



# TECHNICAL DOCUMENT

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# 1 INTRODUCTION

PTTEP Australasia (Ashmore Cartier) Pty Ltd (PTTEPAAA), a wholly owned subsidiary of PTTEP Australia Perth Pty Ltd and part of the PTTEP Australasia Group (PTTEPAA), is proposing to undertake a three-dimensional (3D) seismic survey (the Sandalford 3D Seismic Survey) of AC/RL7, AC/P54, AC/RL4 and AC/RL5. These petroleum titles are located in Commonwealth waters approximately 600km west of Darwin and 750km northeast of Broome.

An Environment Plan (EP) was prepared for this seismic survey and accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) on the 23rd of February 2012 in accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

This EP summary document has been prepared to comply with the requirements of Regulation 11(7) and (8) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

# 2 LOCATION OF ACTIVITY

The Sandalford 3D Seismic Survey targets AC/RL7, AC/P54, AC/RL4 and AC/RL5 titles located in the Timor Sea approximately 600 km west of Darwin and 750km northeast of Broome (see **Figure 1**). The boundary coordinates of the proposed seismic survey area are provided in **Table 1** and a schematic showing its location is provided in **Figure 2**. The seismic acquisition area within the seismic survey area is the target area for data collection, however an additional buffer to the east and west is provided to allow for the vessel's turning circle as well as run ins and approaches to ensure orientation and effective operation of seismic equipment prior to acquisition.

**Table 1 Boundary coordinates of Sandalford 3D Seismic Survey area**

Location Point (Fig 2)	Easting (m)	Northing (m)	Latitude	Longitude
A	650703.056221	8660605.787299	12° 6' 45.595" S	124° 23' 5.426" E
B	643321.598407	8664634.966913	12° 4' 35.645" S	124° 19' 0.643" E
C	660618.759882	8691078.876390	11° 50' 12.146" S	124° 28' 27.992" E
D	719128.214464	8691148.481541	11° 49' 57.998" S	125° 0' 40.825" E
E	726494.085557	8685844.052337	11° 52' 48.823" S	125° 4' 45.418" E
F	706200.205225	8660891.509782	12° 6' 25.451" S	124° 53' 40.660" E

The seismic survey area is in the Vulcan sub-basin, located in the western Bonaparte Basin. The Vulcan sub-basin is a northeast-trending geological structure comprising a complex series of horsts, graben and marginal terraces (DRET, 2010). The Vulcan sub-basin hosts proven oil resources (including Jabiru and Montara) as well as a number of gas resources currently under exploration.

Water depth within the seismic survey area ranges from approximately 100 to 210 m. On the northern boundary of the seismic survey area there are two seamounts that rise from the sea floor to approximately 22m below the surface.

