WEST SEAHORSE PROJECT

GEOPHYSICAL & GEOTECHNICAL SURVEY ENVIRONMENT PLAN SUMMARY (VIC/L31 & VIC/P57) (GIPPSLAND BASIN)

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ABBREVIATIONS

µPa	Micro-pascal
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
AMSA	Australian Maritime Safety Authority
ASBTIA	Australian Southern Bluefin Tuna Industry Association
BOD	Biological Oxygen Demand
CAMBA	China/Australia Migratory Birds Agreement
CFA	Commonwealth Fisheries Association
CHIRP	Combined High Intensity Radar Pulse
CHPL	Carnarvon Hibiscus Pty Ltd
CPT	Cone Penetration Tests
CTS	Commonwealth Trawl Sector
dB	Decibels
DEPI	Department of Environment and Primary Industry
DSDBI	Department of State Development, Business and Innovation
DOC	Department of Communication
DOE	Department of Environment
DP	Dynamic Positioning
DSDBI	Department of State Development, Business and Innovation
ENE	East-North-East
EPBC	Environment Protection Biodiversity Conservation
EPO	Environmental Performance Outcome
ESD	Ecologically Sustainable Development
ESTF	Eastern Skipjack Tuna Fishery
ERA	Environmental Risk Assessment
ETBF	Eastern Tuna and Billfish Fishery
FSO	Floating Storage and Offloading Vessel
GHaT	Gillnet, Hook and Trap Sectors
GHG	Greenhouse Gas
GWP	Global Warming Potential
Ha	Hectares
HSE	Health Safety & Environment
Hz	Hertz
HVAC	Heating Ventilation and Air Conditioning
IMO	International Maritime Organization
IMS	Invasive Marine Species
JAMBA	Japan/Australia Migratory Birds Agreement
JVP's	Joint Venture Partners
kHz	Kilohertz
km	Kilometre

LEFCOL	Lakes Entrance Fisherman's Cooperative Pty Ltd
m	Metres
MARPOL	Marine pollution protocol
MBES	Multibeam Echo Sounders
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
MOPU	Mobile Offshore Petroleum Unit
MSDS	Material Safety Data Sheet
NE	North East
NNTT	National Native Title Tribunal
NOO	National Oceans Office
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administrator
NOx	Nitrous oxides
OCNS	Offshore Chemical Notification Scheme
ODME	Oil Detection Monitoring Equipment
ODP	Ozone Depleting Potential
OIW	Oil in Water
OPEP	Oil Pollution Emergency Plan
OPGGSA	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGSER	Offshore Petroleum and Greenhouse Gas Storage (Environment) regulations 2009
OSCP	Oil Spill Contingency Plan
PLONOR	Poses Little or No Risk
POB	Persons on Board
PROD	Portable remotely operated drill
R	Regulation
RAMSAR	RAMSAR Convention on Wetlands
RCC	Rescue Coordination Centre
ROKAMBA	Republic of Korea/ Australia Migratory Birds Agreement
ROV	Remotely Operated Vehicle
SBTF	Southern Bluefin Tuna Fishery
SEL	Sound Exposure Level
SESSF	Southern and Eastern Scalefish and Shark Fishery
SETFIA	South East Trawl Fishing Industry Association
SFD	Seafloor Drilling
SIV	Seafood Industry Victoria
SOLAS	Safety of Life at Sea Convention
SOPEP	Shipboard Oil Pollution Emergency Plan
SOx	Sulphur oxides
SPF	Small Pelagic Fishery
SPL	Sound Pressure Level
SSE	South-south east
SSF	Sustainable Shark Fishing
SSS	Side Scan Sonar

SSW	South-South-West
STCW95	International Convention on Standards of Training, Certification and Watch-keeping
SW	South West
Tcf	Trillion cubic feet
TTS	Temporary Threshold Shift
VIC	Victoria
VSFA	Victorian Scallop Fishermen's Association
W	West
WA	Western Australia
WNW	West-North-West
WSH	West Seahorse
WSW	West-South-West

1.0 INTRODUCTION

Carnarvon Hibiscus Pty Ltd ('CHPL') is proposing to undertake a Geotechnical and Geophysical Survey in the Commonwealth waters of the Gippsland Basin to support site selection for the West Seahorse (WSH) Development infrastructure and site selection for an exploration target, Sea Lion. The WSH Field lies in Petroleum Production Licence VIC/L31 and Sea Lion lies in Petroleum Exploration Permit VIC/P57.

The purpose of the survey is to:

- Obtain information on the seabed conditions at the WSH location for the proposed development infrastructure (Mobile Offshore Production Unit [MOPU], export crude flowline and Floating Storage and Offloading [FSO] Vessel);
- Geotechnical information for the infrastructure for MOPU foundations and anchoring of the FSO's Rigid Arm and information associated with the flowline corridor between Sea Lion and WSH should the Sea Lion well be successful; and
- Obtain information on the seabed conditions at the Sea Lion location for the *West Telesto* Jack-up rig during exploration drilling activities.

CHPL, as titleholder of VIC/L31, and on behalf of its Joint Venture Partner 3D Oil Limited in Exploration Permit VIC/P57, has prepared an Environment Plan (EP) in accordance with the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* which has been reviewed and accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

This EP summary document has been prepared to comply with the requirements of Regulation 11(3) and 11(4) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.*

2.0 ACTIVITY LOCATION

The WSH Field is located in Production Licence VIC/L31 in Bass Strait and Sea Lion is located in the south-west section of exploration permit VIC/P57. The WSH Field is located approximately 18km SSE of Loch Sport, with the closest landfall site 14km north-west on the Ninety Beach at a point midway between Loch Sport and Golden Beach (refer **Figure 2-1**). Sea Lion is located approximately 6.5km inshore from the WSH location and is located approximately 13.5km SSW of Loch Sport.

