

PHOENIX 3D MARINE SEISMIC SURVEY & AIRBORNE MAGNETIC SURVEY ENVIRONMENT PLAN: PUBLIC SUMMARY

This summary of the Environment Plan for the Fugro Phoenix 3D marine seismic survey, and Airborne Magnetic Survey, which will be acquired within the within the Bedout Sub-basin (part of the Roebuck Basin) offshore from Western Australia (WA), has been submitted to the WA Department of Mines and Petroleum (DMP), to comply with sub-regulations 11(7) and 11(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

INTRODUCTION

Fugro Multi Client Services Pty Ltd (Fugro MCS) and Fugro Airborne Surveys (Fugro AS) propose to undertake a three-dimensional (3D) marine seismic survey (Phoenix 3D MSS) and an Airborne Magnetic Survey (AMS) within the Bedout Sub-basin (part of the Roebuck Basin) offshore from Western Australia (**Figure 1**). The Phoenix 3D MSS will be comprised of a maximum of 1,100 km² and 410 line kilometres of 3D seismic acquisition, and the AMS will be comprised of 22,423 line km of airborne magnetic data acquisition.

PHOENIX 3D MSS

Coordinates of the Proposed Activity

The Phoenix 3D MSS will comprise a maximum of 1,100 square kilometres (km²) of 3D seismic acquisition in Petroleum Permit Areas WA-435-P and WA-437-P (**Figure 1**). The survey will also include 410 line km of 3D seismic acquisition, comprised of three "Tie-In" lines:

- Tie-In Line #1 – 98 km in length; extending from WA-435-P into WA-436-P;
- Tie-In Line #2 – 111 km in length; extending from WA-436-P across Release Area W08-13 into WA-438-P; and
- Tie-In Line #3 – 200 km in length; extending from WA-438-P into WA-437-P.

The survey area is located approximately 155 km north of Port Hedland, on the Pilbara coast of Western Australia. The nearest emergent land to the survey area is Bedout Island, which is located approximately 90 km south-southeast of the Phoenix 3D polygon, and 40 km due north of the mainland coastline at Larrey Point. Bedout Island is an 'A' Class Nature Reserve, managed by the WA Department of Environment and Conservation (DEC).

At the closest point, the northern boundary of the survey area is located a minimum distance of 100 km south of the boundary of the Imperieuse Reef, in the Rowley Shoals. Together, Imperieuse and Clerke Reefs constitute the Rowley Shoals Marine Park (State Waters). At the closest point, the northern boundary of the survey area is located approximately 170 km south-southeast of the boundary of the Mermaid Reef Marine National Nature Reserve (a Commonwealth marine protected area).

Water depths across the four permit areas (WA-435-P, WA-436-P, WA-437-P and WA-438-P) and the release area (W08-13) range from approximately 35 to 265 m (**Figure 1**). The shallowest water depths (~35 m) occur in the southeast portions of WA-437-P and WA-438-P, approximately 50 km southeast of the survey area. The deepest water depths (~265 m) occur along the northwest boundary of WA-435-P, at a distance of approximately 50 km northwest of the survey area. Water depths across the area covered by the Phoenix 3D 1,100 km² polygon and the three tie-in lines range from approximately 50 m to 150 m (**Figure 1**).

Boundary coordinates for the 1,100 km² area of 3D seismic data acquisition are provided in **Table 1** below.

Figure 1: Location map – Phoenix 3D Marine Seismic Survey & Airborne Magnetic Survey

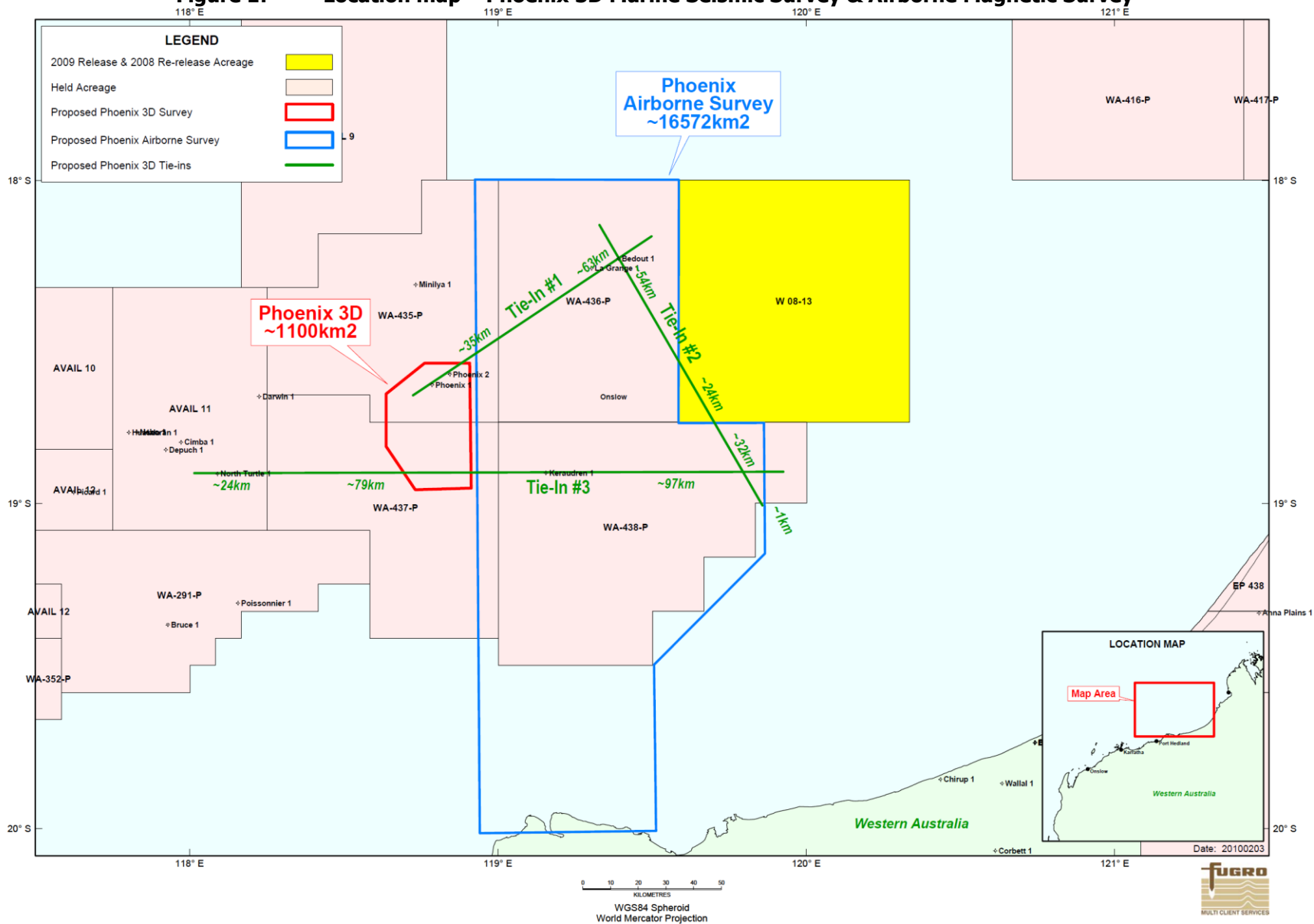




Table 1: Boundary coordinates of the Phoenix 3D MSS

Latitude (S)			Longitude (E)		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
18	57	09.35	118	54	47.97
18	33	58.61	118	54	29.85
18	33	59.27	118	45	43.98
18	39	42.24	118	38	13.71
18	49	26.40	118	38	14.66
18	57	27.03	118	43	54.54

Datum: WGS84

Description of the Proposed Activity

The survey is scheduled to occur in the period between the end of May and early July 2010, and is expected to be of approximately six weeks duration. Timing of commencement is dependent on fair sea state conditions suitable for marine seismic acquisition, the availability of the survey vessel for conducting the survey, and granting of approvals from the appropriate government bodies.

