



**Pomodoro 3D
Marine Seismic Survey**

**North West Shelf
[Commonwealth Waters]**

ENVIRONMENT PLAN SUMMARY

January 2009

INTRODUCTION

Apache Energy Ltd (Apache) proposes to undertake a three-dimensional (3D) marine seismic survey (MSS) within Commonwealth waters of the offshore Carnarvon Basin, within Gazettal blocks W-08-16 and W-08-17. The project is referred to as the Pomodoro 3D Marine Seismic Survey.

The Pomodoro 3D MSS survey area is to the west of the Greater West Anchor 3D Seismic Survey. Apache will use the Greater West Anchor 3D Seismic Survey Environment Plan (EP) (EA-00-RI-168) to undertake the Pomodoro 3D MSS as it covers the expected environmental risks and control measures to be undertaken during the seismic survey. The Greater West Anchor 3D Seismic Survey EP was approved by the former Department of Industry and Resources (DoIR), now Department of Mines and Petroleum (DMP), on 22nd December 2008.

Apache has submitted a bridging document to the Greater West Anchor 3D MSS EP (for the Pomodoro 3D MSS) to the DMP. The bridging document was accepted by the DMP on the 9th January 2009. This summary of the Pomodoro EP bridging document has been submitted to comply with Regulation 11(7)(8) of the Petroleum (Submerged Lands) (Management of Environment) [P(SL)(MoE)] Regulations 1999.

PROJECT DESCRIPTION

Seismic Operations

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

During the survey 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 streamers, each with a maximum length of 6.6 km. The source (airgun array) tow depth will be 5-6 m, the streamer tow depth will be 6-8 m and the lead-in line will be at 13 m (during acquisition). 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 volume of 3,200 cui. These sub-arrays will be fired alternately, with a shotpoint interval of 25 m vertical distance, and will produce at source (i.e. within a few metres of the airguns) sound pulses in the order of 260-270 dB re 1 μ Pa-m at frequencies extending up to approximately 128 Hz. Based on a spherical spreading noise propagation model, these sound pulses will decrease to levels in the order of 150 to 160 dB re 1 μ Pa-m within 1 km of the source and approximately 145 dB re 1 μ Pa-m within 2 km, dependent on the sound propagation characteristics of the area. Details of the seismic array are given in **Table 1**.

Table 1: Details of the seismic array

| Parameter | Value |
|------------------------------------|------------------|
| No. of streamers | 10 |
| Streamer length | 6,600 m |
| Streamer depth | 6-8 m |
| Size of each airgun sub-array | 3,200 cui |
| Operating pressure | 2,000 psi |
| Shotpoint interval | 25 m (flip flop) |
| Source depth | 5-6 m |
| Peak at source sound levels (<1m) | 270 dB re 1µPa-m |
| Frequency range | 0–128 Hz |
| Distance between survey sail lines | 500 m |

Timing

The Pomodoro 3D MSS is scheduled to commence in late January 2009. The proposed seismic survey schedule is estimated to take 10 to 15 days to complete based on a 24 hour a day operation (though data acquisition will not take place all the time). The survey is estimated to conclude by early February 2009, 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.

Location

The proposed survey area is located within the Carnarvon Basin of Western Australia in Gazettal blocks W-08-16 and W-08-17. The eastern boundary of the survey area is located approximately:

- 115 km west of the nearest mainland.
- 51 km west of the Montebello Islands.
- 47 km west of Barrow Island (see **Figure 2**).

The proposed survey covers an area of approximately 315 km² and is located within water depths ranging from 100 m to over 300 m. Coordinates of the survey area are listed in **Table 2**.