The survey will be undertaken within the proposed offshore WSH development area and the Sea Lion exploration prospect area which is defined by the coordinates provided in **Table 2-1**. The survey covers an area of approximately 3.164km^2 [WSH: 1.607km^2, Sea Lion: 1km^2, WSH/Sea Lion Flowline Corridor: 0.56km^2 and will be undertaken in approximate water depths of between 24m (Sea Lion) and 39m (WSH. **Figure 2-2** provides details of the proposed survey area.

Table 2-1: Survey Area (GDA94) (UTM Zone 55)

Point	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
PEZ1	38	10	46.92	147	32	47.76
PEZ2	38	10	14.52	147	32	47.40
PEZ3	38	10	14.52	147	33	28.44
PEZ4	38	10	35.76	147	33	28.80
PEZ5	38	10	39.36	147	33	28.80
PEZ6	38	10	46.92	147	33	28.80
PEZ7	38	12	11.16	147	36	59.04
PEZ8	38	12	4.32	147	37	03.72
PEZ9	38	12	6.84	147	37	09.12
PEZ10	38	11	45.96	147	37	31.44
PEZ11	38	11	37.32	147	37	11.64
PEZ12	38	11	9.24	147	37	32.52
PEZ13	38	11	25.44	147	38	08.16
PEZ14	38	11	53.52	147	37	47.28
PEZ15	38	11	51.00	147	37	41.88
PEZ16	38	12	11.52	147	37	20.28
PEZ17	38	12	14.04	147	37	25.32
PEZ18	38	12	30.96	147	37	13.08
PEZ19	38	12	21.24	147	36	51.84
PEZ20	38	12	14.04	147	36	56.88

Figure 2-1: Regional Location of the WSH Field & Sea Lion Prospect

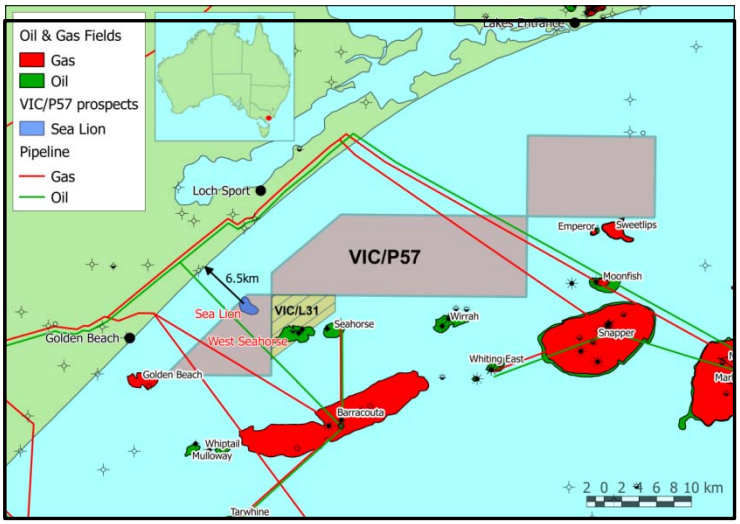
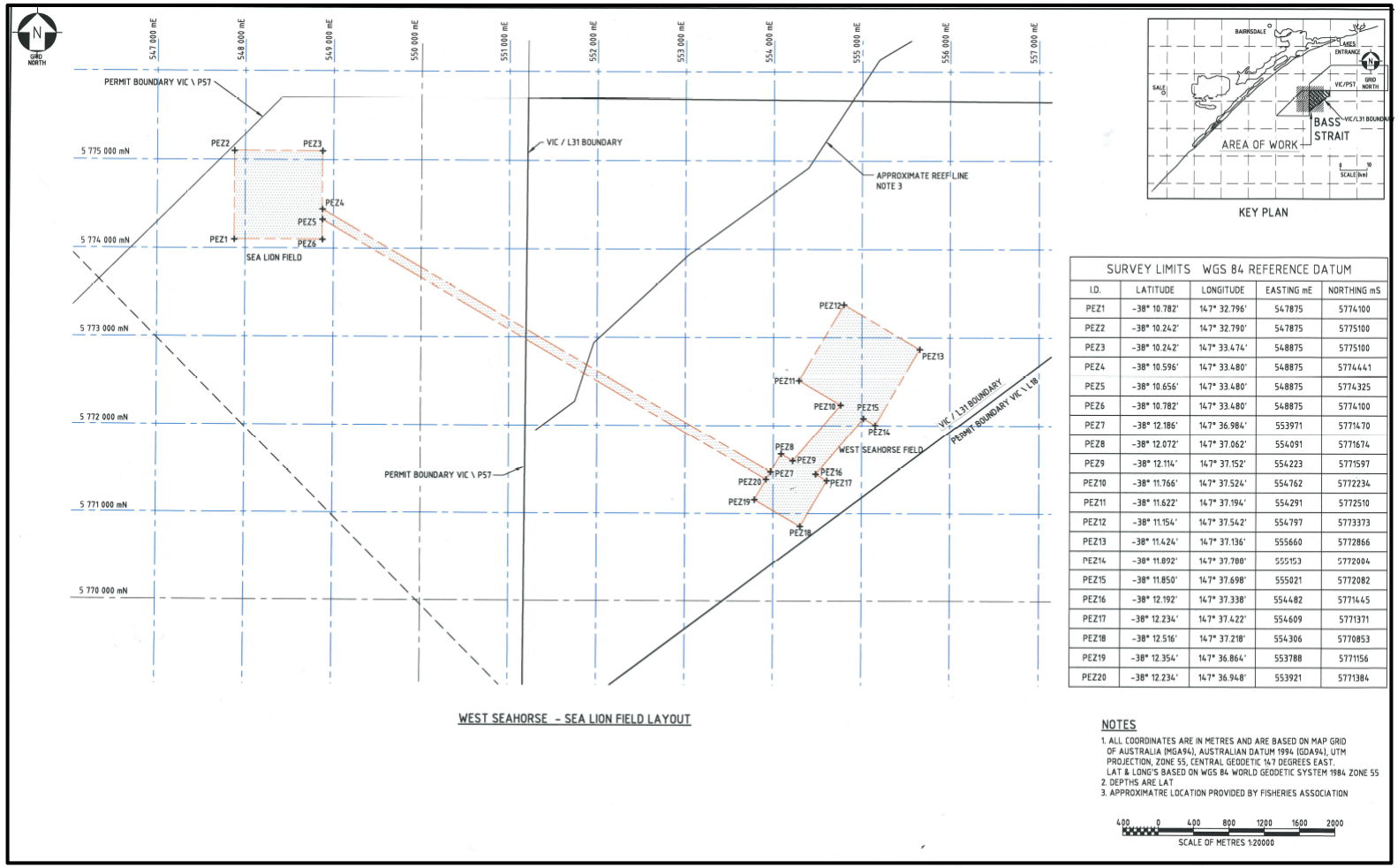