During the proposed activities, the survey vessel will traverse a series of pre-determined sail lines within the survey area at a speed of approximately 8-9 km/hr. As the vessel travels along the survey lines, a series of noise pulses (every 8 seconds) will be directed down through the water column and seabed. The released sound is attenuated and reflected at geological boundaries and the reflected signals are detected using sensitive microphones arranged along a number of hydrophone cables (streamers) towed behind the survey vessel. The reflected sound is then processed to provide information about the structure and composition of geological formations below the seabed in an attempt to identify hydrocarbon reservoirs.

The seismic array will comprise of 10 solid streamers, with a maximum length of 7.0 km. Streamer spacing will be 100 m, and line spacing will be 200 m. The source (airgun array) tow depth will be 6 m (+/- 1 m) and the streamer tow depth will be 7 m (+/- 1 m). The operating pressure for the airgun array will be approximately 2,000 psi. The airgun array will consist of two sub-arrays, each with a maximum volume of 3,200 cui. These sub-arrays will be fired alternately, with a shotpoint interval of 25.0 m vertical distance, and will produce at source (i.e. within a few metres of the airguns) received sound energy levels (SELs) in the order of 225 dB re 1µPa².s at frequencies extending up to approximately 128 Hz.

Fugro proposes to conduct the Phoenix 3D MSS using the purpose-built seismic survey vessel the M/V *Geo Atlantic*, which has a complement of approximately 80 crew. The M/V *Geo Atlantic* is owned and operated by the geophysical acquisition company Fugro-Geoteam AS. The vessel has all necessary certification/registration and is fully compliant with all relevant MARPOL and SOLAS convention requirements for a vessel of this size and purpose. The M/V *Geo Atlantic* has a Shipboard Oil Pollution Emergency Plan (SOPEP) in place, in accordance with Regulation 26 of Annex I of MARPOL 73/78.

The survey vessel will travel within the survey area at an average speed of 4.5 knots (approximately 8.3 km per hour).

A support vessel, the M/V *Tanux 1*, will accompany the seismic survey vessel to maintain a safe distance between the survey array and other vessels, and also to manage interactions with shipping and fishing activities, if required.. The support vessel will also re-supply the survey vessel with fuel and other logistical supplies. The support vessel will have a crew of approximately 15 personnel.

During the survey, it is likely that the survey vessel will be refuelled at sea using the support vessel, either within or immediately adjacent to the survey area. At sea refuelling of the *Geo Atlantic* will only take place during daylight hours.



AIRBORNE MAGNETIC SURVEY

Coordinates of the Proposed Activity

The Airborne Magnetic Survey will comprise a maximum of 22,423 line km of airborne magnetic data acquisition in Petroleum Permit Areas WA-435-P, WA-436-P, WA-437-P and WA-438-P, and in the area of nearshore waters not covered by any petroleum titles between the southern boundaries of the WA-437-P and WA-438-P permits and the Pilbara coast at Breaker Inlet (at the mouth of the De Grey River) (**Figure 1**).

The proposed airborne magnetic survey, which covers an area of 16,572 km², will be conducted across the Rowley Shelf, from the northern boundaries of the WA-435-P and W-A436-P permits to the coast, including a small area of land from Larrey Point to Poissonnier Point, on either side of Breaker Inlet. The AMS will be comprised of a total of 100 survey lines (100 traverse lines (N-S); 75 tie lines (E-W)). This grid of lines extends from the coastal strip to a maximum water depth of approximately 265 m (along the northern extent of the survey area).

The survey area boundary coordinates are provided in **Table 2** below.

Table 2: Boundary coordinates of the AMS

Latitude (S)			Longitude (E)		
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
17	59	51.43	118	55	32.16
17	59	54.25	119	35	11.68
18	45	06.08	119	35	08.26
18	45	03.68	119	51	45.19
19	09	15.00	119	51	57.20
19	29	47.68	119	30	21.99
20	00	24.68	119	30	45.85
20	00	50.56	118	56	28.37

Datum: WGS84

Description of the Proposed Activity

The AMS is scheduled to occur in the period between early April and late May 2010, and is expected to be of approximately six to eight weeks duration. Timing of commencement is dependent on fair wind and sea state conditions suitable for airborne magnetic data acquisition, the availability of pilots and the survey aircraft for conducting the survey, and granting of approvals from the appropriate government bodies.

During the proposed activity, the survey aircraft will fly at an altitude of 80 m above sea level, and travel at a speed of 110-150 knots (204-279 km per hour). The aircraft will traverse a series of pre-determined flight lines (traverse lines and tie lines), which have a line spacing (separation distance) of 1,000 m (traverse lines) and 3,000 m (tie lines). As the aircraft travels along the flight lines, a magnetometer (which is a passive instrument used to measure the magnetic field of the earth), will take measurements. These magnetic field measurements will be recorded and the data will be processed to produce geophysical maps of the target area.

The AMS survey area encompasses Bedout Island (**Figure 1**), an 'A' Class Nature Reserve with significant populations of breeding seabirds. To minimise potential disturbance to seabird populations on the island, the survey aircraft will be required to fly any survey lines within 500 m horizontal distance of the island at an altitude of 152 m (500 ft), rather than the standard altitude of 80 m for the rest of the survey area.

The AMS will be conducted using a light, twin piston-engine aircraft (either a Rockwell Aero Commander AC50; or a Diamond DA42), crewed by two pilots. The survey aircraft will be based at the airport in Port Hedland, approximately 45 km southwest of the survey area at the closest point. The survey aircraft will be re-fuelled at appropriate re-fuelling facilities at the Port Hedland airport.

DESCRIPTION OF THE RECEIVING ENVIRONMENT

The proposed Phoenix 3D survey area and AMS area lie entirely in Commonwealth marine waters in the Northwest Shelf Province of the North-west Marine Region (NWMR). The Northwest Shelf Province is located primarily on the shelf between North West Cape and Cape Bougainville, and encompasses much of the area more commonly known as the North West Shelf (NWS). Both survey areas are within the Pilbara system of the NWMR, which is characterised by:

- tropical arid climate;
- transition between Indonesian Throughflow (ITF) and Leeuwin Current dominated areas;
- predominantly tropical species;
- high cyclone activity with frequent crossing of the coast;
- transitional tidal zone;
- internal tide activity;
- large areas of shelf and slope; and
- a dry coast with ephemeral freshwater inputs.

