Southern Margins Seismic Program 2006
T/32P, T/33P, T40P, VIC/P50
& EPP27

Summary

Environment Plan

May 2006

Version/s:	**Distribution:**
EP Southern Margins_06_v3 May 2006	DIER – 1 copy DPI – 1 copy PIRSA – 1 copy Essential – 1 copy Oilex – 1 Copy Santos – 1 copy

Contents

1. Introduction 2

   1.1 Project Outline 2

   1.4 Background 8

2. Description of Environment 10

   2.1 Physical Environment 10

   2.2 Biological Environment 12

   2.3 Socio-Economic Environment 18

3. Environmental Hazards, Management Approach and Controls 23

   3.1 Potential Environmental Hazards 23

4. Consultation 32

Figures

Figure 1.1 Location of proposed T32/P, T33/P and T40/P seismic survey 3

Figure 1.2 Location of proposed VIC/P50 seismic survey 5

Figure 1.3 Location of proposed EPP27 seismic survey 6

Figure 1.4 Typical marine seismic reflection survey schematic 9

Tables

Table 1.3 Seismic survey program area coordinates 7

Table 2.1 Climate of the seismic survey areas 10

Table 2.1 Marine fauna of national significance that may occur in the seismic survey area 12

Table 2.2 Summary of peak whale activities in the Otway Basin 16

Table 3.1 Identified Environmental risk and mitigation measures 28

1. Introduction

1.1 Project Outline

1.1.1 Seismic Survey

This is a summary of the Environment Plan prepared Santos Ltd (Santos) for the 2006 Southern Margins Seismic Program.

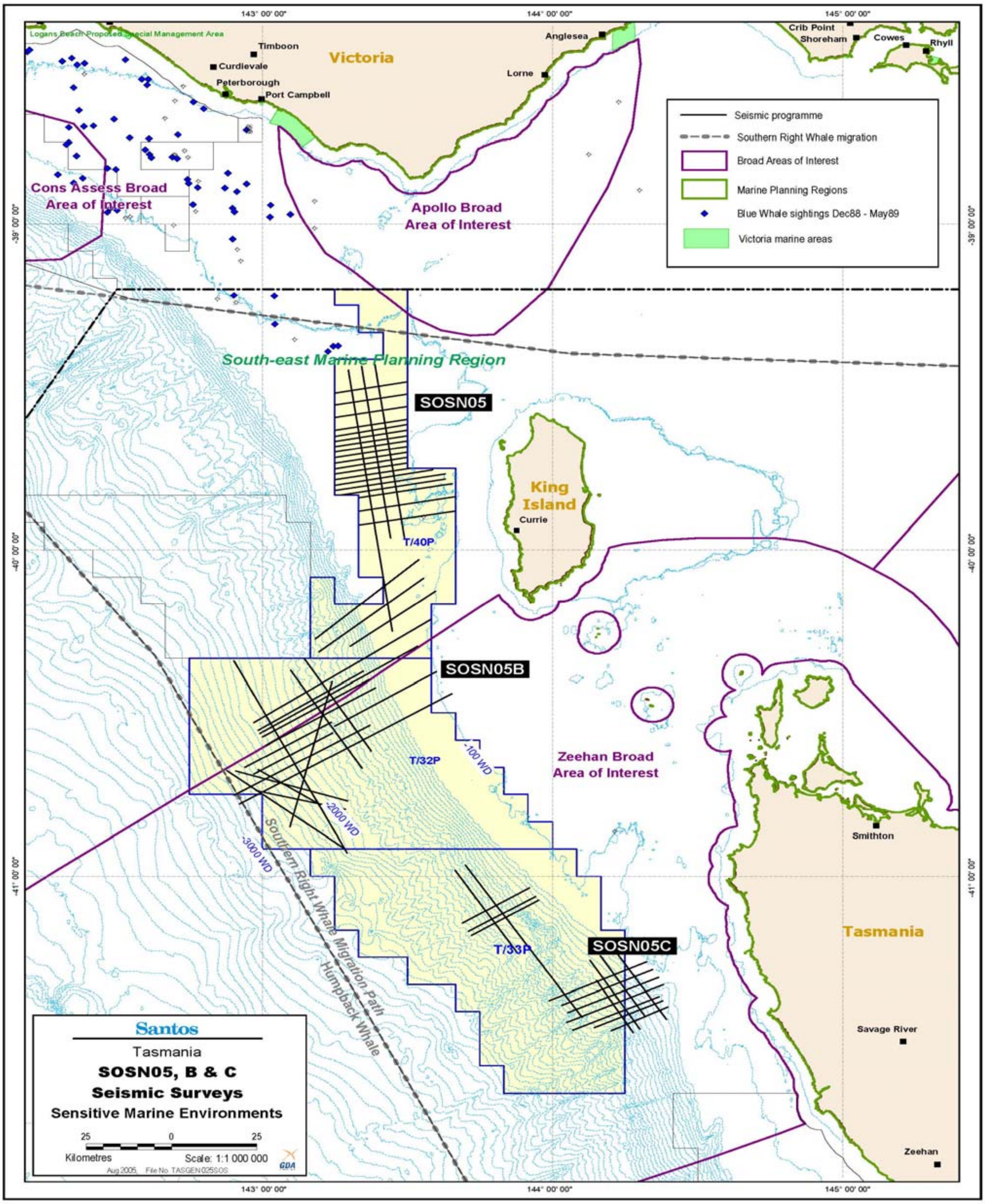
The seismic exploration program will be undertaken over approximately 30 days commencing mid May 2006, in Petroleum Exploration Permits (PEP) T32/P, T33/P and T40/P located in Commonwealth waters off the west coast of Tasmania in the offshore Sorell Basin. In conjunction with the T32/P, T33/P and T40/P program, Santos proposes to undertake seismic exploration in the Otway Basin on behalf of Essential Petroleum Pty Ltd (EPRL) in petroleum exploration permits VIC/P50 (Figure 1.1) and on behalf of Oilex NL (Oilex) in petroleum exploration permit EPP27. The surveys will be undertaken sequentially and all are expected to be completed during the period from May to June 2006. The precise commencement date and timing of each of the survey phases will be dependent upon any changes to the seismic vessel schedule that may occur as a result of a variety of factors including weather.

Multiwave Geophysical Company's 'Pacific Titan' seismic survey vessel has been contracted to undertake the seismic operations.

Tasmania (T/32P, T/33P & T/40P)

The main phase of the Southern Margins program will acquire up to 2184 surface km (2007km full fold) of 2D seismic data in Petroleum Exploration Permit Areas T32/P, T33/P and T40/P, which are located off the west coast of Tasmania, approximately 15 km west of King Island and 100 km from Strahan (Figure 1.2). The seismic survey is scheduled to occur over approximately 30 days (including approximately 8 days weather standby) and will be undertaken in Commonwealth waters between 15 and 160 km from the west coast of Tasmania in water depths ranging from 100 m to 2,900 m.

Figure 1.1 Location of proposed T32/P, T33/P and T40/P seismic survey



Victoria (VIC/P50)

In addition to the survey in T32/P, T33/P and T40/P, the vessel will acquire 344 km of 2D seismic data on behalf of EPRL in VIC/P50 off the southwest of Victoria in the Otway Basin (Figure 1.3). The most inshore part of the survey area lies approximately 30 km from the coast near Portland in Victoria. The main survey area extends from beyond the shelf break into deep water, covering depths ranging from 200-2500 m. The seismic program is scheduled to occur over approximately 5 days (including approximately 2 days weather standby).

South Australia (EPP27)

To complete the Southern Margins Seismic Program, the vessel will then move to permit area EPP27 in the Otway Basin off the South Australian coast to acquire 1,452 km of 2D seismic data (Figure 1.3) on behalf of Oilex. The survey area lies in Commonwealth waters 7 to 40 km from the south east coast of South Australia, approximately 7 km offshore from Port McDonnell and 60 km offshore from Beachport in water depths from 50 m to 500 m. The seismic program is scheduled to occur over approximately 18 days (including 3 days weather standby).