Figure 2-2: Geophysical and Geotechnical Survey Area



SURVEY LIMITS WGS 84 REFERENCE DATUM

I.D.	LATITUDE	LONGITUDE	EASTING mE	NORTHING mS
PEZ1	-38° 10.782'	147° 32.796'	547875	5774100
PEZ2	-38° 10.242'	147° 32.790'	547875	5775100
PEZ3	-38° 10.242'	147° 33.474'	548875	5775100
PEZ4	-38° 10.596'	147° 33.480'	548875	5774441
PEZ5	-38° 10.656'	147° 33.480'	548875	5774325
PEZ6	-38° 10.782'	147° 33.480'	548875	5774100
PEZ7	-38° 12.186'	147° 36.984'	553971	5771470
PEZ8	-38° 12.072'	147° 37.062'	554091	5771674
PEZ9	-38° 12.114'	147° 37.152'	554223	5771597
PEZ10	-38° 11.766'	147° 37.524'	554762	5772234
PEZ11	-38° 11.622'	147° 37.194'	554291	5772510
PEZ12	-38° 11.154'	147° 37.542'	554797	5773373
PEZ13	-38° 11.424'	147° 37.136'	555660	5772866
PEZ14	-38° 11.892'	147° 37.708'	555153	5772004
PEZ15	-38° 11.850'	147° 37.698'	555021	5772082
PEZ16	-38° 12.192'	147° 37.338'	554482	5771445
PEZ17	-38° 12.234'	147° 37.422'	554609	5771371
PEZ18	-38° 12.516'	147° 37.218'	554306	5770853
PEZ19	-38° 12.354'	147° 36.864'	553788	5771156
PEZ20	-38° 12.234'	147° 36.948'	553921	5771384

NOTES
1. ALL COORDINATES ARE IN METRES AND ARE BASED ON MAP GRID OF AUSTRALIA (MGA94), AUSTRALIAN DATUM 1994 (GDA94), UTM PROJECTION, ZONE 55, CENTRAL GEODETIC 147 DEGREES EAST. LAT & LONG'S BASED ON WGS 84 WORLD GEODETIC SYSTEM 1984 ZONE 55
2. DEPTHS ARE LAT
3. APPROXIMATRE LOCATION PROVIDED BY FISHERIES ASSOCIATION

3.0 ACTIVITY DESCRIPTION

3.1 SURVEY SCOPE

The survey scope consists of the following two components:

- **Geophysical Survey** which may consist of:
  - **Bathymetry** assessment across the alignment measured using a Multi-beam Echo Sounder (MBES). This equipment emits sound levels of 220dB re 1µPa at frequencies between 200-400kHz (high frequency);
  - **Refraction sub-bottom profiling** (obtaining subsurface data to depths of 0-60m below seabed) utilising a Combined High Intensity Radar Pulse (CHIRP)/Side Scan Sonar (SSS) system. This system is towed above the seabed at approximately 12.5-15m. The CHIRP system operates at a source level of approximately 170dB re 1µPa in across the mid-frequency range 2 kHz to 16 kHz. The SSS system has a peak source level of 205dB re 1µPa in the high frequency range 120kHz to 410kHz; and
  - **Reflection sub-bottom profiler** boomer system (obtaining data 0-100m depth below seabed) which is surface-towed. This equipment emits sound levels of 215dB re 1µPa in the mid-frequency range 0.5kHz to 2kHz and includes a surface hydrophone streamer which is towed at up to 60m (including the 20m length of the hydrophone) behind the vessel.
- **Geotechnical Survey** which may consist of:
  - **Grab Samples:** Up to 10 seabed sediment samples within the total survey areas between 0.5-1.0m deep;
  - **Cone Penetration Test (CPT):** Up to 10 locations within the total survey area to a depth of 40m; and
  - **Cores:** Up to 20 locations within the total survey area to a depth of 40m.

  For the geophysical survey activity, all equipment will be operating simultaneously as there is sufficient differentiation in frequency bands of equipment utilised to collect data.