Physical Environment

The NWS is subject to an arid (mainly summer rain) subtropical climate with tropical cyclone activity from November to April. The summer and winter seasons fall into the periods September-March and May-July respectively. Winters are characterised by clear skies, fine weather and predominantly strong east to south-east winds and infrequent rain. Summer winds are more variable, but west to south-west predominates. The cyclone season is November to April with the majority of cyclones moving down the northwest coast between 40-400 km offshore and at an average speed of 16 km per hour. During tropical cyclones, mean wind speeds of 56 ms^{-1} have been recorded with gusts up to 69 ms^{-1} . Three to four cyclones per year can be expected, primarily in the December to March period, though cyclones have been recorded as late as June.

Winds are predominantly WSW from October to April and ESE from May to September. Average 10 minute wind speed in non-cyclonic conditions is 6 ms^{-1} with a 5% exceedence value of 12 ms^{-1} .

The Pilbara system is a transitional oceanographic region between the strongly ITF-influenced surface waters to the north and the Leeuwin Current-influenced surface waters to the south. The along-shore pressure gradient in this system results in a predominantly southward movement of the surface water mass, which becomes the source waters of the Leeuwin Current

The Pilbara system is believed to have the strongest internal tides of the entire NWMR, which are thought to be an important physical driver in water depths of between 50 and 500 m depth on the shelf. Internal tides may result in the drawing of deeper cooler waters into the photic zone, stirring up nutrients and triggering primary productivity. The zone between 50 and 500 m depth is thought to be the highest energy zone in the system (possibly correlated with an increased incidence of internal tides) and it is thought that broadly the greatest productivity is found around the 200 m isobath associated with the shelf break

Offshore near surface water temperatures range from 30°C maximum in summer to 22°C minimum in winter. Tides are semi-diurnal and generally flow onshore-offshore with peak neap and spring speeds of 0.3 ms^{-1} and 0.65 ms^{-1} , respectively. Swells up to 2 m can be expected year round offshore with April being the calmest month and June and January the roughest. Wave direction predominantly follows wind direction (ESE in winter, WSW in summer) except during cyclone or storm events. Extreme wave heights offshore, associated with cyclonic activity are in the order of 14 m. Extreme wave heights inshore, associated with cyclonic activity, are in the order of 7-8 m.

The WA-435-P, WA-436-P, WA-437-P, WA-438-P and W08-13 areas are expected to have fine-grained and

soft seabed sediments. The predominant seabed type is likely to be characterised by deep (>5 m) soft silty sediments that become deeper, softer and finer quite quickly with increasing depth. The thin underlying calcarenite layer (approximately 0.5 m thick) becomes more weakly consolidated and at 300 m water depth is overlaid by up to 15 m of sediment. Sand streamers, approximately 100 m wide and 2-3 km long, support mobile sand ripples and occur occasionally over the sea floor. Relict sediments are also present in shallow waters, and rhodolith beds of coralline red algae growing on rocks occur between 30-90 m water depths.

The dynamic oceanic environment influences sediment distribution throughout the bioregion. The seabed of this bioregion is particularly strongly affected by cyclonic storms, long-period swells and large internal tides, which can resuspend sediments within the water column as well as move sediment across the shelf.

Biological Environment

Enhanced pelagic production occurs on the outer shelf as a result of the interaction of surface and deeper water masses on the adjacent shelf break, via vertical mixing and possibly internal wave action. The mixed water masses travel towards shore and can stimulate biological productivity when the deeper nutrient-rich waters move into the photic zone where light allows phytoplankton to take up the influx of nutrients. However, such upwelling events are likely to be sporadic and short-lived. The most favourable conditions for upwelling are associated with a weakening of the ITF during summer, although some upwelling may still occur during winter.

Benthic Habitats

The sandy substrates on the shelf within the Northwest Shelf Province are thought to support low density benthic communities of bryozoans, molluscs and echinoids. Extensive seabed sampling has consistently shown that the soft sediments of the NWS support a low abundance, high diversity invertebrate fauna comprised largely of burrowing polychaete worms and crustaceans. Echinoderms and molluscs also contribute significantly to the faunal composition of soft sediments on the continental shelf and slope in this region.

Coastal habitats are important for many marine species in the NWMR. Areas of mangrove along the Pilbara coast provide important nursery habitat for many marine fish species and support prawn and crab (e.g. coral, blue and swimmer crab) fisheries. Coastal seagrasses and algal mats also provide important habitat for fish and dugongs through the length of the bioregion. Coastal mangrove and algal mats are sites of nitrogen fixation and nutrient recycling, providing nutrients in shallower waters that are transported across the shelf via currents and tides. The shallower waters also contain an extensive array of small barrier and fringing reefs, including important sites such as Dampier Archipelago, which is thought to be the richest area of marine biodiversity in Western Australia.

Sharks and Ray-finned Fishes

The whale shark is listed as Vulnerable and Migratory under the EPBC Act. Although there are no records of the whale shark's presence in the Phoenix 3D survey area there have been sightings in the region, and they are known to occur in both tropical and temperate waters and are normally oceanic and cosmopolitan in their distribution. It is possible that they may be encountered during the proposed Phoenix 3D survey. Other EPBC Act protected marine species that may occur within the Phoenix 3D survey area include various species of pipefishes and seahorses.

The dwarf sawfish and the green sawfish are listed as Vulnerable under the EPBC Act. Very little information is available concerning the distribution, abundance, feeding and movement patterns of these species in Pilbara coastal waters. They are believed to occur mainly in inshore coastal waters and riverine environments, including mangroves and mudflats.

Marine Reptiles

Five marine turtle species may occur in the Phoenix 3D survey area and adjacent waters - the green turtle, leatherback turtle, hawksbill turtle, loggerhead turtle, and the flatback turtle. Green turtles feed on macroalgae and are by far the most common turtle seen in nearshore waters. Loggerhead turtles are carnivorous, feeding mainly on molluscs and crustaceans. Hawksbill turtles feed mainly on sponges and are

more often found in deeper waters of the NWMR. Green, flatback and loggerhead turtles all breed from September to March, while the hawksbill turtle breeds from July to March. The reefal habitats in the photic zone are key feeding habitats for green and hawksbill turtles.

Green, hawksbill, flatback and loggerhead turtles are known to feed and nest in the Pilbara sub-system of the Northwest Shelf Province. Leatherback and olive Ridley turtles also migrate through the sub-system and feed there. No turtle nesting or feeding areas are likely to be present in the Phoenix 3D survey area. The closest important nesting beaches for turtles to the survey area are probably the flatback rookeries at Port Hedland and Cape Thouin, which are located approximately 144 km south and 158 km SSE of the survey area respectively.

Other EPBC Act protected marine species that may be present in the survey area include seasnakes. Seasnakes are frequently observed in and around offshore islands and the waters of the shelf generally. There is no information on their frequency of occurrence in deeper offshore waters, though individuals are often observed at the surface.