Figure 1.2 Location of proposed VIC/P50 seismic survey

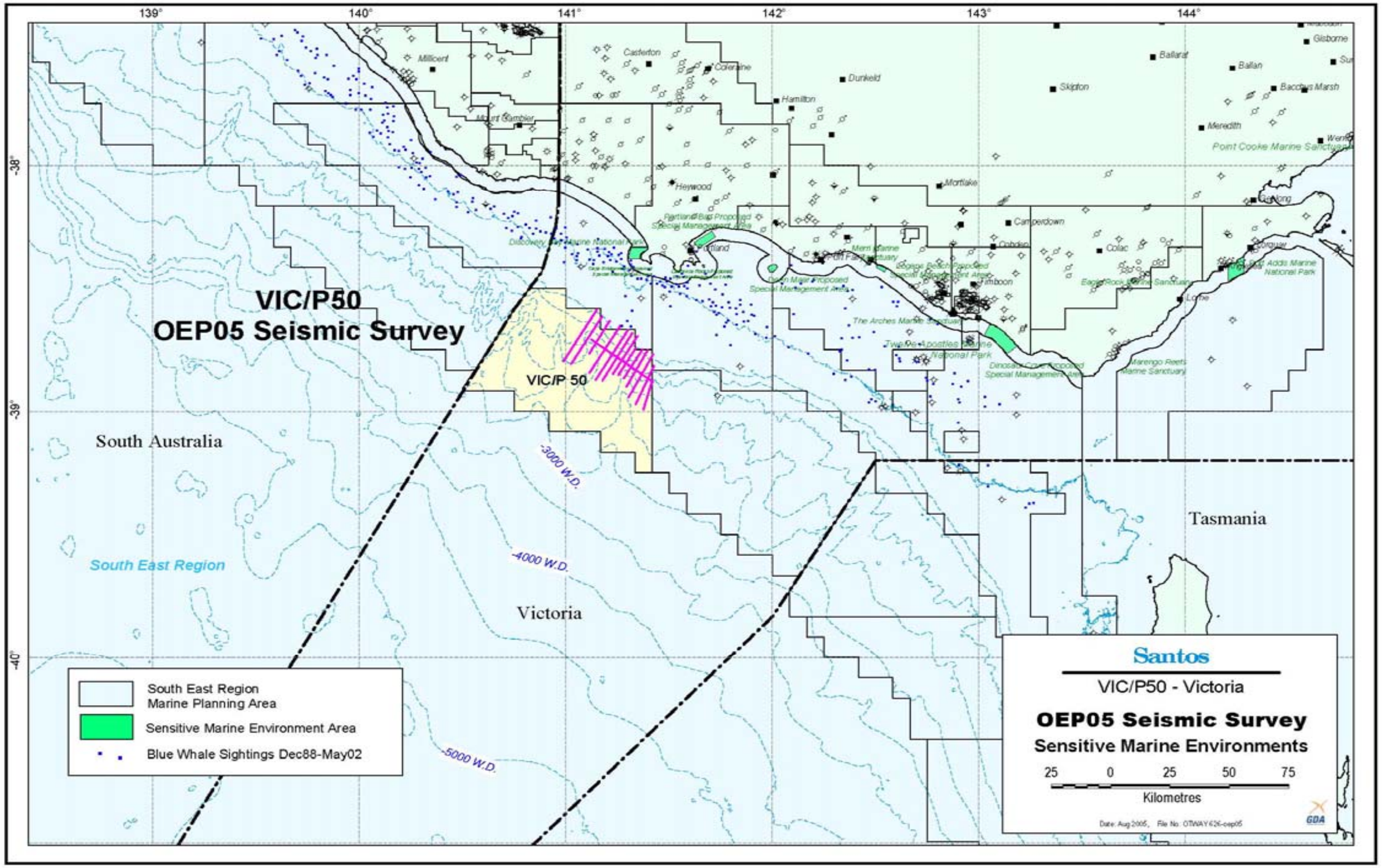


Figure 1.3 Location of proposed EPP27 seismic survey

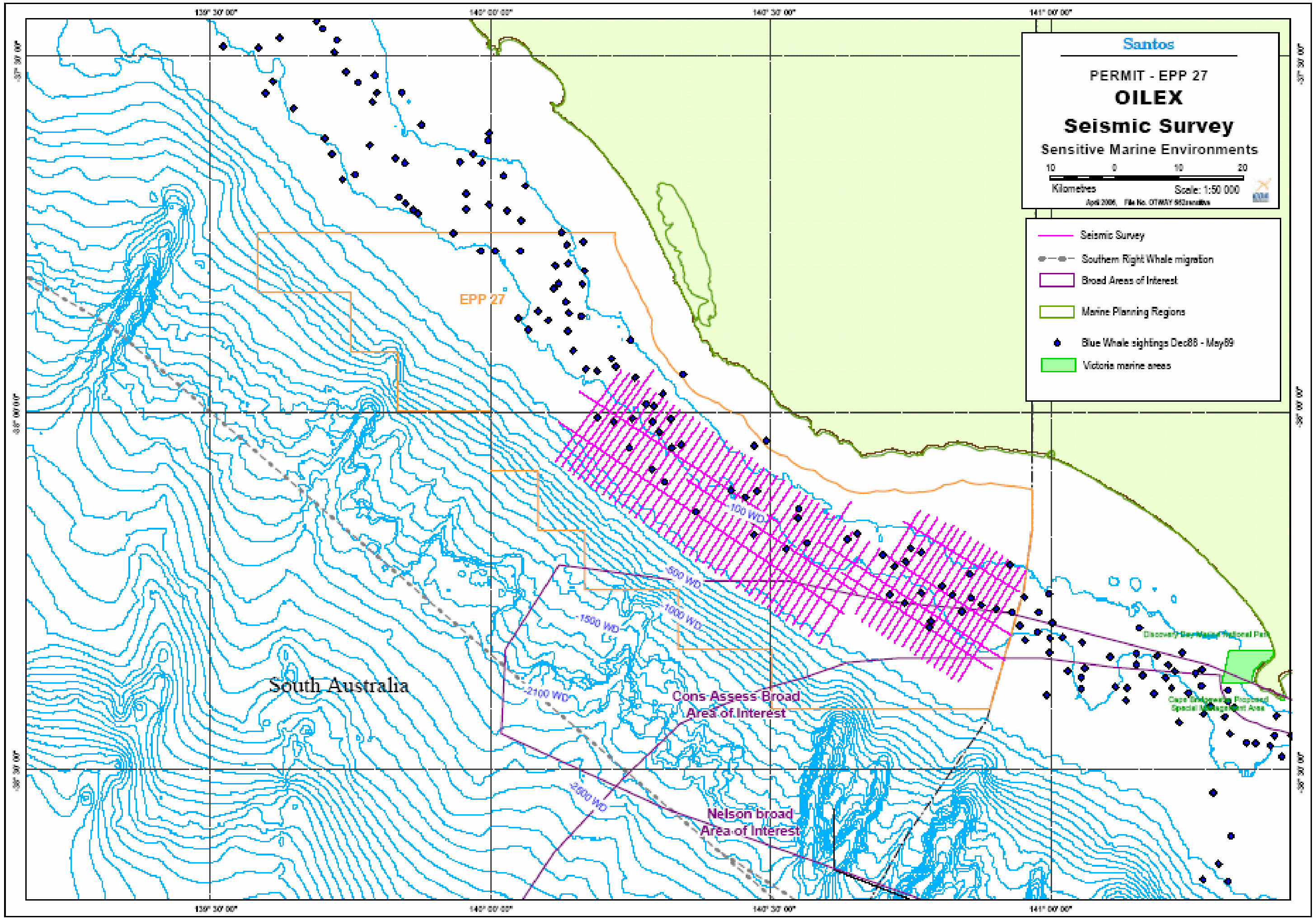


Table 1.3 Seismic survey program area coordinates

T/32P	
Latitude (GDA94)	**Longitude** (GDA94)
40 48 00S	142 49 00E
41 01 00S	143 18 00E
40 58 00S	143 23 00E
40 45 00S	143 23 00E
40 27 00S	143 47 00E
40 15 00S	143 37 00E
40 15 00S	142 49 00E
T/33P	
Latitude (GDA94)	**Longitude** (GDA94)
41 10 00S	144 21 00E
41 10 00S	144 10 00E
40 55 00S	143 55 00E
40 53 00S	143 42 00E
40 56 00S	143 35 00E
41 10 00S	143 35 00E
41 15 00S	143 40 00E
41 15 00S	143 45 00E
41 35 00S	144 03 00E
41 35 00S	144 15 00E
41 25 00S	144 35 00E
T/40P	
Latitude (GDA94)	**Longitude** (GDA94)
39 21 00S	143 09 00E
40 12 00S	143 09 00E
40 12 00S	143 04 00E
40 25 00S	143 04 00E
40 25 00S	143 20 00E
40 12 00S	143 46 00E
39 40 00S	143 46 00E
39 40 00S	143 41 00E
39 21 00S	143 41 00E
VIC/P50	
Latitude (GDA94)	**Longitude** (GDA94)
38 29 00S	141 08 30E
38 49 45S	140 52 30E
39 06 30S	141 25 45E
38 43 30S	141 34 00E
EPP27	
Latitude (GDA94)	**Longitude** (GDA94)
37 51 00S	140 09 45E
38 06 15S	140 38 45E
38 05 45S	140 47 15E

38 13 45S	141 04 00E
38 29 30S	140 54 45E
38 22 00S	140 39 10E
38 25 00S	140 37 00E
38 04 00S	139 57 40E
37 51 00S	140 09 45E