Equipment which may be utilized for the geotechnical survey activities include:

- **Seabed CPT Unit:** This testing method pushes an instrumented cone into the sediment using a seabed reaction frame and records the resistance of the head of the cone. The footprint of the equipment when resting on the seabed is approximately 2m x 2m. The diameter of the CPT rod that will be pushed into the seabed is ~44 mm and is expected to generate a surface diameter of 66mm (the hole will be self-closing after the CPT rod is withdrawn);
- **Seabed Drilling Systems**:
  - **Sea Floor Drilling (SFD):** The SFD package utilizes wire-line coring to obtain subsurface soil samples from an aluminum core barrel installed by a rotary drill bit. The footprint of the equipment is 3.8m (W) x 5.4m (L) x 6.6m (H). The equipment produces a core diameter of up to 83mm with a corresponding hole diameter of approximately 100mm.
  - **ROV Drill:** A self-contained drilling and geotechnical testing system utilizing a polymer injection mud system with real-time monitoring of the operation (cameras and sensors). The footprint of the equipment when resting on the seabed is 2.3m (W) x 5.5m (L) x 5.4m (H). The equipment produces a core diameter of up to 85mm with a corresponding hole diameter of approximately 100mm.
  - **Portable Remotely Operated Drill (PROD) System:** This fully self-contained PROD system utilizes a rotary system to undertake geotechnical surveys and has a seabed footprint of 2m (W) x 2m (L) x 3m (H). This equipment produces a core diameter of 44mm with a corresponding hole diameter of approximately 95.2mm.

All units are controlled manually from surface vessels utilizing closed-system hydraulics.

All seabed drilling units may utilize additives to the seawater drilling fluid to optimize coring activities.

The Geotechnical and Geophysical survey may be undertaken as two separate activities. Scopes for these survey(s) are found in **Table 3-1**.

Table 3-1: Possible Geophysical/Geotechnical Program Scope

Survey	Scope/Details
Survey 1: Geophysical **Survey Duration:** ~2-3days	**Scope:** • Bathymetry Assessment (MBES) • Refraction Sub-bottom Profiling (CHIRP/SSS) • Reflection Sub-bottom Profiling (Boomer)
	Vessel Requirements: Small local marine survey vessel with crane capability and the following typical specifications: • Gross Tonnage ~300tonnes • Length ~35m • Breadth ~11m • Draft~2m • POB~32 persons • Max Fuel Tank size~25m^3 (Marine Diesel Oil)
Survey 2: Geotechnical **Survey Duration:** ~10days	**Scope:** • 20 x 40m (100mm diameter) boreholes • CPTs: 10 x 40m • 10 grab samples of seabed sediment (0.5-1.0m deep).
	Vessel Requirements: Larger Marine Survey vessel with the following typical specifications: • Gross Tonnage ~2440-4500tonnes; • Length ~67-90m; • Breadth ~16-20m; • Draft~6m; • POB~40-60 persons; • Max Fuel Tank size~80-110m^3 (Marine Diesel Oil)

The Geophysical and Geophysical Surveys will operate on a 24hr/7day basis.

Timing of the commencement of the geophysical and geotechnical fieldwork is dependent on sea states suitable for data acquisition, the availability of a survey vessel and the granting of approvals from appropriate government authorities.

3.3 SURVEY VESSELS

The survey vessel for the proposed geophysical and geotechnical survey has not yet been selected. If the survey is undertaken as two separate activities, a smaller geophysical survey vessel is expected to mobilize to the survey location from Lakes Entrance. A larger geotechnical vessel is required to undertake boring works and this vessel will mobilize from Australian waters, however from ports located outside the Gippsland Basin.

Vessels selected for the survey activities will have the necessary Class Certification/ Registration and will be compliant with all the requirements of the MARPOL/SOLAS conventions including a Shipboard Oil Pollution Emergency Plan (SOPEP) (or equivalent appropriate to size and class) in accordance with MARPOL 73/78 Annex I (Regulation 37) and the *Protection of the Seas (Prevention of Pollution from Ships) Act 1983*.

During the survey, no 'at sea' refueling will take place. All crew changes and resupply of vessels will take place at port.

The supply port for the smaller geophysical survey is expected to be Lake Entrance. The supply port for a larger geotechnical survey vessel, if required, is expected to be Port of Geelong.

4.0 DESCRIPTION OF THE RECEIVING ENVIRONMENT

4.1 GENERAL ENVIRONMENTAL SETTING

The survey area is located on the Twofold Shelf Bioregion of the South East Marine Region[1]. The continental shelf is relatively narrow in the northern section, becoming much broader and shallower in the southern area of the Gippsland Basin. The Twofold Shelf area is strongly influenced by a number of different currents that run through and near by the shelf, bringing both warm and cool currents. Nutrients from cooler upwellings supply rich biota that thrives in the warmer, shallower shelf region. Fauna is characterized by assemblages of reef fish, echinoderms, gastropods and bivalves[2].

The coastline consists of long sandy beaches broken by rocky headlands and numerous coastal lagoons. Estuary systems occur along the coastline within the region, with the larger estuaries located at Lakes Entrance (Gippsland Lakes); Sydenham Inlet and Mallacoota Inlet[3]. Most of these estuary systems are normally closed to the marine environment.

The nearest **Victorian State Marine Reserves** to the survey area are:

- Ninety Mile Beach Marine National Park (Vic) located approximately 37km southwest;
- Nooramunga Marine and Coastal Park (Vic) located approximately 77km southwest;
- Beware Reef Marine Sanctuary (Vic) located approximately 105km ENE;
- Wilsons Promontory Marine Park (Vic) located approximately 130km SW; and
- Point Hicks State Marine National Park (VIC) located approximately 150km ENE.

