



Gazelle 3D Marine Seismic Survey  
 Environment Plan: Public Summary  
 February 2011

*This summary has been submitted to comply with Regulation 11(7)(8) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) (OPGGGS(E)) Regulations 2009*

**Introduction**

Apache Energy Limited (Apache) is proposing to undertake a 3 dimensional (3D) marine seismic survey (MSS) program within Commonwealth waters of the offshore Carnarvon Basin, within exploration permit WA-399-P and the WA-42-L production licence area during February 2011. The seismic program is referred to as the **Gazelle 3D Marine Seismic Survey (MSS)**.

Apache prepared an Environment Plan (EP) for the Gazelle 3D MSS, which was approved by the Department of Mines and Petroleum (DMP) on the 11<sup>th</sup> of February 2011. This document provides a summary of the EP for the Gazelle 3D MSS and includes the proposed environmental controls to address the operational activities associated with the Gazelle 3D MSS.

**Location**

The proposed survey area is located within the Carnarvon Basin of Western Australia in WA production licences WA-42-L and WA exploration permit WA-399-P (**Figure 1**). Ingress into exploration permit WA-155-P(1) is also required. The boundary of the survey area is located approximately:

- 105 m from the Ningaloo Marine Park (Commonwealth Waters) northern boundary;
- 6 km west of the Muiron Islands;
- 80 km west of Onslow;
- 32 km north of Exmouth;
- 15 km north of the nearest mainland (the North West Cape Peninsula); and
- 14 km east-southeast of the nearest FPSO facility (Pyrenees).

The proposed survey covers an area of approximately 129 km<sup>2</sup> within Commonwealth Waters, and is located within water depths ranging from 40 m up to 180 m (**Figure 2**). The seismic and support vessels will travel through the Ningaloo Marine Park to execute vessel line turns however, the airguns will not be operated when the survey vessel travels through the reserve. Coordinates of the survey area are listed in **Table 1**.

**Table 1: Proposed Gazelle 3D Seismic Survey Coordinates**

Latitude (S)			Longitude (E)		
degrees	minutes	seconds	degrees	minutes	seconds
21	34'	25.32	114	20'	46.70
21	39'	50.35	114	15'	43.95
21	39'	51.86	114	12'	41.61
21	35'	05.50	114	12'	48.04
21	32'	13.27	114	15'	27.33
21	32'	13.47	114	18'	04.82

Datum: GDA94, UTM Zone: 50

\* see **Figure 1** for geographical location of proposed seismic survey area.

## Timing

The proposed Gazelle 3D MSS program is scheduled to commence mid February 2011. The proposed seismic survey is estimated to take 13 days to complete based on a 24 hour a day operation. The survey is estimated to conclude late February/early March 2011, however, any delays to the start date of the survey or adverse prevailing sea and weather conditions during the survey could potentially extend the finish date.

## Seismic Operations

The Gazelle 3D MSS is a typical 3D survey similar to most others conducted in Australian marine waters, in terms of technical methods and procedures (**Figure 3a** and **b**). No unique or unusual equipment or operations are proposed. The survey will be conducted using a purpose-built seismic survey vessel.

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/hour. As the vessel travels along the survey lines, a series of noise pulses (every 7-8 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 up to 10 solid or gel filled hydrophone cables (streamers), each with a maximum length of 4.05 km. The source (airgun array) tow depth will be 5-6 m, the streamer tow depth will be at 6-8 m which will be maintained by the used of "birds" which are a standard component of the streamer arrangement used in seismic surveys in order to maintain a constant depth of the streamer. The lead-in line will be at 13 m (during acquisition). The operating pressure for the airgun array will be approximately 14 Mpa (2,000 psi). The airgun array will consist of two sub-arrays, each with a volume of 44 L (2,700 cubic inch (cui)). These sub-arrays will be fired alternately, with a shotpoint interval of 12.5 m vertical distance, and will produce at source (i.e. within a few metres of the airguns) sound pulses in the order of 230-240 dB re 1 $\mu$ Pa-m at frequencies extending up to approximately 110 Hz. Based on a spherical spreading noise propagation model on an 2,700 cui airgun array, the likely sound pulses will decrease to levels below 160 dB re 1 $\mu$ Pa-m within 1 km of the source and approximately 145 dB re 1 $\mu$ Pa-m within 2 km, dependent on the sound propagation characteristics of the area.

Summary of the seismic survey parameters are provided in **Table 2**.

**Table 2: Seismic Survey Parameters**

Parameter	Value
No. of streamers	10
Streamer length	4,050 m
Streamer depth	6-8 m
Size of each airgun sub-array	2,700 cui
Operating pressure	2,000 psi
Shotpoint interval	12.5 m (flip flop)
Source depth	5-6 m
Peak at source sound levels (<1m)	240 dB re 1 $\mu$ Pa-m
Frequency range	0–110 Hz

Parameter	Value
Distance between survey sail lines	250 m

### Vessels

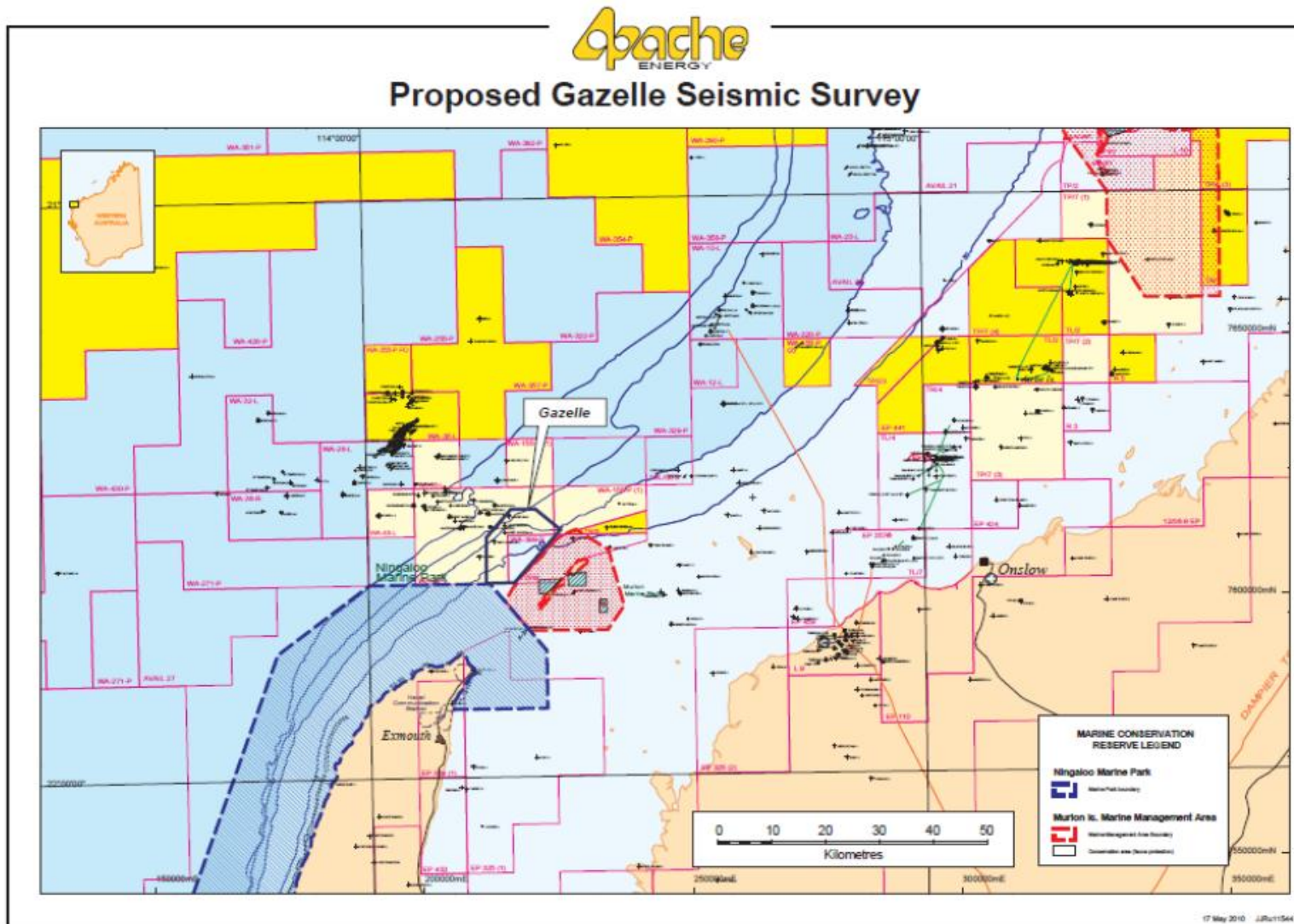
Apache proposes to conduct the survey using the purpose-built seismic survey vessel M/V Geo-Atlantic (see **Figure 4** and **Figure 5a**) which has a complement of approximately 80 crew. The M/V Geo-Atlantic is leased and operated by the geophysical acquisition company Fugro-Geoteam AS. The vessel will travel within the survey area at an average speed of 4.5 knots (approximately 8.3 km per hour).

