



Woodside Energy Ltd.

Carpenter 3D Marine Seismic Survey EPP27

Environment Plan

29/08/02

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1 INTRODUCTION

Woodside Energy Ltd (Woodside) as Operator of the EPP27 Exploration Permit, proposes to conduct the Carpenter 3D Marine Seismic Survey (Carpenter 3D MSS) in Otway Basin, off the southeast coast of South Australia. The Carpenter 3D MSS will comprise a minimum of approximately 300 km² of full fold seismic data acquisition plus a further 85 km² contingent on weather conditions and one 2D line of approximately 61 km full fold. The survey is scheduled to be carried out over a period of around 24 days between 1st October 2002 and 7th December 2002.

1.1 Purpose and Structure of Document

This Environment Plan for the Carpenter 3D MSS, has been prepared in accordance with the Commonwealth regulatory requirements of the *Petroleum (Submerged Lands) (Management of Environment) Regulations 1999*.

The overall purpose of this Environment Plan is not only to comply with statutory requirements but also to ensure that the seismic acquisition is planned and conducted in line with Woodside corporate environmental policies and Health, Safety and Environment (HSE) Management System. It is also intended to serve as a practicable environmental management tool that can be used throughout the proposed seismic survey by operators to implement targeted environmental control measures. This Environment Plan includes:

- A description of the proposed activity;
- A description of the existing environment in the area of proposed operations;
- The identification and assessment of all environmental risks in advance of the seismic operations commencing;
- The identification of environmental performance objectives, standards and criteria; and
- The development of appropriate environmental management and mitigation measures that will allow any environmental risks and effects to be avoided or reduced to as low as is reasonably practicable.

1.2 Corporate Environmental Policy

Woodside is committed to protecting the environment and consequently has a written corporate Environment Policy (see Appendix A) that provides a public statement of the corporate commitment to protecting the environment during offshore exploration operations such as seismic surveys.

1.3 Environment Legislation

All activities conducted during the Carpenter 3D MSS will comply with legislative requirements established under a combined South Australian and Commonwealth Government regulatory framework. The major relevant Commonwealth statutes and regulations¹ are:

- [Petroleum \(Submerged Lands\) Act 1967](#), and delegated legislation;
 - i. *P(SL) Acts Schedule - Specific Requirements as to Offshore Petroleum Exploration and Production 1999*
 - ii. [Petroleum \(Submerged Lands\) \(Management of Environment\) Regulations \(1999\)](#)
- [Environmental Protection and Biodiversity Conservation Act 1999](#);
- [Australian Maritime Safety Authority Act 1990](#);
- [Environment Protection \(Sea Dumping\) Act 1981](#);
- [Historic Shipwrecks Act 1976](#); and
- [Protection of the Sea \(Prevention of Pollution from Ships\) Act 1983](#).

¹ If internet access is available full text of the Acts can be obtained by clicking on the Act name.

Other South Australian legislation complements the Commonwealth legislation Acts and regulations discussed above. For instance, petroleum exploration activities in waters under South Australian jurisdiction (out to three nautical miles) have to comply with a variety of South Australian legislation and regulations including:

- [Environment Protection Act 1993](#)
- *Environmental Protection (General) Regulations 1994*
- [Fisheries Act 1982](#)
- [National Environmental Protection Council \(South Australia\) Act 1995](#)
- [Environment Protection \(Sea Dumping\) Act 1984](#)
- [Environment, Resources and Development Court Act 1993](#)
- [Protection of Marine Waters \(Prevention of Pollution From Ships\) Act 1987](#)
- [Pollution of Waters by Oil and Noxious Substances Act 1987](#)
- [Historic Shipwrecks Act 1982](#)
- [Petroleum \(Submerged Lands\) Act 1982](#)

Under the *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)*, the proponent must refer those proposals considered to have the potential for significant impacts on matters of 'National Environmental Significance' to Environment Australia (EA) or may choose to refer the proposal for determination by EA. The proposed seismic survey was referred to Environment Australia under the *EPBC Act*. It was determined that the survey did not represent a 'controlled action' under the EPBC Act, subject to the survey being conducted in the manner specified (Letter of Determination: EPBC 2002/648 dated 12th June 2002). The specified manner in which the proposed action is to be taken is:

- The seismic survey will be carried out within the period of 1st October 2002 to 7th December 2002 inclusive;
- The seismic survey will be carried out in accordance with the '*Guidelines on the Application of the Environmental Protection and Biodiversity Conservation Act to Interactions Between Offshore Seismic Operations and Larger Cetaceans*' (October 2001).

1.4 International Agreements and Conventions

A number of international agreements and conventions may have impacts on petroleum activities in both State and Commonwealth waters. The principal ones are:

- [International Convention for the Prevention of Pollution from Ships, London, 1973](#) (commonly known as MARPOL)
- [Protocol to International Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter, 7 November 1996](#) (Previously known as the London Dumping Convention)
- [International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990](#) (commonly known as OPRC 90)
- [Agreement Between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and Their Environment](#) (commonly referred to as the China Australia Migratory Bird Agreement or CAMBA)
- [Agreement Between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and Their Environment](#) (commonly referred to as the Japan Australia Migratory Bird Agreement or JAMBA)
- [Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal](#)

2 PROPOSED SEISMIC SURVEY

2.1 Location

The EPP27 Permit Area is located in the Otway Basin off the southeast South Australian coast. The proposed survey will occur in an area that, at its closest point, is approximately 7 km from the coastline (refer to Figure 1). The water depth across the survey area varies from 30 m to approximately 150 m. The bounding coordinates of the full fold survey area are given in Table 1

Table 1: Bounding Coordinates of Carpenter 3D MSS

Latitude	Longitude
37° 45'S	139° 54'E
37° 45'S	140° 12'E
37° 54'S	140° 17'E
37° 54'S	139° 59'E

2.2 Description of the Survey

Petroleum Permit Area EPP27 is operated by Woodside on behalf of the Joint Venture Partners (Great Artesian Oil and Gas Pty Ltd; formerly Tyers Petroleum Investment Pty Ltd) and administered by the Department of Primary Industry and Resources of South Australia (PIRSA), Minerals and Energy Division.

As operator of the Permit Area, Woodside Energy Ltd is committed to undertaking a seismic survey in the permit area. The Carpenter 3D MSS is scheduled to commence in early to mid October 2002 and extend for a scheduled duration of 20 to 30 days depending on weather. The survey vessel will be the 'Geco Beta', which is operated by WesternGeco. As the survey is of a short duration, the vessel is not expected to return to port during the survey. It is anticipated that the vessel will not anchor or enter shallow waters near the shore unless an emergency situation develops. There will be two support vessels, one acting as a dedicated scout vessel and the other for supply and logistic support.

The seismic array will comprise six streamers, with a maximum length of 4.6 km. The source depth will be 5 m and the streamer depth will be 7- 8 m. The operating pressure for the airgun arrays will be approximately 2,000 psi. The airgun array will have a volume of 3,542 cui and will produce at source (ie. within a few metres of the airguns) sound pulses in the order of 220-240 dB re 1 μ Pa-m at frequencies extending up to approximately 110 Hz. These levels will decrease to levels in the order of 170-180 dB re 1 μ Pa-m within 1 km of the source and approximately 150 dB re 1 μ Pa-m within 10 km, dependent on the sound propagation characteristics of the area (McCauley, 1994). Details of the seismic array for the survey are provided in Table 2.

Table 2: Seismic Array Details

Parameter	Value
No of streamers	6
Streamer length	4.6 km
Number of Airgun Arrays	2
Airgun array total volume	3,542 cui (per array)
Operating pressure	2000 psi
Streamer depth	7 - 8 m
Airgun depth	5 m
Shotpoint interval	18.75 m (~8 seconds)
Peak source sound pulse	220-240 dB re 1 μ Pa-m
Frequency range	10 to 110 Hz