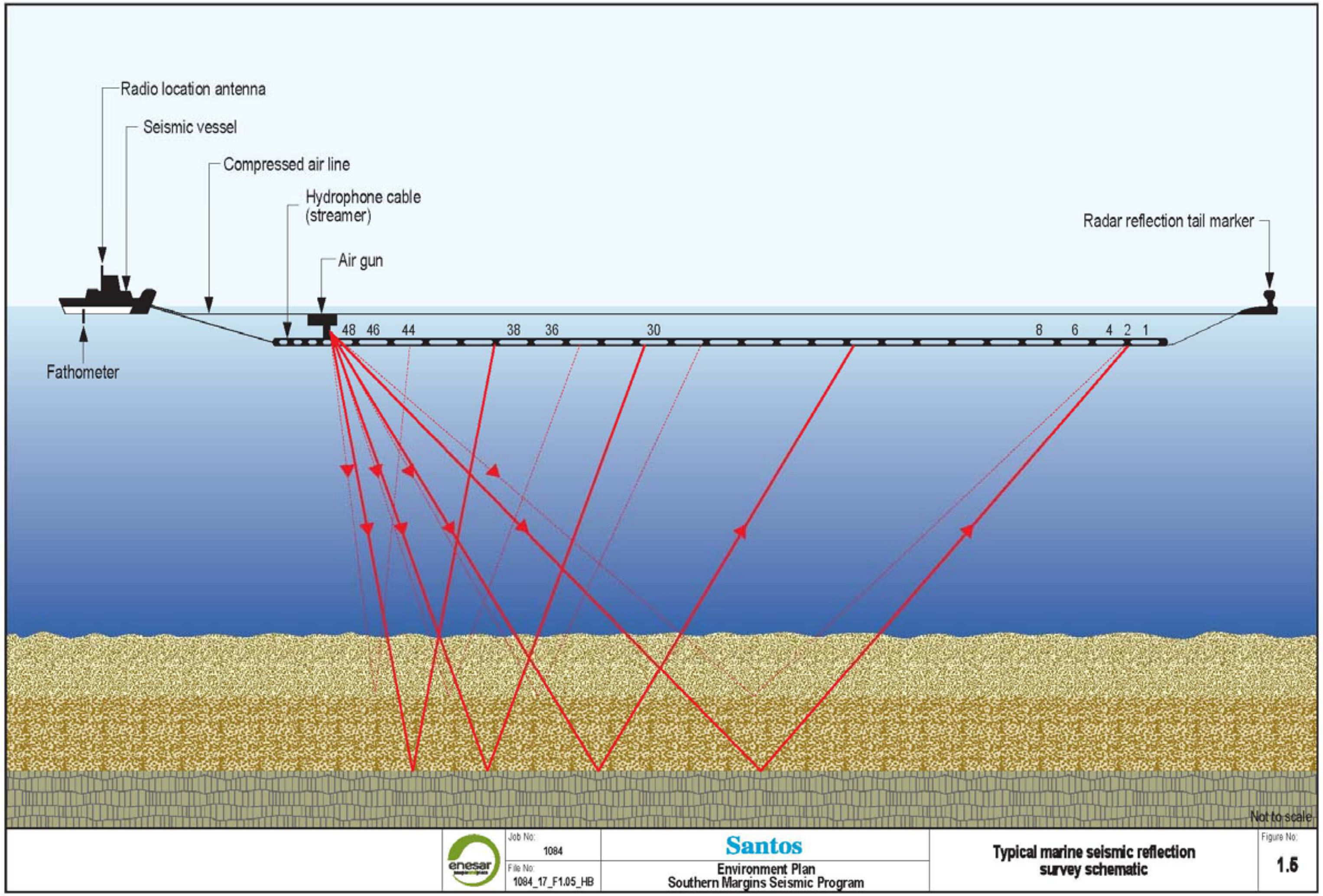
1.4 Background

Seismic exploration is undertaken to map the subsurface geology of an area and enable identification of potential petroleum reservoir rocks, such as sandstones. During a seismic survey, an acoustic pulse is generated by the rapid release of compressed air from a signal source (air-gun array) towed behind the seismic vessel. This pulse is reflected from the boundaries separating the rock layers in the subsurface, and the reflected signals are recorded by many hydrophones towed in a cable several kilometres long (Figure 1.5). This is a key step in exploration for hydrocarbons and there is currently no other method that has sufficient resolution to identify rock structure beneath the surface.

Marine seismic surveys are conducted using a specialised vessel towing the acoustic source and one or more hydrophone cables. The acoustic source for the Southern Margins Seismic Program will be comprised of one array, generating an acoustic (pressure wave) pulse at approximately 11 second (25 metre) intervals which travels as a seismic signal down through the geological layers. The seismic signals are reflected back and recorded by hydrophones towed behind the vessel in a single streamer cable between 5 and 7 km in length. The acoustic pulse is in the order of 220-240 dB re 1µPa within a few metres of the source at frequencies extending up to approximately 110 Hz (McCauley, 1994). These levels vary depending on sound propagation characteristics of the area (McCauley, 1994), such as water depth and seabed features, and with distance from the source. The acoustic source will have an operating pressure of about 2,000 pounds per square inch (psi) and a volume of 3,040 cubic inches.

The seismic survey vessel (the Multiwave 'Pacific Titan') will traverse the survey area along defined transects (or seismic lines), as shown in Figures 1.1 to 1.3. The hydrophone cable streamers are towed at a depth of approximately 7 metres below the sea surface depending upon sea conditions. Streamer depth is maintained by mechanical devices called 'birds' that prevent the equipment from making contact with the seabed.

Figure 1.4 Typical marine seismic reflection survey schematic



2. Description of Environment

2.1 Physical Environment

2.1.1 Climate

The climate of the seismic survey areas is summarised in Table 3.1, using the nearest towns as measurement tools.

Table 2.1 Climate of the seismic survey areas

Parameter	Cape Sorell (Tas)	Cape Nelson (Vic)	Robe (SA)
Distance to nearest seismic line	*70 km*	*50 km*	*90km*
Climate classification[1]	No dry season, mild summer	No dry season, mild summer	Moderately dry winter, warm summer
Average annual rainfall (mm)	633.9	784.8	1354.1
Mean number of rain days	153	189	236
Mean daily maximum temperature (°C)	18.1	17.0	14.9
Mean daily minimum temperature (°C)	10.9	11.1	9.5
Mean relative humidity (9 am) (%)	74	80	83
Mean relative humidity (3 pm) (%)	68	76	79
Mean wind speed (9 am) (km/hr)	16.5	24.3	22.8
Mean wind speed (3 pm) (km/hr)	17.4	25.5	25

Source: Bureau of Meteorology, 2005.
[1] Based on the Koppen climate classification of Australia, 30-year climatology (1961-1990) (Bureau of Meteorology, 2004.).

2.1.2 Oceanography

Tasmania

The tidal velocity of the survey area ranges from 0.04 to 0.16 m/s (moving west to east), with velocity increasing closer to the coast. The National Oceans Office (2002) indicates a western wind shift in the western part of Bass Strait.

The main surface current running southward along the continental slope in summer is the Zeehan Current. It transports warmer water down the west coast of Tasmania, and is somewhat weaker than the East Australian current and the Leeuwin Current (in the Great Australian Bight). During winter, the Zeehan current also runs north of King Island, bringing with it cold, nutrient-rich waters (National Oceans Office, 2002).

Victoria

High energy wave conditions are characteristic of the survey area, with more severe wave conditions occurring in winter. Wave heights in the Port Campbell region commonly range between 2.0 to 3.5 m for 50% of time however in winter they can reach 7.6 m (BHP Petroleum and Santos (BOL) Ltd, 1999).

Tidal range is considered microtidal, 0.8 – 1.2 m (IMCRA, 1998). There are two high tides and two low tides per day with levels in Port Campbell varying from 0 to 1.1 m (Woodside, 2003).

Wind driven currents are the most predominant in the area, generally running parallel to the coast and in a majority of the cases from west to east (BHP Petroleum and Santos (BOL) Ltd, 1999; Woodside, 2003).

Tidal currents are in the order of 0.1 m/s and run in an east to south-east direction for most of the time, and occasionally currents swing around to the west and north-west (BHP Petroleum and Santos (BOL) Ltd, 1999).

The typical thermocline temperature is 16.5°C, with surface temperature varying from 14.5 to 19°C and bottom temperatures in the area of 13.5°C to 14.5°C. There is a seasonal thermocline at a depth of 30 m in December which moves to 100 m in May and is then rapidly destroyed as mixing occurs during winter months (BHP Petroleum and Santos (BOL) Ltd, 1999).

Upwelling is known to occur along the Bonney Coast (Robe, SA to Portland, Vic) and extends through to the study area throughout the summer period (November-March) (Butler et al., 2002). This ‘Bonney Upwelling’ is a result of south-east winds generating water movements to the surface away from the coast. This water is replaced by colder water drawn from greater depths off the continental shelf that is generally nutrient-rich and plays an important role in the generation of plankton blooms (Woodside, 2003).

South Australia

The characteristics of the coastline and marine environment of this region include shallow to moderate offshore gradients, high wave energy coastline and cool temperature waters subject to nutrient-rich upwelling (IMCRA, 1998).