The nearest **Commonwealth Marine Reserves** to the survey area are:

- East Gippsland Commonwealth Marine Reserve located approximately 200km ESE; and
- Beagle Commonwealth Marine Reserve located approximately 110km SSW.

The nearest **Coastal Park** to the survey area is the Gippsland Lakes Coastal Park, located approximately 14km west of the WSH Development area and 6.5km west of the Sea Lion prospect, is a narrow coastal reserve covering 17000Ha along the Ninety Mile Beach from Seaspray to Lakes Entrance. The park consists of lakes and wetlands and is jointly managed by Parks Victoria and the Gunaikurnai as traditional owners of the land. The area is popular for camping along Shoreline Drive, surf fishing and swimming and is rich in wildlife including Eastern Grey Kangaroos, Black Wallabies and the Common brush-tail and Ring-tailed possums[4].

This coastal park forms a dune barrier which protects the Gippsland Lakes RAMSAR site from sea-based impacts. This RAMSAR area contains 540 flora species and 300 species of indigenous fauna. Of the fauna, 35 are listed under the *Flora and Fauna Guarantee Act 1988*. Ten (10) fauna species are listed as vulnerable and two as nationally endangered. Twenty four species of bird species listed under the Japan-Australia Migratory Bird Agreement (JAMBA) and twenty six bird species listed under the China-Australia Migratory Bird Agreement (CAMBA) have been observed in the Gippsland Lake system[5].

4.2 PHYSICAL ENVIRONMENT

The climate of the Twofold Shelf bioregion is moist, cool temperate with warm summers and a tendency towards winter-spring rainfall[6].

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[1] National Oceans Office (NOO), 2002 – Ecosystems – Nature's Diversity – The South-East Regional Marine Plan Assessment Reports downloaded on 27th June 2012 at http://www.environment.gov.au/coasts/mbp/publications/south-east/pubs/natures-diversity.pdf

[2] Ibid

[3] Ibid

[4] Parks Victoria, 2013 – Park Notes – Gippsland Lakes Coastal Park available at http://parkweb.vic.gov.au/__data/assets/pdf_file/0004/314572/Park-note-Gippsland-Lakes-Coastal-Park.pdf

[5] Ibid

[6] National Oceans Office (NOO), 2002 – Ecosystems – Nature's Diversity – The South-East Regional Marine Plan Assessment Reports downloaded on 27th June 2012 at http://www.environment.gov.au/coasts/mbp/publications/south-east/pubs/natures-diversity.pdf

Tenements VIC/L31 and VIC/P57 are protected from south-westerly swells by Tasmania but are strongly influenced by south-easterly and easterly swells of height 1-1.5m with maximum heights varying between 1.9-2.7m[7]. Stalled low pressure systems in the Tasman Sea during summer can generate higher wave energy at this time[8].

Tides within the South East Marine Region show seasonal variation with spring tides of approximately 0.9m and neap tides of 0.6m[9]. Strong semi-diurnal tidal currents (2-2.5knots) run parallel to the coast and are characteristic of this area[10].

The seabed at the WSH Development location is relatively flat and featureless on a sandy seabed with localized depressions (not considered pock-marks) in water depths of approximately 38-40m. No debris was evident at the current WSH-3 location in 2007[11].

The seabed at the Sea Lion location, based upon previous surveys, identifies the NW section of the survey area to be smooth with minor seafloor channels (approx. 30-35m in width and 0.2m deep). Very small depressions are the main feature to the SE. No debris or obstructions were identified at the site in 2007[12].

The seabed between Sea Lion and WSH is expected to be similar to those experienced at the Sea Lion and WSH locations.

4.3 MARINE SPECIES

The Southeast Marine Region displays a large diversity of plant and animal species. In addition to high diversity, the region has large numbers of endemic species including 600 species of fish, of which 85% are thought to be endemic and 11% are common only to waters of neighboring New Zealand. Up to 95% of mollusks present, approximately 90% of echinoderms and up to 62% of macro-algae (seaweed) species are only found in these waters[13].

A search of the EPBC Act Protected Matters Database[14] identified the following species as potentially having habitat within the survey area (refer **Table 3-1**):

- Twelve (12) species of cetacean are listed. Three (3) species have a threatened status and eight (8) species have a migratory status;
- Three (3) reptile species have a threatened and migratory status;
- Three (3) species of shark are listed. Two (2) species have a threatened status and all species have a migratory status;
- Eighteen (18) bird species are listed as threatened and seventeen (17) listed as migratory marine bird species;

[7] Barton, J., Pope, A, and Howe, S. (2012) – Parks Victoria Technical Series No 79 – Marine Natural Values Study Vol 2: Marine Protected Areas of the Flinders and Twofold Shelf Bioregions, available at http://parkweb.vic.gov.au/__data/assets/pdf_file/0009/545517/PV_TS79_complete.pdf

[8] National Oceans Office (NOO), 2002 – Ecosystems – Nature's Diversity – The South-East Regional Marine Plan Assessment Reports downloaded on 27th June 2012 at http://www.environment.gov.au/coasts/mbp/publications/south-east/pubs/natures-diversity.pdf

[9] Parks Victoria, 2013 – Ninety Mile Beach Marine National Park, downloaded on 24/1/13 at http://parkweb.vic.gov.au/__data/assets/pdf_file/0018/314730/20_1046.pdf