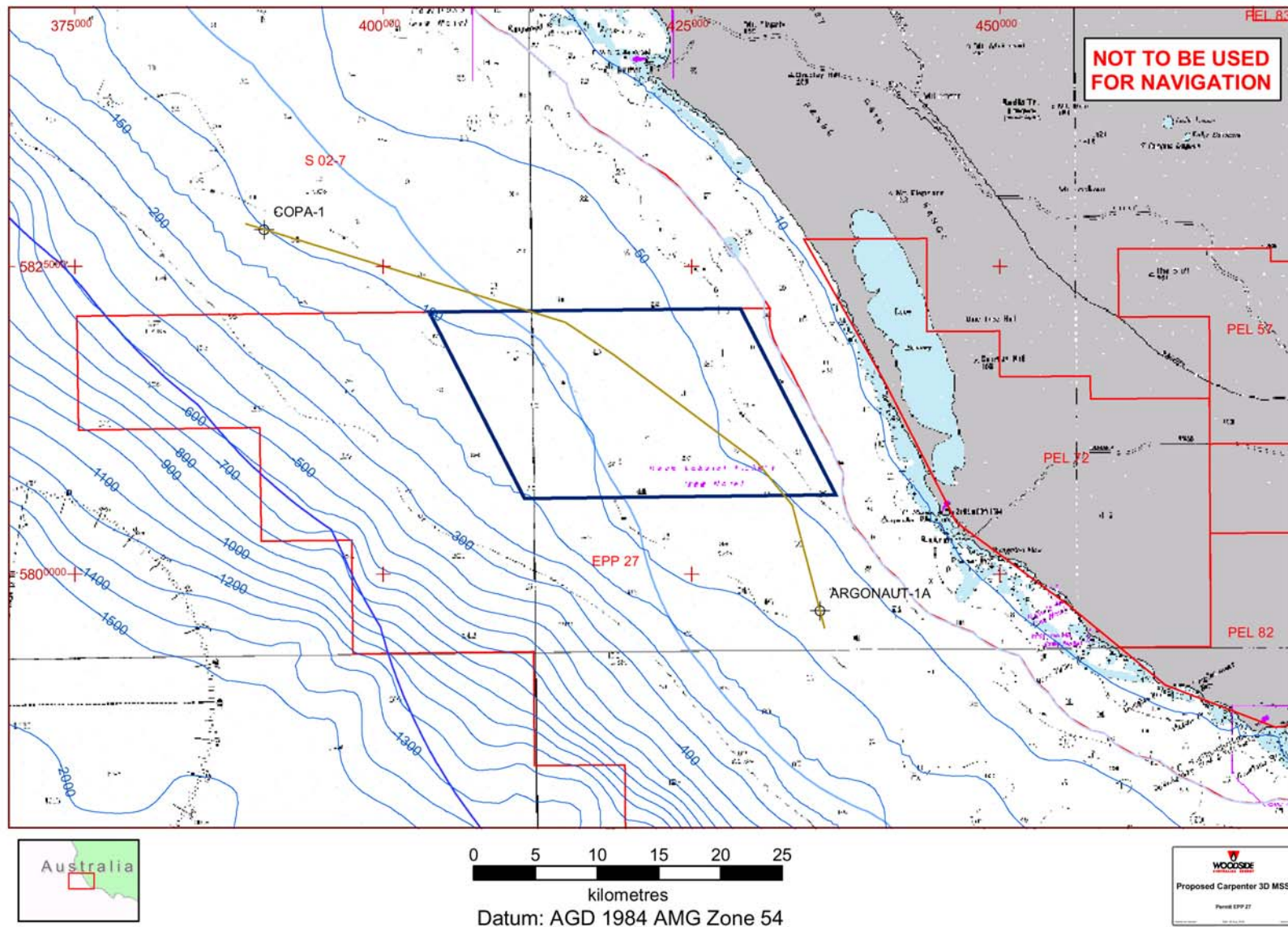


Figure 1: EPP27 Carpenter 3D MSS Location Diagram

3 DESCRIPTION OF THE EXISTING ENVIRONMENT

3.1 Physical Environment

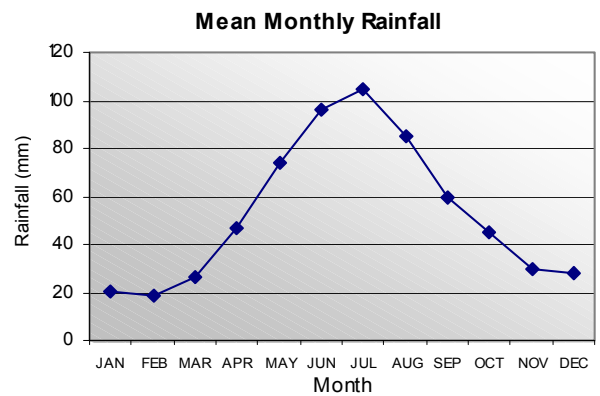
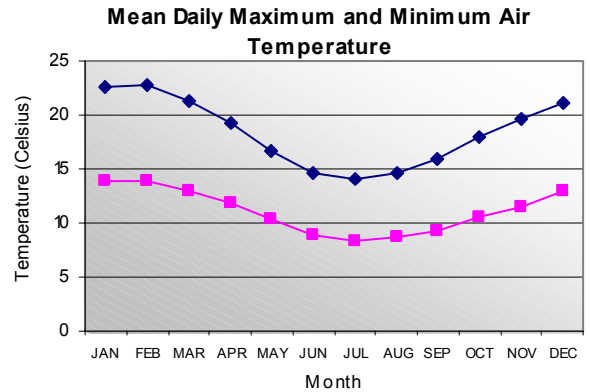
3.1.1 Climate and Oceanography

The climate of the area is temperate with most rainfall occurring during winter months. The figures (right) illustrate the range of daily maximum and minimum air temperatures and rainfall throughout the year at Robe, which is approximately 50 km north east of the proposed survey area.

Waters are transitional warm to cold temperate, with mean sea surface temperatures varying from 14°C in winter to 19°C in summer (decreasing to 11-12°C under the influence of the localised, nutrient rich, coastal upwellings that are known to occur in mid to late summer). The coastline is typically high energy, with a high deepwater wave energy, attenuated by a steep offshore-nearshore gradient and offshore reefs which provide for moderate to low energy conditions. Tidal range is small ranging from approximately 0.8 to 1.2 meters range.

3.1.2 Bathymetry and Seabed Features

The dominant feature of the bathymetry and seabed in the area is the narrow width of the Australian Continental Shelf. The shelf break (200 m water depth contour) commences approximately 30 km offshore. The water depths over the area of proposed seismic acquisition range from 30 m to approximately 150 m, generally trending deeper towards the west. The bathymetry of the area is shown by Figure 1: Location Diagram.



3.2 Biological Environment

3.2.1 Benthic Habitats

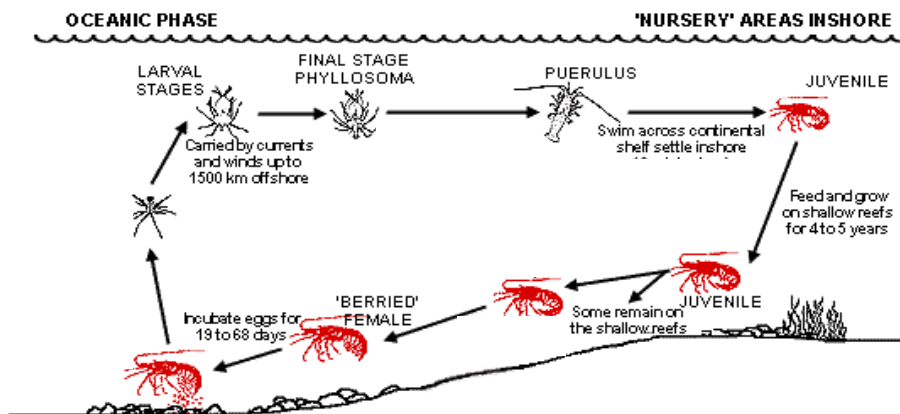
Marine flora and fauna are typically cold temperate (ie. Maugean element of the Flindersian Province). The intertidal and sublittoral fringe is dominated by the bull kelp, *Durvillea potatorum*. Rocky subtidal macro-algal communities are dominated by *Macrocystus angustifolia*, *Phyllospora comosa* and other large brown fucoid algae. For many macro-algal communities, this region forms the westward limit of a number of key species. Extensive areas of seagrass occur in the limited sheltered embayments (generally *Posidonia ostenfeldii* group), with smaller areas in the lee of reefs (*P. australis*). Subtidal seagrass meadows are dominated by *Posidonia australis* in shallow areas, *P. sinuosa*, *P. angustifolia* and *Amphibolis antarctica* in deeper waters. Rivoli Bay is the easterly limit of *P. coriacea* and *P. denhartogii*. Port MacDonnell is the easterly limit of *P. angustifolia*. Plant species diversity is very high, particularly among the red algae.

Rock Lobster

Rock lobster are found all around the Australian coast sheltering in caves and crevices during the day and moving out at night to forage in surrounding areas. The southern rock lobster (*Jasus edwardsii*) supports the most valuable fishery in south-east Australia.

The life cycle of the rock lobster has been well studied. Breeding occurs in spring and early summer. The eastern parts of the permit area are likely to be an area of rock lobster breeding. Fertilised eggs are carried on the underside of the female for nine to 12 weeks before hatching. Hatched larvae, called phyllosoma, rise to the sea surface and drift long distances offshore (generally 400 to 1,000 km offshore) growing to about 35 mm over 9 to 11 months before metamorphosing into the puerulus stage. The puerulus then swims back across the continental shelf to settle in the holes and crevices of the shallow coastal reefs such as occurs in the eastern parts and shoreward of the permit area.

Once settled the puerulus undergoes a molt and assumes the form of a juvenile rock lobster. Juvenile rock lobster are cryptic and the numbers seen are very small compared to the total numbers that may be present in the reef system. For example an intensive study carried out at Seven Mile Beach in Western Australia estimated the density of juvenile lobster in the reef system to be approximately 40,000 per hectare².



3.2.2 Pelagic Biota

A large number of pelagic and demersal fish species are found in the region, many of which, including Gummy Shark (*Mustelus antarcticus*), School Shark (*Galeorhinus galeus*) flathead species (*Platycephalus spp.*), school whiting (*Sillago bassensis*), Jack Mackerel (*Trachurus declivis*), silver trevally (*Pseudocaranx dentex*), snapper (*Pagrus auratus*), ocean perch (*Helicolenus spp.*) are of commercial importance.

3.2.3 Listed Biota

Species that are listed as 'Endangered' or 'Vulnerable' are afforded special protection under the EPBC Act. A list of endangered and vulnerable species that may migrate or move through the EPP27 Permit Area is provided in the Table below³. None of the listed species depend upon the Permit Area for food or reproduction.

The southern right whale is known to be present throughout the waters of southern Australia. Southern rights migrate from the sub-Antarctic to coastal waters off southern Australia to calve and breed and would be expected to be migrating in the project area during May to September (Environment Australia, 2001). There are no known Southern right whale calving or breeding areas along the coast adjacent to the project area and it is unlikely that any would be present during the survey period.

Blue whales are sighted seasonally in the area (Gill, 2000). Aerial surveys undertaken on behalf of Woodside in December 1999 to April 2000 (Gill, 2000) and April to June 2001 (Choquenot and Gillespie, 2002) have shown that Blue whales are seasonally present in the wider region from about December to April/May.

The area lies within the known habitat for the listed great white shark, whose range extends primarily from Moreton Bay in Southern Queensland, around the southern coastline to the North West Cape of Western Australia (Bruce, 1995).

The Australian fur seal is distributed throughout the region. There are no breeding sites within or near to the proposed survey area.

Migratory seabirds, some of which are protected by international agreements (Bonn Convention, JAMBA and CAMBA), may pass through the proposed survey area. They are uncommon in the proposed survey area due to the lack of suitable roosting and breeding habitat but foraging groups of seabirds are sighted occasionally.

² Bruce Richardson, Curtin University *pers. comm.* July 2002.