Table 2: Proposed Pomodoro 3D MSS Coordinates

| Location Point | Latitude | Longitude | Latitude (decimal) | Longitude (decimal) |
|----------------|---------------|----------------|--------------------|---------------------|
| A | 20°09'58.46"S | 114°55'07.32"E | 20.1662 | 114.9187 |
| B | 20°09'58.20"S | 115°00'01.23"E | 20.1662 | 115.0003 |
| C | 20°29'54.18"S | 115°00'03.19"E | 20.4984 | 115.0009 |
| D | 20°29'54.14"S | 114°55'06.90"E | 20.4984 | 114.9186 |

For location points, see **Figure 1**
GDA94, Map Zone ref. 50

Vessels

Apache proposes to conduct the survey using the purpose-built seismic survey vessel the M/V *Geo Atlantic* (see **Figure 1**), 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 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 *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 fishing activities, if required. The supply vessel will also re-supply the survey vessel with fuel and other logistical supplies. The support vessel will have a crew of around 15 personnel.



Figure 1: Seismic survey vessel M/V Geo Atlantic

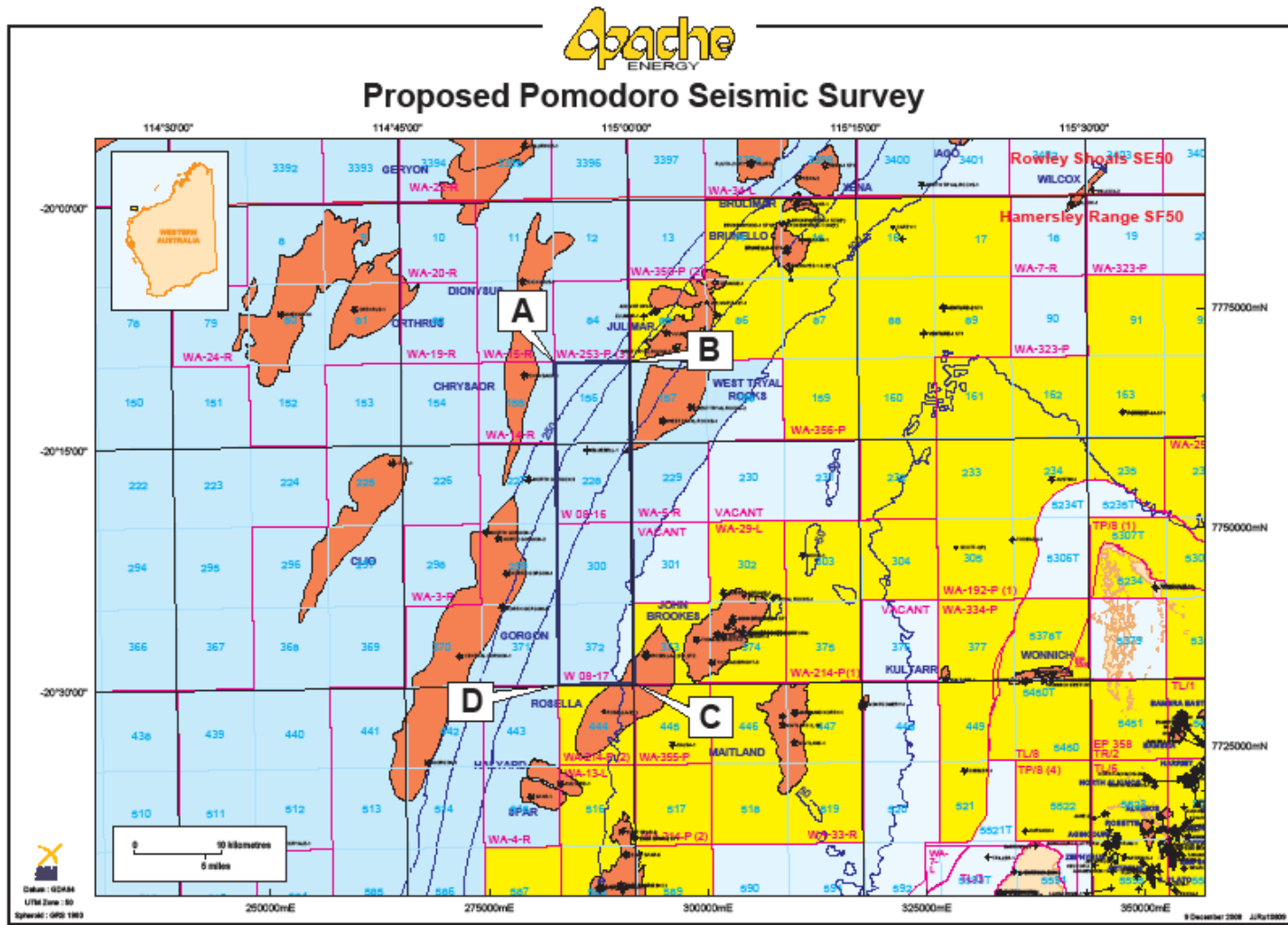


Figure 2: Map showing the location map of the Pomodoro 3D MSS

EXISTING ENVIRONMENT

A general overview of the receiving environment in terms of its physical and biological aspects is provided in the following sections.

Physical Environment

Climate

The climate of the region is arid subtropical with hot summer temperatures, high evaporation, periodic cyclones and associated rainfall. Rainfall in the region is generally low with evaporation exceeding rainfall throughout the year. Intense rainfall may sometimes occur during the passage of summer tropical cyclones and thunderstorms (NSR, 1995). Mean air temperatures over the neighbouring ocean area range from a minimum of 11°C in winter to a maximum of 37°C in summer. Due to the arid climate, daytime visibility in the area is generally greater than 5 nautical miles (Steedman, Science and Engineering (SSE) 1991).

The summer and winter seasons fall into the periods October to March and May to July, respectively. Winters are characterized by clear skies, fine weather, predominantly strong east to southeast winds and infrequent rain. Summer winds are more variable, with strong south-westerlies dominating. Three to four cyclones per year are typical, primarily between December and March (WNI, 1995). The months of April and September are considered transitional between the summer and winter seasons.

Oceanography

