University.

McCauley, R. D. 1994. ''Seismic surveys,'' in Environmental Implications of Offshore Oil and Gas Development in Australia—The Findings of an Independent Scientific Review, edited by J. M. Swan, J. M. Neff, and P. C. Young ~Australian Petroleum Exploration Association, Sydney, pp. 19–122.

McCauley, RD. 2011. Woodside Kimberley Sea Noise Logger Program, Sept-2006 to June-2009: Whales, Fish and Man-made noise. Report produced for Woodside Energy Ltd, 86 pp.

Moein, SE, Musick, JA, Keinath JA et al. 1995. Evaluation of seismic sources for repelling sea turtles from hopper dredges. In: Hales LZ (ed) Sea turtle research program: summary report. Prepared for US Army Engineer Division, South Atlantic, Atlanta, GA, and US Naval Submarine Base, Kings Bay, GA. Technical Report CERC-95, 90, pp. 75–78.

National Imagery and Mapping Agency, US. 2004. Sailing Directions (Enroute) - North, West and South Coasts of Australia, 8th Edition (Revised and Corrected through NTM 38/04. Publication 175. https://books.google.com.au/books?id=d1pxcX5ged8C&pg=PP1&lpg=PP1&dq=north,+west+and+south+coasts+of+australia+2004+eighth+edition&source=bl&ots=iwwSNQf_5n&sig=cVZBXKMZeHu54IFgsrAu6r43x4E&hl=en&sa=X&ei=0NWUVdqcFciSoQSX7JLQAg&ved=0CB0Q6AEwAA#v=onepage&q&f=false. Viewed 02 July 2015

Popper, A. N., M.E. Smith, P.A. Cott, B.W. Hanna, A.O. MacGillivray, M..E. Austin, and D.A. Mann. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. J. Acoust. Soc. Am. 117:3958-3971.

Popper, AN, Hawkins, AD, Fay, RR, Mann, DA, Bartol, S, Carlson, TJ, Coombs, S, Ellison, WT, Gentry, RL, Halvorsen, MB, Løkkeborg, S, Rogers, PH, Southall, BL, Zeddies, DG and Tavolga, WN. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014. pp. 73.

PTTEP 2013. Montara Environmental Monitoring Program – Report of Research Edition 2. http://www.au.pttep.com/wp-content/uploads/2013/10/2013-Report-of-Research-Book-vii.pdf. Viewed on 30 June 2015

Southall, BL, Bowles, AE, Ellison, WT, Finneran, JJ, Gentry, RL, Greene Jr., CR, Kastak, D, Ketten, DR, Miller, JH, Nachtigall, PE, Richardson, WJ, Thomas, JA and Tyack, PL. 2007. Marine mammal sound exposure criteria: Initial scientific recommendations. Aquatic Mammals, vol. 33, iss. 4, pp. 411-509.

Whiting, SD. 1999. Use of the remote Sahul Banks, northwestern Australia, by dugongs, including breeding females, Marine Mammal Science, vol. 15, pp. 609–615. Whittell, H.M. (1942). A review of the work of John Gilbert in Western Australia. Emu. 41:289-305.

Wood, J., B.L. Southall, and D.J. Tollit. 2012. PG&E offshore 3 D Seismic Survey Project EIR-Marine Mammal Technical Draft Report. SMRU Ltd.

Woodside, 2011, Impacts of seismic airgun sound on benthic communities: a coral reef case study. Maxima 3D MSS Monitoring Program, Information Sheet 4. Woodside, Perth, 9 pp.

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