³ Species list derived from search of [Environment Australia's database of listed species](#)

Table 3: Endangered and Vulnerable Species That May Occur in the Study Area

Species	Common Name	Listed Threatened Species Status	Covered by Migratory or Marine Provisions of EPBC Act	Predicted Presence in Area
<i>Balaenoptera musculus intermedia</i>	Blue Whale	Endangered	✓	Possible
<i>Balaenoptera musculus brevicauda</i>	Pygmy Blue Whale	Not Listed	Not Listed	Possible
<i>Eubalaena australis</i>	Southern Right Whale	Endangered	✓	Unlikely
<i>Balaenoptera physalus</i>	Fin Whale	Vulnerable		Very Unlikely
<i>Balaenoptera borealis</i>	Sei Whale	Vulnerable		Very Unlikely
<i>Megaptera novaeangliae</i>	Humpback Whale	Vulnerable	✓	Very Unlikely
<i>Carcharodon carcharias</i>	Great White Shark	Vulnerable		Possible
<i>Arctocephalus pusillus</i>	Australian Fur Seal		✓	Possible
<i>Eudyptula minor</i>	Little penguin		✓	Unlikely
<i>Osteichthyes</i>	Sea horses, Sea dragons and Pipefish (22 species)		✓	Possible some species present

3.3 Socio-Economic Environment

3.3.1 Commercial Fisheries

Commercial fisheries are an important component of the regional economy. It has been estimated that 6 to 9% of the regional population are directly employed in commercial fisheries (National Oceans Office, 2002). The percentage is likely to be even higher in small coastal communities near to the survey area, such as Carpenter Rocks and Southend.

3.3.1.1 Rock Lobster Fishery

The rock lobster fishery is the most valuable single species fishery in south-east Australia. EPP27 Permit Area is one of the highest yield areas for rock lobster fishery in all of south-east Australia. The annual rock lobster catch in the area is estimated at 220 to 390 kg per km² with a landed value of \$8,000 to \$20,000 per km² (Larcombe *et al.*, 2002).

The survey is to be conducted (due to time restrictions imposed by Environment Australia, refer to Section 1.3) at a time that coincides with commencement of the annual rock lobster fishing season. Rock lobster fishing is conducted from small vessels (typically 12 to 20 m in length) by setting trap pots that are retrieved daily. Port MacDonnell is harbour to the largest fleet of rock lobster fishing vessels in the southern hemisphere. Fourteen vessels fish for rock lobster from Carpenter Rocks and 14 from Southend. It is estimated that 10 to 12 vessels would normally fish in the area of the proposed survey during the period of the survey.



3.3.1.2 Other Commercial Fisheries

Other commercial fisheries operating in the area include:

- Abalone Fishery
- Southern Shark Fishery;
- Southern Bluefin Tuna Fishery;
- South East Trawl Fishery; and
- South East Non-Trawl Fishery.

3.3.2 Shipping

The permit area lies within one of the main shipping routes connecting eastern Australia and ports in the Gulf of St Vincent and Spencer Gulf. Approximately 500 to 1000 vessels pass by, or through, the outer parts of the Permit Area each year (Larcombe, 2002).

3.3.3 Tourism

The coastline adjacent to the Permit Area includes the Canunda National Park. As well as conserving important coastal habitat the Park is a locally important tourism site popular for beach activities, fishing and bushwalking. At times during the survey the survey vessel will be visible from the park. A small number of charter boat operators and dive vessels operate out of Port MacDonnell, Millicent and Robe and may pass through the survey area.

3.3.4 Recreational fishing.

Recreational fishing occurs mainly from the coastline and in waters near to the coast although there is a significant amount of fishing activity in deeper waters. The main target species in coastal waters are mulloway, salmon, shark, sand flathead, mullet, garfish, King George whiting, rock lobster and abalone.

3.4 Areas Of Cultural or Heritage Importance

There are a large number of known shipwrecks in the region. However, there are no known shipwrecks located within the proposed survey area.

There are no marine parks or reserves within the survey area. A marine protected area has been proposed for the area adjacent to the Cununda National Park.

There are no areas of Aboriginal heritage or native title claim affected by the proposed survey.

4 DESCRIPTION AND ASSESSMENT OF ENVIRONMENTAL EFFECTS

4.1 Potential Environmental Effects

The components of the seismic survey that could result in significant environmental effects have been determined through an evaluation of the proposed activity, the surrounding environment and the legislative requirements. The activities with potential to cause significant environmental effect include:

- operation of the seismic vessel and towing of the airgun and streamer (hydrophone) array through the survey area;
- discharge or 'firing' of the airgun arrays;
- routine waste discharges from the survey vessel;
- accidental fuel and oil spills from the survey vessel; and
- accidental loss of streamers and associated equipment.

Although the risk is considered to be remote, each of these activities has the potential to result in detrimental impacts on the physical, biological and socio-economic environment of the area. The key potential environmental aspects associated with the proposed Carpenter 3D MSS are discussed in the following sections.

It is worth noting that aside from the noise generated by operating seismic survey vessels there are a number of general sources of non-biological sea noise. These include wind, rain and shipping:

- Wind – wind noise is consistent and may reach levels in the vicinity of 85-95 dB re $1\mu\text{Pa}^2/\text{Hz}$ at low frequencies under extreme conditions.
- Rain – rain may produce short periods of high underwater noise with flat frequency spectra to levels of 80 dB re $1\mu\text{Pa}^2/\text{Hz}$.
- Shipping - in areas where ship traffic is high, the averaged noise of many ships may produce a widespread, nondescript, continuous, 'pink' type noise level over the frequency range 1-500 Hz. Highest levels of this widespread background noise from shipping is in the order of 75 dB re $1\mu\text{Pa}^2/\text{Hz}$ at 50 Hz. Source levels for large ships may be in the range of 170-200 dB re $1\mu\text{Pa}$ -m. High shipping noise levels may be experienced in narrow or shallow shipping channels.

4.2 Disturbance to Marine Fauna

McCauley (1994) provides a detailed review of the potential effects of seismic acquisition on marine animals. The review was undertaken by an Independent Scientific Review Committee (ISRC), chaired by Professor John Swan, and commissioned by the Australian Petroleum Exploration Association (APEA) and the Energy Research and Development Corporation (ERDC). The ISRC report examined all aspects of the possible effects of seismic surveys on marine life, from whales to plankton. Potential impacts on hearing, and behaviour at different stages of development were studied. The ISRC report concluded on this note:

"Given the relatively small scale of seismic activity, the often large scales over which biological events occur, and 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."

4.2.1 Sonic Disturbance

Studies relating to the environmental effect of marine seismic surveys have largely focused on the potential effects to fish stocks and marine mammals from the sound waves associated with the seismic energy source. Concerns have included:

- Pathological effects (lethal and sub-lethal injuries) – immediate and delayed mortality and physiological effects to nearby marine organisms;
- Behavioural change to populations of marine organisms;
- Disruptions to feeding, mating, breeding or nursery activities of marine organisms in such a way as to affect the vitality or abundance of populations;

- Disruptions to the abundance and behaviour of prey species for marine mammals, seabirds and fish; and
- Changed behaviour or breeding patterns of commercially targeted marine species, either directly, or indirectly, in such a way that commercial or recreational fishing activities are compromised.

4.2.1.1 Pathological Effects

The response of marine fauna to marine seismic survey sounds will range from no effect to various behavioural changes. Immediate pathological effects are likely to be restricted to very short ranges and high sound intensities, which are unlikely to occur for the majority of species, as most free-swimming animals will practice avoidance manoeuvres well before they get within the ranges at which pathological effects may occur. Table 4 (over page) lists pathological effects observed to occur as a result of seismic survey noise.

It is prudent to point out that there is presently confusion in some quarters caused by people wrongly associating the biological effects of high explosives with those of other types of underwater sound sources. High explosives produce a shock wave in the water that is subtly different to that of a sound wave, as produced by most underwater sources (including airguns), but vastly different in its biological implications. Shock waves produce severe pathological effects at considerable ranges, which vary depending on charge size, and physical or biological factors. Airguns do not produce shock waves and the effects described for high explosives do not apply to them. For example Larson (1985) concluded from experiments with caged fish that mortality from shock waves only occurs when two criteria are met simultaneously:

- peak pressure is $\geq 2.75 \times 10^5$ Pa, and
- rise time and decay time is ≤ 1 ms.

Airguns do not meet these criteria and do not cause shock waves.

4.2.1.2 Disruption to Benthic Invertebrates

Most marine benthic invertebrates, including rock lobster, have poorly developed mechano-sensory systems and would therefore be little affected by seismic survey noise. It has been postulated that shellfish, crustaceans and most other invertebrates can only hear seismic survey sounds at very close range, such as less than 15 m away (McCauley 1994). This means that only surveys run in very shallow water will have any detrimental effects. The proposed seismic programme will not traverse any such areas and therefore it is unlikely that any benthic invertebrates would suffer any direct negative impacts.

4.2.1.3 Disruption to Planktonic Organisms

Except for larvae, fish eggs and other minute planktonic organisms within a few meters of an air-gun, no planktonic organisms are likely to be significantly affected by air-gun array discharges (McCauley, 1994). Data presented in Table 4 indicates that the range of pathological effect on plankton is likely to be restricted to less than approximately 2 m. Calculations show that less than 0.01% of plankton in the area would be effected⁴. Any effect of the seismic on planktonic organisms, such as the puerulus stage of the southern rock lobster, is insignificant compared with the size of the planktonic population in a survey area or natural mortality rates for planktonic organisms.

4.2.2 Disruption to Fish

Studies⁵ have shown that fish can be exposed directly to the sound of seismic survey without lethal effects, outside of a very localised range of pathological effects. There is a wide range of susceptibility among fish, however, those with a swimbladder will be more susceptible than those without this organ. Many adult fishes, including the elasmobranchs (sharks and rays) do not possess a swimbladder and so are not susceptible to swimbladder-induced trauma. Most pelagic fish are expected to swim away when seismic noise reaches levels at which it might cause pathological effects, however the presence of many open sea fish near operating vessels suggest that some of these species are hardly affected by the sounds at all.

⁴ This assumes; plankton are uniformly distributed, 2 gun array 18.75 m shot point interval, maximum range of pathological effect 2m.

⁵ For example refer to APPEA (1998). Seismic surveys and the petroleum industry. Independent Scientific Review Committee Internet Database, Fact Sheet 1. Australian Petroleum Production and Exploration Association.