Surface currents within the survey area are generated by several components, including tidal-forcing, local wind-forcing and residual drift. Tidal and wind forcing are the dominant contributions to local surface currents.

The tides of the NWS have a strong semi-diurnal signal with four tide changes per day (Holloway & Nye 1985). Within the survey area, the tidal flows give an elliptical pattern. Based on measurements at nearby locations, tidal currents are predicted to attain average speeds of approximately 0.25 knots over the survey area during neap tides and up to 0.5 knots during spring tides (NSR, 1995; WNI 1996). Thus, over the six-hourly periods of tide flow, a maximum tidal excursion of 3 nautical miles, or 5.5 km, is predicted.

Local winds will generate stress on the water surface, forcing the surface layer in the general direction of wind movement, but with an offset (15-45%) in an anti-clockwise direction (the Coriolis effect). In the open ocean, sustained winds result in wind-forced currents of approximately 3% of the wind speed (Holloway & Nye 1985). Thus, a sustained wind of 20 knots may force surface currents of up to 0.6 knots. The mean drift or steady currents are predominantly oceanic driven, including the influence of the Leeuwin Current and other broad-scale oceanic flows. They are not correlated to tidal oscillations or local wind forcing (Holloway & Nye 1985). Generally, the net drift is towards the southwest throughout the year, but may periodically swing to the north-east (King, 1994). Residual currents are generally weak in the area, with typical flows of less than 0.2 knots (Holloway & Nye 1985).

Bathymetry

The seismic survey area is located within the central section of the continental shelf, at approximately 100 to 300 m depth and 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 (Racal 1994; Dames & Moore 1995). Surveys conducted over the NWS indicate that a similar seafloor occurs extensively over

this geographic region, but with spatial variation in the grain size and origin of the surface sediments (McLoughlin & Young 1985; Woodside 1990). Surface sediments in the area are predominantly composed of skeletal remains of marine fauna, with lenses of weathered sands (McLoughlin & Young 1985).

A survey of the seafloor at the Rosella-1 well site in 2006, located to the south of the seismic survey area, found the surface sediments are composed of unconsolidated or weakly consolidated sediments. A paleochannel near the Rosella-1 well was found to contain calcareous silts and sands. No exposed rock outcroppings were identified during side-scan sonar surveys.