A supply vessel, the M/V Cassandra VI (inset of **Figure 4** and **Figure 5b**) will accompany the seismic survey vessel to maintain a safe distance between the survey array and other vessels; and manage any interactions with fishing activities, if required. The support vessel will have a crew of up to 38 personnel and will re-supply the survey vessel with logistical supplies as required. On-site vessel to vessel refuelling will not be permitted to take place during this survey.

It is expected that the M/V Cassandra VI will remain in the field with the source vessel throughout the duration of this short survey (13 days). However if additional equipment is required or other circumstance dictate (disposal of food wastes to shore), it may temporarily leave the source vessel for collection and return of this equipment/disposal of wastes.

As a precautionary measure, whenever the support vessel leaves the field a locally sourced chase vessel will be deployed to accompany the Geo-Atlantic.

The seismic vessel will traverse through the Ningaloo Marine Park (Commonwealth Waters) for carrying out line turns. However, the seismic source (airguns) will not be operated within the boundaries of the Marine Park as the survey vessel passes through this area. It is estimated that the vessel will re-enter the commonwealth reserve approximately every 6.5 hours after completion of one turn in the marine reserve (a full round trip is expected to take 9 hrs and a turn is approximately 2.5 hrs). The total time within the park during the seismic programme will be approximately 76 hours based on the average speed of 8-9 km/hr and a requirement of 64 turns to complete the survey.



**Figure 1: Location of the Gazelle 3D MSS**

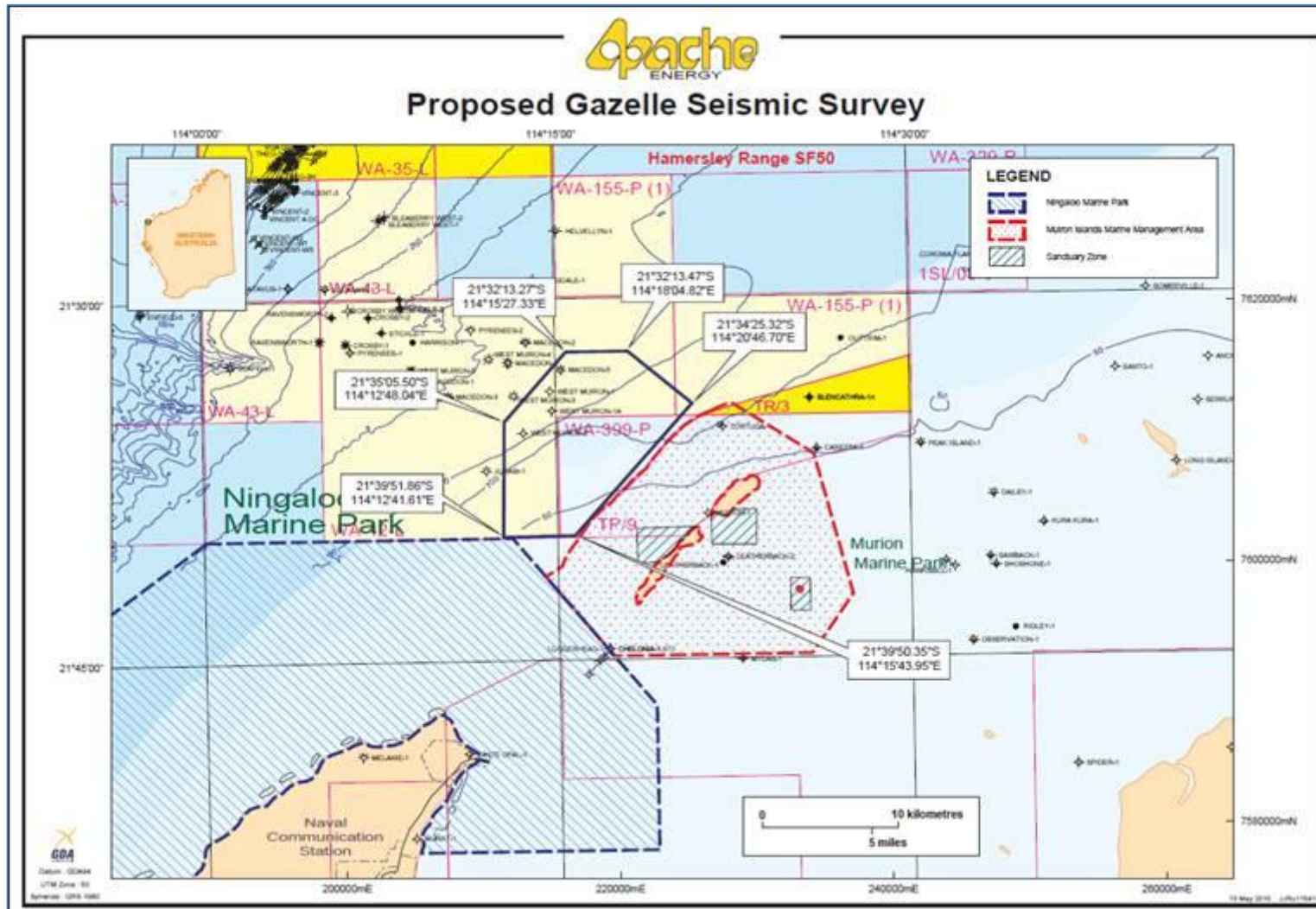
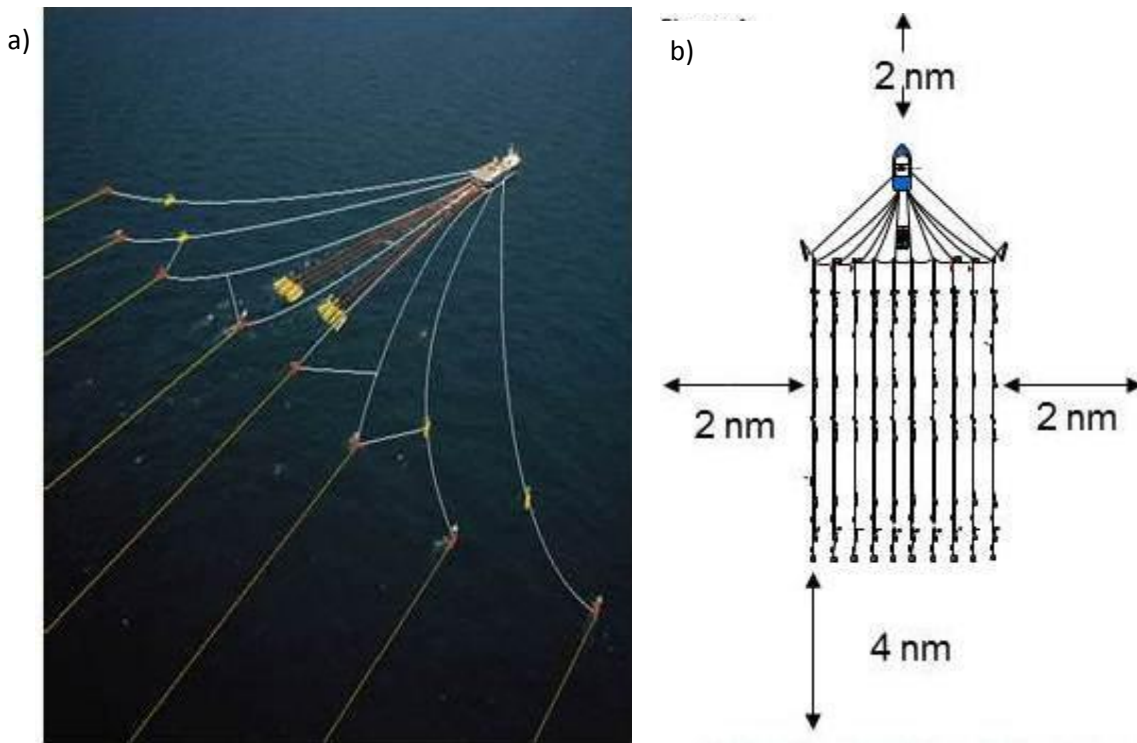