For some fish, strong 'startle' responses have been observed at sound levels of 200-205 dB re 1 μ Pa, indicating that sounds at or above this level may cause fish to flee. Sound levels of this level are likely to occur approximately 100-300 m from an airgun array. Based on this an approximate range of 200 m is given as the minimum distance at which fish may flee from an operating array and below which pathological effects may occur (McCauley, 1994). Based on existing information, significant impacts on fish populations resulting from seismic survey noise are likely to be restricted to:

- Short ranges and high sound intensities (ie <200 m range from source);

Table 4: Observed Seismic Noise Pathological Effects

Species	Source	Level (dB re 1 μ Pa @ 1m)	Distance From Source (m)	Exposure Level (dB re 1 μ Pa)	Observed Effect	Reference
Fish and Plankton						
Cod (adults)	Single airguns and arrays, 1,000 – 20,000 cm ³	220-240 (estimated)	0.5	226 – 246	Haemorrhaging and eye damage	Kosheleva, 1992
			1.0	220 - 240	No harmful effects	
Cod (adults)	Electrically generated signal in laboratory conditions	Not stated	Not stated	192 – 198	Transient stunning, no subsequent mortalities	Hastings, 1990
Cod (larvae 5 days)	Single airgun	250	1	250	Delamination of the retina	Matishov, 1992
Cod (larvae 2- 110 days)	Single airgun	222	1	222	No injuries detected	Dalen and Knutsen, 1987
			10	202	No injuries detected	
Fish eggs Anchovy	Single airgun	230 dB (estimated)	1	230	7.8% of eggs injured relative to control	Kostyvchenko 1973
			10	210	No injuries detected	
Fish eggs Red Mullet	Single airgun	230 dB (estimated)	1	230	No injuries detected	
			10	210	No injuries detected	
Dungeness crab (larvae)	Seven airgun array	244 (estimated)	1	233.5	No significant difference in survival rate relative to controls	Pearson <i>et al.</i> , 1994
			3	230.9		
			10	222.5		
Benthic Species						
Mussel	Single airgun	223 (estimated)	0.5	229	No detectable effect, all three groups continued to function normally after airgun exposure. Monitoring over next 30 days revealed no adverse effects.	Kosheleva, 1992
Periwinkles						
Crab						
Sea Urchin	Single airgun	223 (estimated)	2	217	15 % of spines fell off	Matishov, 1992

- Populations that cannot move away from operating arrays (eg shallow water site-attached benthic species);

- Surveys that take place over protracted periods close to areas important for the purposes of feeding, spawning or breeding; and
- Surveys that take place over protracted periods close to areas that constitute narrow restricted migratory paths.

Fish may possibly be exposed to noise levels sufficient to cause startle response or pathological damage if air-gun arrays start suddenly. 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 pathological damage might take place. There are no narrow or restricted areas within the permit areas that could 'trap' fish.

Available evidence suggests that behavioural changes for some fish species may be no more than a nuisance factor. For example, the temporary, short range, displacement of pelagic or migratory fish populations may have insignificant repercussions at a population level.

4.2.2.1 Disruption to Cetaceans

Cetaceans employ an extremely acute acoustic sense to monitor their environment and are correspondingly sensitive to sounds below and, to a lesser extent, above the water surface. Sound waves created from seismic operations may interfere with the acoustic perception and communication of any cetaceans in the vicinity, and may have the potential to induce stress. In the short to medium term, repetitious acoustic disturbance could cause abandonment of important habitats such as calving and nursery sites. Since the disturbances associated with the proposed seismic survey will be short-term and very localised, the effects on marine mammals are therefore expected to be minimal.

A study carried out by McCauley, *et al.* (1998) has recently monitored the effects of seismic survey noise on Humpback Whales in the Exmouth Gulf region of Western Australia. The following conclusions were drawn from this research:

- Only localised avoidance was seen by migrating whales during the seismic operation, indicating that the 'risk factor' associated with the seismic survey was confined to a comparatively short period and small range displacement;
- Coupled with the fact that Humpbacks were seen to be actively utilising the 'sound shadow' near the surface, then it is unlikely that animals will be at any physiological risk unless at very short range from a large air-gun array, perhaps of the order of a few hundred metres;
- Given these two factors, that displacements to migratory animals are comparatively short in time and involve small ranges and the low chance of physiological effects, then there appears to be a low risk for migratory animals;
- Upper levels of noise at 1.5 km from the seismic survey array are in the order of 182 dB re $1\mu\text{Pa}^2$, which is still well below the source levels of the highest components of Humpback Whale song (192 dB re $1\mu\text{Pa}^2$). Thus at 1.5 km the received air-gun signal is still well within the range which Humpback Whales would be expected to cope with physiologically, since it would be difficult to argue that Humpback Whale song can cause physiological problems to the animals (McCauley, 1994).

No published information is available about the reactions of any smaller toothed cetaceans (dolphins and porpoises) to seismic noise. Smaller toothed cetaceans have poor hearing in the low frequency range of air-gun array noise (10-300 Hz), so they may be able to approach operating seismic vessels closely without adverse behavioural or pathological effects. 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.

4.2.3 Disturbance to Benthic Habitats

Disturbance to benthic habitats from the Carpenter 3D MSS is highly unlikely given the depth of water in the survey area and the fact that the survey vessel will not be anchoring during the survey. The only possible activity that could have impacts on benthic habitats would be the accidental loss of equipment that could sink to the seabed as debris.

In the event of damage to or loss of a streamer, potential environmental effects will be limited to:

- Undetectable acute effects resulting from toxicity of the streamer fluid (ISOPAR M, a mixture of light, hydrotreated petroleum distillates, predominantly C₁₂-C₁₅ isoparaffinic hydrocarbons, very similar to kerosene);
- Physical impacts on benthic communities arising from the cable and associated equipment sinking to the seafloor; and
- Potential chemical/biological impacts on benthic, demersal and pelagic communities arising from slow leakage of ISOPAR M, as individual sections of the cable are punctured.

Because of the nature of the streamer fluid, expected weather and sea-state conditions, and the relatively small volumes likely to be released, spillages of ISOPAR M are likely to disperse and weather rapidly. As a result of this, there will be limited opportunity for any adverse effects on biota in the area. Physical impacts on soft sediment infauna from a lost streamer and associated equipment (such as the 'birds') will be limited, as the gear is not likely to penetrate the substrate to any extent and the sensitivity of the seafloor communities of the area is low.

4.3 Interference with Commercial fishing

As identified in section 3.3, the area is extensively utilised by rock lobster fisheries during the 24 day period in which the survey is to be carried out (1st October to 7th December). Minor effects on this fishery could result from restriction of access to fishing grounds for the short term of the seismic programme. An extensive consultation process has been initiated to identify and establish suitable procedures to avoid and minimise interference with rock lobster fishing activities.

4.4 Interference With Shipping

Shipping in the area is significant, however it is not expected that the short survey will cause any disruption to shipping activity in the region.

4.5 Waste Disposal

Routine discharges from the seismic survey and support vessels are restricted to sewerage and putrescible wastes (food scraps).

4.5.1 Sewerage and Putrescible Wastes

No sewage or putrescible wastes will be discharged within 4 nautical miles of the coastline unless the vessel has a certified approved sewage treatment plant in place under Regulation 8 (1) (b) of MARPOL 73/78 Annex IV. Beyond this sewerage may be discharged to sea if it has been macerated and disinfected. If the sewage is not treated it is not to be discharged within 12 nm of land. The discharge of these wastes overboard may cause a slight increase in the nutrient content in the water column however the total nutrient loading from the survey vessel is insignificant in comparison to the natural daily nutrient flux that would occur in the region.

4.5.2 Other Wastes

The survey vessel also produces a variety of other solid and liquid wastes, including packaging and domestic wastes, such as aluminium cans, bottles, paper and cardboard and hazardous materials such as acids, solvents and toxic wastes. A variety of chemicals, such as lubricating oils and cleaning chemicals, are also stored and used on the survey vessel. All of these materials could potentially impact the marine environment if discharged in significant quantities; however the applicable routine procedure will be for all wastes (other than sewage and putrescible food scraps) to be returned for recycling/disposal onshore.

4.6 Fuel and Oil Spills

The potential for spillage of oil or fuel (separate to loss of streamer which is discussed in Section 4.2.3) is similar to the risk associated with normal maritime activities in the area, such as fishing fleet and general transport activities. Due to the short duration of the project it is not expected that refuelling will be necessary. Should at sea refuelling take place, detailed procedures are in place to reduce the risk of a spill.

5 ENVIRONMENTAL RISK ASSESSMENT

5.1 Methodology

The environmental risks associated with the proposed seismic operations have been assessed by a methodology that:

- Identifies the activity and the environmental aspects associated with it (Section 2);
- Identifies the values/attributes at risk within and adjacent to the survey area (Section 3);
- Defines the potential environmental effects of the activity (Section 4);
- Identifies the likelihood of occurrence (Section 5.2);
- Identifies the consequences of potential environmental aspects (Section 5.2); and
- Determines overall environmental risk levels using a likelihood and consequence matrix (Section 5.3)

The overall method applied is consistent with that described within AS/NZS 4360 however the terminology used for ranking of likelihood and consequence differ slightly in accordance with emerging industry standards. The terminology used in the assessment of likelihood and consequences are defined in the following Sections.

5.2 Assessment of Likelihood of Occurrence and Environmental Consequence

The likelihood of occurrence for the key potential environmental impacts from the survey (see Section 4) have been estimated based on industry incident reporting. Quantitative probabilities have been determined as the number of occurrences per year. Environmental consequences arising from potential environmental aspects of the survey have been categorised from Slight to Catastrophic, using the qualitative methodology shown by Table 5 below.

Table 5: Definition of Likelihood and Environmental Consequence

Likelihood	Quantitative/Qualitative Description
Likely	More than once per year. Includes continuous emissions
Quite Likely	Once every 1 to 10 years. Has occurred frequently
Possible	Once every 10 to 100 years. Has occurred once or twice
Unlikely	Once in every 100-10,000 years. Not likely during project lifetime
Highly Unlikely	Once every 10,000-100,000 years. Has occurred a few times worldwide
Remote	Once in more than 100,000 years. Has almost never occurred, but conceivably could
Consequence	Qualitative Description of Environmental Consequence
Slight	Possible incidental impacts to flora and fauna in a locally affected environmental setting. No ecological consequences.
Minor	Reduction of the abundance/biomass of flora and fauna in the affected environmental setting. No changes to biodiversity or ecological system.
Moderate	Reduction of abundance/biomass in the affected environmental setting. Limited impact to local biodiversity without loss of pre-incident conditions.
Major	Substantial reduction of abundance/biomass in the affected environmental setting. Recovery to pre-incident conditions within medium term (years).
Massive	Substantial reduction of abundance/biomass in the affected environmental setting. Significant impact to biodiversity and ecological functioning. Eventual recovery of ecological systems possible, but not necessarily to the same pre-incident conditions.
Catastrophic	Irreversible and irrecoverable changes to abundance/biomass in the affected environmental setting. Loss of biodiversity on a regional scale. Loss of ecological functioning with little prospect of recovery to pre-incident conditions.