Biological Environment

Marine Habitats

Benthic flora and fauna diversity and abundance is likely to be comparable to that found over similar substratum and at similar depths over the wider region (Rainer, 1991). The unconsolidated sediments in this habitat support a diverse benthic infauna, consisting predominantly of mobile burrowing species, which include molluscs, crustaceans (crabs, shrimps and smaller related species), polychaete, sipunculid and platyhelminth worms, asteroids (sea stars), echinoids (sea urchins), and other small infaunal animals.

The abundance and composition of this infauna is variable over both space and time (Kinhill 1997). Differences from location to location are due to factors such as depth and seafloor texture while changes over time at any one location may be related to changes in the physical environment, such as water temperature or wave-induced currents. Ward & Rainer (1988) reported a seasonal pattern in the abundance of small species of decapod crustaceans in this region. However, because they only conducted two sampling events, it is not clear if this pattern was related to season or to other factors, such as storm events, which operate at much shorter time scales.

Marine Fauna

A review of the Commonwealth Department of Environment and Heritage database indicates that there are a number of listed species identified as potentially occurring within the seismic survey area.

A brief overview of these listed species and other biota is given under faunal groupings in the following sections: marine mammals; sea turtles; pipefish, pipehorses, seahorses and sea snakes; fish; and sharks, rays and skates.

Marine Mammals

A number of whale species, including the blue whale (*Balaenoptera musculus*), pygmy blue whale (*Balaenoptera musculus brevicauda*), humpback whale (*Megaptera novaeangliae*), Bryde's whale (*Balaenoptera edeni*), killer whale (*Orcinus orca*) and minke whale (*Balaenoptera acutorostrata*) may occur infrequently in the project area.

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 Kimberly region of Western Australia. The peak of the northerly migration occurs around 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 (DoIR, 2003).

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 (Woodside, 2002).

The timing of the Pomodoro 3D MSS will not coincide with the northerly or southerly migration periods of the humpback whale.

Dugong (*Dugong dugong*) occur across the tropical coastal waters of Australia from Shark Bay to Queensland and are protected under national legislation and international agreements. Dugongs are herbivorous and are generally associated with seagrass beds, upon which they feed. They are commonly found in shallow (less than 5 m deep) sheltered areas, often near island or large bays.

Current knowledge on the size and distribution of dugong populations and their migratory habits in the region between North West Cape and the Dampier Archipelago is limited. Dugongs have been found to breed between September through to April. Recent aerial surveys of dugong distribution have found that the animals occur around Barrow Island, Airlie Island, Lowendal Islands and the Montebello Islands further offshore (Prince 2001), with a large population in the Exmouth Gulf.

Dolphins are relatively common in the region. Species known to occur in the region are 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*).

Sea Turtles

Four species of marine turtle nest on sandy shore sites of the Dampier Archipelago, Montebello Islands, Lowendal Islands, Barrow Island, Airlie Island, Thevenard Island, other coastal islands and the Exmouth region. These include the loggerhead turtle (*Caretta caretta*), the green turtle (*Chelonia mydas*), the hawksbill turtle (*Eretmochelys imbricata*) and the flatback turtle (*Natator depressus*). The leatherback turtle (*Dermochelys coriacia*) is also known to visit open waters. These five species are on the National List of Threatened Species as either endangered or vulnerable under the EPBC Act.

The nearest turtle nesting sites are located in the Montebello Islands, Lowendal Islands and Barrow Island. The peak turtle nesting and hatching period occurs from November to January. The regional sea turtle population is estimated to be over 49,000 animals (Prince 2001).

The distribution, abundance and activity of turtles vary widely across the NWS and among the different species. The loggerhead, flatback and leatherback turtles are known to feed on mid-water plankton and benthic animals, and can forage in mid-shelf water depths, so may occur in the survey area.

Pipefish, Pipehorses, Seahorses and Sea Snakes

Twenty four species of pipefish and pipehorses may occur in the project area. A further 4 species of seahorses and fifteen species of sea snakes may also occur, however little is known of the distribution of individual species, population sizes or aspects of their ecology.