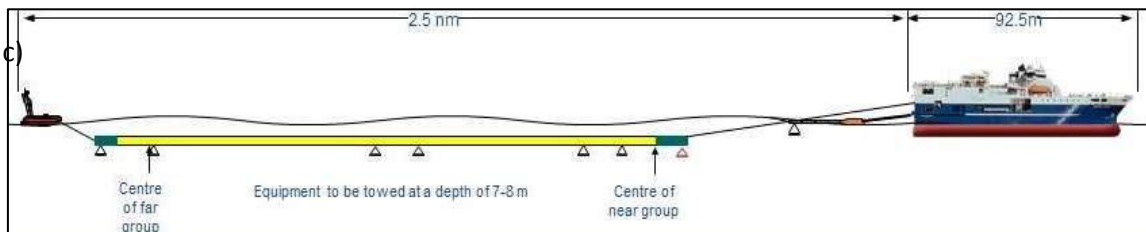
Figure 2: Location of and bathymetry at the Gazelle 3D MSS



**Figure 3: a) Typical Seismic Survey Arrangement and b) requested vessel clearance**



**Figure 4: Seismic Vessel M/V Geo-Atlantic and Support vessel Cassandra VI (inset)**



**Figure 5: a) Seismic survey vessel M/V Geo-Atlantic; b) Support vessel M/V Cassandra; and c) Streamer profile**

## Existing Environment

This section describes the existing marine environment in the vicinity of the proposed survey area.

## Physical Environment

The Exmouth region lies in the arid subtropical zone of Australia, experiencing hot temperatures, summer droughts, and low rainfall (no wet season), with terrestrial ecosystems dominated by grasslands. The region's climate is controlled by the seasonal movement of subtropical high-pressure belts and related summer continental heating. These seasonal variations do not accord directly with the traditional four seasons of higher latitudes.

Exmouth experiences two main seasons, with a hot summer (October to April) and a mild winter (May to September). Summers are typically hot and humid, with occasional heavy rainfall events associated with the passage of infrequent tropical cyclones; and winds are mainly from the southwest. Winters are cooler, with some seasonal rainfall and with generally strong winds from the east and southeast.

On average, the region experiences three to four cyclones each year, these typically occur between January and March. Climate data from the Bureau of Meteorology's Learmonth weather station has been used to describe the regional climate.

The proposed seismic survey area is located on the middle shelf area of the continental shelf with water depths varying between 40 m in the south up to 180 m in the north (see **Figure 2**). The seafloor is characterised by a thick sequence of carbonate rock that is overlain by

thin layers of unconsolidated fine to medium grained, carbonate sediments with occasional shell or gravel patches. A survey of the seafloor at the Tortuga-1 well site in 2006, located east of the proposed seismic survey area, found the seabed displayed high relief with large regular undulations over sand waves with wavelengths of between 80 m and 150 m and amplitudes of up to 4 m in the south east of the 1 km by 1 km survey grid centred around the well location. Elsewhere the seabed is composed of coarser sand and fine gravel sediments deposited on a gentle regional slope. There were no other seabed features recorded.

## **Biological Environment**

### Marine Habitats

Habitats in the Exmouth Sub-basin can be categorised as oceanic, continental slope, continental shelf, reef, lagoonal, intertidal and shallow subtidal. The proposed survey area is located on the continental shelf.

The Ningaloo Marine Park is the most iconic conservation reserve of the region. It protects the Ningaloo Reef, and the park stretches for more than 300 km from the North West Cape south to Red Bluff. Ningaloo Reef is the largest fringing coral reef in Australia, and contains over 217 species of coral, over 600 species of mollusc, over 460 species of fish and over 25 species of migratory wading birds. The Muiron Islands Marine Management Area lies adjacent to the northern portion of the Ningaloo Marine Park and also protects coral reef and shallow, sub-tropical marine environments.

An extensive lagoon system occurs landwards from Ningaloo Reef and in Exmouth Gulf, containing habitats such as coral bommies, exposed rocky and sandy seabeds and deep holes and channels. In stable sections of sandy seabed, seagrasses and macroalgae thrive, providing food and shelter for dugongs, turtles, crustaceans and fish. Macroalgae and seagrasses are important primary producers in tropical inshore waters and support the juvenile stages of prawn species that are commercially important in the region.

Intertidal habitats in the region are found around the islands of the NWS and along the coast, and include sandy beaches, rocky shores and mangrove-lined creeks and shores (see **Figure 6**).

The sandy substrates on the shelf within the Northwest Shelf Province bioregion are thought to support low density benthic communities of bryozoans, molluscs and echinoids. Unconsolidated sediments on the North West Shelf support a diverse benthic infauna consisting predominantly of mobile burrowing species that include molluscs (oysters, clams, mussels, snails abalone, octopus, squid and cuttlefish); crustaceans (including lobsters, crabs and shrimps), and echinoderm (including sea urchins, seastars, starfish and sea cucumbers)

### Marine Fauna

A total of 80 species of marine fauna may occur in the survey area of which 11 threatened species were listed under the EPBC Act database as being threatened marine species that may occur within the proposed survey area, with 17 species listed as migratory (ten of these being the same as the threatened species).

The proposed survey area is not considered a habitat that is critical to the survival of any Listed Species. There are, however, numerous Listed Species and whales and other cetaceans listed as other matters protected by the EPBC Act that may occur within or adjacent to; and/or likely to be transient through the survey area. A summary of the known biological breeding cycles and activities on the NWS and the Exmouth Gulf is outlined in **Table 3**.



### Marine Mammals

A number of whale species, including the blue whale (*Balaenoptera musculus*), humpback whale (*Megaptera novaeangliae*), southern right whale (*Eubalaena australis*), Bryde's whale (*Balaenoptera edeni*), killer whale (*Orcinus orca*), Antarctic minke whale (*Balaenoptera bonaerensis*) and sperm whale (*Physeter macrocephalus*) may occur infrequently in or around the survey. The blue whale, humpback whale and southern right whale are listed threatened species under the EPBC Act.