Dugong

In the Pilbara system of the NWMR, dugongs are believed to be confined to the Coastal Zone, which extends from the coast to the 30 m depth contour. Within this zone, dugongs and seagrass communities are widely distributed, but most are located in WA State waters, well inshore of the proposed Phoenix 3D survey area. However, seagrass beds are believed to provide critical habitat for dugongs and occur in scattered patches that can be severely degraded by disturbances such as cyclones. Dugongs are known to occur from Dampier to Exmouth, suggesting seagrasses are more prevalent in the southern parts of the Coastal Zone. Turtle grass occurring on sandy substrate of the northern section of the Coastal Zone is believed to be critical for dugong foraging.

Whales and Dolphins

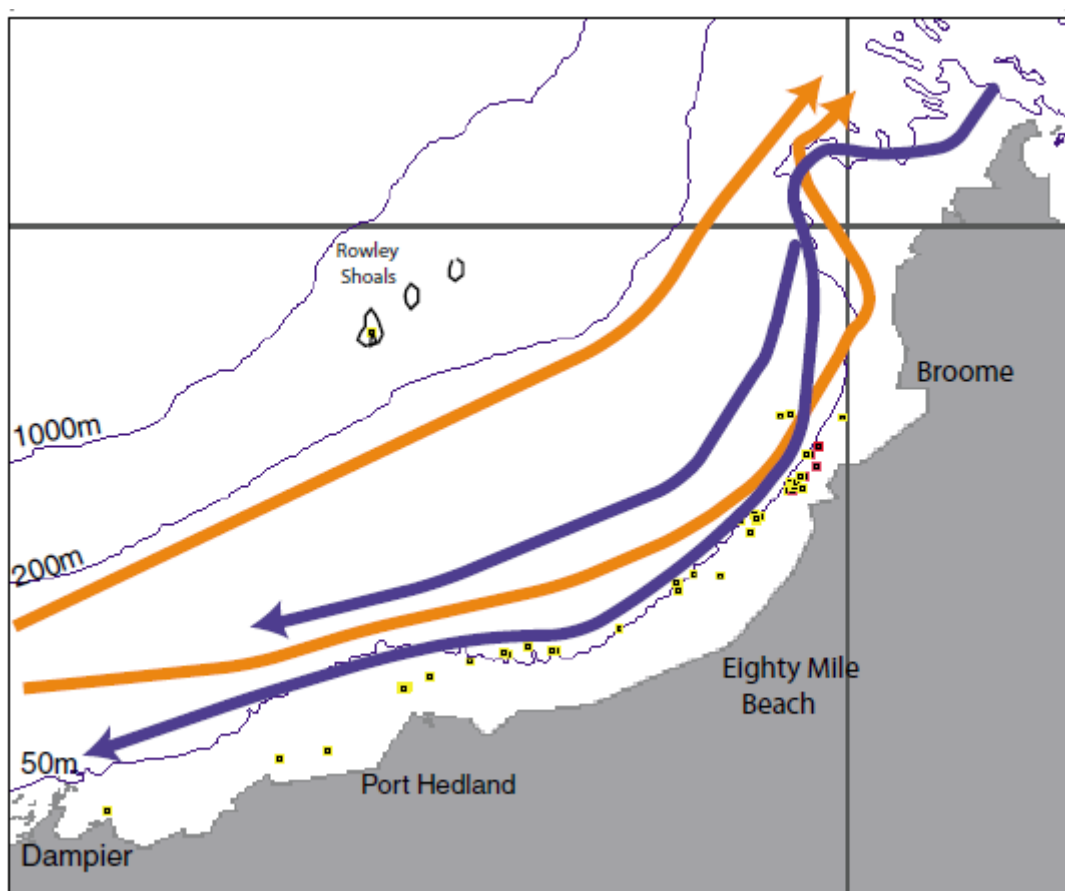
Although whales and dolphins are not expected to be common inhabitants of the survey area, a number of cetacean species have broad distributions that may include the NWMR. The humpback whale is the most commonly sighted whale in north Western Australian waters. The species has been observed seasonally to complete their northern migration in the Camden Sound area of the west Kimberley, after feeding in Antarctic waters during the summer months. It is likely that the whales follow a predictable migratory path and migrate both north and south within the continental shelf boundary (200 m bathymetry) (**Figure 2**). However, on the southbound migration it is likely that most individuals, and particularly cow/calf pairs, will stay closer to the coast than the northern migratory path (**Figure 2**).

It is possible that some humpback whales may be encountered within the Phoenix 3D survey area and adjacent waters during the proposed survey, given the survey timing of between the end of May and early July 2010.

The blue whale may be present in the Phoenix 3D survey area and surrounding waters. The blue whale is rarely present in large numbers outside recognised aggregation areas. 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. The Phoenix 3D survey area and adjacent waters does not include any known blue whale feeding, breeding or resting areas. In the NWMR pygmy blue whales migrate along the 500 m to 1,000 m depth contour on the edge of the slope, and are likely to be feeding on ephemeral krill aggregations. The northward component of this migration takes place from May to mid-August, with a peak in July-August, and the southward component occurs from late October to November-December, with a few isolated individuals moving south in January. The migration appears to be centred on the 500 m depth contour.

Consequently, it is possible that blue whales could be encountered in the survey area and adjacent waters during the period when the proposed survey will take place (between the end of May and early July 2010). However, large numbers of blue whales are not likely, as the survey will be taking place in water depths of 50-150 m, somewhat shallower than the 500 m isobath, where the highest density of migrating blue whales may occur.

Figure 2: Humpback whale migratory routes through the Phoenix 3D survey area



Other species whose broad distributions cover the region include whales that are infrequently observed usually restricted to cooler or deeper waters (e.g. killer and Bryde's whales) and are unlikely to be encountered in the area during the survey in significant numbers. There are no known breeding, calving or feeding grounds for any listed threatened or migratory whale species within, or in the immediate vicinity of the Phoenix 3D survey area.

The Phoenix 3D survey is scheduled to occur during the period between the end of May and early July 2010 and is expected to be of approximately six weeks duration. Therefore, the survey will occur largely before the start of the northward migration of humpback whales across the NWS, and will occur outside the peak period for the northward migration in the Port Hedland to Broome area (late July to early August). Given the water depth range covered by the survey area (50-150 m), the survey will overlap the main migratory route for the northward humpback whale migration (see **Figure 2**).

By applying comprehensive cetacean interaction management procedures (including the use of 'Standard Management Measures': soft starts, a 2 km low-power zone and 500 m shut down zone, plus the additional mitigation measure of two dedicated Marine Mammal Observers [MMOs]), direct adverse physiological effects on any whales that may be encountered during the surveys are extremely unlikely and any potential disturbance would be minimised.

Seabirds and Shorebirds

Based on the results of two survey cruises and other unpublished records, 18 species of seabirds have been recorded over North West Shelf (NWS) waters. These included a number of species of petrel, shearwater, tropicbird, frigatebird, booby and tern, as well as the silver gull. Of these, eight species occur year round

and the remaining 10 are seasonal visitors. From these surveys, it was noted that seabird distributions in tropical waters were generally patchy except near islands.