[10] Barton, J., Pope, A, and Howe, S. (2012) – Parks Victoria Technical Series No 79 – Marine Natural Values Study Vol 2: Marine Protected Areas of the Flinders and Twofold Shelf Bioregions, available at http://parkweb.vic.gov.au/__data/assets/pdf_file/0009/545517/PV_TS79_complete.pdf

[11] Fugro, 2007 – Report for the West Seahorse 3 Site Survey, Fugro Survey Job No: P0635-7, prepared for Australian Drilling Associates, Melbourne

[12] Fugro, 2007b – Report for the West Seahorse 3 Site Survey, Fugro Survey Job No: P0635-8, prepared for Australian Drilling Associates, Melbourne

[13] Director of National Parks, 2012 – Draft South-East Commonwealth Marine Reserves Network Management Plan, Director of National Parks, Canberra downloaded on 5th July 2012 at http://www.environment.gov.au/coasts/mbp/south-east/publications/pubs/se-draft-management-plan.pdf

[14] Department of Environment (DOE) 2014a – Protected Matters Database Search for Survey Area undertaken on 4th November 2014 at www.environment.gov.au

- Twenty-seven (27) species of fish are listed including one which is vulnerable, nineteen (19) species of pipefish, three (3) species of pipe-horse, one (1) species of sea-dragon and four (4) species of sea-horse; and
- Two additional mammal species also have habitat within Bass Strait waters, the New Zealand Fur Seal (*Arctocephalus forster)* and Australian Fur Seal (*Arctocephalus pusillus doriferus*) (Shaughnessy, 1999). These species do not have an EPBC protection status but are listed under that legislation and may be encountered foraging within the survey area.

Table 4-1: EPBC Listed Threatened/Migratory Species for the WSH Survey Corridor (DOE, 2014)

Status:
E: Endangered
V: Vulnerable
M: Migratory
L: Listed

Likelihood of Occurrence:
LO: Species/species habitat likely to occur in area
MO: Species/species habitat may occur within area
KO: Species/species habitat known to occur within area
BLO: Breeding Likely to Occur
FLO: Foraging Likely to Occur

Species Type	Scientific Name	Common Name	EPBC Status	Type of Presence
Marine Birds	*Apus pacificus*	Fork-tailed Swift	M	LO
	Diomedea epomophora epomophora	Southern Royal Albatross	V, M	FLO
	Diomedea epomophora sanfordi	Northern Royal Albatross	E, M	FLO
	Diomedea exulans antipodensis	Antipodean Albatross	V, M	FLO
	Diomedea exulans exulans	Tristan Albatross	E, M	MO
	Diomedea exulans gibsoni	Gibson's Albatross	V, M	FLO
	Diomedea exulans (sensu lato)	Wandering Albatross	V, M	FLO
	Fregetta grallaria grallaria	White-bellied Storm Petrel	V	LO
	Halobaena caerulea	Blue Petrel	V	MO
	Macronectes giganteus	Southern Giant-Petrel	E, M	MO
	Macronectes halli	Northern Giant-Petrel	V, M	MO
	Puffinus carneipes	Flesh-footed Shearwater	M	LO
	Sternula nereis nereis	Fairy Tern	V	KO
	Thalassarche bulleri	Buller's Albatross	V,M	MO
	Thalassarche cauta cauta	Tasmanian Shy Albatross	V, M	FLO
	Thalassarche chrysostoma	Grey-headed Albatross	E, M	MO
	Thalassarche melanophris	Black-browed Albatross	V, M	MO
	Thalassarche cauta salvini	Salvin's Albatross	V, M	FLO
	Thalassarche impravida	Campbell Albatross	V,M	FLO
Marine Mammals	*Balaenoptera acutorostrata*	Minke Whale	L	MO
	Balaenoptera edeni	Bryde's Whale	M	MO
	Balaenoptera musculus	Blue Whale	E, M	LO
	Caperea marginata	Pygmy Right Whale	M	MO
	Delphinus delphis	Common Dolphin	L	MO
	Eubalaena australis	Southern Right Whale	E, M	KO
	Grampus griseus	Risso's Dolphin	L	MO
	Lagrnorhynchus obscurus	Dusky Dolphin	M	MO
	Megaptera novaeangliae	Humpback Whale	V, M	LO
	Orcinus orca	Killer Whale	M	MO
	Tursiops aduncus	Spotted Bottlenose Dolphin	L	LO
	Tursiops truncatus	Bottlenose Dolphin	L	MO
	Arctocephalus forsteri	New Zealand Fur Seal	L	MO
	Arctocephalus pusillus	Australian Fur Seal	L	MO
Sharks/Fish	*Carcharodon carcharias*	Great White Shark	V, M	MO

Status:
E: Endangered
V: Vulnerable
M: Migratory
L: Listed

Likelihood of Occurrence:
LO: Species/species habitat likely to occur in area
MO: Species/species habitat may occur within area
KO: Species/species habitat known to occur within area
BLO: Breeding Likely to Occur
FLO: Foraging Likely to Occur

Species Type	Scientific Name	Common Name	EPBC Status	Type of Presence
	Lamna nasus	Porbeagle, Mackerel Shark	M	LO
	Irurus oxyrinchus	Shortfin Mako, Mako Shark	M	LO
	Rhincodon typus	Whale Shark	V, M	MO
	Prototroctes maraena	Australian Grayling	V	LO
Reptiles	*Caretta caretta*	Loggerhead Turtle	E, M	LO
	Chelonia mydas	Green Turtle	V,M	KO
	Dermochelys coriacea	Leatherback Turtle	E, M	LO

4.4 SOCIAL ENVIRONMENT

4.4.1 Commercial Shipping

Bass Strait is one of Australia's busiest commercial shipping routes in Australia with more than 3000 vessels making the east-west passage through Bass Strait each year[15]. A vessel traffic separation scheme has been instituted between the Victorian/NSW border and Wilsons Promontory to enhance maritime safety in the area separating shipping into discrete, one direction lanes. Additionally, an "Area to be Avoided" has been designated by the International Maritime Organisation (IMO) to protect the Esso-BHP Bass Strait Oil and Gas Facilities. As such all ships over 200 gross tonnage are restricted to the shipping channels to the east and south of this area.