The most commonly sighted whale is the humpback whale. Humpback whales are listed as an endangered migratory species under the EPBC Act and are known to migrate between the Antarctic waters and the Kimberley region of Western Australia. The peak of the northerly migration occurs mid-June to late July, while the southerly return migration peaks around late August to early September, with a peak of cow and calves occurring in early to mid-October. An important resting area for the cows and calves is Exmouth Gulf.

The migratory whale route, where most whales are observed, occurs in deeper waters (> 20 metres), passing to the west and north of Serrurier Island, westward of Barrow Island and north of the Montebello Islands.

The timing of the proposed Gazelle 3D MSS is outside of the peak humpback whale migration periods.

Dolphins are relatively common in the region. A diverse range of dolphin species have been recorded in the Ningaloo Marine Park and Marine Management Area. Species known to occur in the region include the spotted bottlenose dolphin (*Tursiops aduncus*), bottlenose dolphin (*Tursiops truncatus*), Risso's dolphin (*Grampus griseus*), spotted dolphin (*Stenella attenuata*) and the common dolphin (*Delphinus delphis*).

Current knowledge on the size, distribution and migratory habits of the dugong population in the region between North West Cape and the Dampier Archipelago is limited; however dugong numbers in Ningaloo Marine Park is considered to be in the order of approximately 1,000 individuals. The number of dugongs at any one time can vary considerably from a few to several thousand; primarily dependant on the availability of their main food source. Seagrass beds around the shallow, sandy lagoonal areas of the marine park provide a valuable food source for dugongs.

Dugongs in the Northwest Shelf region have been found to breed between September and April. Specific areas supporting dugongs in Western Australia include Shark Bay, Ningaloo Marine Park and Exmouth Gulf, Pilbara Coastal and Offshore regions (Exmouth Gulf to De Grey River), and Eighty Mile Beach and Kimberley Coast Region. Dugongs are unlikely to be encountered in the deeper waters of the survey area.

### Marine Turtles

Four species of sea turtle (loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and flatback turtle (*Natator depressus*)) nest on the sandy shore sites of the Ningaloo Coast and on coastal islands in the Exmouth region.

The closest turtle nesting sites to the proposed survey area are those of the Muiron Islands (western side) and the North West Cape beaches, which are located approximately 6 km southeast and 14 km south respectively. The beaches of the Ningaloo coast and the Muiron Islands are identified as a critical nesting habitat for the West Coast population of the Loggerhead turtle and Green turtle. Green turtles tend to nest in higher proportions in the northern areas of the Ningaloo Marine Park; while Loggerheads tend to favour the sandy beaches of the Muiron Islands and the southern parts of the Marine Park towards Shark Bay.

It is unlikely that marine turtles will be encountered within the survey area, given that there are no known turtle feeding and breeding areas within the Gazelle 3D MSS area.

### Fish

The demersal habitat of the NWS hosts a diverse assemblage of fish, with up to 1,400 species known to occur, with a great proportion of these occurring in shallow coastal waters. Many of these are commercially exploited by trawl and trap fisheries. Pelagic fish in this area include tuna, mackerel, herring, pilchard and sardine, and game fish such as marlin and sailfish.

Whale sharks (*Rhincodon typus*), the world's largest fish (growing up to 12 m in length), are oceanic and cosmopolitan in their distribution, however, they do aggregate in and near the waters of the Ningaloo Marine Park during autumn. The main period of the whale shark aggregation at Ningaloo reef is late March to June, with the largest numbers recorded around April.

Although the Gazelle survey period falls outside the peak whale shark aggregation period it is possible that some individuals may be sighted during the survey.

### Seabirds

At least 64 species of birds feed and nest on the surrounding waters and islands within the Barrow/Montebello/Lowendal islands region. The main seabird breeding/nesting season occurs between October and January on the island group. As the proposed seismic surveys will take place in offshore waters distant from breeding sites it is highly unlikely that the proposed survey areas cover any habitat critical to the survival of any seabirds in the region.

Giant-petrels are migratory species (i.e. Bonn Convention, JAMBA and CAMBA) and tend to be the most oceanic of all seabirds, opting for land primarily for breeding purposes. It is highly unlikely that the survey area covers any habitat critical to the survival of any listed migratory seabird species.

It is possible that this species may fly over the survey area, however it is not anticipated that the seismic survey will have any impact on these or other seabirds due to their mobility and distance of the survey areas from any critical nesting or feeding sites.

**Table 3: Simplified NWS and Exmouth Gulf biological processes summary**

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
Dugong breeding	breeding								breeding				
Hawksbill turtle nesting													
Flatback turtle nesting													
Green turtle nesting													
Loggerhead turtle nesting													
Coral spawning													
Humpback whale migration						north			south				
Whalesharks			Main aggregation period										
Macroalgae	growing				shedding fronds				growing				
Seabird nesting													
Gazelle 3D MSS													

**Key**

- Peak activity, presence reliable and predictable
- Low level of abundance/activity/presence
- Activity not occurring within the area
- Proposed 3D MSS activity

**Socio-economic Environment**

The Cape Range Peninsula is located in the Pilbara region of WA, close to the Gascoyne-Murchison region. The Shire of Exmouth encompasses 6,261 km<sup>2</sup> of the peninsula, including the largest town in the region, Exmouth, located in the northeast part of the Cape (see **Figure 1**). The two closest towns to Exmouth are Onslow, 107 km to the northeast and Carnarvon, 331 km to the south. The smaller townsite of Coral Bay is located on the western side of the Cape Range Peninsula, about 135 km southwest of Exmouth.

Local residents seeking aquatic recreation such as boating, diving and fishing use the coast and islands of the Exmouth Gulf, such as the Muiron Islands and Sunday Island. The adjacent Ningaloo Marine Park is heavily utilized for nature-based tourism and recreational activities. Activities conducted in the area include coral observing, wildlife viewing and interaction (particularly whale sharks, but also whales, turtles, dugongs and rays), snorkelling, boating, recreational fishing (beach and cliff fishing, shallow-water and offshore boat angling), diving, on-water activities (surfing, kayaking etc.), beach recreational activities and camping. These activities are conducted in State Waters, with recreational fishing the only activity currently undertaken in Commonwealth waters.

The Muiron Islands are a popular recreational fishing area. Recreational fishing is approved within the general use zone, however is prohibited in the conservation (flora/fauna protection) areas. Passive nature-based activities can occur within this zone, as well as some boating and recreation activities.

The Exmouth Gulf Fishing Club holds annual club fishing events out of Exmouth throughout the year such as the Tantabiddi Camp Out (January 8-9); Australian International Billfish Tournament (March 14-18); Gamex (March 19-26); Exmouth Classic (10-13 June); Ultra-light Tournament (August 20-22); and Betta Billfish Bonanza (October 14-17).

It is expected that recreational and charter fishing boats may travel through or near the survey area based upon the location of the seismic survey adjacent to the Muiron Marine

Management Area and the survey vessel travelling through the Marine Park for line turns. Apache has consulted with all Exmouth stakeholders on the proposed seismic survey so they are aware of the timing for the survey and activities undertaken.

The region supports a valuable and diverse fishing industry, with the offshore and coastal habitats being significant at all life stages for commercial species in the region. Several commercial fisheries operate out of Exmouth and Onslow. They are managed by either the state (WA Fishing Industry Council, WAFIC) or the Commonwealth (Australian Fisheries Management Authority, AFMA).

The Department of Fisheries (Western Australia) has also identified two known commercial fisheries operating in State waters near WA-399-P. Both commercial fisheries operated in the Exmouth Gulf. Commercial fishing is not permitted in the Commonwealth waters of the Ningaloo Marine Park, however fishing for shell species and aquaria occurs in the general use zone north of Tantabiddi Creek (North West Cape) and in the unclassified area of the Muiron Islands Marine Management Area. Commercial prawn fishing occurs in the Exmouth Gulf, including the general use zone of the Marine Park and the Marine Management Area.