Bedout Island (located approximately 20 km from the nearest survey line) supports one of the largest colonies (>1,000 nesting pairs) of brown boobies in Western Australia. It is a sandy, heavily vegetated island on a limestone substrate that is a high value seabird nesting location—in addition to the brown boobies, it also has >1,000 nesting pairs of common noddy, >1,000 crested tern, 500-1,000 lesser frigatebird, 100-500 masked booby, as well as lesser crested tern, roseate tern, sooty tern, silver gull and white-bellied sea eagle. Several of these do not nest elsewhere in the Pilbara. Many of these species, including the brown booby, breed during the winter months (May to September).

Eighty Mile Beach, which is located approximately 100 km southeast of the southeast boundary of the WA-438-P permit, is one of the most important feeding areas/staging points in Australia for migratory shorebirds. Eighty Mile Beach is considered of international significance given the numbers of birds that feed in the area seasonally, and it is also a listed Ramsar site (Wetlands of International Importance).

Migratory shorebirds are likely to be present in the region between July and October and again between March and April as Eighty Mile Beach is an important site for birds using the East Asian-Australasian Flyway. Migratory shorebirds are listed as Migratory and Marine species under the EPBC Act and all are also listed under the Convention on Migratory Species (CMS). Additionally, some species are listed on the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA), or the Republic Of Korea Australia Migratory Bird Agreement (ROKAMBA).

Socio-Economic Environment

Heritage Values

The closest marine protected area to the WA-435-P, WA-436-P, WA-437-P, WA-438-P permits and the W08-13 release area is the Rowley Shoals Marine Park (State Waters). At the closest point, the northern boundary of the Phoenix 3D survey area is located a minimum distance of 100 km south of the boundary of the Imperieuse Reef, in the Rowley Shoals. Together, Imperieuse and Clerke Reefs constitute the Rowley Shoals Marine Park (State Waters). At the closest point, the northern boundary of the survey area is located approximately 170 km south-southeast of the boundary of the Mermaid Reef Marine National Nature Reserve (a Commonwealth marine protected area). All three reefs are listed on the Register of the National Estate. Mermaid Reef is also a Listed Place on the Commonwealth Heritage List.

The Proposed Dampier Archipelago Marine Park is located in WA State waters approximately 225 km southwest of the WA-437-P permit area. The Dampier Archipelago is a Listed Place on the Register of National Estate.

There are no listed Ramsar wetlands in or adjacent to the WA-435-P, WA-436-P, WA-437-P, WA-438-P permits and the W08-13 release area. The nearest listed Ramsar site is Eighty Mile Beach, which is located approximately 100 km southeast of the southeast boundary of the WA-438-P permit. Eighty Mile Beach is also a Listed Place on the Register of the National Estate.

The "Coastal Islands Dixon Island to Cape Keraudren, Port Hedland, WA, Australia" is a Listed Place on the Register of National Estate. This comprises an area of approximately 3,000 ha, and includes all islands from Dixon Island to Cape Keraudren, including Dixon, Bezout, Pelican Rocks, Picard, West Moore, East Moore, Sandy, Depuch, Sable, Ronsard, Reef, Weerde, Little Turtle, North Turtle, Downes, Finucane, and Bedout Island, and other small unnamed islands. The Australian pelican nests on North Turtle Island. Bedout Island is an outstanding seabird breeding site (see above). Other islands may be breeding sites for turtles and seabirds.

The "Coastal Margin Cape Preston to Cape Keraudren, Port Hedland, WA, Australia" is a Listed Place on the Register of National Estate. This area is regarded as an important representation of intact tidal flats and mangrove thicket of the north west coast of WA, and is seen as very important in supplying nutrients for the adjacent marine ecosystem. It also includes important habitat for juveniles of many marine species. It covers an area of approximately 60,000ha, in several sections extending 400 km north-east and south-west of Port

Hedland, comprising saline coastal flats between Cape Preston and Burrup Peninsula, between Roebourne and Cape Cossigny, between Cape Thouin and 35 km north-east of Port Hedland, and at Spit Point, Poissonnier Point and Cape Keraudren.

The AMS survey area encompasses Bedout Island, an 'A' Class Nature Reserve managed by the WA DEC. The island is situated approximately 90 km south-southeast of the Phoenix 3D polygon, and 40 km due north of the mainland coastline at Larrey Point (**Figure 1**).

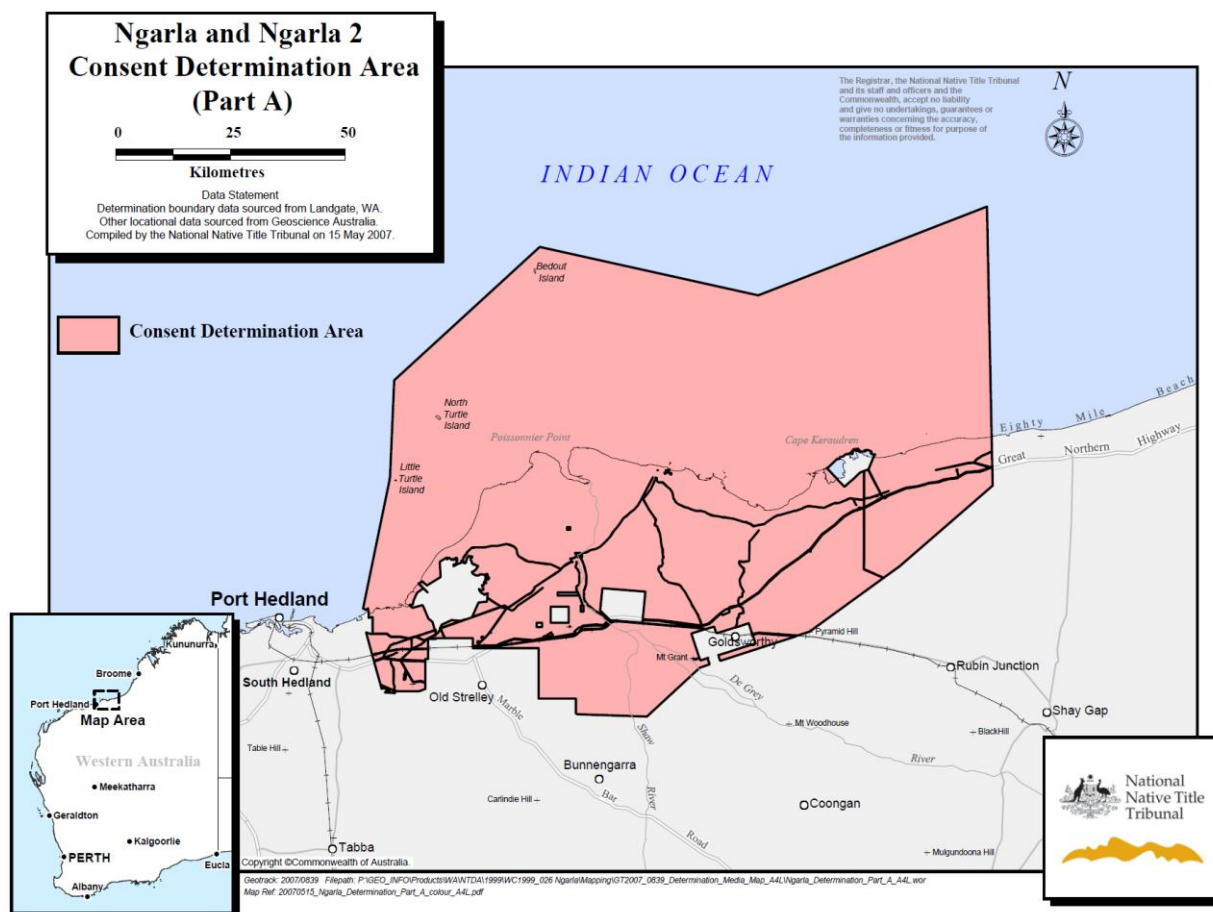
A search of the National Shipwrecks database for a circular search area centred on a position of 19°S 119°E and extending over a radius of 55 nm (~100 km) indicates only one known historic shipwreck that could occur in this area – that of the *SS Koombana*. The *SS Koombana* was a coastal passenger and cargo steamship that sank at an unknown location north of Port Hedland, during a cyclone on 20th March 1912 with the loss of approximately 138 lives. Additionally, there are three listed shipwrecks around Bedout Island. All of these wrecks are of vessels wrecked between 1890 and 1912.