5.3 Overall Environmental Risk Assessment

Table 6 below shows the overall environmental risk assessment matrix (also referred to as an event potential matrix) that compares the likelihood and consequences of key environmental aspects arising from the survey and assigns a level of risk from 1 to 4. Table 7 presents a summary of the assessed level of environmental risk associated with the proposed Carpenter 3D MSS. No intolerable risks are identified for the proposed seismic activity. All identified risks will be subject to management controls (as described in Sections 6 and 7) to avoid and minimise the environmental risk to as low as reasonably practicable.

Table 6: Environmental Risk Assessment Matrix

CONSEQUENCE	LIKELIHOOD						
	Remote	Highly Unlikely	Unlikely	Possible	Quite Likely	Likely	
Catastrophic	3	3	4	4	4	4	
Massive	2	3	3	4	4	4	Risk Level 1: Manage using normal business practises
Major	2	2	3	3	4	4	Risk Level 2: Reduce to ALARP using conventional cost:benefit methods
Moderate	1	2	2	3	3	4	Risk Level 3: Reduce to ALARP using industry best practise
Minor	1	1	2	2	3	3	Risk Level 4: Intolerable risk, apply strict precautionary principle
Slight	1	1	1	2	2	3	

Table 7: Summary of Overall Environmental Risk Associated With Carpenter 3D MSS

Aspect / Source of Risk	Potential Environmental Effects	Likelihood	Consequence	Environmental Risk Ranking
Interference with commercial fishery activities	Disruption to rock lobster fishing vessels	Likely	Minor	3
Disturbance to marine fauna	Disruption to cetaceans.	Possible	Slight	2
	Disruption to populations of fish.	Likely	Slight	3
	Disruption to populations of benthic invertebrates	Unlikely	Slight	1
	Disruption to populations of plankton	Likely	Slight	3
Disturbance to benthic habitats	Damage and/or destruction of seafloor habitats from anchoring and vessel grounding	Unlikely	Slight	1
Interference with shipping	Disruption to vessels in the main shipping route	Likely	Slight	3
Waste disposal	Localised temporary decrease in ambient water quality from discharge of sewage, putrescible waste, chemicals and solid and hazardous wastes	Quite Likely	Slight	2

Aspect / Source of Risk	Potential Environmental Effects	Likelihood	Consequence	Environmental Risk Ranking
Fuel and oil spills	Damage to or loss of streamer resulting in loss of fluid	Likely	Slight	3
Fuel and oil spills	Leak from survey vessels fuel tanks, or during at sea refuelling operations	Possible	Minor	2

6 PERFORMANCE OBJECTIVES, STANDARDS AND CRITERIA

Performance objectives, standards and criteria for the Carpenter 3D MSS are described in Table 8 below.

Table 8: Environmental Performance Objectives, Standards and Criteria for the Carpenter 3D MSS

Objectives	Standards	Criteria
Minimise disruption to cetaceans	<ul style="list-style-type: none"> Woodside <i>Environment Policy</i> Environment Australia <i>Guidelines for Minimising Acoustic Disturbance to Whales</i> Environment Australia <i>Whale and Dolphin Sighting Report</i> 	<ul style="list-style-type: none"> Guidelines in place and adhered to 'Soft start' procedures 10 minute continuous whale watch every hour Stop work procedures if whales within 3 km Responsibilities for monitoring and recording Sighting reports completed and returned to Woodside and Environment Australia
Minimise disturbance to benthic habitats	Woodside <i>Environment Policy</i>	<ul style="list-style-type: none"> No anchoring of the vessel will take place during the survey unless in an emergency. Recovery of lost items where practicable Recording and reporting of all items lost overboard
Minimise interference with commercial fishing	<ul style="list-style-type: none"> P(SL)A 1967, Section 124 AMSA requirements 	<ul style="list-style-type: none"> Consultation with fishermen Operations carried out in a manner that does not interfere with fishing to a greater extent than is necessary Use of dedicated scout vessel
Minimise interference with shipping traffic	<ul style="list-style-type: none"> AMSA requirements P(SL)A 1967, Section 124 	<ul style="list-style-type: none"> Written and radio warnings to shipping Operations carried out in a manner that does not interfere with navigation to a greater extent than is necessary
Minimise effects of sewage discharge	<ul style="list-style-type: none"> Woodside <i>Environment Policy</i> P(SL)A Schedule 1995, clause 222(4) Protection of the Sea (Pollution from Ship) Act 1983 and MARPOL Annex IV Vessel waste management procedure 	<ul style="list-style-type: none"> Procedures for treatment and disposal of sewage are in place Sewage treatment system operational and includes maceration and disinfection Relevant discharge requirements are adhered to. Vessel to have certified approved sewage treatment plant in place under Regulation 8 (1) (b) of MARPOL 73/78 Annex IV. Vessel waste log form completed
Minimise occurrence and effects of fuel and oil spills	<ul style="list-style-type: none"> Woodside <i>Environmental Policy</i> MARPOL 73/78 Annex I AMSA <i>Marine Notice 6/1995</i> P(SL)A Schedule 1995, Clause 220 P(SL)A Schedule 1995, Clause 285 Vessel <i>Oil Spill Contingency Plan</i> 	<ul style="list-style-type: none"> Procedures comply with MARPOL 73/78 requirements MARPOL <i>Oil Record Book</i> kept up to date Fuel spill contingency procedures are in place and operational Designated containment areas onboard the vessel for storage of oils, greases and streamer fluid Sufficient spill response equipment on

Objectives	Standards	Criteria
	<ul style="list-style-type: none"> • Vessel SOPEP (<i>Shipboard Oil Pollution Emergency Plan</i>) • Vessel bunkering procedures 	<p>board to respond to foreseeable spill events</p> <ul style="list-style-type: none"> • Appropriate actions are taken to minimise pollution • Any spills >80 litres are reported to the Designated Authority • Personnel responsibilities are clearly identified <p>No at sea refuelling may be necessary due to the short duration of the survey.</p> <p>If at sea refuelling is necessary, the following will take place:</p> <ul style="list-style-type: none"> • At sea refuelling supervised by Vessel Master or nominated Officer • Refuelling does not commence without Woodside approval (24 hours notice to be given if possible) • All valves and the flexible transfer hose checked for integrity prior to use • Use of dry-break couplings • Completion of <i>WesternGeco Bunkering Checklists</i> • Procedures comply with MARPOL 73/78 requirements • MARPOL <i>Oil Record Book</i> kept up to date • AMSA notified in advance of all transfer operations at sea •
<p>Minimise potential impacts of solid and hazardous wastes</p>	<ul style="list-style-type: none"> • Woodside <i>Environment Policy</i> • MARPOL 73/78 Annex V • Vessel waste management procedure • Vessel hazardous substances procedures 	<ul style="list-style-type: none"> • Correct segregation of solid and hazardous wastes • A vessel <i>Waste Log Form</i> is kept detailing quantities of wastes transported ashore • Procedures comply with MARPOL requirements

7 IMPLEMENTATION STRATEGY

7.1 Management of Environmental Risk

To either eliminate potential environmental risks or to reduce them to as low as reasonably practicable, a number of key control and mitigation measures must be implemented. The management actions and strategies for control of the significant environmental risks associated with the proposed survey are described in the following sections.

7.1.1 Management of Disturbance to Marine Fauna

The proposed survey largely avoids potential disruption to sensitive ecological values in the area by spatial separation or by temporal separation. Table 9 summarises the control and mitigation measures that eliminate or reduce any significant environmental impacts on marine life to ALARP levels. The management actions and implementation strategy are discussed further in the following sections.

Table 9: Control and Mitigation Measures to Minimise Marine Fauna Impacts

Sensitive Ecological Values	Control and Mitigation Measures
Cetaceans	Survey is to be conducted outside of the time when southern right whales and blue whales may be expected to be present (1 st October to 7 th December). Specific Environment Australia endorsed procedures must operate if any whales are encountered. Other cetaceans are unlikely to be significantly affected by the survey. 'Soft start' of airguns at the start of each line
Fish	The survey will not be operating over critical habitat for feeding, spawning, breeding or migrating fish populations. 'Soft start' of airguns at the start of each line.
Benthic Communities	The survey is unlikely to have any significant effects on benthic communities due to the water depth.

The main control measure to minimise the survey's potential impacts on cetaceans is timing of the survey. The survey is to be conducted in the period when whales are not expected to be in the area (1st October to 7th December). The implementation of specific whale encounter procedures will further minimise the potential for any adverse effects. These procedures (Appendix B) are contained within Environment Australia 'Guidelines on the Application of the EPBC Act to Interactions Between Offshore Seismic Operations and Larger Cetaceans, 2001'. The procedures have the following key elements:

- **Visual observations** A visual check for the presence of whales must be made before the commencement of each acquisition line (during daylight hours);
- **Delay procedures** Airgun discharge must not begin unless whales are a minimum distance of three kilometres from the survey vessel;
- **Soft start procedures** A sequential build-up of warning pulses (over a period of 20 minutes) must be made at the start of each acquisition line ('soft start') to warn and deter whales from approaching the survey vessel. 'Soft starts' over a 20 minute period at the start of each new line will also serve to warn and scatter any other free-swimming fauna (ie dolphins, pelagic and demersal fish) in the area, thereby minimising the likelihood of animals being within pathological effects range;
- **Whale watch** A continuous watch for whales must be maintained during 'soft start' sequences and during operations to determine the presence or absence of whales within three kilometres of the vessel; and
- **Stop work procedures** Airgun array discharge must cease if whales approach within 3 km, and are moving towards, the vessel. Operations must not recommence until the animals have moved outside a range of three kilometres or have not been seen for twenty minutes.

Any cetacean sightings during the proposed survey will be recorded on Environment Australia *Whale and Dolphin Sighting Report* sheets (see Appendix C). Copies of these sheets will be sent to the Woodside Project Geophysicist during the survey. They will then be forwarded to Environment Australia's Marine Species Section at the end of the survey.