There are currently 21 aquaculture licenses and 8 pearl farm leases in the Exmouth Gulf mainly silver lipped pearl oysters (*Pinctada maxima*), black lipped pearl oysters (*Pinctada margaritifera*); however there are no aquaculture sites or pearl farm sites in the vicinity of the proposed survey area.

Indigenous and non-indigenous sites of significance do not occur in the proposed seismic survey area, though in shallower waters of the Exmouth Gulf and closer to the reef in proximity to North West Cape, numerous shipwrecks are known to occur.

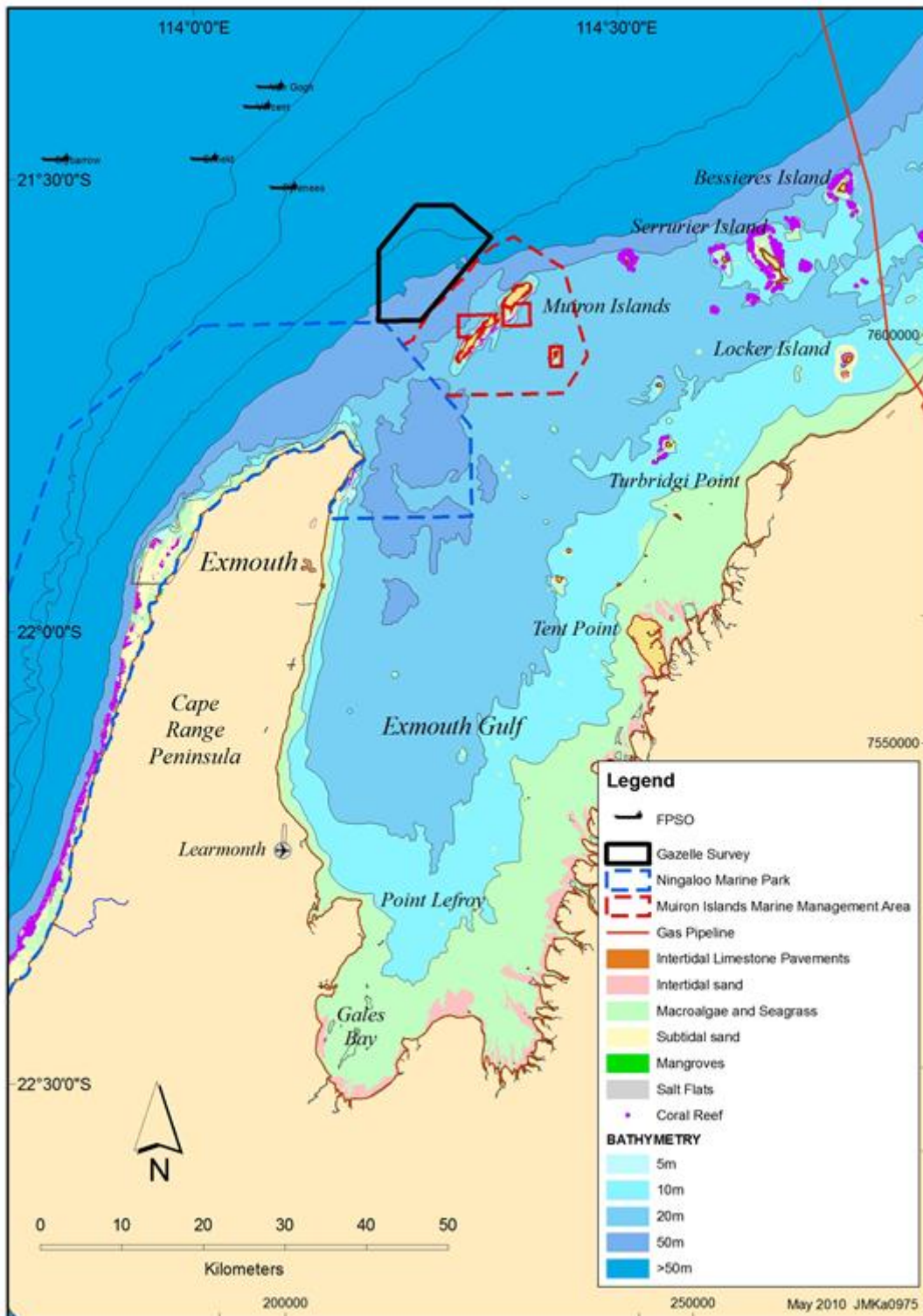


Figure 6: Location of nearshore and offshore habitats

## Major Environmental Hazards and Controls

The key potential environmental hazards associated with the proposed Gazelle 3D MSS include:

- Operation of the seismic and support vessel and towing of the airgun and streamer (hydrophone) arrays through the survey area.
- Discharge of acoustic pulses from air gun firing in the survey area.
- Routine waste discharges from the seismic and support vessel.
- Accidental loss of streamers and associated survey equipment.
- Accidental fuel and oil spills from the seismic and support vessel.
- Collision with another vessel.
- Introduction of non-indigenous marine species from ballast water discharge.

Although the risk is considered to be remote, each of these activities has the potential to result in the following environmental and social implications:

- Disturbance to marine fauna (including marine mammals, turtles, fish and sharks)
- Physical disturbance of benthic habitats.
- Effects of acoustic discharge to divers (from acoustic pulses).
- Interference with commercial and recreational fisheries.
- Waste disposal impact on marine environment.
- Refuelling operations.
- Onboard storage and handling of materials.
- Generation of exhaust emissions.
- Vessel collisions (and associated potential for oil spill if a collision were to occur).
- Introduction of exotic marine species.

## Risks and Effects of Routine Operations

Marine seismic surveying involves the discharge of compressed air to create sound pulses that are reflected from layers under the sea floor and recorded back at the surface. Interpretation of these reflections is a key step in exploration for hydrocarbons. There is currently no other method that has sufficient resolution to identify rock structure beneath the surface.

In 1995, the Australian Petroleum Production and Exploration Association (APPEA) initiated a major programme of research to address these concerns. The seismic research studies, based mainly in Western Australia, ran from 1996 to 1999 and were published in 2003 and included:

- Characterisation and measurement of airgun signals and modelling of their propagation.
- Development of a model to predict exposure through time for any given seismic survey configuration, linked to effect types and threshold response levels.
- Monitoring of the movement and behaviour of humpback whales through an area in which seismic was operating.
- Conduct of approach trials with airguns to determine responses of humpback whales.
- Conduct of trials exposing caged fish to airgun noise approach, and to measure behavioural, physiological and pathological effects.
- Modelling of response of fish otoliths to applied airgun signals.
- Conduct of approach trials with single airgun to captive turtles.
- Conduct of approach trials with single airgun to cage-held squid.

A review of the marine impacts from seismic surveys, undertaken by McCauley (1994) as part of an independent scientific review commissioned by APPEA, concluded the following:

- The response of Australian marine animals to marine seismic survey sounds will range from no effect to various behavioural changes.
- Except for plankton and larvae at close range, few species are likely to be killed outright.
- The sound intensities required to produce pathological changes in marine mammals probably occur at < 100 m and at < 200 m for fish.
- Most invertebrates, dugong and small toothed whales have poor hearing at low frequencies (e.g. the range of seismic discharges).
- Some fishes, baleen whales and possibly marine turtles may hear seismic sounds well and behavioural changes may occur at greater distances.
- It is possible that animals will habituate to sound.
- Behavioural impacts can include flight response, displacement, dispersal, and disruption of feeding or breeding activity.
- Operating seismic vessels for protracted periods across narrow, restricted migratory paths may hinder the passage of migrating animals.
- The greatest risk from marine seismic surveys to marine animals appears to be during breeding or spawning periods.
- Provided that seismic surveys are avoided at locations and times of particular sensitivity, and given the relatively small scale of seismic activity, the often large scales over which biological events occur, the low probability of encounter between seismic surveys and 'at risk' populations at an appropriate time and place, then the wider implications of disruption by seismic surveys appear to be small for most species.