Figure 1 – Regional Setting

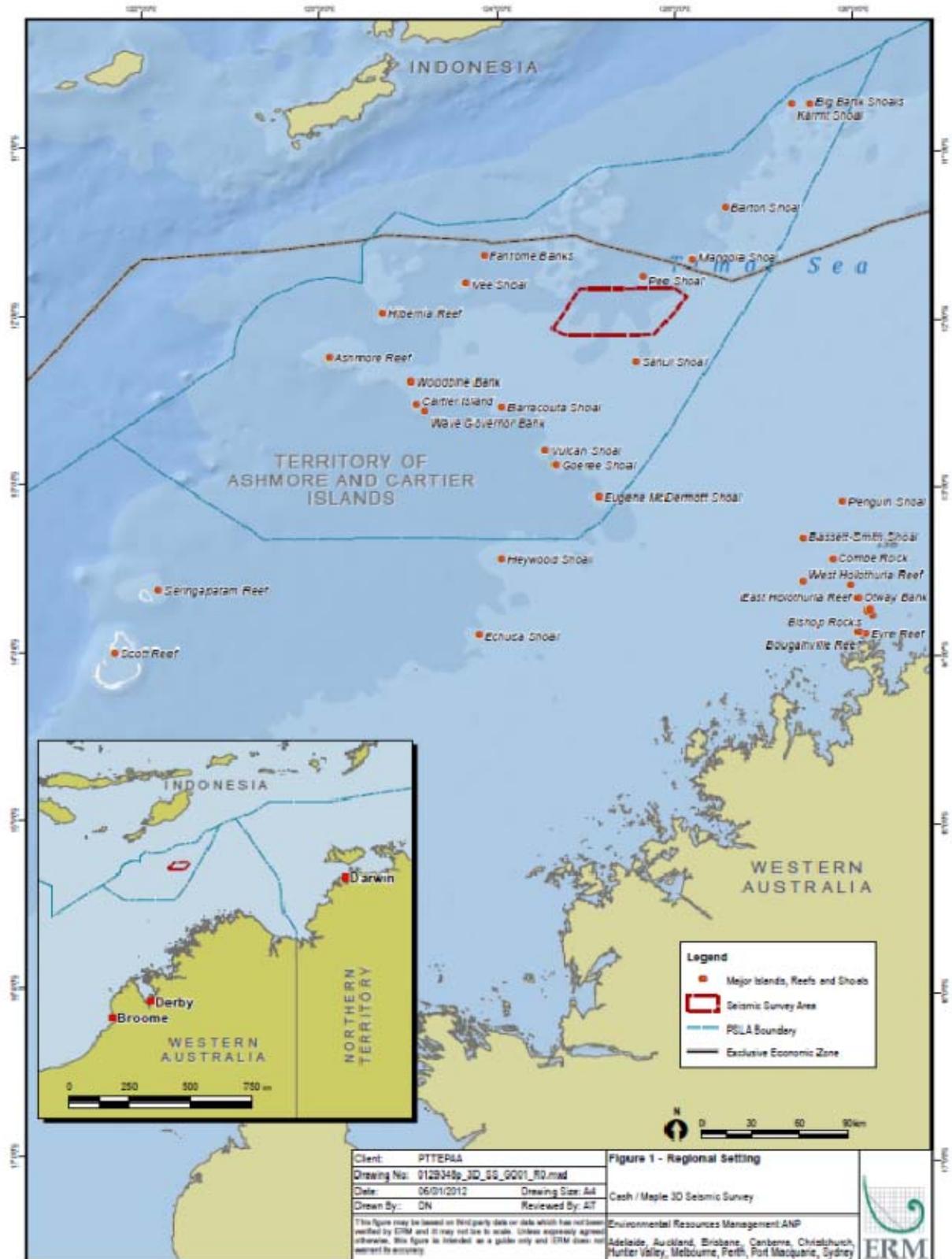
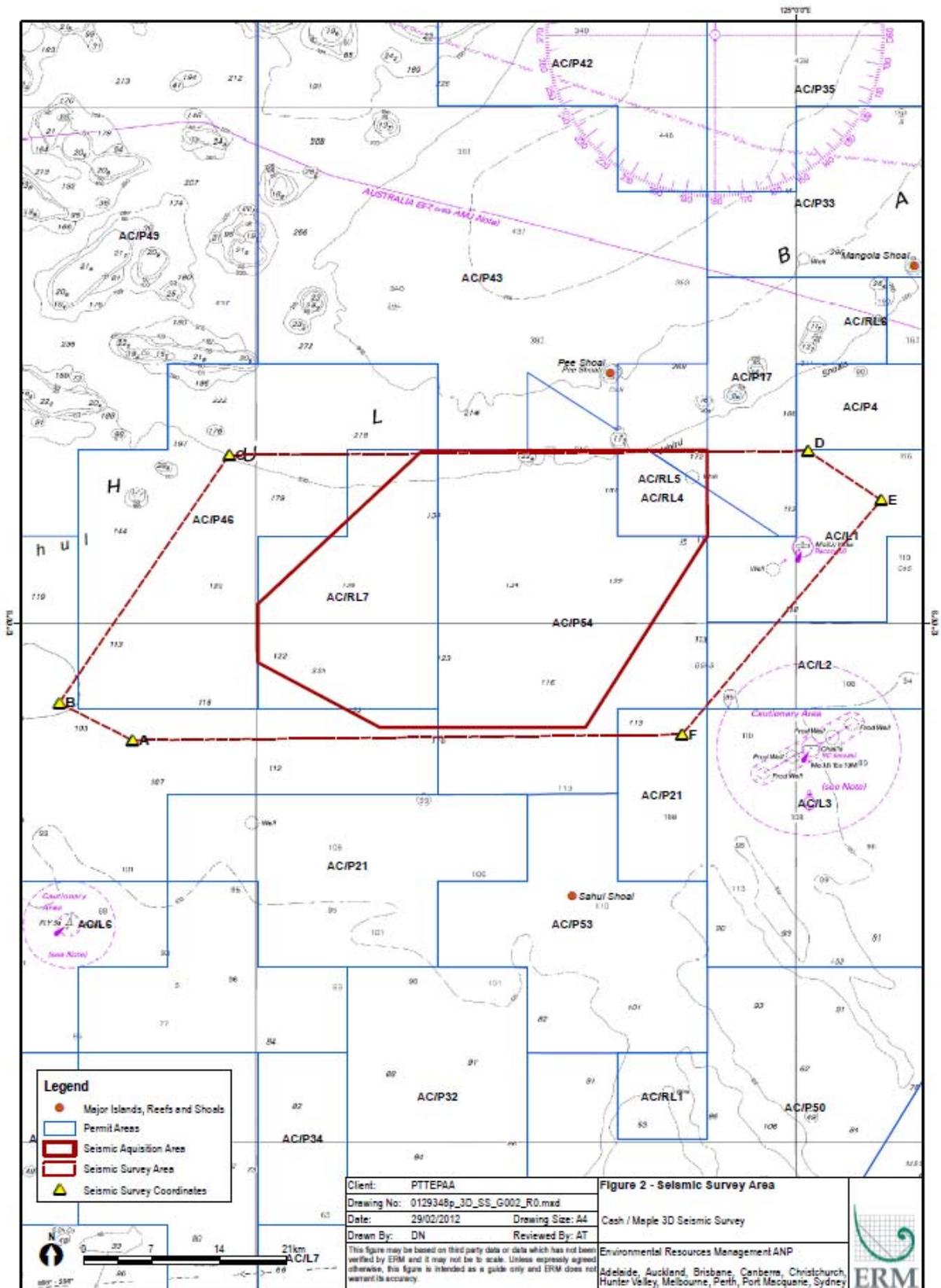




Figure 2 – Seismic Survey Area





### **3 DESCRIPTION OF ACTIVITY**

Petroleum Geo-Services (PGS) have been contracted to supply and operate the specialist seismic acquisition vessel *Ramform Explorer* for this survey. The vessel will tow seismic equipment along a predetermined grid within the survey area, acquiring approximately 1,050 km<sup>2</sup>. The survey will be conducted using an east-west acquisition direction with an average line length of 37.8 km. Lines will be spaced approximately 100 m apart. The vessel will turn within the seismic survey area.

The seismic energy source to be used during the survey will be provided by a dual array of Bolt 1900 LLXT airguns, which have a total capacity of approximately 4,130 cubic inches (in<sup>3</sup>) and an operating pressure of 2,000 psi. The seismic array will be towed astern of the vessel at a depth of approximately 6 m. Seismic pulses will be produced at 25 m shot point intervals, achieved by alternating the seismic sources.