7.1.2 Management of Interference With Shipping And Commercial Fishing

The control and mitigation measure to eliminate or minimise potential impacts from the proposed survey on commercial fisheries in the EPP27 area are:

- The survey area will be divided into four zones, the coordinates of which will be provided to all local rock lobster fishermen. The survey vessel will provide fisherman with a minimum of 48 hours notice of the zones within which it will be working. Fishermen have agreed to set their pots outside of the zones in which the survey vessel will be working.
- A dedicated scout vessel will be used to assist in removing any commercial rock lobster pots that may inadvertently be placed in the path of the seismic vessel;
- The Australian Maritime Safety Authority (AMSA) will be notified of the survey vessel position, via the Maritime Rescue Coordination Centre (MRCC) in Canberra;
- Issuing of standard AusCoast radio warnings to shipping by the MRCC; and
- Standard maritime safety procedures (radio contact with approaching vessels, display of appropriate navigational beacons and lights).

7.1.3 Management of Disturbance to Benthic Habitat

The survey is unlikely to have any significant effects on benthic communities due to the water depth. The survey vessel and support vessels will not anchor during the duration of the survey unless in an emergency. As a result of the water depths there are unlikely to be any significant effects from discharge of the airgun arrays on the benthic environment. In the event of loss of a streamer or associated equipment (eg paravanes, tail buoys) there is the potential for some limited disturbance of benthic habitats to occur. Wherever possible, streamers and associated equipment are recovered when lost during survey activities.

7.1.4 Management of Waste

Risks to the marine environmental resources in EPP27 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 returned to shore for recycling or disposal.

7.1.4.1 Sewage and Putrescible Wastes

Sewage and foodscraps disposal must conform to the requirements of MARPOL 73/78 Annex IV and must be macerated to a diameter of less than 25 mm, prior to disposal. No sewage or putrescible wastes (ground or unground) is to be discharged within 12 nautical miles of any land unless vessel has a certified approved sewage treatment plant in place under Regulation 8 (1) (b) of MARPOL 73/78 Annex IV, in which case, sewage must not be discharged within 4 nautical miles of land. No significant environmental impacts are expected because of the biodegradability of the waste, short period of seismic activities and large dilution factor. Total nutrient (nitrogen and phosphorus) input levels will be insignificant compared with natural nutrient flux in the area.

7.1.4.2 Solid Wastes

No significant environmental impacts are expected as solid wastes will not be discharged to the ocean. All solid wastes, such as packaging and domestic wastes, must be segregated into clearly marked containers prior to onshore disposal. In accordance with MARPOL 73/78 regulations, no plastics or plastic products of any kind are to be disposed of overboard. No domestic waste ie. cans, glass, paper or other waste from living areas is to be discharged overboard. No maintenance wastes ie. paint sweepings, rags, deck sweepings, oil soaks, machinery deposits etc., are to be disposed of overboard.

7.1.4.3 Chemical and Hazardous Wastes

All chemical and hazardous wastes, such as cleaning products, acids, solvents, toxic waste and medical waste, will be segregated into clearly marked containers prior to onshore disposal. No significant environmental impacts are expected as chemical and hazardous wastes will not be discharged to the ocean.

All storage facilities and handling equipment must be segregated in good order and designed in such a way as to prevent and contain any spillages as far as practicable.

7.1.5 Management of Potential Fuel and Oil Spills

In the event of at sea refuelling taking place during the Carpenter 3D MSS, there are a number of specific control and mitigation measures that must be implemented to eliminate or minimise the risk of spills and potential environmental impacts. These are:

- Refuelling of the survey vessel at sea must be undertaken from a supply vessel positioned directly alongside or in front of the survey vessel;
- The operation must be managed through detailed vessel specific procedures for bunkering at sea (*WesternGeco Bunkering Procedure* and *Bunkering Checklists*) which are designed to minimise the risk of a spillage of fuel during bunkering from other vessels;
- The refuelling must take place in a location that minimises risks to sensitive environmental resources (eg away from reefs and shoals, marine parks etc). Prior to commencement of the surveys, primary and secondary refuelling locations must be identified by WesternGeco, and this information must be submitted to Woodside for approval. Refuelling must take place only in these approved locations.
- Additional procedures are to be in place to further minimise the risks of fuel spillage. These measures must include:
 - dry-break couplings for the flexible transfer hoses;
 - documented inspection and maintenance schedule for the transfer hoses;
 - threshold sea-state and wind conditions above which the operation will not be conducted;
 - a stipulation that the operation can only be conducted during daylight hours; and
 - the exclusion of concurrent refuelling and streamer operations.
- In the event that vessel refuelling becomes critical and the sea-state conditions are unsuitable, approval must be obtained from Woodside to return to port to complete this task.
- The vessel has specific fuel spill contingency procedures in the unlikely event of a fuel spill (*WesternGeco Oil Spill Contingency Plan* and *Shipboard Oil Pollution Emergency Plan - SOPEP*); and
- Under Marine Notice 6/1995 AMSA must be notified in advance of all ship-to-ship transfer operations at sea. Information to be provided to AMSA should include:
 - date and place of the proposed transfer and full details of the ships involved;
 - purpose of the transfer;
 - materials to be transferred;
 - technical details of cargo including temperatures and pressures (where appropriate);
 - whether other craft (such as tugs) are to be in attendance; and
 - what equipment is to be provided to assist in manoeuvring, pollution prevention, cargo transfer and arrangements for oversight of other vessels in the transfer area.

The survey vessel will have specific fuel spill contingency procedures in the unlikely event of a fuel spill and a *Shipboard Oil Pollution Emergency Plan (SOPEP)*. Minor spillages will be managed through housekeeping cleanliness and the use of sorbent materials to clean up any spilled fuel or oils.

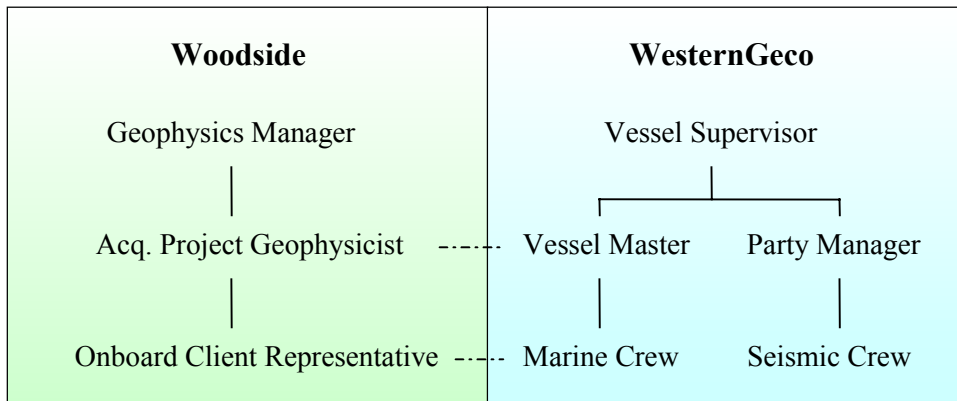
Any fuel or oil spills must be reported to Woodside, all spills of greater than 80 L will be reported to the Designated Authority. Incineration of any oil sludges onboard, or disposal of any oil sludges/slops in port, must be recorded in the vessel *Oil Record Book* (a requirement under MARPOL 73/78). Stocks of absorbent materials onboard the survey vessel must be checked for their adequacy and replenished as necessary prior to the commencement of activities.

7.2 Roles and Responsibilities

The organisation and structure of the seismic survey to be undertaken, including roles and responsibilities for all key personnel onboard the survey vessel, are described in the Contract Plan for the Carpenter 3D MSS. Figure 2 presents an organisation diagram for personnel with key roles in the implementation of this Environment Plan. All staff and contractors taking part in the survey will be advised of their responsibilities

prior to commencement of survey activities. If the personnel do not have appropriate skills to undertake the identified responsibilities training will be provided or they will be replaced with competent personnel.

Figure 2: Organisational Structure for Implementation of This Environment Plan



With regard to the implementation and management of this Environment Plan, the key responsibilities are:

- Vessel Master
 1. Responsible for the safe execution of all operations of the survey vessel.
 2. Overall responsibility for HSE management onboard the vessel, and for ensuring that appropriate control and mitigation measures are implemented to minimise potential environmental effects resulting from vessel operations (eg waste management/disposal, and fuel/oil spill response).
 3. Responsible for immediately notifying the Client Site Representative of any incidents/activities arising from vessel operations that are likely to have a negative impact on the performance objectives detailed in this Environment Plan.
 4. Responsible for notifying AMSA and other relevant authorities, as per requirements of Marine Notices, Woodside reporting procedures (Section 7.4) and any conditions of the approval to conduct the surveys from the Designated Authority
- Party Manager
 1. Responsible for safe execution of all operations carried out by the seismic crew onboard the survey vessel.
 2. Responsible for ensuring that appropriate control and mitigation measures are implemented to minimise potential environmental impacts resulting from seismic acquisition (eg 'soft start' procedures, whale watch and stop work procedures, cetacean recording).
 3. Responsible for ensuring compliance with all aspects of HSE reporting and for investigations of all incidents and near misses.
 4. Responsible for immediately notifying the Woodside Representative of any incidents/activities arising from seismic operations that are likely to have a negative impact on the performance objectives detailed in this Environment Plan.
- Woodside Onboard Representative
 1. Responsible for ensuring that, during the Carpenter 3D MSS all sub-contractors perform operations in a manner consistent with the performance objectives and environmental management procedures detailed in this Environment Plan.
 2. Responsible for ensuring that the Vessel Master and Party Manager are adhering to the requirements of this Environment Plan.
 3. Responsible for keeping himself fully appraised of ongoing operations, particularly for environmentally critical activities.
 4. Responsible for immediately alerting the Woodside Project Geophysicist of any changes in operations that could have a negative impact on environmental performance.

5. Responsible for immediately reporting any reportable incidents to the Woodside Project Geophysicist.
- Woodside Project Geophysicist
 1. Responsible for ensuring that the Designated Authority is notified of all reportable incidents in a timely fashion.
 2. Responsible for ensuring full briefing all project personnel of the environmental sensitivities of the survey area and environmental management procedures and commitments detailed in this Environment Plan.
 3. Responsible for communicating details of the survey programme to relevant Government agencies in advance of operations commencing.
 - Environmental Advisor
 1. Responsible for ensuring survey personnel are aware of their roles and responsibilities, with respect to environmental protection and the requirements of this Environment Plan.