The proposed survey area is located within the Bass Strait 'Area to be avoided'. AMSA (2013) has advised that vessel encounter will be limited to commercial fishing and recreational vessels.

4.4.2 Fisheries

Commonwealth fisheries, managed by the Australian Fisheries Management Authority (AFMA), and Victorian state-managed fisheries, managed by the Victorian Department of Environment and Primary Industries (DEPI) are located in the survey area. Fisheries form a significant source of employment and income to the region.

AFMA (2012) have advised that the survey area lies in the following Commonwealth-managed fishing areas:

- Southern and Eastern Scalefish and Shark Fishery (SESSF) (includes the Commonwealth Trawl Sector (CTS), Gillnet, Hook and Trap Sectors (GHaT)) (*consultation has identified that Danish seine operators, predominantly located at Lakes Entrance, may be present in the WSH section of the survey area but not the Sea Lion location. GHaT fishermen, as confirmed via consultation, are likely to be present in the area in winter. Advice provided by the Sustainable Shark Fishery Inc. (SSF) was that gillnet activity does not normally occur within the reef line (i.e. at the Sea Lion location)*;
- Small Pelagics Fishery (SPF) (*consultation has identified that it is unlikely that members of the SPF will be present in the survey area at the time of the survey*);

[15] National Oceans Office (NOO), 2002 – Ecosystems – Nature's Diversity – The South-East Regional Marine Plan Assessment Reports downloaded on 27th June 2012 at http://www.environment.gov.au/coasts/mbp/publications/south-east/pubs/natures-diversity.pdf

- Southern Bluefin Tuna Fishery (SBTF) (*consultation has identified that this fishery does not operate in the survey area*);
- Eastern Tuna and Billfish Fishery (ETBF) (*consultation has identified that members of this fishery will not be present in the survey area)*;
- Skipjack Tuna Fishery (*consultation has identified that this fishery does not operate in the survey area)*; and
- Southern Squid Jig Fishery (*consultation has identified that it is unlikely that members of this fishery will have a presence in the area at the time of the survey*).

DEPI (2013) has advised that the following state-managed fisheries, permitted to operate within the survey area, include the following:

- Ocean Access Fishery (*Activity within the area is reported as low and given the 'day trip'/small vessel nature of the fishing fishermen are unlikely to be present in the survey area however encounter is possible)*;
- Ocean Purse Seine Fishery (*It is possible that this fisherman may be encountered during the survey, however given the distance of the survey area from Lakes Entrance this is considered unlikely*);
- Rock Lobster Fishery (*consultation has identified that given the sandy substrates within the survey area rock lobster fishermen are not expected to be actively fishing in the survey area, however may be active in reef areas around the Sea Lion portion of the survey)*;
- Giant Crab Fishery (*consultation has identified that no commercial fishery is present in the area and crab fishermen do not actively fish the area)*;
- Inshore (Ocean) Trawl Fishery (*This fishery has not been recorded as having a fishing presence in the WSH survey area however may be present in the Sea Lion survey area)*; and
- Ocean Scallop Fishery (*this fishery may be active in the WSH and Sea Lion areas however based upon fishery statistics the area is not intensively fished by this fishery)*.

DEPI (2013) also advises that in the past ten years only two fisheries have been active within the WSH survey area – the Ocean Access Fishery and the Ocean Scallop Fishery. Fisheries active in the Sea Lion area in the past five years include the Ocean Access Fishery, Purse Seine Fishery, Rock Lobster Fishery, Scallop Fishery and Inshore Trawl Fishery.

4.4.3 Commonwealth/State Heritage

There are no listed Commonwealth Heritage Places, National Heritage Places or places on the Register of National Estate within, or in the immediate vicinity of the proposed survey area. The closest Commonwealth Heritage Place is the Gabo Island Lighthouse located 215km ENE of the survey area[16].

Review of the National Shipwreck Database showed that no Historic Shipwrecks lay within the survey area[17]. The closest shipwreck is the *Julius* (16km NE of the survey area). Other wrecks include an unknown wreck 45km south of the survey area; *Trinculo* (1879) wrecked on Ninety Mile Beach (25km from survey location); and the *Norfolk*, also wrecked on Ninety Mile Beach approximately 20km from the survey location.

[16] SEWPC, 2013s – Heritage Listing – Gabo Island Lighthouse – downloaded on 15th May 2013 at http://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=place_detail;search=state%3DVIC%3Blist_code%3DCHL%3Blegal_status%3D35%3Bkeyword_PD%3D0%3Bkeyword_SS%3D0%3Bkeyword_PH%3D0;place_id=105379

[17] SEWPC, 2013r – Australian National Shipwrecks Database, downloaded on 26/1/13 at https://apps5a.ris.environment.gov.au/shipwreck/public/maps/shipwreck-map-search-load.do

4.4.5 Oil & Gas Development

The Gippsland Basin has been producing hydrocarbons since 1969 (a total of 4 billion barrels of liquids and 9.8Tcf of gas to the end of June 1998). Currently the Gippsland Basin has (DPI, 2011):

- Seventeen (17) developed offshore oil and gas fields;
- Twenty-four (24) offshore production facilities (platforms, mono-towers & subsea completions); and
- Over 600km of pipeline network.