During the summer months in southern Australia, south easterly winds produce favourable conditions for ocean upwelling (see description in Victorian section above). This upwelling is a rare feature in the Great Australian Bight.

2.1.3 Seabed Bathymetry

Tasmania

The T32/P, T33/P and T40/P 2D seismic survey is located in water depths ranging from 100 to 2,900m in depth on the continental shelf and continental slope between 15 and 160 km (8 nm and 86 nm) from the west coast of Tasmania.

The DEH characterises the area covered by the T32/P, T33/P and T40/P permits as continental shelf slope with numerous canyons (DEH, 2003).

Victoria

The VIC/P50 area is located in water depths ranging from 100 to 2,500 m in depth, on the continental shelf slope, where numerous canyons are present (DEH, 2003).

The geology of the seabed on the continental shelf is likely to reflect the coastline geology and therefore consist of calcarenite, limestone, sandstone and marl, with areas of sand of varying grain size. Seabed collections in Bass Strait (Wilson and Poore, 1987) were taken from grabs, sleds and trawls over a large area of Bass Strait shelf and those between Cape Otway and Warrnambool (mostly between 50 and 180 m water depth) were characterised by medium to coarse sand, some with varying proportions of shelly carbonate sand and rock. Visual information obtained from remote underwater camera of the pipeline routes for the Casino and Geographe Thylacine projects (Santos 2004, Woodside 2003), shows the mixture of bare sand, coarse sand and shell, and patches of low-profile reef. Although these projects are located to the east of the proposed seismic survey, they are in similar depth ranges (70–100 m), and the types of seabed are likely to extend to the VIC/P50 survey area.

Less is known about the seabed bathymetry on the edge of the continental shelf and the shelf slope however the seabed is likely to consist of calcarenite, limestone, sandstone, marl and granite, with areas of sand of varying grain size. Benthic substrate can be expected to consist of sand, silt, gravel, calcareous gravel and calcareous ooze. Deep rocky reefs are likely to occur in much shallower waters north of the survey area.

South Australia

The EPP27 seismic survey is located in water depths ranging from 50-500m on the continental shelf and continental slope from 7-40 km from the South Australian coast. The continental slope within the survey area is steep (grading from a depth of 50 m to 1,500 m over a distance of 40 km). The slope and the abyssal plain along the Eyre Peninsula and the Bonney Coast are connected by over 20 large and steep canyons (Butler et al., 2002).

2.2 Biological Environment

2.2.1 Marine Fauna

Fauna of national significance that may be encountered within the Southern Margins Seismic Program area are listed in Table 2.1. The list is based on a search of the DEH EPBC Online Database (DEH, 2005) for the coordinates of the proposed survey areas. Unless otherwise specified, the list applies to all survey areas (Tasmania and Victoria).

Table 2.1 Marine fauna of national significance that may occur in the seismic survey area

Species	Common Name	Status
Whales		
Balaenoptera acutorostrata	Minke whale	LC
Balaenoptera bonaerensis	Antarctic minke whale	M

Species	Common Name	Status
Balaenoptera borealis	Sei whale	V, M
Balaenoptera edeni	Bryde's whale	M
Balaenoptera musculus	Blue whale	E, M
Balaenoptera physalus	Fin whale	V, M
Berardius arnuxii	Arnoux's beaked whale	LC
Caperea marginata	Pygmy right whale	M
Eubalaena australis	Southern right whale	E, M
Globicephala macrorhynchus	Short-finned Pilot whale	M
Globicephala melas	Long-finned pilot whale	LC
Kogia breviceps	Pygmy sperm whale	LC
Kogia simus	Dwarf sperm whale	LC
Megaptera novaeangliae	Humpback whale	V, M
Mesoplodon bowdoini	Andrew's beaked whale	LC
Mesoplodon densirostris	Blainville's beaked whale	LC
Mesoplodon grayi	Gray's beaked whale	LC
Mesoplodon hectori	Hector's beaked whale	LC
Mesoplodon layardii	Strap-toothed beaked whale	LC
Mesoplodon mirus	True's beaked whale	LC
Orcinus orca	Killer whale	M
Physeter macrocephalus	Sperm whale	M
Pseudorca crassidens	False killer whale	LC
Tasmacetus sherpherdi	Tasman Beaked whale	LC
Ziphius cavirostris	Cuvier's beaked whale	LC
Sharks		
Carcharodon carcharias	Great white shark	V, M
Seals		
Arctocephalus pusillus	Australian fur-seal	L
Dolphins		
Delphinus delphis	Common dolphin	LC
Grampus griseus	Risso's dolphin	LC
Lagenorhynchus obscurus	Dusky dolphin	LC
Lissodeplphis peronii	Southern right whale dolphin	LC
Tursiops truncatus s. str.	Bottlenose dolphin	LC
Birds		
13 species (genera *Diomedia, Phoebetria* and *Thalassarche*)	Albatross	M, L (3E and 10V)
4 species (genera *Halobaena*, *Macronectes* and *Phoebetria*)	Petrel	M (1E & 3V)
Catharacta skua	Great skua	L
Fish		
22 species	Pipefish	L
3 species	Pipehorse	L
2 species	Seahorse	L
2 species	Seadragon	L

L - listed, LC - listed cetacean, V - vulnerable, E - endangered, M – marine.

Those species and marine fauna groups that may occur in the project area at various times of the year (e.g., for feeding, breeding or migration) are discussed below.

Marine Mammals

Whales. The T32/P, T33/P and T40/P survey area lies approximately 50 km south of the south eastern margin of the Bonney Coast (which extends from Robe, South Australia to Cape Otway, Victoria). It is the nearest identified significant habitat (feeding, breeding and calving area) for species of whales including blue whales. The VIC/P50 survey area lies within the central region of the Bonney Coast, and EPP27 lies within the western margins of the Bonney Coast.

Whales of Commonwealth conservation significance that may occur in the seismic survey area (see Table 3.3) include blue, southern right and humpback whales; they are discussed below.

Blue whales (*Balaenoptera musculus*) (listed as endangered) have widespread migratory paths and are not known to follow coastlines or oceanographic features (Bannister et al., 1996). Until 1999, there were fewer than 50 sightings in Bass Strait but since that time, feeding blue whales have been more regularly observed in the Discovery Bay area, near to Portland and more generally along the Bonney coast from Robe to Cape Otway. The time and location of the blue whale appearance generally coincides with the cold-water summer-autumn upwelling along this coast (now referred to as the Bonney Upwelling) and the associated aggregations of the krill species *Nyctiphanes australis* (Environment Australia, 2002a; Gill, 2002; Gill and Morrice, 2003) upon which the whales feed. Most sightings are centred along the 100m isobath between Robe and Portland, between late November and April, but because each season has a unique upwelling signature, the exact timing and location of first appearance is difficult to predict (Gill pers. comm., 2003). During the 2003 and 2004 seasons blue whales have been sighted in the first half of November during seismic survey operations.

Off Cape Bridgewater in Victoria, blue whale sightings are concentrated along the shelf break but are more dispersed over a wider shelf and deepwater area to the northwest and southeast (refer Figure 1.3 and 1.4). There are few sightings of blue whales off the western Tasmanian coast, although Bannister et al. (1996) reports sightings off east and west Tasmania. The survey area has not been identified a critical habitat (feeding, breeding or calving) for this species.

Southern right whales (*Eubalaena australis*) (listed as endangered) congregate every year from about May to October off the Warrnambool coast approximately 100 km east of the VIC/P50 survey area, 150 km northwest of the T32/P, T33/P and T40/P survey area and 160 km east of the EPP27 survey area. They have breeding cycles of three years (Environment Conservation Council, 2000). Encounter Bay, approximately 200 km northwest of the EPP27 survey area is described as an area of frequent use by Environment Australia, and Logans Beach near Warrnambool is one of several known over-wintering and nursery areas for this species along the southern Australian coast. Southern right whales may migrate through the survey areas, travelling north from

Antarctic waters, from early May to the end of June, but there is no known critical habitat (feeding, breeding or calving) for the species in the survey areas.

Humpback whales (*Megaptera novaeanglia*) (listed as vulnerable) occur in coastal areas of Australia in winter and spring. Western Tasmanian and Victorian coastal waters are not a key location for this whale species. Most east coast humpbacks migrate along the east coast of Tasmania, between summer feeding grounds in the Antarctic and winter breeding and calving grounds in sub-tropical east coast Australia. A discrete population of humpback whales that uses the west coast of Tasmania and Bass Strait for this migration may pass the survey areas. Some animals have also been observed in the eastern Great Australian Bight (e.g., near Kangaroo Island) in early winter (Bannister et al., 1996). From these migratory patterns, their presence may be expected moving northwards during autumn and southwards in spring. However, exact timing is difficult to predict. During Santos' 2002 seismic surveys in the deep water Otway Basin several humpback sightings were made during November.