All Woodside personnel and contractors in all areas of the Company's activities are responsible for applying the Corporate Environment Policy (Appendix A).

7.3 Monitoring, Audit and Review

The monitoring, audit and review programme for the Carpenter 3D MSS will consist of the following actions:

- The project start-up meeting will include a presentation to review the environmental sensitivities of the survey location, key environmental performance objectives and commitments, as detailed in this Environment Plan.
- An environmental management review will be carried out aboard the survey vessel during the survey. This review will include an assessment of the environmental components of the contractor's HSE Management System as part of the HSE compliance review. The Client Site Representative will carry out this review.
- Recording of interactions with commercial fishing vessels/equipment
- Recording of all cetacean sightings on Environment Australia *Whale and Dolphin Sighting Report* sheets. Copies of these sheets will be provided to Woodside Project Geophysicist and will be forwarded to the Wildlife Management Unit of Environment Australia.
- Total number of environmental incidents (minor spills, streamer loss etc.) and reportable environmental incidents (spills >80 litres) will be recorded.
- A *Waste Log* will be maintained, detailing the quantities of wastes produced and returned to shore for disposal.

7.4 Reporting

All incidents that have the potential to cause significant effects on the environment must be reported and investigated according to legislative requirements, survey vessel procedures and the Woodside Environmental Policy.

The Designated Authority will be notified of all reportable incidents, according to the requirements of Regulation 26 of the *Petroleum (Submerged Lands)(Management of Environment) Regulations 1999*. Under these regulations, a reportable incident is defined as "*for the operator of an activity, means an incident arising out of operations for the activity that is not within the parameters of the environmental performance standards in the environment plan in force for the activity*". As operator of the survey, Woodside has to provide written reports on any reportable incidents to the Designated Authority, and it is the responsibility of the Woodside Project Geophysicist to comply with this requirement.

All environmental incidents and interference with commercial fishery vessels or equipment will be reported to the Client Site Representative and the Woodside Project Geophysicist within 24 hrs of the incident occurring. The following is a summation of reporting requirements:

- Woodside must be informed within one hour of any incidents involving fuel/oil spill, the loss of streamers/individual streamer sections and spillage of ISOPAR M. If it is determined that these are reportable incidents, under definitions of the P(SL)(MoE) Regulations then Woodside must report these to the Designated Authority within 2 hours of the incident occurring (or being detected).

- Woodside is responsible for reporting all spills >80 litres to the Designated Authority. Any spills greater than 10 tonnes must be reported to Woodside within one hour.
- All oil pollution incidents in Commonwealth waters must be reported to AMSA, under Marine Notice 1/1996. Any spills greater than 10 tonnes in Commonwealth waters must be reported to AMSA within one hour, via the national 24 hour emergency notification contacts:

Freecall: 1800 641 792
Fax: (02) 6230 6868
Telex: +7162349 (computer connected)
Email: mdo@amsa.gov.au

7.5 Consultation

Ongoing consultation during planning and preparation for the proposed Carpenter 3D MSS has, and will continue to, involve discussions with the following agencies, stakeholder organisations and individuals:

- Port MacDonnell Professional Rock Lobster Fishery Association
- Southend Professional Rock Lobster Fishery Association
- PIRSA Southern Zone Rock Lobster Advisory Council
- Fishery representative Robe
- Local Conservation groups
- Grant Shire Council

Additionally the proposed survey was referred to Environment Australia and they placed the referral information on the internet for a public review of two weeks and submissions sought from interested parties.

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APPENDIX A

Corporate Environment Policy

THE WOODSIDE GROUP OF COMPANIES

ENVIRONMENTAL POLICY

General Policy Objectives

As an Australian Company, Woodside shares the desire of the community to develop resources in a way that meets the needs of the present, without compromising the ability of future generations to meet their own needs.

All Woodside activities will be planned and performed so that adverse effects on the environment are either avoided or kept to an acceptable level while meeting all statutory requirements.



Strategies


Our strategies to implement this Policy are:

- Apply a systematic approach to environmental management to achieve and demonstrate continuous improvement.
- Delay or stop activities where effective environmental controls are not in place.
- Comply with all applicable laws and regulations, strive towards higher standards and apply responsible standards where laws and regulations do not exist.
- Seek and demonstrate continuous improvement in all aspects of environmental management including energy use, discharges, emissions and wastes.
- Monitor the effects of our activities on the environment and take action to address effects where necessary.
- Openly communicate our environmental performance with our workforce, Government and the wider community.
- Promote a positive culture by providing environmental training and awareness programs and encouraging individual involvement with environmental issues.
- Assure the effectiveness of our systems through rigorous application, review and improvement processes.

Application

The Managing Director of Woodside Energy Ltd. is accountable to the Board of Directors for ensuring this Policy is implemented and that its effectiveness is reviewed annually. This Policy will be updated every three years.

All Woodside personnel and contractors in all areas of the Company's activities are responsible for applying the Environmental Policy.



J H Akehurst
Managing Director
January 2000

APPENDIX B

EA Guidelines on the Application of the EPBC Act to Interactions Between Offshore Seismic Operations and Larger Cetaceans, 2001

MANAGEMENT GUIDELINES FOR SEISMIC VESSELS OPERATING IN AUSTRALIAN WATERS SO AS TO AVOID OR MINIMISE INTERFERENCE WITH WHALES AND CERTAIN OTHER LARGER CETACEANS.

The following procedures should be followed by all seismic vessels operating in Australian waters during all seismic surveys so as to avoid interference with whales and other larger cetaceans as set out in the attached list.

PRE START-UP VISUAL OBSERVATION PROCEDURES

For all seismic surveys in all waters the following checks should be made:

- During daylight hours, visual checks (using binoculars from a suitable, high observation platform on the survey vessel) for the presence of whales will be undertaken before the commencement of operations.
 - During night time operations, Infra-Red (IR) or night-vision binoculars will be used to undertake visual checks before the commencement of operations.
 - Observations will begin at least 90 minutes prior to use of any high-energy acoustic sources, with particular focus on a 3 kilometres radius around the survey vessel. (See attached diagram).
- ⇒ For Information, indicators of whale activity may be in the form of blows and surface activity resulting in large splashes.

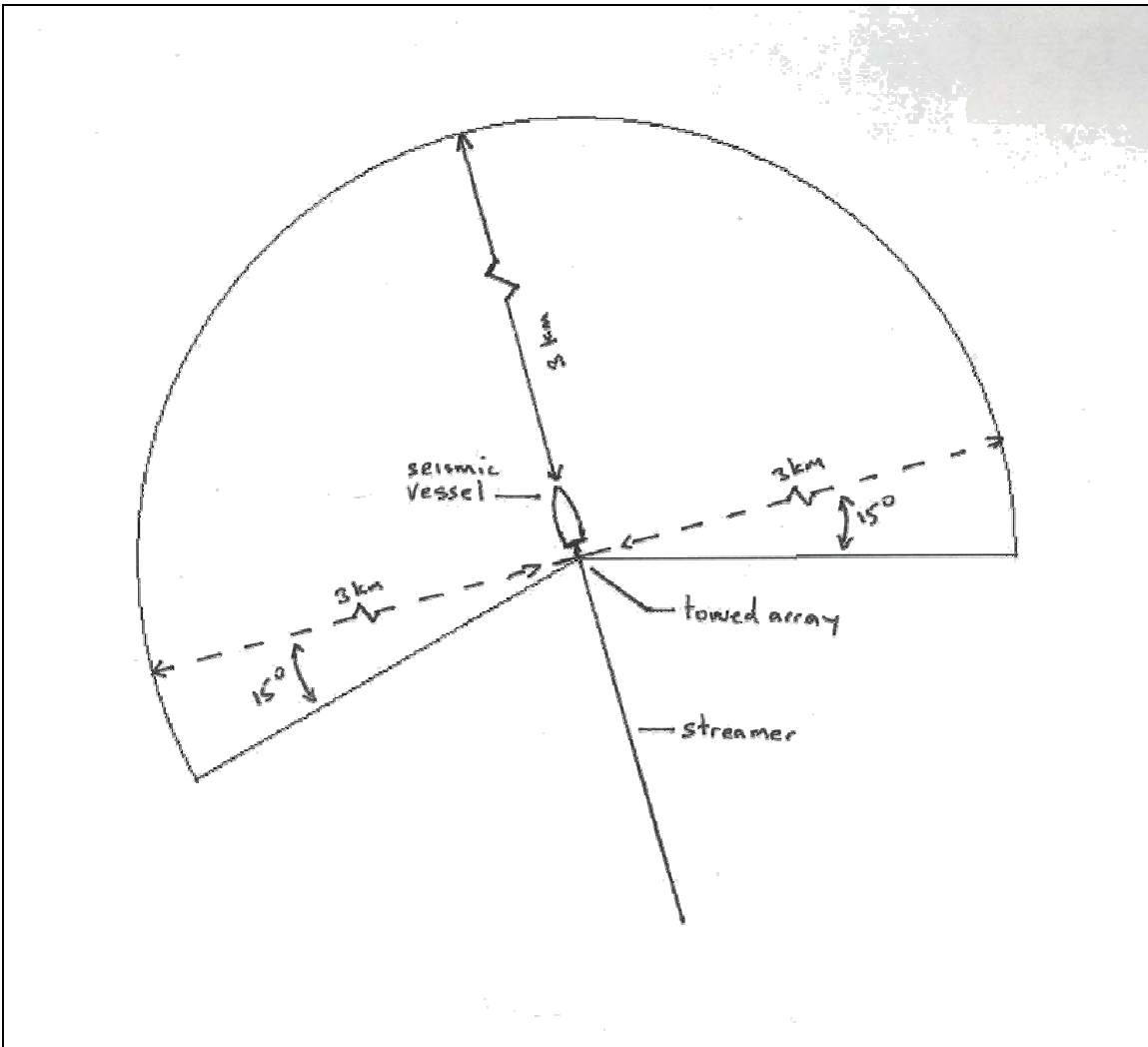


Diagram of area surrounding a seismic vessel that must be monitored for the presence of whales

⇒ For information, a practical and reliable method to accurately determine the range of a marine mammal from a ship's bridge is to measure the angle of the whale below the horizon. By then using standard formula which take into account the earth's curvature and refraction, and using the known height of eye of the observer, a reasonable estimate of the whale range can be calculated. The Norie's Nautical Almanac has standard tables and formula for calculating range from angles below the horizon. There are two methods of measuring angles below the horizon:

- Range finding binoculars which have a graticule of set angle increments fixed in one eyepiece. The number and fraction of graticule units from the whale to horizon gives the angle below the horizon;
- Sextant angles below the horizon. These provide the most accurate measure, and although require some experience at using and reading a sextant, are relatively easy to measure, although care needs to be taken whether reading the angle off or on the arc.