Sea snakes are widespread throughout waters of the NWS and are frequently observed in the surrounding waters to Varanus Island. They can be highly mobile and cover large distances or they may be restricted to relatively shallow waters and some species must return to land to eat and rest.

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 (BBG, 1994).

Sheltered inshore areas and mangrove-lined creeks of the Dampier Archipelago support a characteristic and rich fish fauna of greater than 100 species (Blaber et al. 1985). This fauna has little overlap with that of deeper waters (>20 m) of the NWS. Consequently, the inshore habitats in this region are not considered to be significant nursery grounds for commercially important deeper-water fish species (Blaber et al. 1985).

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, approximately 200 km south of the survey area.

The main period of the whale shark aggregation is late March to June, with the largest numbers recorded around April (Wilson et al., 2001). However, the season is variable and individual whale sharks have been recorded at other times of the year. Whale shark presence coincides with the coral mass spawning period, when there is an abundance of food (krill, planktonic larvae and schools of small fish) in the waters adjacent to the reef.

Woodside have carried out aerial surveys and supported scientific research to extend existing information and knowledge of whale sharks and other megafauna in the Exmouth region (Woodside, 2003). The aerial surveys found only a small number of whale sharks in offshore waters, with most sighted on the outer edge of the Ningaloo Reef, and several spotted in waters deeper than 100 m. Reports from tour operators in the Exmouth region report most whale shark sighting as occurring close to the reef front. Whale sharks are occasionally observed from Apache's offshore oil and gas facilities on the NWS (Harriet Alpha and Stag platforms).

Rays and Skates

The filter-feeding devil rays (manta ray, *Manta birostris* and mobulid ray, *Mobula eregoodootenkee*) congregate in the same areas at the same times as whale sharks. Devil rays are widely distributed throughout the world's tropical waters and can weigh up to 2 tonnes (CALM, 2005). Most devil rays are recorded in waters less than 100 m deep, though they are known to occur in deeper waters. Skates are a common and widespread demersal species of deepwater environments.

Areas of Environmental Significance

There are currently 3 Marine Conservation Reserves in the North West Shelf region:

- Ningaloo Marine Park and Muiron Islands Marine Management Area
- Montebello/Barrow Islands Marine Conservation Reserves
- Dampier Archipelago Marine Park and Cape Preston Management Area.

The Montebello/Barrow Islands Marine Conservation Reserves, located to the east of the survey area, was gazetted by the State Government in December 2004 (see **Figure 1**). The Barrow Island Marine Park is located approximately 45 km to the south east of the survey area.

Socio-economic Environment

Population Centres

The Pomodoro 3D MSS area is located approximately 160 km offshore from the Port of Dampier. Smaller coastal fishing and tourism settlements occur at Onslow, approximately 130 km to the south.

Dampier and Karratha are the main service and population centres for the region. Although developed initially for the iron ore industry, these towns have expanded to service the oil and gas industry located on the NWS.

Aboriginal History

There is no evidence of archaeological or heritage sites having been observed within the survey area. There are also no known registered archaeological sites for the area and no records of aboriginal occupation having been recorded for the surrounding marine waters of the nearby Montebello and Lowendal islands.

Recreation

Local people seeking aquatic recreation such as boating, diving and fishing use the coast and islands of the Pilbara. These activities are concentrated in the vicinity of the population centres such as Dampier, Onslow, Point Samson and Port Hedland. The open waters of the Commonwealth permit areas do not support significant recreational or tourist activity.

Commercial Fisheries

A variety of marine species are commercially harvested from the Carnarvon Basin and managed by the Commonwealth and State.

Live pearl shell for subsequent use in the pearl culture phase is harvested by divers from several areas off the Pilbara coast, with pearl culture leases located in the Montebello Islands and the Dampier Archipelago. Prawn trawling activities occur near Onslow and Nickol Bay, the major target species being the tiger, western king and banana prawns.

Through the consultation process undertaken for the Greater West Anchor MSS, a number of fishing vessel operators (operating out of Exmouth) that fish in the area of the Pomodoro 3D MSS were identified. Apache will continue to consult with these fishing operators to minimise disruption to their activities.