Cultural Values

It is considered highly unlikely that any items of Aboriginal cultural significance are located in the proposed Phoenix 3D MSS area. There are no known indigenous cultural heritage values or issues for the waters and seabed within and immediately adjacent to the survey area. Similarly, there are no Native Title claims or issues covering the waters and seabed within and immediately adjacent to the Phoenix 3D MSS area.

The proposed AMS polygon overlaps an area covered by a Native Title Determination. The Ngarla and Ngarla #2 (Determination Area A) Determination, made by the Commonwealth Native Title Tribunal on 30/05/2007, includes parts of the Ngarla and Ngarla #2 Native Title applications and covers approximately 11,000 km² of land and waters surrounding the mouth of the De Grey River (**Figure 3**).

Figure 3: Ngarla and Ngarla #2 (Determination Area A) Native Title Determination



Commercial Fisheries

The principal commercial fisheries in the North Coast bioregion focus on tropical finfish, particularly the high-value emperors, snappers and cods that are taken by the Pilbara Fish Trawl Fishery and the Pilbara and Northern Demersal trap fisheries. The typical catch is in the order of 3,000 t annually, making these fisheries, at an estimated annual value of around \$12 million, the most valuable finfish sector in the state. The North Coast bioregion has a number of small, limited-entry trawl fisheries for prawns, producing about 700 t annually, valued at around \$10 million. There are also significant fisheries for Spanish mackerel, barramundi/threadfin salmon and shark, and a developing fishery for blue swimmer crabs. However, the bioregion is increasingly coming under threat from international poaching, particularly for sharks. A number of finfish activities, including offshore demersal line fishing and near-shore beach seining and gillnetting, also occur in the region.

The main commercial fishery that occurs in the area, in the water depth range covered by the proposed Phoenix 3D MSS, is the Nickol Bay Prawn Managed Fishery (NBPMF – managed by the WA Department of Fisheries (DoF)). The NBPMF primarily targets banana prawns using otter trawls. The other DoF-managed commercial fisheries active in nearshore and shelf waters off the Pilbara coast are the Pilbara Fish Trawl (Interim) Managed Fishery, the Pilbara Trap Managed Fishery and the Pilbara Line Fishery). The Pilbara Trawl Fishery is seaward of the 50 m isobath and landward of the 200 m isobath, and consists of two zones, Zone 1 in the southwest of Fishery (which is closed to trawling) and Zone 2 in the north, which consists of six management areas.

The Pilbara Trap Managed Fishery lies north of latitude 21° 44' S and between longitudes 114° 9' 36" E and 120° E on the landward side of a boundary approximating the 200 m isobath and seaward of a line generally following the 30 m isobath. The Pilbara Line fishing boat licensees are permitted to operate anywhere within "Pilbara waters". This means all waters bounded by a line commencing at the intersection 21° 56' S latitude and the high water mark on the western side of the North West Cape on the mainland of Western Australia; thence west along the parallel to the intersection of 21° 56' S latitude and the boundary of the Australian Fishing Zone.

Recreational Fisheries

Recreational fishing is experiencing significant growth in the North Coast bioregion, with a distinct seasonal peak in winter when the local population is swollen by significant numbers of metropolitan and inter-state tourists travelling through the area and visiting, in particular, the Onslow, Dampier Archipelago and Broome sections of the coastline. Owing to the high tidal range, much of the angling activity is boat-based, with beach fishing limited to periods of flood tides and high water.

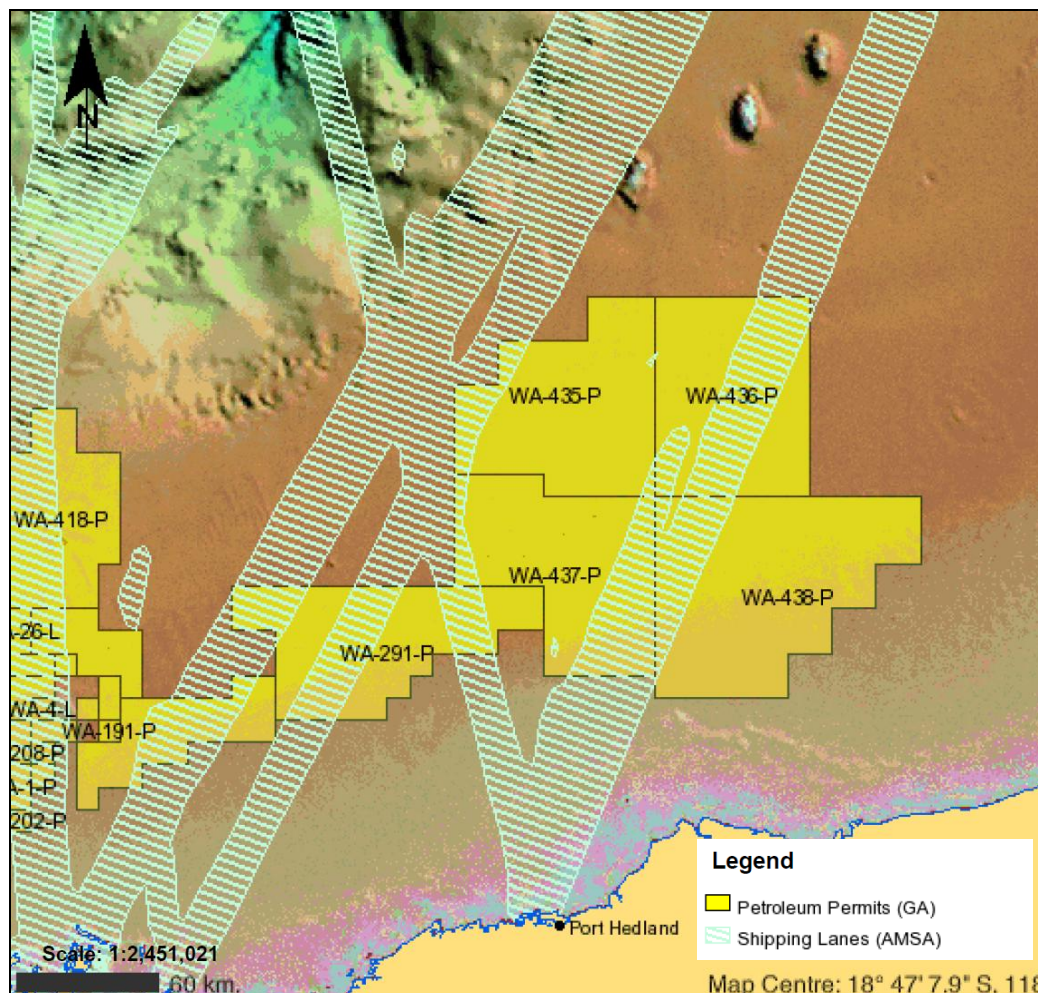
Creek systems, mangroves and rivers, and ocean beaches provide shore and small boat fishing for a variety of species including barramundi, tropical emperors, mangrove jack, trevallies, sooty grunter, threadfin, mud crabs and cods. Offshore islands, coral reef systems and continental shelf waters provide species of major recreational interest including saddletail snapper and red emperor, cods, coral and coronation trout, sharks, trevally, tuskfish, tunas, mackerels and billfish.