Sei whales (*Balaenoptera borealis*) are rare in Australian waters, but have been observed offshore of Tasmania and in the eastern Great Australian Bight (Bannister et al., 1996). Their distribution is mainly deep-water and not often found near coasts. They are known to undertake long migrations between warm water breeding grounds and colder water feeding grounds, but specific locations and migration paths are not well known. In general, just the one sei whale has been seen each season during Santos' extensive aerial survey and seismic observations along the Southern Margins.

Pygmy right whales (*Caperea marginata*) are generally found in temporal subantarctic waters, and oceanic, pelagic and inshore sightings have also been made. There have been sightings of this whale from Tasmania and South Australia, and the frequency of strandings (two or three a year) suggests that it is not rare in southern Australian waters (Bannister et al., 1996).

Killer whales (*Orcinus orca*) are commonly found in cold deep waters. Off Australia, they are often seen along the continental slope and on the shelf as well as often being seen near seal colonies (Bannister et al., 1996). Concentrations of the species are believed to occur around Tasmania and South Australia (Bannister et al., 1996). Although not a migratory species, their movements vary seasonally and are related to food supply (Bannister et al., 1996).

Minke whales (*Balaenoptera acutorostrata*) tend to migrate in wide migration paths from cold water feeding grounds to warmer waters to breed during the winter period (Thiele and Gill, undated; Bannister et al., 1996). The mating period for minke whales occurs from August to September and calving occurs from June to July (Bannister et al., 1996). Their distribution is worldwide and oceanic but not restricted to deep waters. There are no specific habitats identified in the vicinity of the survey area.

There are two forms of the Bryde's whale (*Baleonopetra edeni*); an inshore and an offshore form. It is typically found in tropical and temperate waters from the equator to approximately 40°S both in deeper oceanic waters and inshore (IFAW, undated;

Bannister et al., 1996). Mating occurs throughout the year for the inshore form and during autumn/winter for the offshore form (Bannister et al., 1996).

The sperm whale (*Physeter macrocephalus*) is found in deep waters off the continental shelf, with a strong preference for the 1,000 m depth contour (Perry et al., 1999; Anonymous, 2001) and rarely seen at depths less than 300 m (Anonymous, 2000). Concentrations of sperm whale populations are generally found where the seabed rises steeply from great depths. This may coincide with areas where potential food sources (cephalopods) are concentrated particularly in areas of upwelling (Bannister et al., 1996). According to Bannister et al. (1996) key localities for the sperm whale include waters off Tasmania’s west and south coasts, and southwest of Kangaroo Island. The sperm whale mating season is between September to December, with calving occurring between November to March (Bannister et al., 1996; Perry et al., 1999). There are no known specific calving locations in Australian waters for the sperm whale but they are known to occur in temperate and tropical oceanic waters (Bannister et al., 1996). A number of sperm whale sightings have been made in deep waters between Western Tasmania and West of Kangaroo Island during seismic surveys conducted by Santos in 2002, 2003 and 2004.

Other Marine Mammals. Risso’s dolphin (*Grampus griseus*) is considered a pelagic and oceanic species also frequently seen over the continental slope (Bannister et al., 1996). Dusky dolphins (*Lagenorhynchus obscurus*) predominantly occur in temperate subantarctic zones inshore but also pelagic at times (Bannister et al., 1996). The common dolphin (*Delphinus delphis)* is found in neritic, pelagic and oceanic habitats in all oceans. This species has been associated with high topographical relief of the ocean floor, escarpments and areas of upwelling (Bannister et al., 1996). The bottlenose dolphin (*Tursiops truncatus*) is generally found in coastal estuarine pelagic and oceanic habitats. In southern Australia, this species can occur close to shore (i.e., within a few hundred meters of the coastline) as well as in waters beyond the continental slope (Bannister et al., 1996) all year round.

A summary of the timing of peak whale activities in and around the Otway Basin is provided in Table 2.2. The timing of these activities are peak only, and individuals of the species listed still have the possibility of occurring in the Otway Basin outside of the times indicated in Table 2.2.

Table 2.2 Summary of peak whale activities in the Otway Basin

Species	**Activity**	**Month**											
		J	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Southern right whale	Migration, calving, nursing					■	■	■	■	■	■		
Blue whale	Feeding aggregation	■	■	■	■	■							■
Humpback whale	Migration												■
Sei whale	Probably feeding	■	■	■									■
Fin whale	Probably feeding	■	■	■									■
Minke whale	Probably feeding	■	■	■									■
Beaked whale*	Probably feeding	■											■

* Species unknown.

Sharks. There is a long-term decline in the abundance of white sharks (*Carcharodon carcharias)* in Australian waters. White sharks (*Carcharodon carcharias*) are uncommon but there are areas in Australian waters where they appear to be more frequent (Environment Australia, 2002b), including around seal colonies (e.g., Neptune Island and The Pages). Juveniles are most commonly encountered in inshore areas, often in the vicinity of open coast beaches. Western Tasmanian waters do not appear to provide any significant habitat for the species (i.e., they lack seal colonies that the shark appears to favour as feeding grounds) (Environment Australia, 2002b).

Grey nurse sharks (*Carcharias taurus)* are not common in southern Australian waters (Environment Australia, 2002c).

Pinnipeds. The Australian fur-seal (*Arctocephalus pusillus*) range includes South Australia, southern Tasmania, New South Wales and Victoria (Shaughnessy, 1999), but it breeds only on islands in Bass Strait (Strahan, 1995; Shaughnessy, 1999), and it has been recorded at Kangaroo Island although this is not an established breeding colony. Preferred habitat is on rocky islands in exposed places close to the sea, on open slopes, shore platforms and reefs, pebbled beaches and caves (Strahan, 1995). The Australian fur seal diet consists of fish, cephalopods and seabirds (Shaughnessy, 1999), diving up to 200 m in search of prey (Strahan, 1995). Births occur from late October to late December (Strahan, 1995; Shaughnessy, 1999).

A. pusillus has established four breeding areas on islands in Victoria and five breeding areas on Tasmanian islands in Bass Strait (Shaughnessy, 1999). In Victoria the largest breeding colonies are at Lady Julia Percy Island and Seal Rocks (Shaughnessy, 1999). There are several small non-breeding colonies, one of which is at Little Henty Reef near Apollo Bay (Woodside, 2003). In Tasmania the breeding areas include Tenth Island, Moriarty Rocks, West Moncoeur, Judgement Rocks and Reid Rocks, the latter two the largest.

Australian fur-seals are present in the region of the VIC/P50 survey all year round, however estimates of the numbers that utilise the area are lacking (Woodside, 2003).Breeding areas are well north east of the Tasmanian survey area.

New Zealand fur-seals (*Arctocephalus forsteri*) from populations at Kangaroo Island may also forage in western Victoria.

The Australian sea lion (*Neophoca cinerea*) is endemic to Australian waters and has its principal breeding colonies at Kangaroo Island and Dangerous Reef, near Port Lincoln (Shaughnessy, 1999). Sea lions stay relatively close to the colonies and do not undertake migrations. They come ashore on sandy beaches, and usually spend their entire life very close to their birth area. Its diet consists of fish, cephalopods, penguins, sharks and sea birds (Strahan, 1995; DPIWE, 2003a). Breeding females are benthic feeders on the continental shelf 20-30 km offshore, diving to depths of less than 150 m (DPIWE, 2003a).

Seabirds. Marine birds are not listed in Table 3.3 as they are mostly migratory, and may overfly the project area but are highly unlikely to be impacted by the activity. The Bay of

Islands (west of Peterborough) and the offshore limestone stacks are important roosting and breeding colonies for many bird species, including the pacific gull (*Larus pacificus*).

There are 13 species of migratory albatross listed as occurring across all the survey areas, of which three species are endangered and nine are vulnerable. There are four threatened species of petrel, of which one is endangered and three are vulnerable.

Pipefish and Seahorses. Pipefishes, seahorses and seadragons are associated with kelp forests in sheltered to moderately exposed reef areas at a range of depths 0-50 m depending on the species (Edgar, 1997). They are unlikely to be found in high numbers in the areas where the seismic surveys will take place due the water depths in the project areas.

2.3 Socio-Economic Environment

2.3.1 Maritime Heritage

Shipwrecks are most commonly associated with submerged shallow reefs. Shipwrecks represent significant archaeological, educational and recreational (i.e., diving) opportunities for the general public, historians, students, and tourists. No known shipwrecks occur in the survey areas (Larcombe et al., 2002), nor are any expected due to the surveys being located in open seas a significant distance from coastal waters.

The nearest shipwrecks to the T32/P, T33/P and T40/P permit areas are situated along the northern part of the west coast, with a high concentration of shipwrecks along King Island's west coast, where about eight shipwrecks rest. Shipwrecks closest to the VIC/P50 area occur all along the west coast, also referred to as the 'Shipwreck Coast', while the nearest shipwrecks to the EPP27 permit area are located in Guichen Bay at Robe and along the South East coast (Larcombe et al., 2002).

2.3.2 Commercial Fisheries

A variety of marine species are commercially harvested from the Southern Margins Seismic Survey area. Table 2.3 outlines the commercial fisheries present within the survey areas.