The seismic source will generate acoustic pulses with an approximate peak sound level at source of 220 dB re 1uPa at 1m over a frequency of 0-210Hz. These levels are likely to decrease to around 160-180 dB re 1uPa peak to peak sound pressure level within 1km of the source and 145-160 dB re 1uPa peak to peak sound pressure level within 15km, depending upon the propagating characteristics of the area.

Seismic reflections from the subsurface layers will be detected by hydrophones inside an array of 10 solid streamers approximately 6km in length, towed behind the survey vessel approximately 100m apart and at a water depth of approximately 15m. The streamers are maintained at this depth by ION DigiCourse 5011 depth controllers.

Seismic acquisition is proposed to occur over an approximate 36 day period commencing within Quarter 2 2012. The precise commencement and completion dates will be dependent on vessel availability and weather conditions.

Darwin will be used as a logistics and supply base for the operation. During the seismic survey there will be one support/scout vessel, *Nautika Pride*, servicing *Ramform Explorer* and used for logistical, safety and equipment management support. The support vessel will be supplied and crewed by PGS.

During seismic operations a standard 500 m safety exclusion zone will be in place around the vessel and streamers. A notice to mariners will be issued for the survey, to notify vessels which may be operating in nearby waters and the support vessel will be on standby to direct any shipping traffic away from the survey area. In addition the vessel and streamers will display appropriate day shapes, lights and reflective tail buoys to indicate that she is towing and restricted in her ability to manoeuvre. A visual and radar watch will be maintained on the bridge at all times.

### **4 DESCRIPTION OF RECEIVING ENVIRONMENT**

#### **4.1 PHYSICAL AND BIOLOGICAL ENVIRONMENT**

The seismic survey area is located on the Australian continental shelf in the Timor Sea. In general, the continental shelf is a flat featureless submarine plain that dips gently northward toward the edge of the shelf, but scattered throughout the region are sea mounts, shoals and occasional islands that support a diverse flora and fauna.

The seismic survey area is located in the Northwest Shelf Transition Bioregion and is part of the Northwest Marine Region Planning Area. The biological communities of the Northwest Shelf Transition Bioregion are typical of Indonesian/West Pacific tropical flora and fauna (DEWHA, 2008). Softer, silty substrates are generally sparsely covered by sessile filter-feeding organisms (such as gorgonians, sponges, ascidians and bryozoans) and mobile invertebrates (such as echinoderms, prawns and detritus feeding crabs) (DEWHA, 2008). Primary productivity in the seismic survey area is low, as the deeper Commonwealth waters of the Northwest Shelf Transition Bioregion are generally nutrient-limited and reliant on physical drivers, such as seasonal winds, to resuspend benthic deposits and release nutrients into the water column (DEWHA, 2008).



The title areas are located on the Australian continental shelf in approximately 100 to 210m of water. The seafloor of the outer continental shelf is characterised by clayey-silts to sand-sized marine carbonate sediments [LeProvost Dames & Moore (LDM) 1997].

Seabed surveys have been conducted in the nearby Challis Field (approximately 10km from the southeastern corner of the seismic survey area) and identified this region as predominantly comprised of soft sediment with little topographic relief, and subsequently little diversity in habitat (URS, 2002).

On the northern boundary of the seismic survey area there are two seamounts that rise from the sea floor to approximately 22m below the surface. There are a number of other similar seamounts present to the north of the seismic survey area and these are considered part of the Sahul Banks located across the Sahul Shelf. The Sahul Shelf is described as a broad, shallow platform off the northern Australian coast, ranging from 300 to 500 km in width. The water depth of the Sahul Shelf ranges from 50 to 120 m. At the outer edge of the Sahul Shelf lies a series of submerged carbonate banks and terrace system. The banks are composed of a number of isolated and aggregated shoals which rise from depths of 100-200 m plus to depths as shallow as 15-20 m. The carbonate bank and terrace system of the Sahul Shelf is described as a unique seafloor feature and regionally important for the likely ecological role of the shoals in enhancing biodiversity and local productivity relative to the surrounding deepwater environment (SEWPAC 2011).

Across the northern continental shelf, the predominant animals living within sea floor sediments are polychaetes (burrowing worms) and crustaceans (prawns, shrimp, crabs, etc.). Sampling in the nearby Challis Field (LDM, 2000) indicated the occurrence of a very sparse infauna composed mainly of polychaetes and molluscs.

In shallower coastal waters of the continental shelf and on reefs & shoals in less than 50m water depth (where adequate light may penetrate), epibenthic fauna are abundant and diverse. However, sea floor communities in deeper waters are generally low in fauna abundance and diversity. In the nearby Challis area, at a little over 100m depth, there is little evidence of epibenthic communities. Heyward et al. (1997) noted that with little sea floor topography, such areas offered minimal habitat diversity or niches for animals to occupy. Species found in these areas include sponges, gorgonians (sea whips and sea fans), ascidians (sea squirts), echinoderms, crustaceans, bryozoans (lace corals), and soft corals.

## Protected Fauna

A review of the EPBC database (Protected Matters Search Tool) administered by the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) indicates that a total of 10 threatened marine species potentially occur within the vicinity of the seismic survey area, with 17 listed as migratory (9 of the migratory species are also listed as threatened). These are listed in **Table 2**.