Such recreational fishing activities are unlikely to extend into the Phoenix 3D survey area, given the water depths and distance offshore. Game fishing is likely to be concentrated in the deeper waters on reef edges and around islands in the area, and targets species such as marlin, sailfish, Spanish mackerel, tuna and trevally.

Commercial Shipping

Data obtained from the Australian Marine Spatial Information System (AMSIS) for 2006-2007 indicates a clear shipping lane, orientated SSW to NNE, which overlaps the WA-435-P, WA-436-P, WA-437-P and WA-438-P permits (**Figure 4**). This is the main shipping route between Port Hedland/Port Walcott and the Indonesian straits. Just to the west of the permit area area are several other shipping routes originating in Port Hedland and the port of Dampier. These routes carry significant traffic comprising bulk carriers and LNG vessels. These shipping routes are likely to overlap with the survey area to some degree.

Figure 4: Shipping lanes and petroleum permits in the vicinity of the Phoenix 3D survey area



Oil and Gas Industry

Seismic coverage of the WA-435-P, WA-436-P, WA-437-P, WA-438-P permits and the W08-13 release area areas varies from moderately sparse in the east (WA-436-P, W08-13 and WA-438-P) to relatively dense in the west (WA-435-P and WA-437-P). The first significant phase of seismic acquisition in the region occurred between 1971 and 1974. Regional speculative seismic was acquired across the sub-basin in 1987 by JNOC (Japanese National Oil Company), and this grid was tied to the wider NWS regional grid by an AGSO (Australian Geological Survey Organisation, now Geoscience Australia) seismic survey. The most recent seismic exploration activities in the Bedout Sub-basin occurred in the early to mid-1990s with the acquisition of relatively dense industry seismic grids in the western permit areas.

The first significant phase of exploration drilling in the Bedout Sub-basin occurred between 1971 and 1974, with the drilling of Bedout 1, Keraudren 1 and Minilya 1. The remaining three wells in the sub-basin (Phoenix 1 and 2 and Lagrange 1) were drilled between 1980 and 1983. Recent exploration activity in the Roebuck Basin has been confined to the outboard Rowley Sub-basin, where the deep water potential has been unsuccessfully tested by Whitetail 1 (2003) and most recently Huntsman 1 (2006).

Defence Activities

There are no designated military / defence exercise areas in the waters covered by the Phoenix 3D MSS area, or the proposed AMS area, and the immediate vicinity.



MAJOR ENVIRONMENTAL HAZARDS AND CONTROLS

All aspects of the Phoenix 3D MSS and the AMS have been subjected to risk analyses, which has been used to evaluate the potential environmental risks and effects associated with each activity, and characterize risk likelihood and severity. **Table 3** summarises the risk analysis for the key aspects of both the Phoenix 3D survey and the AMS.

Phoenix 3D MSS

Given the management requirements that will be implemented for all environmental aspects of the proposed Phoenix 3D MSS survey, the risk of significant adverse environmental effects from the survey has been assessed as low for all aspects, apart from acoustic disturbance to cetaceans, interference with commercial shipping activities, and fuel and oil spills, which have been assessed as medium. The implementation of specific whale monitoring and encounter procedures will be used to minimise the potential for any adverse effects to whales. These procedures comply fully with the Australian Commonwealth Government Guidelines: *EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales* (September 2008). Two dedicated, expert Marine Mammal Observers (MMOs) will be aboard the survey vessel for the entire duration of the Phoenix 3D survey. The key role of the MMOs will be to visually monitor the waters around the survey vessel for the presence of cetaceans, turtles and dugongs during daylight hours. The MMOs will be responsible for recording any marine fauna sightings during the survey on the appropriate sightings forms, using the DEWHA 'Cetacean Sightings Application' software.

The survey will be conducted in water depths of 50-150 m away from any shallow water habitat areas that may be important for dugong or turtle feeding. The survey area is located at least 100 km away from any beaches and adjacent shallow waters that are important for turtle nesting, hatching and breeding. The survey area is located at least 90 km from any locations important for seabird breeding (e.g. Bedout Island), and shorebird feeding (e.g. western end of Eighty Mile Beach).

Airborne Magnetic Survey

Given the management requirements that will be implemented for all environmental aspects of the proposed Airborne Magnetic Survey, the risk of significant adverse environmental effects from the survey has been assessed as low for all aspects, apart from disturbance to seabirds and shorebirds. To minimise potential disturbance to seabird populations on Bedout Island, the survey aircraft will be required to fly any survey lines within 500 m horizontal distance of the island at an altitude of 152 m (500 ft), rather than the standard altitude of 80 m for the rest of the survey area. Flight paths outside the survey area will avoid inshore locations regarded as critical habitat for dugongs and shorebirds (e.g. western end of Eighty Mile Beach).

MANAGEMENT APPROACH

The environmental management approaches relevant to key aspects of the Phoenix 3D MSS and the AMS are summarised in **Table 3**. The surveys will be conducted in accordance with all legislative and regulatory requirements, to the satisfaction of the Designated Authority (DMP). Fugro's overall environmental objective for the two surveys is to avoid or minimise environmental risks to levels as low as reasonably practicable (ALARP).