Table 2.3 Commercial fisheries in the Southern Margins Seismic Program area

Fishery	T/32P, T/33P & T/40P (Tas)	VIC/P50 (Vic)	EPP27 (SA)
Commonwealth-managed fisheries			
South East Fishery (SEF)	Y	Y	Y
Gillnet, hook and trap	Y	Y	Y
Eastern tuna and billfish	Y	Y	-
Southern tuna and billfish	-	-	Y
Jack mackerel	Y	Y	Y
Southern squid	Y	Y	Y
State-managed fisheries			
Southern rock lobster	Y	Y	Y
Giant crab	Y	Y	-
Scale fish	Y	-	-

The commercial fisheries present within the survey areas are discussed below.

South East Fishery

The South East Fishery (SEF) fishes more than 100 species, but 17 species or species groups provide the bulk (>80%) of trawl landings. Such species include the orange roughy, gemfish, flathead, blue grenadier, redfish, school whiting, warehou and jackass morwong (BRS, 1994; AFFA, 2003). All survey areas coincide with fishing in the SEF.

Trawling along the shelf edge could potentially take place. Communication systems with the commercial trawl operators will advise of day-to-day activities to avoid interactions.

Gillnet, Hook and Trap Fishery

The Gillnet, Hook and Trap Fishery (formerly the Southern Shark Fishery and South East non-Trawl Fishery) extends from southeast Queensland to the South Australia/Western Australia border. Among the 21 species subject to quota arrangement include blue eye trevalla, blue grenadier, flathead, gemfish, john dory, orange roughy, royal red prawn and silver trevally (AFMA, 2003). Shark species caught include school and gummy shark, with school shark overfished (BRS, 2003). Methods of fishing include demersal longline, dropline, trotline and handline for scalefish, hook to target sharks, gillnets in waters deeper than 200 m and fish traps (AFMA, 2003). All survey areas coincide with fishing in the Gillnet, Hook and Trap Fishery.

Shark gill netting and long lining may occur periodically along shelf edge depths in the survey areas. Communication systems with the shark fishers will advise of day-to-day activities to avoid interactions.

Southern Squid Jig Fishery

The Southern Squid Jig Fishery, which mainly targets the arrow squid (*Nototodarus gouldi*), is located in Commonwealth waters of southeast Australia in water depths ranging from 50 to 200 m, with peak catches being between January and June (AFMA, 2003). In August 2002, there were 84 squid jig entitlements. The 2000-2001 catch was 1,830 tonnes, worth $2.8 million (AFMA, 2003).

The Southern Squid Jig Fishery fishes areas mainly around Portland and Queenscliff in Victoria, close to the coast between January and June. The surveys will predominantly be carried out in areas other than those used by Southern Squid Jig fishers, so the potential impacts to the fishery are likely to be minimal.

Communication systems with the Southern Squid Jig fishers will advise of day-to-day activities to avoid interactions.

Southern Tuna and Billfish Fishery

This fishery extends south of the 200 m isobath. The primary species caught in the Southern Tuna and Billfish Fishery includes bigeye, skipjack and albacore tunas. There are 124 fishing permits for the fishery, with the value of production at $4.3 million in 1998/1999 (AFMA, 2003).

Only the EPP27 survey area coincides with fishing in the Southern Tuna and Billfish Fishery. The majority of southern bluefin tuna are caught from the Great Australian Bight, northwest of EPP27, and it is unlikely that impacts to the operations of this fishery will occur.

Eastern Tuna and Billfish Fishery

The Eastern Tuna and Billfish Fishery extends from the northern coast of Australia south to the Victoria/South Australia border, encompassing Tasmania. Species targeted using longline and minor line includes yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus abesus*) and broadbill swordfish (*Xiphias gladius*), while purse seine fishing (yielding low quantities) targets the skipjack tuna (*Katsuwonus pelamis*) (AFMA, 2003). The fishery has 311 fishing concessions, and its estimated value in 2001-2002 was $56 million (AFMA, 2003).

The majority of are caught along the east coast of Australia and it is unlikely that impacts to the operations of this fishery will occur.

Southern Bluefin Tuna Fishery

Southern bluefin tuna (*Thunnus maccoyii*) is a migratory species and has a wide distribution through the southern oceans. Southern bluefin tuna stocks are severely depleted and at historically low levels (AFMA, 2003). Around 98% of Australia’s southern bluefin tuna quota is taken by 5-10 purse seine vessels fishing in the Great Australian Bight. The tuna are towed alive back to static grow out cages off Port Lincoln and fattened for up to 6 months before harvest and export to Japan. Southern bluefin tuna is a largely incidental catch for long-line vessels operating in southern Australian waters (AFMA, 2004). The fishery operates year-round.

Communication systems with the Southern Bluefin Tuna fishers will advise of day-to-day activities to avoid interactions.

Southern Rock Lobster Fishery

The Southern rock lobster (*Jasus edwardsii*) occurs from the southwest of the Western Australian coast to southern New South Wales, including waters around Tasmania and New Zealand. The southern rock lobster fishery is an extremely valuable fishery (e.g., it was the second-most valuable fishery in Victoria in 2000/2001, worth $21.3 million (DPI, 2003a)).

Southern rock lobsters are abundant from the shoreline to depths up to 200 m (DPI, 2003a), but generally fished from rocky reefs in shallower waters up to 150 m deep. Commercial fishers mainly use lobster pots while recreational fishers use SCUBA and hook netting (DPI, 2003a). Pot numbers and dimensions are restricted (pot and escape gap size) to ensure sustainable commercial harvests.

In Tasmania, there are 315 fishing licences and 228 vessels participating in the Southern Rock Lobster Fishery (DPIWE, 2004), and fishing occurs. The closed season for female rock lobster is May 1 to 5 November, and is closed between September 1 and November 5 for male rock lobsters (DPIWE, 2004).

The VIC/P50 survey area lies within the Victorian Western Zone, which extends from Apollo Bay to the South Australian border. There are 89 Rock Lobster Fishery Access Licences (RLFAL) in the Western zone, with 5,388 licensed pots (Hobday & Smith, 2001), out of a total of 139 licences for Victoria (2001/2002) (DPI, 2003a). There is a closed lobster fishing season for female rock lobsters from June 1 to November 15, and for males starting September 1 to November 15 (SIV, 2004).

In South Australia, EPP33 lies within the Southern Zone, which extends from the Victorian border to the Murray River (PIRSA, 2004). In South Australia, the rock lobster season is closed from June 1 to November 1 in the Southern Zone (PIRSA, 2004).

Predominantly surveys will be carried out in waters deeper than those used by lobster fishers, so the potential impacts to the fishery are likely to be minimal.

Consultation with rock lobster fishing groups has been undertaken to ensure mutual awareness of each other’s planned activities.

Giant Crab Fishery

The giant crab (*Pseudocarcinus gigas*) is only found in southern Australian waters from central NSW to south western Australia, including Tasmania. Giant crabs occur at the continental shelf break and upper slope to depths greater than 400 m, however, they are most abundant at depths between 150 m to 350 m (DPI, 2003b), and primarily taken from depths between 140 and 270 m (DPIWE, 2003). The giant crab season is the same as that for the southern rock lobster (i.e., closed season for female giant crab is May 1 to 5 November, and is closed between September 1 and November 5 for male giant crab) (DPIWE, 2004).

Targeted crab potting operations may occur in shelf break and upper continental slope depths in all three survey areas. Communication systems with the crab fishers will advise of day to day activities to avoid interactions. As many are rock lobster fishers with licences endorsed to take crabs, the communications will be appropriate for both operations.

3. Environmental Hazards, Management Approach and Controls

Santos is committed to conducting our operations in a manner that is compatible with the environmental and economic needs of all communities in which we operate.

The seismic survey will be conducted in accordance with the Santos EHSMS and Santos Environmental Policy. Santos developed the EHSMS based on international standards and industry best practice for application to all Santos operations. The Santos EHSMS consists of two sets of standards; “management” and “hazard”.

The framework has been developed to ensure that Santos’ system is compliant with AS 4801: 2000 (Occupational Health and Safety Management Systems) and AS/NZS ISO 14001:1996 (Environmental Management Systems). Development of the Santos EHS Management Standards was completed and approved in July 2003. This has involved the drafting, management review, and approval of 18 Management Standards, which all sites are required to implement.

Management Standards are documents that define the requirements necessary to ensure that environmental, health and safety risks are systematically managed. Hazard Standards are documents which detail the specific controls required to manage the risks of specific hazards to acceptable levels.

For each standard, an assessment guide and auditor guide has been, or will be developed. The assessment guides are used to evaluate the status of implementation of the standard while auditor guides are used to determine the level of conformance to the standard. The auditor guides provide additional detail as to the requirements for practical implementation.

The contractor is required to implement and comply with the EHSMS procedures, or have equivalent procedures in place.