#### Impacts on Marine Fauna

Baleen whales such as blue, southern right and humpback whales communicate by low frequency sounds and are therefore considered to be the most sensitive of the marine mammals to specific low frequency sounds. The hearing of baleen whales is thought to overlap with the energy output of seismic related noise. The hearing capability of larger toothed whales (such as the killer whale) is unknown, but it is possible that they can hear better in the lower frequencies than the smaller toothed cetaceans. If this is the case, in lieu of any other information, their reactions to seismic survey vessels may be akin to those of the baleen whales.

Marine seismic surveys do not necessarily constitute a threat to marine mammals if care is taken to avoid situations that could potentially harm the animals. The guidelines on the application of the EPBC Act Policy Statement 2.1 to interactions between offshore seismic operations and whales will be applied during the seismic program.

Given the timing and location of the seismic programme and the adherence to EPBC Act Policy Statement 2.1, the risk of effects to cetaceans from the proposed seismic programme is considered low.

Potential effects to whale sharks associated with seismic surveys will be the same as for other fish, resulting in behaviour change (avoidance of the area) and potential injury if the shark is within close range of the survey vessel. Given that the survey area lies close to the whale shark's known aggregation and feeding areas (Ningaloo Reef near Exmouth), but will be carried out outside of the peak aggregation period (March to June) the impact of the survey on this species is considered to be low.

Studies indicate that sea turtles may begin to show behavioural responses to an

approaching seismic array at received sound levels of approximately 166 dB re 1  $\mu$ Pa (rms), and avoidance at around 175 dB re 1  $\mu$ Pa (rms). This corresponds to behavioural changes at approximately two kilometres, and avoidance from approximately one kilometre.

Spherical spreading noise propagation source decay modelling has been undertaken for the 2,700 cubic inch air gun array (the size proposed for the Gazelle survey) to provide an indication of the likely resultant noise levels from the air gun with distance. The modelled results indicate that the lower noise level of 166 dB re  $\mu$ 1 Pa, recorded during airgun exposure tests, would only be exceeded within distance of less than a kilometre from the seismic source. Beyond this distance noise levels would be below levels where behavioural effects were observed for Loggerheads.

Marine turtles may possibly be exposed to noise levels sufficient to cause physical damage if airgun arrays start suddenly with turtles nearby (less than 30 metres). In circumstances, where arrays are already operating (as a vessel moves along an acquisition line), individuals would be expected to implement avoidance measures before entering ranges at which physical damage might take place.

To minimise potential effects to sea turtles from seismic operations, management measures will be implemented during the survey based on conducting seismic survey in deeper waters away from any shallow water habitat areas known to be important for turtle feeding and breeding; using 'Soft start' procedures at the start of each line; and ensuring the survey vessel will not pass directly over shallow water areas (<20 m water depth).

Given the distance from known nesting sites, the timing of the survey and the implementation of the aforementioned management measures, no significant impacts to turtles are likely.

#### Physical disturbance of Benthic Habitats

Physical disturbance to benthic habitats associated with marine seismic surveys are typically limited to the impacts of anchoring, vessel grounding or the accidental loss of equipment such as vanes (used to keep the streamers spread apart at the required distance) and streamers. With respect to the proposed Gazelle 3D MSS, these impacts are unlikely to occur, as anchoring will only occur in emergency circumstances, and the seismic and support vessels are fitted with highly sophisticated position fixing equipment.

In principle, the vessel's distance from shore (predominantly in Commonwealth waters) in water depths from 40 m to up to 180 m and minimum operating depth of 20 m will avoid possible disturbance to the seabed and benthic environment, including the areas of the Ningaloo Marine Park that the proposed survey passes through.

In addition, the seismic source (airgun) will not be operated within the boundaries of the Montebello Islands Marine Park.

#### Effects of Acoustic Discharge to Divers (from acoustic pulses)

The proposed Gazelle 3D MSS will operate in Commonwealth waters and the risk is considered low that the acoustic energy discharged during the survey may be harmful to recreational and commercial divers. Risk is also very low for other water activities that have a lesser degree of submerged activity such as swimming and bathing, surfing and snorkelling. Due to the location and depth of the survey it is highly unlikely diving operations will be encountered.

#### Interference on Commercial and Recreational Fisheries

Potential impacts on commercial fisheries are largely due to navigational conflicts, given that seismic vessels tow long streamers and commercial fishers often deploy trawl nets or long



lines over the same areas. However, effective communication and up to date notification of the location of the seismic vessel to commercial fishermen in the region will assist in avoiding any impacts. Communications with fishing groups known to be operating in the area of the Gazelle 3D MSS will be maintained throughout the duration of the survey.

Recreational fishing activity is unlikely to be significantly affected by the proposed seismic program as there would be little overlap with this activity and the seismic survey area. Boat-based recreational fishing occurs mainly out of Exmouth as there are few other access areas. Boat anglers principally catch reef fish and mostly operate reasonably close to the shore. As with commercial fisheries, effective communication will assist in avoiding any impacts. It is considered that there would be minimal, if any effect on recreational fishing.

#### Waste disposal impact on marine environment

Routine discharges from seismic survey vessels are restricted to sewerage and putrescible wastes (food scraps). Food scraps will be ground to less than or equal to 25 mm prior to discharge overboard in waters more than 3 nm from shore. In waters less than 3 nm from shore, food scraps will be bagged and placed in skips for disposal onshore.

Risks to the marine environmental resources in the survey area and adjacent areas from disposal of wastes are considered to be negligible given that wastes other than routine sewage and putrescible material discharge will be sent to shore for waste treatment, recycling or disposal.

#### Refuelling operations

Refuelling at sea within the permit area will not be permitted during the Gazelle 3D MSS programme. The Geo-Atlantic will be refuelled before or during its mobilisation to the Gazelle permit area. This process will involve the support vessel being used to refuel the seismic vessel at sea. Refuelling operations will be carried out in strict accordance with the Fugro-Geoteam refuelling procedure.

In the extremely unlikely event of an accidental oil spill to the ocean during a refuelling event, the contractor vessel's approved Shipboard Oil Pollution Emergency Procedure (SOPEP) would be immediately activated, in conjunction with the Emergency Procedures Manual if necessary. All spills must be logged and reported to the Vessel Master. Any spills greater than 80 L must also be immediately reported to the DMP.

#### Onboard Storage and Handling of Materials

All oils or chemicals used or stored onboard the survey vessels will be contained and managed to prevent damage to the containers or leakage/spillage onto the deck or into the ocean. These materials will be stored in bunded areas such that any spills or leaks can be contained and recovered. Deck drains and bunds will be inspected to ensure their integrity prior to the commencement of operations. Sufficient absorbent materials will be held onboard to mop up possible leaks.

Should onboard spills or leaks occur, they would be cleaned up immediately using absorbent materials held on the vessel. Recovered oils or chemicals and used absorbent materials will be placed in appropriately marked drums for recycling or onshore disposal.

#### Generation of Exhaust emissions

The combustion of fossil fuels in vessel engines and onboard power generators will contribute to exhaust emissions including the greenhouse gas CO<sub>2</sub>. Emissions will be minimised by ensuring that all engines and generators are serviced to manufacturers' specifications.