Table 3: Summary of Environmental Risks and Management Approach for Key Aspects of the Phoenix 3D MSS and the Airborne Magnetic Survey

Hazard/ Incident	Potential Hazard Consequence	Risk and Management Approach
Phoenix 3D MSS		
Disturbance to marine fauna	Cetaceans - behavioural reactions (avoidance, diving, increased dive times). Disturbance to dugongs. Disturbance to marine turtles. Disturbance to fish communities. Disturbance to benthic invertebrates.	Low (benthic invertebrates, fish, turtles, dugong); Medium (cetaceans) risk. <ul style="list-style-type: none"> • Interaction procedures in place and adhered to • Observation zone of 3 km radius, low power zone of 2 km radius, shut-down zone of 500 m radius • 'Soft start' procedures • Use of two dedicated MMOs for entire duration of the survey • Marine fauna sighting reports completed and returned to Fugro and to the Australian Marine Mammal Centre at the Australian Antarctic Division, using the 'Cetacean Sightings Application' software
Disturbance to benthic habitats	Small localised disturbance to epibiota in event of loss of equipment	Low risk. <ul style="list-style-type: none"> • The survey will be conducted in water depths of 50-150 m away from any shallow water habitat areas • No anchoring of either the survey vessel or support vessel will take place during the survey unless in an emergency • All reasonable efforts taken to retrieve lost equipment • Recording and reporting of all items lost overboard
Interference with commercial fisheries	Interference to fishing vessels operating within or near the survey area and surrounding waters. Potential direct and indirect noise impacts on target species. Restriction of access to fishing grounds, loss or damage to fishing gear.	Low risk. <ul style="list-style-type: none"> • Consultation with fisheries management agencies, fishing industry bodies and individual companies prior to survey commencing, to inform them about the location of survey area and timing of operations • Display of appropriate navigational beacons and lights, radar watch • Recording of sightings of fishing vessels, consultation with fishermen at sea, if necessary • Operations carried out in a manner that does not interfere with fishing to a greater extent than is necessary
Interference with shipping activities	Interference to commercial shipping operating within or near the survey area and surrounding waters.	Medium risk. <ul style="list-style-type: none"> • Issuance of Notice to Mariners • Display of appropriate navigational beacons and lights, radar watch • Radio warnings to shipping, as required • Operations carried out in a manner that does not interfere with navigation to a greater extent than is necessary

Hazard/ Incident	Potential Hazard Consequence	Risk and Management Approach
Waste disposal	Localised temporary decrease in ambient water quality from discharge of sewage, grey water, putrescible waste, chemicals and solid and hazardous wastes.	Low risk. <ul style="list-style-type: none"> • Procedures comply with MARPOL requirements • Procedures for treatment and disposal of sewage are in place and relevant discharge requirements are adhered to • Sewage treatment system operational and includes maceration and disinfection • Quantities of treated sewage and putrescible wastes discharged overboard are recorded on the vessel's <i>Waste Log Forms</i> • Correct segregation of solid and hazardous wastes • A vessel <i>Waste Log Form</i> is kept detailing quantities of wastes transported ashore
Fuel and oil spills	Acute toxicity effects on marine fauna such as marine turtles, fishes and seabirds.	Medium risk. <ul style="list-style-type: none"> • Procedures comply with MARPOL 73/78 requirements (e.g. <i>Oil Record Book</i> kept up to date) • Fuel spill contingency procedures are in place and operational • Adherence to the at sea refuelling procedures • At sea refuelling of the survey vessel will only take place during daylight hours • Designated containment areas onboard the vessel for storage of oils, greases and streamer fluid • Sufficient spill response equipment on board to respond to foreseeable spill events • Appropriate actions are taken to minimise pollution • Any significant spills (>80 L) are reported to the relevant sections within DMP • Personnel responsibilities are clearly identified
Introduction of marine pests	Introduction and establishment of non-indigenous (i.e. foreign) marine species with consequent impacts on benthic communities, fisheries etc.	Low risk. <ul style="list-style-type: none"> • Procedures comply with AQIS <i>Australian Ballast Water Management Requirements</i> • AQIS ballast water log is kept up to date • Procedures comply with the <i>National Biofouling Management Guidance for the Petroleum Production and Exploration Industry</i> • Both survey and support vessel have all AQIS clearances to operate unrestricted in Australian waters
Airborne Magnetic Survey		
Disturbance to cetaceans and dugongs	Visual and acoustic disturbance to cetaceans and dugongs.	Low risk. <ul style="list-style-type: none"> • Maintain 80 m altitude for flight lines within survey grid • Low altitude flying to take place only within survey area, apart from test lines outside the survey area, which will be performed up to twice daily at survey height (80 m)

Hazard/ Incident	Potential Hazard Consequence	Risk and Management Approach
		<ul style="list-style-type: none"> Flight path planning outside survey area to avoid inshore locations regarded as important feeding habitat for dugongs (e.g. Eighty Mile Beach)
Disturbance to seabirds and shorebirds	Visual and acoustic disturbance to seabirds and shorebirds.	<p>Medium risk.</p> <ul style="list-style-type: none"> Maintain 80 m altitude for flight lines within survey grid Low altitude flying to take place only within survey area, apart from test lines outside the survey area, which will be performed up to twice daily at survey height (80 m) Minimum 152 m altitude for flight lines within 500 m of Bedout Island to minimise potential disturbance to seabird breeding colonies on the island Flight path planning outside survey area to avoid inshore locations regarded as critical habitat (feeding and resting areas) for shorebirds (e.g. western end of Eighty Mile Beach)
Interference with commercial and recreational fisheries	Disturbance to commercial and recreational fishing activities from low-flying aircraft.	<p>Low risk.</p> <ul style="list-style-type: none"> Maintain 80 m altitude for flight lines within survey grid Low altitude flying to take place only within survey area, apart from test lines outside the survey area, which will be performed up to twice daily at survey height (80 m) Consultation with fishing industry bodies and individual companies prior to airborne survey commencing, to inform them about the location of survey area, timing and nature of operations Measures taken to avoid flying directly over vessels, if possible



CONSULTATIONS

Phoenix 3D MSS

Consultation regarding the proposed Phoenix 3D MSS has been undertaken with stakeholder groups, primarily within the commercial fishing industry, in Western Australia. The following organisations have been contacted and informed of the proposed operations:

- A Raptis and Sons
- Austral Fisheries Pty Ltd
- Australian Fisheries Management Authority
- Australian Maritime Safety Authority
- Commonwealth Fisheries Association
- Northern Fishing Companies Association
- TunaWest
- Western Australian Department of Fisheries
- Western Australian Fishing Industry Council
- Western Australian Northern Trawl Owners Association

Fugro is not expecting to get many issues or concerns raised by the stakeholders listed above. To date none of the fisheries stakeholders consulted has raised any issues or concerns relating to the proposed Phoenix 3D MSS.

Airborne Magnetic Survey

Given that the proposed Airborne Magnetic Survey overlaps an area covered by a Native Title Determination (the Ngarla and Ngarla #2 (Determination Area A) Determination) the Wanparta Aboriginal Corporation has been informed about the proposed operations. The Wanparta Aboriginal Corporation administers land on behalf of the Ngarla people.

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

FURTHER DETAILS

Phoenix 3D MSS

For further information about the proposed Fugro Phoenix 3D MSS within the Bedout Sub-basin offshore from Western Australia, please contact:

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Airborne Magnetic Survey

For further information about the proposed Fugro Airborne Magnetic Survey within the Bedout Sub-basin offshore from Western Australia, please contact:

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