Commercial shipping

The Pomodoro 3D MSS is located east of the main north/south coastal shipping lane paralleling the WA coastline then heading north to SE Asia, but is partially located within the Dampier inbound and outbound route and is associated with vessel movements to and from the ports of the NWS, in particular Dampier. Consequently there is the possibility that the seismic and support vessel could encounter minor merchant vessel traffic during data acquisition.

ENVIRONMENTAL HAZARDS AND CONTROLS

A summary of the main environmental hazards, their potential effect and management controls for the Pomodoro 3D MSS is outlined in **Table 3**.

Table 3: Environmental Hazards and Controls for the Pomodoro 3D MSS

| Activity | Potential Environmental Effect | Control |
|--|--|--|
| Release of sound from acoustic source. | <p>Pathological and physiological effects to marine biota.</p> <p>Disruption to behaviour patterns of marine fauna.</p> <p>Avoidance of acoustic source.</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>Adhere to EPBC Act Policy Statement 2.1 for avoiding interference with cetaceans during seismic surveys.</p> <p>'Soft start' procedures will be implemented at the start of each line.</p> <p>The seismic source (airgun) will not be operated within the boundaries of the Montebello Islands Marine Park.</p> |
| Grey water/sewage disposal | Localised impact to marine water quality/nutrient enrichment. | <p>Use of biodegradable detergents only.</p> <p>Treat sewage in line with MARPOL 73/78 Annex IV requirements.</p> <p>Maintain the sewage treatment plant in order to ensure effective treatment.</p> <p>No discharge of sewage within the Montebello Islands Marine Park.</p> |
| Discharge of oily water from bilges | <p>Localised impact to marine water quality.</p> <p>Localised and temporary toxic effects.</p> | <p>Bilge discharges treated to <15 ppm hydrocarbons.</p> <p>Oily water separator (set at 15 ppm) operational with discharge quality continuously monitored.</p> <p>Ability to store >15ppm water in sludge tank.</p> |
| Solid waste disposal | Localised pollution/nutrient enrichment. | <p>No disposal into marine environment of solid wastes.</p> <p>Collection and disposal onshore to landfill site</p> <p>Adherence to MARPOL 73/78 Annex V requirements.</p> |
| Disposal of waste oil | If spilled to marine environment, localised toxic effects. | <p>Adherence to MARPOL 73/78 Annex 1 requirements.</p> <p>All waste oils collected and returned to</p> |

| Activity | Potential Environmental Effect | Control |
|--------------------------------|---|--|
| | | shore for recycling/disposal |
| Atmospheric emissions | Increase in greenhouse emissions. | Engines maintained to operate at optimum efficiency to minimise emissions. |
| Artificial lighting | Disturbance to marine biota and seabirds. | Lighting minimum required for navigation and safety requirements. |
| Anchoring activity | Localised disturbance to benthos. | Anchoring in designated locations. |
| Spillage of diesel fuel or oil | Toxic effects on marine biota from liquid hydrocarbons. | No refuelling within 10 km of the Montebello Islands Marine Park Refuelling only during suitable weather and sea-state conditions, discretion of both skippers, integrity checks on equipment etc). Adhere to the Fugro Re-fuelling Procedure. |

CONSULTATION

Consultation with stakeholder groups, primarily representatives of commercial groups/vessels, concerning the proposed seismic program has commenced. The following groups have been contacted to date as part of the consultation process for the survey:

- Commonwealth Fisheries Association (CFA)
- WA Department of Fisheries
- Western Australia Fishing Industry Council (WAFIC)
- Western Australian Northern Trawl Owners Association (WANTOA)
- Northern Fishing Companies Association
- Australian Fisheries Management Authority (AFMA)
- A Raptis and Sons
- Fishing Vessels: *Morning Rose*; *Van Demon*; *Abduct Me*; *Flying Fish 4*; *Alcyone 2*
- MG Kailis (Exmouth)

FURTHER DETAILS

For further information about the Pomodoro 3D MSS, please contact:

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