**Table 2: Threatened and Migratory Species**

Type	Common Name	Scientific Name	Threatened Status	Migratory Species
Marine Mammal	Blue Whale	<i>Balaenoptera musculus</i>	Endangered	Migratory
	Humpback Whale	<i>Megaptera novaeangliae</i>	Vulnerable	Migratory
	Antarctic Minke Whale	<i>Balaenoptera bonaerensis</i>		Migratory
	Bryde's Whale	<i>Balaenoptera edeni</i>		Migratory
	Killer Whale	<i>Orcinus orca</i>		Migratory
	Sperm Whale	<i>Physeter macrocephalus</i>		Migratory
	Spotted Bottlenose Dolphin (Arafura/Timor Sea populations)	<i>Tursiops aduncus</i>		Migratory
Reptile	Leaf-scaled Sea snake	<i>Aipysurus foliosquama</i>	Critically endangered	
	Loggerhead Turtle	<i>Caretta caretta</i>	Endangered	Migratory



Type	Common Name	Scientific Name	Threatened Status	Migratory Species
	Green Turtle	<i>Chelonia mydas</i>	Vulnerable	Migratory
	Leatherback Turtle	<i>Dermochelys coriacea</i>	Endangered	Migratory
	Hawksbill Turtle	<i>Eretmochelys imbricata</i>	Vulnerable	Migratory
	Olive Ridley Turtle	<i>Lepidochelys olivacea</i>	Endangered	Migratory
	Flatback Turtle	<i>Natator depressus</i>	Vulnerable	Migratory
Fish	Whale Shark	<i>Rhincodon typus</i>	Vulnerable	Migratory
	Shortfin Mako, Mako Shark	<i>Isurus oxyrinchus</i>		Migratory
	Longfin Mako	<i>Isurus paucus</i>		Migratory
Bird	Streaked Shearwater	<i>Calonectris leucomelas</i> <i>Puffinus leucomelas.</i>		Migratory

There are also additional listed species including mammals (17), sea snakes (13), seahorse (4) and pipefish (27) protected by the EPBC Act that may occur within the seismic survey area.

No known breeding grounds or sensitive habitats, critical to species outlined in **Table 2** are known to exist within, or in close proximity to the seismic survey area. The whale shark is the only species known to feed or forage in the area.

## Fish

Based on the flat, generally featureless and low diversity of habitat of the majority of the seismic survey area it is reasonable to conclude that pelagic fish species may traverse the area but not aggregate in large numbers. However, greater fish abundance is known to occur in the shallow, coastal fringe at the edge of the continental shelf and around reefs and shoals e.g. Vulcan and Barracouta Shoals, Hibernia and Ashmore Reefs and Cartier Island. Fish abundance is therefore likely to be higher in the north of the seismic survey area around the two seamounts. The broader area of the Timor Sea supports a variety of shark and pelagic finfish species of commercial and recreational game-fishing importance.

The whale shark (*Rhincodon typus*) is listed in the Protected Matters Search as likely to occur within 5km of the seismic survey area and foraging, feeding or related behaviour is known to occur within this area. Whale sharks have a broad distribution in tropical and warm temperate seas. In Australian waters, they are known to aggregate at Ningaloo Reef (approximately 1,500 km southwest of the seismic survey area) and in the Coral Sea (approximately 2,500 km to the east) between March and July. The Whale shark is a highly migratory fish and only visits Australian waters seasonally when significant numbers aggregate oof the Ningaloo Reef between March and July (SEWPAC, 2011). It is considered possible that whale sharks may be encountered during the seismic survey.

The Shortfin Mako (*Isurus oxyrinchus*) is a wide-ranging oceanic and pelagic shark. The Longfin Mako (*Isurus paucus*) is a widely distributed but rarely encountered oceanic tropical shark. Neither the Shortfin or Longfin Mako has known feeding or breeding areas within the vicinity of the survey area.

Other EPBC Act protected marine species that may occur within the seismic survey area include various species of pipefishes and seahorses.

## Marine Mammals

No marine mammal species are identified in the SEWPAC Protected Matters database as being likely to occur or have habitats occur within 5km of the survey area. No foraging, feeding or related behaviour of any marine mammal species is known to occur within 5km of the survey area.

Twenty-four marine mammal species (14 whales and 10 dolphins) are identified in the SEWPAC Protected Matters database as potentially utilising the area within 5 km of the seismic survey area.



Two species of marine mammal, the Blue Whale and Humpback Whale, are listed as threatened under the EPBC Act and may occur in or around the survey area.

### ***Blue Whale (Endangered/Migratory)***

Blue whales (*Balaenoptera musculus*) are widely distributed throughout the world's oceans. It is generally accepted that there are two subspecies in the Southern Hemisphere: the southern blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*Balaenoptera musculus brevicauda*) (DEWHA, 2008). In general, the southern blue whale is found south of 60° S and pygmy blue whales are found north of 55° S (DEWHA, 2008).

Blue whale migration is thought to follow deep oceanic routes, although little is known about their precise migration routes (SEWPAC, 2011d). Sea noise loggers set at various locations along the coast of Western Australia have detected an annual northbound and southbound migration of pygmy blue whales past Exmouth and the Montebello Islands and locations to the north (McCauley and Jenner, 2010). Pygmy Blue whales appear to migrate south from Indonesian waters passing Exmouth through November to late December each year. Observations suggest most Pygmy Blue whales pass along the shelf edge out to water depths of 1,000 m but centred near the 500 m depth contour. The northern migration passes Exmouth over an extended period ranging from April to August (McCauley and Jenner, 2010).

The Perth Canyon is the only area so far identified off the Western Australia coast where Pygmy Blue whales aggregate with some predictability. The area represents a significant feeding ground for Pygmy Blue whales between January and April (McCauley and Jenner, 2010). Blue whales are believed to calve in tropical waters in winter and births peak in May to June, however the exact breeding grounds of this species are unknown (Bannister et al, 1996).

The seismic survey area does not include any recognised Blue whale migratory routes or known feeding, breeding or resting areas. However, Blue whales may occasionally pass through the area (SEWPAC, 2010).