3.1 Potential Environmental Hazards

The environmental hazards (and main associated consequences) of the seismic program are:

- Discharge of high intensity sound.
  - Disturbance or injury to marine fauna.
- Physical presence of the vessel.
  - Disturbance or injury to marine fauna.
  - Interference with commercial shipping and fishing.
  - Collision with other vessels.

- Waste disposal (sewage, putrescible waste, chemicals and solid and hazardous wastes).
  - Increased nutrient levels.
  - Water contamination.
  - Low-level contamination of some fauna species.

- Hydrocarbon spills – spillage from the survey vessel or from the streamer.
  - Increased nutrient levels.

- Hull maintenance.
  - Low-level contamination of some fauna species.

These hazards are discussed below.

3.1.1 Discharge of High Intensity Sound

Seismic surveys use an exploration technique that uses the controlled release of compressed air to make sound waves that travel into the seabed and reflect back from rock layers under the sea floor. With the experience of over three decades of seismic surveying, no evidence has been found to suggest that seismic operations have resulted in physical injury or damage to hearing in any marine mammal.

The oil and gas industry has carefully studied the use of sound waves as an exploration tool and their effect on marine species and to the point were we believe that seismic activities can be managed with minimal impact on the environment.

Due to the potential to encounter cetacean species in oceanic waters DEH's guidelines for avoiding interference with larger cetaceans during seismic surveys (Environment Australia 2001) will be implemented. Key aspects of the controls include:

- Dedicated marine mammal observers to monitor for cetaceans throughout the survey;

- Soft starts (gradual ramp up of acoustic source during start up);

- Pre-start up observations to ensure cetaceans are not within 3km of the boat when the acoustic source commences firing; and,

- Source shutdowns when cetaceans are identified within 3km of the source array.

3.1.2 Physical Presence of the Vessel

Santos has undertaken an extensive program of consultation with fisheries operating in the area, with the objectives of:

- Raising awareness of the survey; and

– Minimising the impact of the survey on the local fishing industry;

Communication systems with the fishers will advise of day-to-day activities to avoid interactions.

3.1.3 Waste Disposal

Routine discharges from seismic vessels are restricted to sewage and putrescible wastes (food scraps).

Sewage and Putrescible Wastes

Disposal of sewage and putrescible wastes overboard will be a routine discharge to the environment except when the vessel is within 3 nautical miles of the coast. Out side of this distance the disposal of sewage and putrescible wastes to the ocean that have been treated in accordance with the requirements of MARPOL Annex IV is considered to be best practice management for these waste types.

Disposal of sewage and putrescible wastes overboard may increase the nutrient content in the water column, acting as a food source for some organisms and temporarily altering the species diversity and richness in a localised area for a short time (i.e., a number of hours or days). Sewage will be treated through an on-board effluent treatment plant that meets regulatory requirements prior to being discharged to sea. Sewage and putrescible wastes will be macerated to less than 25 mm diameter prior to being discharged to sea. No sewage or macerated putrescible wastes shall be discharged within 3 nm of land (under the P(SL)Act).

Solid Wastes

The seismic vessel also produces other solid and liquid wastes, including packaging and domestic wastes, such as aluminium cans, bottles, paper and cardboard. A variety of chemicals, such as lubricating oils and cleaning chemicals, are also stored and used on the vessel. Many of these items are consumed through use and are not accumulated in significant quantities as waste.

Solid waste items (e.g., aluminium cans, bottles, paper and cardboard) released to the marine environment have the potential to pollute seabed habitats or injure or kill marine fauna through ingestion. This risk of this occurring during the survey is extremely low, as all solid consumable materials will be safely stored on board to prevent accidental releases to the ocean. Solid inert combustible wastes will be incinerated on-board. Non-combustible solids will be returned to shore for disposal.

Hazardous Wastes

Hazardous wastes, generally of low quantity (mainly lithium batteries and small volumes of acids, solvents, paints and solvents), will be segregated and stored in sealed storage areas and transferred to onshore licensed hazardous material handlers for disposal to a licensed depot.

3.1.4 Hydrocarbon Spills

The following hydrocarbons have the potential to be spilt from the survey vessel:

- Fuel.
- Diesel (from power generation).
- Oil from hydraulic hoses and oil drums.
- Kerosene from the streamers.

Hydrocarbon spills have the potential to cause adverse impact to marine organisms. Many marine species have a larval stage, which is free-floating and potentially vulnerable to an oil spill. Shellfish can become tainted if oil is ingested, even at low concentrations. Seabirds may suffer from hypothermia that can result in death as oil reduces the insulation properties of feathers. Embryo chicks in eggs may be prevented from receiving oxygen if their shells become coated with oil (on brooding parent's feathers). Seabirds may ingest the oil while feeding or preening and may be poisoned.

Oil may contaminate the skin and damage the digestive system of some cetacean species. Indirect effects may include the destruction of habitats and reductions in the population of staple prey.

Risks of any significant spills from seismic activities are low, because no refuelling at sea will be undertaken. Any spills will be recorded in a wastes and emissions log, reported to Santos and regulatory authorities advised in accordance with regulatory requirements. In addition, petroleum legislation requires a safety and emergency response plan to be submitted to the designated authority for approval prior to any activities commencing. Measures to minimise the risk of a fuel or oil spill include the following:

- Satellite navigation of survey vessel assisted by constant visual observation.
- Communications shall be constantly maintained with other vessels operating in the area to advise of the location of the survey vessel and avoid collision.
- The depth at which the hydrophone cables travel is controlled by 'birds' which ensure a constant depth of approximately 7 m.
- Tail buoys maintain the transect line of each hydrophone cable.
- The Vessel Master will cease operating and seek safe harbour (or deep water) where extreme conditions make it unsafe to continue survey operations.

The survey parameters are well inside safe operational requirements. The mitigation measures listed will reduce any potential fuel or oil spill risk to as low as reasonably practicable.

3.1.5 Hull Maintenance and Ballast Exchange

As with any vessel, the Pacific Titan undergoes regular anti-fouling of the hull (to prevent the build up of barnacles and other organisms that increase the drag on the vessel, leading to increased fuel consumption). The main chemical used in the anti-fouling agent, tributylin (TBT), persists in the environment by attaching itself to muds (accumulating in sediments), and in high concentrations can have toxic effects on marine organisms through bioaccumulation. The impact of TBT leaching off a single vessel in open waters has been found not to be detrimental to marine life (Fabris et al., 1995) and remains under the ANZECC Guidelines for Fresh and Marine Water Quality (2000) TBT trigger value of 0.0004 μgL^{-1} for the protection of 99% of species in marine waters.

As a non-cargo carrying vessel it is not necessary for the Pacific Titan to exchange ballast water during survey or other operations. The vessel also spends limited time in port to transfer people and supplies during the seismic programs. Depending upon the nature of the operations being undertaken port calls are usually undertaken on a monthly basis with the vessel spending less than 24 hours in port at each time.

Prior to being contracted to Santos the Pacific Titan will have been undertaking seismic surveys in Victorian and New Zealand waters for several months for other operators. Due to the nature of the seismic vessels operations being predominantly in open waters with limited port visits and no ballast exchange the risk of introducing exotic marine pests is considered to be very low.

Verification of anti-fouling of the hull will be provided by the survey contractor, who will advise when anti-fouling paint was last applied to ensure that the risk of exotic species introduction from the hull is being appropriately managed.

The trailing equipment of streamer lines and acoustic source arrays is all stowed on deck during the passage from the vessel's last deployment, rather than towed behind the vessel during non-survey periods. The risk of introducing exotic marine pests from the streamers is therefore very low.

3.2 Controls

Table 3.1 contains a summary of the key environmental risks associated with the survey and control measures implemented to reduce the risk to as low as practicable.

Table 3.1 Identified Environmental risk and mitigation measures

Risk Identification			Risk Treatment
Activity	**Hazard/Risk**	**Potential Consequence**	**Safeguards/Mitigation Measures**
Acoustic source discharge	Impacts to cetaceans.	Alteration of cetacean behaviour, interfering with normal activities such as breeding, feeding and migration, temporary threshold shift. interactions with blue or other species may occur. Survey areas are located significant distances from key whale aggregation areas but interactions may occur. Surveys are likely to evoke avoidance response in whales only, but unlikely to displace species from key habitat or migration paths.	• Each survey is of short duration (between 5 and 30 days). • Santos is proposing to undertake aerial surveys across the seismic survey areas prior to the commencement, subject to weather conditions in the survey area. The need to undertake repeat surveys will be made based on the results of the initial survey at each survey area. • DEH (2001) cetacean observation and seismic operations guidelines will be employed: • 90 minutes visual observation prior to soft start. • 30 minutes soft start following visual observation. Soft start not to commence if any larger cetaceans are within 3km of the vessel. • The vessel bridge crew will undertake observations during recording operations as part of their general duties. • Seismic operations will shut down if a whale comes within 3 km of the operating seismic vessel. • Seismic acquisition will not recommence unless the whale(s) have been seen to move outside of the 3 km range or have not been seen for at least 30 minutes. • Low volume acoustic source will remain operational during line changes. This will negate the need for pre-soft start observations prior to each line. • If the acoustic source is inactive for longer than 20 minutes then pre-start visual observations and soft start procedures will be followed. • All whale and dolphin sightings will be reported to the DEH. • Santos has deployed underwater acoustic loggers to build on previous research on whale vocalisations and noise attenuation, for purposes of improving understanding for future reference
	Impacts to pinnipeds (seals).	No direct effects known due to apparent tolerance to high intensity seismic. May effect prey species (see fish).	• Each survey is of short duration (between 5 and 30 days) and not within close proximity to critical breeding or feeding habitat. • No action necessary
	Impacts to plankton or planktonic larvae	Potential lethal or pathological effects in close proximity to air guns.	• Presence of any krill swarms will be noted.