⇒ For information, acoustic monitoring, either ship based using signals taken from the streamer, or externally based from sonar buoys, is becoming an increasingly practical method of monitoring the presence of many whales species. There is merit in the continued exploration of this method of monitoring the presence of cetaceans. Where acoustic monitoring is used on a vessel, the signal should be continuously monitored on the bridge. The use of acoustic monitoring should be used to assist visual monitoring rather than replace it.

START-UP DELAY PROCEDURES

For all seismic surveys in all waters the following procedures should be followed:

- Discharge of the acoustic sources will not commence unless there are no whales within a minimum distance of 3 km from the survey vessel.
- If whales are detected within this zone the start up of acoustic sources will be delayed until they have been observed to move away outside the 3km radius or, if they are no longer observable, 30 minutes after the last sighting within 3km.

SOFT START PROCEDURES

For all seismic surveys in all waters the following procedures should be followed:

- A sequential build-up of warning pulses will be carried out at the commencement of all surveys. The whole array will not be fired without a full soft start. Soft starts will be used even if no whales have been seen.
 - Visual observation will be maintained continuously during soft starts to establish the presence or absence of whales within 3 km of the vessel.
 - If whales are sighted during this soft start procedure within the 3km zone, the seismic source will be shut down. Re-commencement of soft start procedures will take place after 30 minutes has lapsed since the last whale sighting within the 3km zone.
 - There may be continued discharge of the acoustic source during line turns or changes. Discharge of only a limited number of air-guns in the acoustic array would be sufficient in this case.
 - Alternatively the array may be completely shut down between the lines of a survey. In the event that the array is completely shut down between the lines of a survey, the full start-up delay and soft start procedures will be undertaken prior to the whole array being fired.
- ⇒ For information, the soft start procedure involves a gradual increase in the number of air-guns fired over a 20 minute period prior to commencement of a line, and serves to send out a series of warning pulses to whales and give them adequate time to leave the vicinity.

VISUAL OBSERVATION PROCEDURES DURING SURVEY LINE

For all seismic surveys in all waters where a permit under Part 13 Division 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (the Act), or approval under Part 3 of the Act, is not required the following procedures should be followed at a minimum:

- Visual observations of 10 minute duration per hour will be carried out during seismic operations.
 - During night time operations, Infra-Red (IR) or night-vision binoculars will be used for the hourly observations. Night time visual observations will also be of 10 minute duration per hour.
 - Where a whale of a species included in Attachment 1 is seen as part of the observation procedures, continual observations should occur until 2 hours have passed since the last observation of a cetacean of a species included in Attachment 1.
 - All cetacean observations, whether within 3km or not, should be documented and reported.
- ⇒ For information, the area to be monitored for the presence of whales is the same as that applying for pre-start surveys.
- ⇒ For information, wherever practicable a trained, independent observer should be used for the task of undertaking visual monitoring both to ensure that the required observations are

undertaken and to ensure that the best information is obtained from these opportunities to monitor cetaceans.

- ⇒ For information, aerial surveys can increase the amount of information available on the presence of cetaceans in an area and assist in monitoring these animals. Where planning and safety considerations permit aerial surveys of the area to be surveyed could be undertaken to supplement shipboard observation.

For all seismic surveys in circumstances where a permit or approval is required (feeding, breeding and resting areas and migratory routes, as identified in the accompanying maps) the following procedures will form the basis for the consideration of conditions. The exact conditions will be assessed on a case-by-case basis to ascertain if the requirements should be varied.

- In or near migratory paths, other than non-peak Humpback migration paths, 30mins per hour observation by a trained and dedicated cetacean observer will normally be required.
 - In feeding, breeding or resting areas, continuous observation by a trained and dedicated cetacean observer will normally be required.
 - In addition, an independent observer may be required to ensure that the best information is obtained from these opportunities to monitor cetaceans.
- ⇒ For information, the area to be monitored for the presence of whales is the same as that applying for pre-start surveys.
- ⇒ For information, the nominated observer is additional to standard bridge crew members and will have some experience with whale observations. Note: Whale observations become increasingly difficult as sea state increase. An upper limit for practical whale observation is sea state 5. This coincides with the operational weather limits for most seismic vessels.
- ⇒ For information, aerial or stand-off vessel observation is likely to be required as part of any permit or approval.

STOP WORK PROCEDURES

For all seismic surveys in all waters the following procedures should be followed:

- Where a seismic vessel with an operating acoustic source approaches within 3km of an individual whale or pod of whales, the acoustic source will be shut down.
 - Where an individual whale or pod of whales approaches within 3 km of a seismic vessel, the acoustic source will be shut down unless the animal or animals are seen to be skirting the edge of the 3km limit.
 - Seismic source operations will not recommence until the animal or pod has been seen to move outside of a 3 km range, or has not been seen for 20 minutes.
- ⇒ For information, the area to be monitored for the presence of whales is the same as that applying for pre-start surveys.
- ⇒ For information, it is important to monitor the behaviour of any whales that may be approaching the stop-work distance. Ascertain what the whale is doing and the direction it is travelling. If it is seen to be heading away from the seismic vessel and is outside the 3km zone, a shut down may not be necessary.
- ⇒ For information, particular care should be exercised in the monitoring for cetaceans under conditions of reduced visibility.

AERIAL SURVEY AND STAND-OFF VESSEL PROCEDURES

For all seismic surveys in waters where a permit or approval is required (feeding, breeding and resting areas and migratory routes, as identified in the accompanying maps), additional surveys are likely to be required as permit conditions or as part of the approval, if granted. These surveys will in most cases be aerial surveys except where vessel based surveys are required to collect special information or where aerial surveys are impractical. Two types of surveys are envisaged and the requirement for either or both will be assessed on a case-by-case basis.

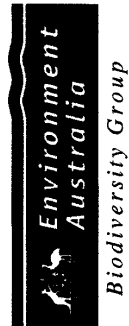
1. Surveys to identify where cetaceans are in relation to seismic activity and to identify when seismic vessels should be especially vigilant. These surveys would be run between the areas to be surveyed by the seismic vessel and the likely approach direction of cetaceans, or in the area in advance of the survey vessel.
2. Scientific surveys to identify which areas are important to cetaceans eg to identify feeding, breeding and resting areas and times of peak migration. In particular these surveys may be required in areas of potential increased sensitivity (areas C or D on the attached maps) where insufficient information currently exists to determine timing and appropriate management arrangements.

RECORDING AND REPORTING PROCEDURES

- Any whale sightings will be recorded on the *Environment Australia Whale and Dolphin Sighting Report* form (attached). This form is also available in electronic format and can be found at www.ea.gov.au/coasts/species/.
- At completion of the seismic survey, copies of all report forms will be submitted to:
Environment Australia
Marine Species Section
GPO Box 787
Canberra ACT 2601

APPENDIX C

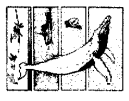
Environment Australia Whale and Dolphin Sighting Forms



Whale and Dolphin Sighting Report

National Cetacean Sighting Program

Please return to:
 Wildlife Management
 Biodiversity Group, Environment Australia
 GPO Box 787
 CANBERRA ACT 2601 AUSTRALIA



DO NOT approach whales/dolphins closer than 100 metres

Date Time (local) Sighting from
 land / vessel
 air / oil platform

Latitude ° ' S ° ' E

SPECIES DETAILS
 Species (as close as possible eg long-finned pilot whale/pilot whale/toothed whale/whale)

animal/s length biggest/smallest How did you estimate length? your distance (min/max) from animal

total number of whales/dolphins Behaviour of whales/dolphins (eg swimming-north, breaching, resting)

number of calves

WEATHER/SEA CONDITIONS
 Beaufort Sea State (please circle)
 0-----1-----2-----3-----4-----5-----6-----7+
 mirror moderate white caps very rough
 calm
 weather (eg sunny, clear, light rain)

Cloud cover → /8

wind direction wind speed

Sea temperature (°c)

How sure are you? (please circle)
 very sure -- sure --not sure

Please draw the shape and features of your animal
 eg. flipper, tail, back and head
 mark in the colour/s and draw colour patterns
 any unusual markings injuries, scars etc....

were there any photographs taken Y/N

Your Name and Address

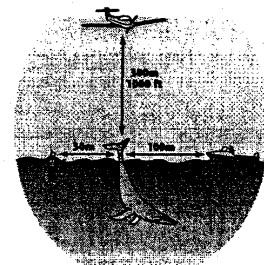
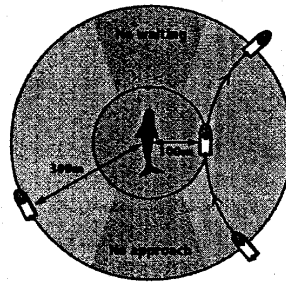
Species guide

Species	On Surface	Diving	Other Characteristics	Length
Southern right				up to 17 metres
Blue				23 to 27 metres
Humpback				11 to 16 metres
Minke				about 9 metres
Sperm				12 to 18 metres
Killer				8 to 10 metres

NB: for guidance only, not all species are shown here

Whale watching guidelines

- Vessels should approach whales or dolphins as in A .
- Within 300 metres of a whale move at a constant slow speed no faster than the slowest whale or at idle, 'no wake' speed.
- Avoid sudden or repeated changes in speed or direction
- Do not approach closer than 100 metres in a boat (B)
- Stopping? allow the motor to idle (1 minute) before turning off
- No more than three vessels should attempt to watch a whale or group of whales at one time
- Do not allow the whales to become boxed in, cut of their path or prevent them from leaving.
- Do not approach mothers with young calves.



Move away slowly at idle, 'no wake' speed to at least 300 metres from the closest whale