### ***Humpback Whale (Vulnerable/Migratory)***

Humpback whales (*Megaptera novaeangliae*) also have a wide distribution and have been recorded from the coastal areas off all Australian states except the Northern Territory (Bannister et al, 1996). Humpback whales migrate north and south along the eastern and western coasts of Australia from calving grounds in the tropical north to feeding grounds in the Southern Ocean (DEH, 2006).

Peak northward migration off the north-western coast of Australia occurs from late July to early August and peak southward migration from late August to early September. From June to mid-September the inshore waters (landward of the 100 m isobath) between the Lacepede Islands and Camden Sound are used as a calving area for this species (Jenner et al., 2001).

The SEWPAC Protected Matters database indicates that Humpback whales may occur in the seismic survey area, however, there are no recognised Humpback whale migratory routes within or near the seismic survey area.

### ***Migratory Cetaceans***

In addition to the Humpback whale and Blue whale, five migratory cetacean species have the potential to occur within the survey area:

- Bryde's whale
- Sperm whale
- Killer Whale
- Antarctic Minke whale
- Spotted bottlenosed dolphin (Arafura/Timor sea populations)

Bryde's Whales have been recorded from all Australian states except the Northern Territory (Bannister et al. 1996). Bryde's Whales are not gregarious and mostly swim alone or in pairs.



(Martin 1990). The association of individuals may therefore be coincidental and connected to a common activity, such as feeding. No specific feeding or breeding grounds of the Bryde's whale have been discovered off Australia.

The Sperm whale (*Physeter macrocephalus*) is a cosmopolitan species occurring in deep water off the continental shelf (beyond 200 m depth). In Western Australia, Sperm whales occur mainly between Cape Leeuwin and Esperance (Bannister et al. 1996). Off the Western Australian coast, where the continental shelf slopes less steeply, Sperm Whales appear to be less concentrated close to shelf edge and more widely dispersed offshore (Bannister et al. 1996). Sperm Whales tend to inhabit offshore areas with a water depth of 600 m or more, and are uncommon in waters less than 300 m deep (NOAA Fisheries Fact Sheet 2006).

In Australia, Killer Whales are recorded from all states, with concentrations reported around Tasmania. Sightings are also frequent in South Australia and Victoria (Ling 1991). A sighting at Yirrkala in April 1999 provides evidence that they also occur in Northern Territory waters (Chatto & Warneke 2000). Killer Whales are frequently seen in the Antarctic south of 60° S and have been recorded from Heard and Macquarie Islands (Gill & Thiele 1997; Kasamatsu et al. 1988; Parker 1978) No key localities are known for Killer Whales within continental Australian waters, however, all populations are considered important for the species' long-term survival.

Antarctic Minke whales (*Balaenoptera bonaerensis*) are found throughout much of Australia's coastal waters. Antarctic Minke Whales have been recorded from all States but not in the Northern Territory (Bannister et al. 1996). The distribution up the west coast of Australia is currently unknown. Antarctic Minke Whales probably do not migrate as far north as Dwarf Minke Whales (to 11° S) (Bannister et al. 1996; Perrin & Brownell 2002), This species' winter breeding areas are thought to be relatively dispersed in open ocean areas throughout tropical and sub-tropical latitudes, but they congregate in Antarctic waters during the summer feeding season.

Spotted bottlenosed dolphins (*Tursiops aduncus* - Arafura/Timor sea populations) occur in topical waters of Australia along the Pilbara and Kimberley coasts and north to Indonesian waters. Movement patterns are variable, ranging from year-round residency in small areas to long-range movements and migration (SEWPAC, 2011a). In Australia, the Indian Ocean Bottlenose Dolphin is restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands (Hale et al. 2000; Kogi et al. 2004; Möller & Beheregaray 2001; Wang et al. 1999).

It is possible that all five migratory cetacean species discussed above may traverse the seismic survey area but they are not expected to be present in significant numbers and there are no recognised migratory routes, feeding, resting or breeding areas within the survey area.

## **Reptiles**

Six species of marine turtles and one seasnake listed as threatened under the EPBC Act (see Table 2) are identified as likely to occur within the seismic survey area. Marine turtles undertake extensive migrations and low numbers of individuals may transit through the seismic survey area and are most likely to occur near the shallower seamount habitats, which may provide occasional feeding habitat. The nearest known regular turtle breeding, nesting, or feeding grounds are located about 126 km to the southwest in the reserves of Ashmore Reef and Cartier Island. The likelihood of encountering significant numbers of turtles or seasnakes within the seismic survey area is considered to be low although it is expected that they may occur in the seismic survey area.

## **Seabirds**

The streaked shearwater (*Calonectris leucomelas*, also known as *Puffinus leucomelas*) is listed as migratory seabirds identified in the EPBC search. *C. leucomelas* is protected under the Japan-Australia Migratory Bird Agreement (JAMBA), and the China-Australia Migratory Bird Agreement (CAMBA). These birds use the area for foraging (fish and squid), and nest on nearby islands and coastlines but given the lack of suitable roosting areas sustained stays in the seismic survey area are considered unlikely.



## **4.2 SOCIAL ENVIRONMENT**

### **Fisheries**

There are a number of commercial fisheries recording catch within the region and all are managed by either the Australian Government through the Australian Fisheries Management Authority (AFMA) or by the West Australian Government through the WA Department of Fisheries (DoF) (DEWHA, 2008). Consultation with AFMA and DoF indicated that the following commercial fishery jurisdictions overlap or are in the vicinity of the proposed survey area:

- Northern Demersal Scalefish Fishery
- Northern Prawn Fishery
- Joint Authority Northern Shark Fishery
- Northwest Slope Trawl Fishery
- Southern Bluefin Tuna Fishery
- Western Skipjack Tuna Fishery
- Western Tuna and Billfish Fishery
- Mackerel Managed Fishery
- West Coast Deep Sea Crustacean Managed Fishery
- Marine Aquarium Fish Managed Fishery
- Specimen Shell Managed Fishery

Advice from DoF regarding this survey is that fishers in the Northern Demersal Scalefish Fishery (NDSF) work within the area of the seismic survey. The NDSF includes an extensive area adjacent to Western Australia from the Bonaparte Gulf west and south to the Pilbara. There are a total of 11 licences issued for the fishery, actively fished by five vessels based out of Broome and ports in the Pilbara and Darwin. Vessels of this fishery may be encountered in the seismic survey although the likelihood is reduced by the fact that the fishing method is trap based compared to trawling.