## Risks and Effects of Non-Routine Operations

### Vessel collisions (and associated potential for oil spill if a collision were to occur)

There is the potential for vessel traffic transiting from and to the Port of Exmouth to pass through the seismic survey area. The potential for a hydrocarbon spill resulting from the collision of the seismic vessels with another ocean going vessel is considered negligible for the following reasons:

- Radio communication will be maintained with any vessels observed transiting the area.
- Information on the location and timing of the seismic programme will be communicated to vessels via AMSA through a Notice to Mariners.
- Support vessel to assist with scouting/communicating with other vessels in the area.
- Notification of the position of the seismic vessels and the area proposed to be working in will be communicated to fishing industry representatives and forwarded to respective members (vessel owners). This will ensure no fishing vessels are operating within the nominated daily run line of the survey.

Apache has undertaken oil spill modelling for a worst case scenario of a diesel spill resulting from a vessel collision with the M/V Geo-Atlantic. The spill scenario results in a combined volume of 612 m<sup>3</sup> of diesel being released at a point 21°45'03.36" S and 114°07'54.73" E where the seismic vessel is at its closest distance to Ningaloo Reef.

The modelling shows that coupled with the strong tidal movement between South Muiron Island and North West Cape as well as the predominant southerly winds, any diesel spill resulting from a vessel collision and subsequent rupture of the Geo Atlantic fuel tanks close to the Ningaloo Reef would disperse quickly (less than 5 days) and result in less than 1% probability of impacting the western beaches of South Muiron Island and certainly no potential oil spill impact to Ningaloo Reef.

In summary, the results of the oil spill modelling show that there is zero probability of a marine diesel spills reaching the Ningaloo Marine Park at concentrations above threshold during the proposed month of February when the Gazelle survey is scheduled to occur.

### Introduction of exotic marine species

Australia has mandatory ballast water requirements are enforced under the Quarantine Act 1908. These requirements are consistent with International Maritime Organisation (IMO) Guidelines for minimising the translocation of harmful aquatic species in ship's ballast water. The seismic and support vessels proposed for the proposed Gazelle 3D MSS have been operating in Australian waters prior to arriving at the survey area. The seismic vessel was docked at Henderson, WA prior to travelling to the North West Shelf to undertake seismic operations in WA-426-P/WA-427-P (Pomodoro MSS) and WA-450-P (Orcus MSS). Following completion of those operations the vessel will travel to the proposed survey area. Therefore, the potential for the introduction of marine pests as a result of the Gazelle 3D MSS is considered negligible. Notwithstanding the above, the seismic survey vessel will be contractually obliged to comply with the AQIS ballast water management requirements as required.

## Management Control

All activities conducted during the survey will comply with legislative requirements established under Commonwealth and State regulatory frameworks, and applicable international agreements and conventions. **Table 4** summarises the major environmental hazards, their potential environmental impacts and management controls for the Gazelle 3D MSS to as low as reasonably practicable (ALARP).

**Table 4: Major Environmental Hazards, Potential Environmental Impact and Mitigation Measures associated with Gazelle 3D MSS**

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation measures	Standards
Release of sound from acoustic source.	Expected to occur.	<p>Pathological and physiological effects to marine biota.</p> <p>Disruption to behaviour patterns of marine fauna.</p> <p>Avoidance of acoustic source.</p>	Minimise risk of adverse effect to marine biota and normal activities such as breeding, feeding and migration.	<p>Minor</p> <p>Small acoustic source used reduces acoustic penetration.</p> <p>Potential for pathological and physiological impacts to marine fauna limited to very close proximity of array.</p> <p>Likely to evoke avoidance response in whales and whale sharks, but unlikely to displace species from key habitat or migration paths.</p> <p>EPBC Act Policy Statement 2.1 cetacean observation and seismic operations guidelines employed using Standard Management Procedures with a 2 km 'low power' zone.</p> <p>Night time use of the acoustic source to adhere to start-up procedures in EPBC Act Policy Statement 2.1.</p>	<p>B</p> <p>Compliance with EPBC Act Policy Statement 2.1 for avoiding interference with cetaceans during seismic surveys.</p> <p>The seismic source (airgun) will not be operated within the boundaries of the Ningaloo Marine Park or Muiron Islands Marine Management Area.</p> <p>Seismic survey will be conducted outside of the peak humpback whale migration periods.</p>	<p>Gazelle 3D MSS EP.</p> <p>EPBC Act Policy Statement 2.1 guidelines for avoiding interference with cetaceans during seismic surveys.</p> <p>DSEWPC Whale and Dolphin Sighting Report.</p>

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation measures	Standards
Grey water/sewage disposal	Expected to occur.	Localised pollution/nutrient enrichment.	Maintain marine water quality.	<p>Negligible</p> <p>Low volumes of treated discharge only.</p> <p>Sewage treatment system operational and includes maceration and disinfection.</p> <p>Discharge offshore in deep water with high dispersion-dilution factor.</p> <p>Temporary input of nutrients to any area.</p>	<p>Negligible</p> <p>Adherence to MARPOL 73/78 Annex IV requirements.</p> <p>Use of biodegradable detergents only.</p> <p>No discharge of sewage within Zone 1 of the Ningaloo Marine Park (NMP), however permitted to discharge sewage within Zone 3 (General Use Zone of the NMP) where survey traverses into.</p>	<p>Gazelle 3D MSS EP.</p> <p>MARPOL 73/78 Annex IV.</p> <p>Management Plan for Ningaloo Marine Park and Muiron Islands MMA 2005-2015</p> <p>DSEWPC conditions to Commercial Vessel Transit in Ningaloo Marine Park (Commonwealth Waters) under Section 359B of the EPBC Act.</p>
Discharge of oily water from bilges	Likely to occur.	Localised and temporary toxic effects.	Maintain marine water quality.	<p>Negligible</p> <p>Bilge discharges treated to &lt;15 ppm hydrocarbons.</p>	<p>Negligible</p> <p>Oily water separator (set at 15 ppm) operational with discharge quality continuously monitored.</p> <p>Ability to store &gt;15ppm water in sludge tank.</p> <p>Adherence to DSEWPC conditions for traversing through the Ningaloo Marine Park (Appendix 3)</p>	<p>MARPOL 73/78 Annex I (Regulation 16).</p> <p>Oil Record Book.</p> <p>DSEWPC conditions to Commercial Vessel Transit in Ningaloo Marine Park (Commonwealth Waters) under Section 359B of the EPBC Act.</p>

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation measures	Standards
Disposal of solid wastes including putrescible galley wastes	Expected to occur.	Localised pollution/nutrient enrichment.	Minimise environmental effects from waste disposal.	Negligible No disposal into marine environment of solid wastes.  Collection and disposal onshore to landfill site Food wastes to be macerated and disposed >3 nm from land	Negligible Adherence to MARPOL 73/78 Annex V requirements.  Adherence to DSEWPC conditions for traversing through the Ningaloo Marine Park (Appendix 3)  Waste bins will be closed at all times to prevent rubbish blowing into the marine environment.	MARPOL 73/78 Annex V.  Vessel Waste Disposal Register & Contract Plan.  Management Plan for Ningaloo Marine Park and Muiron Islands MMA 2005-2015  DSEWPC conditions to Commercial Vessel Transit in Ningaloo Marine Park (Commonwealth Waters) under Section 359B of the EPBC Act.
Disposal of waste oil	Expected to occur.	If spilled to marine environment, localised toxic effects	Minimise risk of adverse effect to environment from hydrocarbons.	Negligible Small volumes only.  All waste oils collected and stored for onshore recycling/disposal.	Negligible Adherence to MARPOL 73/78 Annex 1 requirements.  All waste oils collected and returned to shore for recycling/disposal  Adherence to DSEWPC conditions for traversing through the Ningaloo Marine Park (Appendix 3)	MARPOL 73/78 Annex I.  Oil Record Book.  Vessel Waste Disposal Register & Contract Plan.  DSEWPC conditions for traversing through the Ningaloo Marine Park
Atmospheric emissions	Expected to occur.	Increase in greenhouse effect	Maintain air quality.	Negligible Small volumes/emissions.	Negligible Engines maintained to operate at optimum efficiency to minimise emissions.	Maintenance system for machinery.
Artificial lighting	Expected to occur.	Disturbance to marine biota and seabirds.	Minimise risk of adverse effect to marine biota.	Negligible Survey is distant from shore	Negligible Lighting minimum required for navigation and safety requirements.	Gazelle 3D MSS EP.