Table 3.1 Identified Environmental risk and mitigation measures (cont.)

Risk Identification			Risk Treatment
Activity	**Hazard/Risk**	**Potential Consequence**	**Safeguards/Mitigation Measures**
	Impacts to divers.	Potential health effects for divers within close proximity to acoustic source. Temporary displacement of recreational or commercial diving activities.	• Surveys in each permit area will be of short duration and will be undertaken in water depths generally deeper than those used by recreational or commercial divers. • Santos will liaise with any relevant diving associations prior to the seismic program. • The recommended operating buffer of 1,500 m advised for diving (DMAC, 1979) will be enforced.
Physical presence of vessel	Impacts to commercial fisheries.	Reduction in fish catches or interference with fishing activities likely to be localised and short term.	• Industry and government guidelines available on the avoidance of conflict with commercial fisheries will be adhered to. • Consultation with the commercial fishing industry groups will take place prior to the seismic program to agree impact mitigation measures. • Liaison and communication with commercial fishers regarding daily schedules and work plans will occur during operations. • Planned compensation agreements for actual commercial loses with be negotiated with affected fishers (if necessary).
	Collision with large cetaceans.	Death or injury of large cetaceans.	• Program is over 50 kilometres from key whale migration and aggregation areas. • Seismic vessels move slowly permitting greater response time for evasive action by vessel and/or whale to avoid collision (i.e., risk is less than for normal commercial shipping). • DEH (2001) cetacean observation and seismic operations guidelines (refer Appendix 1), and initial aerial surveys will be employed (refer to first row of this table).
	Impacts to water based leisure craft recreation activities.	Temporary displacement of aquatic recreation activities and potential collision hazard.	• Seismic surveys undertaken in areas generally too far offshore for leisure boat activities. • All vessel operations will be conducted in compliance with the AMSA OSV Code (e.g., radar monitoring, vessel communications). • Watch will be maintained on survey vessel for other craft.

Table 3.1 Identified Environmental risk and mitigation measures (cont'd)

Risk Identification			Risk Treatment
Activity	**Hazard/Risk**	**Potential Consequence**	**Safeguards/Mitigation Measures**
Waste discharge to sea	Localised increase in nutrient levels for short period. Pollution of habitat.	Changes in planktonic or benthic communities due to altered water quality levels. Injury or death from ingestion of solid wastes.	• No waste discharges to the marine environment in State waters (3 nm from the coast). • Sewage will be treated prior to disposal offshore in accordance with MARPOL regulations (Annex IV). • Putrescible wastes will be macerated to a maximum particle size 25mm prior to being discharged to sea. • Solid wastes, hazardous wastes and liquids will be returned onshore for appropriate disposal. • Waste register will be maintained to record waste management practices and audited to verify compliance. • Procedures for disposal of minor discharges of treated sewage and macerated putrescible wastes will be detailed in the vessel's Health, Safety and Environment Plan.
Small volume hydrocarbon spill (e.g., from streamer cable rupture)	Reduced water quality.	Mortality of planktonic or benthic organisms due to hydrocarbon toxicity. Smothering of marine and coastal flora and fauna.	The seismic program will not be conducted during extreme weather conditions. • Streamers (filled with light kerosene type petroleum, 95% of which evaporates or degrades (from light exposure) within 24 hours of spill) are segmented to limit potential spill volumes. • All necessary oil spill contingency plant and equipment will be functional and accessible. • No refuelling at-sea is planned for the short survey. • Ensure that port refuelling operations are monitored by either the vessel's Master or First Officer. • Ensure that equipment and procedures used for transferring fuel (e.g., 'Dry-Break' hose couplings), conform to the AMSA Code for the safe working of support vessels. • The vessel will cease operating and seek safe harbour (or deep water) where extreme conditions make it unsafe, in the view of the Vessel Master, to continue survey operations. • In the unlikely event of a spill during fuel transfer (in port), ensure that the volume spilled is minimised by the automatic operation of shutdown pumps or safety valves and apply Emergency Response.

Table 3.1 Identified Environmental risk and mitigation measures (cont'd)

Risk Identification			Risk Treatment
Activity	**Hazard/Risk**	**Potential Consequence**	**Safeguards/Mitigation Measures**
Moderate fuel spill (e.g., rupture of fuel tanks resulting)	Widespread water surface oil slick, toxic water quality.	Mortality of planktonic or benthic organisms due to hydrocarbon toxicity. Smothering of marine and coastal flora and fauna.	• All vessel operations will be conducted in compliance with the AMSA OSV Code (eg. radar monitoring, vessel communications). • A daily communication schedule will be established with commercial fishing boats. • The seismic contractor's Emergency Response Manual and OSCP will be applied to the operation. • Satellite navigation of the vessel will be assisted by constant visual observation. • Communications will be constantly maintained with other vessels operating in the area to advise of the location of the survey vessel and avoid collision. • The vessel will cease operating and seek safe harbour (or deep water) where extreme conditions make it unsafe, in the view of the Vessel Master, to continue survey operations. • Santos may employ a scout vessel as a precaution to assist the survey vessel. • Senior personnel on vessels are familiar with the contents of the Emergency Response Manual and OSCP such that the initial response to an oil spill is carried out efficiently. • All personnel will be made aware of the existence and location of the above-listed documents. • The OSCP will be maintained up-to-date and staff will appropriately trained in its implementation. • All the necessary oil spill contingency plant and equipment will be functional and accessible. • Any fuel spill clean-up will be undertaken in consultation with the relevant regulatory authorities in each state.
Hull maintenance and ballast exchange	TBT leaching.	Toxic effects on epibenthic fauna and the foodchain.	• The 'Code of Practice for Antifouling and In-water Hull Cleaning and Maintenance' will be applied. • Hull anti-fouling records will be inspected.
	Exotic pest species introductions.	Invasion of marine habitats.	• Seismic vessel will not undertake ballast exchange during surveys. • Streamers carried on deck during surveys. • Hull anti-fouling treatment.

4. Consultation

Impact mitigation planning and implementation relies significantly upon consultation with key stakeholders. In the course of planning seismic, drilling and development programs within the offshore Sorell and Otway Basins over the past three years, Santos has undertaken extensive consultation with all relevant stakeholders in the region to identify regulatory processes, potential environmental issues and management requirements. There is ample precedent for identification of issues and procedures for communicating day-to-day seismic operations for timely consultation with the appropriate stakeholders to be followed, given the small scale of the project and the issues previously raised.

Stakeholders of relevance to the Southern Margins Seismic Program include:

- Tasmania:
  - Department of Primary Industries, Water and Environment (DPIWE)
  - Department of Infrastructure Energy and Resources (DIER)
  - Tasmanian Fishing Industry Council (TFIC)
  - Tasmanian Rock Lobster Fishermen's Association (TRLFA)
- Victoria:
  - Department of Primary Industries (DPI)
  - Seafood Industry Victoria (SIV)
  - Warrnambool Professional Fishermen's Association
  - Portland Professional Fishermen's Association
  - Port Campbell Professional Fishermen's Association
  - Apollo Bay Professional Fishermen's Association
- South Australia:
  - Primary Industries and Resources South Australia (PIRSA)
  - Tuna Boat Owners Association of South Australia
  - South Australian Rock Lobster Advisory Committee (SARLAC)
  - Port MacDonnell Fishermen's Association
- Commonwealth:
  - Department of Environment and Heritage (DEH)
  - Australian Fisheries Management Authority (AFMA)
  - Australian Maritime Safety Authority (AMSA)
  - Australian Marine Oil Spill Centre (AMOSC)

Consultation and information dissemination has been undertaken and will continue to be undertaken through a range of media including:

- Meetings with regulators.
- Meetings and correspondence with key stakeholders.
- Provision of information brochure.

- Invitation for public comment on the EPBC referrals via the DEH website.
- Provision of detailed survey maps.
- Daily schedule communications.
- Vessel communication systems with maritime traffic.

Contact Details:

All queries and comments should be directed to:

John Hughes
Chief Operations Geophysicist
Santos Ltd
GPO Box 2319
ADELAIDE SA 5001

Telephone (08) 8224 7952

Nick Fox
Environmental Adviser
Santos Ltd
GPO Box 2319
ADELAIDE SA 5001

Telephone (08) 8224 7952