Advice from AFMA is that the area of the proposed seismic survey overlaps the area of the North West Slope Trawl Fishery (NWTSTF). The NWTSTF targets deepwater prawns and scampi in the 200m to 800m water depth zone between Brunswick bay (on the Kimberley Coast) and the North West Cape. For this large area there are 7 licenses issued. The NWTSTF has periodic activity throughout the year, historically most active between mid June and mid March.

The proposed survey area is near the Australian Indonesian MoU Box and thus may co-incide with some traditional Indonesian fishing activities (allowed under the 1974 MOU with Indonesia).

### **Oil Industry**

Petroleum exploration of the Bonaparte Basin commenced in the late 1940s, with reconnaissance work in the offshore area. This has included extensive petroleum exploration over the past decades within the Territory of Ashmore and Cartier Islands Offshore Area. For the period 2010 – 2014, a minimum nominated expenditure of a total A\$775 million has been committed on petroleum projects within the Territory of Ashmore and Cartier Islands Offshore Area comprising drilling of 27 wells and acquiring 4,950 kilometres of 2D and 6,002 square kilometres of 3D seismic data (DoR, 2011a). The Jabiru Riser Turret Mooring (RTM) is located within the survey area and is equipped with navigational aids including radar beacons and warning lanterns. The RTM is present on Admiralty Charts to ensure vessels are aware of its location.

### **Shipping**

The major commercial shipping route through the Timor Sea passes to the north of seismic survey area and there are no known recognised shipping routes through the seismic survey area, however, trading vessels may pass through the general area.



## **Areas of Conservation Significance**

Ashmore Reef National Nature Reserve (Ashmore) is located approximately 150km west-southwest of the seismic survey area. Ashmore covers 583 km<sup>2</sup> and includes two extensive lagoons, shifting sand flats and cays, seagrass meadows and a large reef flat covering an area of 239 km<sup>2</sup>. Within Ashmore are three small islands known as East, Middle and West Islands (SEWPAC, 2011).

Cartier Island Marine Reserve (Cartier) is located approximately 126 km southwest of the seismic survey area. Covering an area of 167 km<sup>2</sup>, Cartier includes an un-vegetated sand island (Cartier Island) and the area within a 4 nautical mile radius of the centre of the island, to a depth of 1 km below the sea floor. The area around the island includes a variety of habitats including a mature reef flat, a small submerged pinnacle, known as Wave Governor Bank and two shallow pools to the northeast of the island (SEWPAC, 2011).

Ashmore and Cartier support large numbers of marine species including sea snakes, dugongs, reef building corals, fish and other marine invertebrate fauna. The reserves also provide important seabird and marine turtle nesting sites and provide staging points and feeding areas for large populations of migratory shorebirds. Ashmore was designated a Ramsar Wetland of International Importance in 2002 due to the importance of its islands providing a resting place for migratory shorebirds and supporting large seabird breeding colonies (SEWPAC, 2011).

## **5 MAJOR ENVIRONMENTAL HAZARDS AND CONTROLS**

An environmental hazard identification and risk assessment was undertaken using methods consistent with AS/NZS ISO 3100:2009 and the PTTEP AA SSHE Risk Management Standard (M10-501965-CORP Revision 6).

A total of 18 risks with the potential to result in environmental impacts were identified for the seismic survey. These can be grouped into the following broad risk groups:

- Physical presence of the survey vessels
- Seismic acquisition activity
- Accidental releases

Implemented control measures identified in **Appendix A** ensure that the environmental risks associated with the potential impacts of the activity are as low as reasonably practicable (ALARP) while maintaining economic viability for the activity. The control measures are taken into consideration in calculating the residual risk associated with the various aspects of the activity.

## **6 MANAGEMENT APPROACH**

PTTEPAAA is committed to proactive management of its environmental responsibilities in all its activities. The elements of the management approach include the specific systems, procedures and practices which are used to ensure that the environmental impacts and risks of the activity are reduced to as low as reasonably practicable and that the environmental performance objectives are met. The implementation strategy include roles and responsibilities of personnel, training and awareness of personnel, reporting framework, mitigation and emergency response arrangements, and compliance monitoring and auditing procedures.

PTTEPAAA, as the operator of the activity, is responsible for ensuring the proposed seismic survey is managed in accordance with the accepted Environment Plan. The seismic contractor (PGS) will undertake the operations on behalf of PTTEPAAA and, under contractual arrangements, will implement and comply with all environmental requirements prescribed in the EP.

Environmental performance objectives, standards and criteria have been defined in the accepted EP and are monitored and reviewed to ensure effective implementation of the environmental requirements and continual improvement in achieving environmental outcomes.



All incidents that have the potential to cause significant effects on the environment will be reported and investigated according to legislative requirements, vessel procedures and the procedures laid down in the EP.