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation measures	Standards
Anchoring activity	Unlikely to occur.	Localised disturbance to benthos.	Maintain abundance and diversity of benthic flora and fauna.	Negligible No significant seabed features or reefs known within survey area.	Negligible Dynamic positioning used to maintain location. Anchoring in designated locations only.  No anchoring in Ningaloo MP or Muiron Islands MMA	Gazelle 3D MSS EP.
Spill during fuel transfer at sea	Unlikely to occur.	Toxic effects on marine biota from liquid hydrocarbons.	Minimise risk of adverse effect to marine ecology from hydrocarbon loss.	Moderate Refuelling, if required, to be undertaken prior to mobilisation to the Gazelle area avoiding any potential for a spill to impact the Muiron Islands MMA or the Ningaloo Marine Park.	B No refuelling to occur within the Gazelle survey area. If refuelling is required, then this to be undertaken prior to mobilisation to the permit area and only during suitable weather and sea-state conditions, discretion of both skippers, integrity checks on equipment etc.,  Oil spill modelling can be used to predict trajectory and fate of hydrocarbons.	Vessel bunkering procedures.  Shipboard Oil Pollution Emergency Plan (SOPEP)  Apache's North West Shelf Oil Spill Contingency Plan, AE-00-EF-008/1 Rev. 16

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation measures	Standards
Loss of streamer(s)	Unlikely to occur	<p>Damage to subsea habitat and/or fauna</p> <p>Interference with fishers</p> <p>Toxic effects on marine biota from liquid hydrocarbons.</p>	<p>Maintain abundance and diversity of benthic flora and fauna.</p> <p>Minimise risk of adverse effect to marine ecology from hydrocarbon loss.</p>	<p>Negligible</p> <p>No significant seabed features or reefs known within survey area</p>	<p>Negligible</p> <p>Streamer location is continually monitored</p> <p>Navigation buoy attached at end of streamer (locator)</p> <p>Streamers can be easily retrieved by support vessel</p> <p>Self-inflating mechanism for retrieval to surface</p> <p>Bathymetry of areas known (no shallow areas identified in the survey area)</p> <p>Isopar liquid in streamers is a synthetic Isoparaffinic (aliphatic) hydrocarbon which evaporates rapidly.</p>	<p>Seismic Operational procedures</p> <p>Vessel navigational instruments and dedicated navigational staff.</p> <p>Gazelle 3D MSS EP.</p>

Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation measures	Standards
Spill from stored chemicals or hydrocarbons	Unlikely to occur	Toxic effects on marine biota from liquid chemicals or hydrocarbons	Minimise risk of adverse effect to marine ecology from chemical or hydrocarbon loss.	Minor Survey significant distance from sensitive shorelines of the Muiron islands and North West Cape beaches.	Negligible Secure containment areas for oils and chemicals  Use of appropriate materials, e.g. absorbents, for cleanup.  Use of drip trays whilst decanting.  Cleanup of spills as soon as practicable.  Areas for storage and use of chemicals and dangerous liquids to be contained.  MSDSs available on site.  Training of personnel in safe handling procedures.	Vessel Oil Spill procedure (SOPEP).  Vessel operational procedures for handling and storage of hazardous liquids.  Gazelle 3D MSS EP.
Displacement of other users of marine environment	Expected to occur.	Reduction to recreational and/or commercial access.	Minimise disturbance to other users.	Minor	B Consultation with commercial fishermen prior to seismic programme  Notice to Mariners issued	APPEA Code of Practice 2008.  AMSA Notice to Mariners
Introduction of Marine Pests	Unlikely to occur	Impact on diversity of marine biota.	Minimise risk of introducing marine pests into Australian waters	Moderate	B Full ballast water exchange of vessel at sea prior to entry into Australian waters.  Visual checks and cleaning if necessary of marine gear (streamers and sources).  Vessel relocating from adjacent Australian Commonwealth waters of WA coast.	AQIS Australian Ballast Water Management Requirements



Environmental Hazard	Likelihood of Occurrence	Potential Environmental Impact	Environmental Objective	Consequences	Risk and Mitigation measures	Standards
Accidental hydrocarbon spills > 80 litres e.g. leak from survey vessel following collision with other vessels etc.	Unlikely to occur	Adverse effect to environment from hydrocarbons.	Minimise occurrence of fuel and oil spills	Moderate	<p>B</p> <p>Fuel spill contingency procedures are in place and operational</p> <p>Functional navigational lighting in place and in use.</p> <p>Vessel meets Classification Society and Statutory inspection requirements.</p> <p>Operations carried out in a manner that does not interfere with navigation to a greater extent than is necessary).</p> <p>Marine notices broadcast according to requirements. Rescue Coordination Centre (RCC) of AMSA notified of survey.</p> <p>Radar and Radio monitoring undertaken.</p> <p>Support vessel present throughout survey to facilitate communication between survey vessel and other commercial and recreational vessels.</p>	<p>Apache Environmental Management Policy</p> <p>MARPOL 73/78 Annex I</p> <p>AMSA Marine Notice 36/2002</p> <p>Survey Vessel SOPEP (Shipboard Oil Pollution Emergency Plan)</p> <p>Apache's North West Shelf Oil Spill Contingency Plan, AE-00-EF-008/1 Rev. 16</p>

## Consultation

Apache consults with stakeholder groups, primarily representatives of government departments and commercial fishermen, prior to the commencement of the proposed seismic survey program.

Apache's consultation process includes:

- Verbal communication and email distribution (including written summary detailing the location, timing and description of the proposed seismic program) sent to representatives of government departments, commercial fishermen and charter operators within Exmouth.
- Posters (A4 format) produced and distributed to the Exmouth Game Fishing Club; police station and Department of Transport (for distribution to wider Exmouth community).
- Ongoing verbal communication regarding the commencement seismic operation to the aforementioned stakeholder groups.

The following organisations have been contacted to inform them of the seismic operations over the proposed Gazelle survey area:

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC);
- WA Department of Mines & Petroleum (DMP) (Designated Authority);
- WA Department of Environment and Conservation (DEC);
- WA Marine Parks and Reserves Authority (MPRA);
- Australian Fisheries Management Authority (AFMA);
- Western Australian Fishing Industry Council (WAFIC);
- Western Australian Department of Fisheries (DoF);
- Australian Maritime Safety Authority (AMSA);
- Commonwealth Fisheries Association (CFA);
- Exmouth Department of Transport (DoT);
- Exmouth Police Station;
- Exmouth Game Fishing Club;
- Exmouth Fishing Charter Operators;
- Exmouth Commercial Fisheries;
- Exmouth recreational fishing groups;
- Exmouth Cape Conservation Group (CCG); and
- Adjoining permit holders.

## Further Details

For further information on the Gazelle 3D marine seismic survey program, please contact:

Myles Hyams  
Environment Manager  
Level 9, 100 St Georges Tce  
Perth WA 6000  
Ph: (08) 6218 7421  
Fax: (08) 6218 7200  
Email: [myles.hyams@apachecorp.com](mailto:myles.hyams@apachecorp.com)