NOPSEMA will be notified of all reportable incidents within two hours of the incident first occurring (or the operator becomes aware of the incident), according to the requirements of Regulation 26 of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

A written report will be provided to NOPSEMA within three days of the initial notification of a reportable incident. Reportable incidents for the Sandalford 3D Seismic Survey are:

- An uncontrolled release of hydrocarbon or hazardous chemical spill to the sea greater than 80 litres.
- Death or injury of individual(s) from a Threatened or Migratory Species during the operation.
- Unplanned physical contact with, or damage to, a shallow water seamount
- Breach of AQIS biofouling or ballast water management requirements

## **7 STAKEHOLDER CONSULTATION**

The following relevant stakeholders have been consulted with in regards to the proposed seismic survey:

- Northern Territory Department of Resources – Minerals and Energy;
- Western Australian Department Fisheries (WA DoF)
- Northern Territory Department of Resources – Fisheries
- WA Fishing Industry Council (WAFIC)
- Australian Fisheries Management Authority (AFMA)
- Australian Hydrographic Office
- Australian Maritime Safety Authority (AMSA)
- Australian Marine Oil Spill Centre (AMOSC)
- Defence/Customs
- Western Australian Northern Trawl Owners Association
- Northern Fishing Companies Association
- A Raptis and Sons
- Westmore Seafoods

Consultation with all of the stakeholders listed above, plus any others identified during the consultation process, will continue prior to and during the survey if necessary.

## **8 CONTACT DETAILS**

Further details on the seismic survey can be obtained from:

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## APPENDIX A: ENVIRONMENTAL RISK ASSESSMENT SUMMARY

Aspect	Potential Impacts	Control/Mitigation Measures	Residual Risk
<b>Vessel Presence</b>			
Interference with other sea users	Loss of access for fishing, disruption to shipping routes	<p>Adherence to standard maritime safety and navigation requirements including:</p> <ul style="list-style-type: none"> <li>- IMO International Regulations for Preventing Collisions at Sea (COLREGS)</li> <li>- Issuance of Notice to Mariners</li> <li>- Use of support vessel to manage interactions</li> <li>- Auscoast warnings via AMSA. AMSA Rescue Coordination Centre notified.</li> <li>- Vessels are equipped with sophisticated navigation aids and competent crew maintaining 24 hour visual, radio and radar watch for other vessels.</li> <li>- Radio warnings to shipping as required</li> <li>- Fishermen and other mariners alerted to vessels presence and extent of towed array</li> </ul> <p>Consultation with relevant fisheries management agencies and industry on the location and timing of the survey.</p> <p>No major shipping routes pass through the survey area</p>	Low
Introduction of invasive marine species via biofouling or ballast	Invasive marine species takes holds and alters local ecosystem.	<p>Vessels will mobilise from Australian waters.</p> <p>Vessels do not carry any foreign sourced ballast water in Australian waters in accordance with the vessel Ballast Water Management Plan</p> <p>Unlikely to favour establishment of Invasive Marine Species due to distance from coast and survey area being dominated by soft sediments.</p>	Low
Collision with Marine Fauna	Marine fauna injury or fatality	<p>Interaction procedures (includes continuous observations for marine mammals and all sightings and interactions of cetaceans and turtles to be recorded)</p> <p>Adherence to The Australian National Guidelines for Whale and Dolphin Watching 2005 (including minimum approach distances for dolphins and whales)</p> <p>Shallow Water Procedure to ensure shallow water areas are avoided.</p> <p>In accordance with this procedure the water depth in this vicinity as indicated by charts will be confirmed</p>	Medium



Aspect	Potential Impacts	Control/Mitigation Measures	Residual Risk
		via depth sounders, scouting and visual observations by support vessel or FRC and physical dips if required.  There is a low likelihood of encountering dugongs and cetaceans and the likelihood of encountering large numbers of turtles or whale sharks is also considered low.	
Noise emissions	Disturbance to cetaceans and other marine fauna	Support vessel and helicopters to stay clear of any cetaceans (do not approach) in accordance with The Australian National Guidelines for Whale and Dolphin Watching 2005	Low
Light spill on to ocean attracting fish, turtles and other sea life	Disruption to natural behaviour (e.g., foraging) leading to decline of local population	Lighting is minimum required for navigation and safety requirements  Support vessel and helicopters to stay clear of any cetaceans (do not approach) in accordance with The Australian National Guidelines for Whale and Dolphin Watching 2005	Low
Atmospheric emissions	Increase in greenhouse effect	Engines maintained to operate at optimum efficiency to minimise emissions  Small volumes/emissions	Low
Fish and other sea life attracted to food source.	Impacts on water quality and changes in fauna behaviour leading to decline in local population	All waste treatment systems comply with MARPOL 73/79, including an approved sewage treatment plant. Offshore discharge will occur at least 12 nm from land and putrescible waste will be macerated to less than 25 mm prior to discharge. Only biodegradable detergents are used.	Low
Anchoring Activity	Damage to seabed	No anchoring on location except in an emergency  Majority of survey area is soft sediment allowing for rapid recolonisation if emergency situation does prevail	Low
<b>Seismic Acquisition</b>			
Noise emissions from the airgun arrays	Behavioural reactions from marine mammals (avoidance, diving, increased dive	Interaction procedures detailing the Standard Management Measures (Section 6.2 of EPBC Act Policy Statement 2.1, September 2008) to be followed will be implemented.  The likelihood of encountering marine mammals is considered low based on the seismic survey being outside their recognised migratory routes and any recognised feeding, breeding or resting areas.	Low



Aspect	Potential Impacts	Control/Mitigation Measures	Residual Risk
	times)	Likely to evoke avoidance response in marine mammals but unlikely to displace species from any habitats or migratory paths.	
Noise emissions from the airgun arrays	Disturbance to reptiles, fish communities and invertebrates	<p>Shallow Water Procedure in place ensuring that shallow areas are avoided.</p> <p>In accordance with this procedure the water depth in this vicinity as indicated by charts will be confirmed via depth sounders, scouting and visual observations by support vessel or Fast Rescue Craft and physical dips if required.</p> <p>Interaction procedures (EPBC Act Policy Statement 2.1, September 2008) that include the use of a soft start procedure will allow fauna to implement avoidance measures prior to entering ranges at which physical damage may occur.</p> <p>Potential for pathological and physiological impacts to marine fauna are limited to very close proximity to array and any behavioural impacts likely to be localised and short term.</p> <p>There are no recognised feeding, breeding or resting areas in the survey area for fauna other than whale sharks (known feeding in the area)</p> <p>Based on the predominant habitat in the survey area being soft sandy sediments the fish and benthic invertebrate abundance can be considered low.</p> <p>Short term (~36 days) activity</p>	Low
Unplanned event - loss of streamer	Disturbance to the seabed  Interference with fishing activities in area	<p>Streamer Handling Procedure in place that includes following to prevent streamer loss:</p> <ul style="list-style-type: none"> <li>• GPS pods are fitted to tail-buoys and streamers are fitted with auto floatation devices in case they become disconnected to aid recovery.</li> <li>• Towed equipment is highly visible, and has reflective tape, and strobe lights. PGS logo is visible on equipment.</li> <li>• All reasonable efforts will be taken to retrieve lost equipment</li> </ul> <p>Solid state streamers so no risk of loss of streamer fluid and toxic effects on marine biota.</p> <p>No major shipping routes in or near the seismic acquisition area.</p>	Low
Unplanned event - physical contact of streamer with	Damage to seamounts and disturbance to	<p>Shallow Water Procedure in place to ensure that shallow areas are avoided.</p> <p>In accordance with this procedure the water depth in this vicinity as indicated by charts will be confirmed via depth sounders, scouting and visual observations by support vessel or FRC and physical dips if</p>	Low



Aspect	Potential Impacts	Control/Mitigation Measures	Residual Risk
sea mount	foraging habitat.	required. Vessels are equipped with sophisticated navigation aids and competent crew maintaining 24 hour visual watch.	
<b>Accidental Releases</b>			
Inadequate storage arrangements/ disposal	Accidental discharge at sea with impacts to fauna	Implementation of Waste Management Plan, including compliance with MARPOL requirements, waste log maintained and correct segregation of solid and hazardous wastes in all areas of the vessel.	Low
Unplanned - failure of containment spaces and/or OIW separator	Discharge of oily water drainage to sea from failure of the OIW separator.	OIW Separator shut off valve activates when concentration exceeds 15ppm. Planned maintenance of OIW separator Source of oil is small quantities of hydrocarbons used for vessel maintenance only.	Low
Inadequate storage arrangements or disposal procedures (hazardous chemical or waste spill <80L)	Accidental discharge at sea or incorrect disposal onshore.	Implementation of Waste Management Plan, including compliance with MARPOL requirements, waste log maintained and correct segregation of solid and hazardous wastes in all areas of the vessel. Implementation of a Hazardous Materials Procedure. Only small amounts of hazardous materials or wastes stored on board.	Low
Collision resulting in rupture of a fuel tank and large diesel spill at sea (between 10m3 and 1000m3) –	Water quality and associated biological community impact with potential for damage to sensitive resources	Adherence to standard maritime safety and navigation requirements including: <ul style="list-style-type: none"> <li>- IMO International Regulations for Preventing Collisions at Sea (COLREGS)</li> <li>- Issuance of Notice to Mariners</li> <li>- Use of support vessel to manage interactions (500m exclusion zone established)</li> <li>- Auscoast warnings via AMSA. AMSA Rescue Coordination Centre notified.</li> <li>- Vessels are equipped with sophisticated navigation aids and competent crew maintaining 24 hour visual, radio and radar watch for other vessels.</li> </ul>	Medium



Aspect	Potential Impacts	Control/Mitigation Measures	Residual Risk
		<ul style="list-style-type: none"> <li>- Radio warnings to shipping as required</li> <li>- Fishermen and other mariners alerted to vessels presence and extent of towed array</li> </ul> <p>Approved vessel SOPEP (including drills and contact procedures) and assistance from PTTEP AA OSCP.</p> <p>Modelling indicates that the worst case diesel spill (1000m<sup>3</sup> of total loss of a vessel fuel tank) is unlikely to be present as a sheen after 20 days and would not impact any shoreline.</p>	
Minor operational spill < 80L (refuelling or loss of containment)	Water quality and associated biological community impacts	<p>In the unlikely event that refuelling is required, it will take place at least 12 nm from land and in accordance with vessel-specific refuelling procedures:</p> <p>Designated containment areas onboard for oil, grease and chemical storage.</p> <p>Save-alls around streamer reels and hydraulic reels and on all fuel filling and vent pipes</p> <p>Sufficient spill response equipment to prevent spills on deck reaching the environment</p> <p>SOPEP procedures comply with MARPOL 73/78.</p>	Low
Refuelling spill, (between 80L and 10m <sup>3</sup> )	Water quality and associated biological community impacts with potential for damage to sensitive resources	<p>In the unlikely event that refuelling is required, it will take place at least 12 nm from land and in accordance with vessel-specific refuelling procedures.</p> <p>Designated containment areas onboard for oil, grease and chemical storage.</p> <p>Save-alls around streamer reels and hydraulic reels</p> <p>Save-alls on all fuel filling and vent pipes</p> <p>Sufficient spill response equipment to prevent spills on deck reaching the environment</p> <p>SOPEP procedures comply with MARPOL 73/78</p> <p>Modelling indicates that diesel spilt under worst case refuelling spill (10m<sup>3</sup>) scenario would not make any shore contact at any time of the year and that the diesel slick would not persist in the water column (above a threshold concentration of 0.1 g/m<sup>2</sup>, or a silvery sheen) for any more than 6 days.</p>	Medium