Onshore oil and gas processing facilities are located at both Longford and Orbost. Most of this infrastructure is operated by Esso Australia Resources Pty Ltd.

The nearest boundary of the survey is located approximately 11.5km WNW of Esso-BHP's Barracouta platform and 5km west of the Seahorse subsea wellhead. The survey location is 38km east of the Longford Onshore Processing Facility.

The survey area is located entirely within Production Licence Area VIC/L31 and Exploration Permit VIC/P57.

5.0 ENVIRONMENTAL IMPACT & RISK ASSESSMENT

In accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* R14(3) and R14(3A), an environmental hazard identification and risk assessment has been undertaken to evaluate the potential sources of environmental impact associated with the survey activities. This included an assessment of risks arising from operational activities and unplanned events (non-routine/accident) and the identification of control measures to reduce the impacts and risks to acceptable levels and a level which is as low as reasonably practicable (ALARP).

5.1 ENVIRONMENTAL IMPACT IDENTIFICATION METHODOLOGY

Environmental hazards, possible impacts and associated risks from the proposed survey activities have been identified and risk-assessed by undertaking the following steps:

- Defining the activity and associated environmental aspects;
- Identifying the environmental and social values within and adjacent to the survey area (i.e. the environmental context of the activity);
- Determining the inherent risk of each credible environmental hazard associated with the proposed survey. To achieve this, the worst-case environmental impact of the hazard was identified and, given no control measures, the likelihood of occurrence determined and risk assessed;
- Determining the residual risk of each credible environmental hazard with identified control measures adopted; and
- With controls implemented, defining whether the impact/residual risk lies at acceptable levels and ALARP. If ALARP has not been achieved, the activity is reviewed and additional control measures adopted until the impact and residual risk can be demonstrated to be ALARP.

The impact and risk for each credible environmental hazard has been evaluated using a Qualitative Environmental Risk Assessment (ERA) process defined by CHPL. The CHPL risk assessment framework is consistent with the approach outlined in ISO14001 (*Environmental Management Systems*), ISO31000:2009 (*Risk Management*) and HB203: 2012 (*Environmental Risk Management – Principles and Process*). In accordance with these processes, environmental risk is assessed as follows:

Risk = Likelihood of Occurrence (as it applies to the end-point environmental impact and not the incident) x Environmental Consequence Severity

This framework identifies and assesses environmental risk for each credible environmental hazard in accordance with the CHPL Qualitative Risk Matrix (refer **Table 5-3**) using the definitions for Consequence and Likelihood contained in **Tables 5-1** and **5-2. Table 5-4** defines management actions and responsibilities for each of the residual risk categories. Residual risks defined as high are unacceptable and further action must be taken to reduce the risk further. Residual risk in the medium classification requires further risk reduction controls to be implemented (if possible) via a risk treatment plan. Residual risk assessed as low requires no risk treatment plan however continuous improvement is attained by implementation of best practice management

Table 5-1: Definition of Consequence

Consequence	Description
5. Critical	**S:** Extensive Injuries (Multiple Fatalities). **E:** Large scale catastrophic impact; significant recovery work over years/decades; Level 3 oil spill (>1000tonnes); potential revocation of Licence or Permit. **A:** Extensive Damage (>$25M). **R:** Extreme adverse public, political or media outcry resulting in international media coverage; critical impact on business reputation.

Consequence	Description
4. Major	**S:** Major Injury (Single Fatality). **E:** Major environmental impact with recovery work over months/years; Level 2 oil spill (10-1000tonnes); material breach of licence, permit or act. **A:** Major Damage ($10M-$25M). **R:** Significant impact on business reputation and/or national media exposure; local community complaint.
3. Significant	**S:** Significant Injury (Lost Time Injury (LTI) or Restricted Work Day Case (RWDC)). **E:** Significant environmental impact with recovery work over a few days/weeks; Level 1 oil spill (<10tonnes); impact/damage to item of National Environmental Significance (NES); possible administrative fine level. **A:** Significant damage ($5M-$10M). **R:** Serious local adverse public media attention or complaints; local user concern; moderate to small impact on business reputation.
2. Minor	**S:** Minor Injury (Medical Treatment Injury) **E:** Local environmental impact, negligible remedial/recovery work; <1BBl oil spill; no significant impact to others; regulatory notification required. **A:** Minor Damage ($1M-$5M). **R:** Public awareness but no public concern beyond local users; Minor impact on business reputation.
1. Negligible	**S:** Slight Injury (First Aid Treatment). **E:** Negligible Impact, Effect contained locally; no statutory reporting. **A:** Slight Damage (0-$1M). **R:** Negligible Impact on Reputation; no public or regulator interest.

Legend: **S:** Safety, **E:** Environment, **A:** Asset Damage, **R:** Business Reputation

Table 5-2: Definition of Likelihood

Consequence	Description
5. Very likely	Expected to occur in most circumstances
4. Likely	Probably occur in most circumstances
3. Possible	Might occur at some time
2. Unlikely	Could occur at some time
1. Very Unlikely	Only occurs in exceptional circumstances

Table 5-3: CHPL Qualitative Risk Matrix

		Consequence				
		1. Negligible	2. Minor	3. Significant	4. Major	5. Critical
Likelihood	5. Very Likely					
	4. Likely					
	3. Possible					
	2. Unlikely					
	1. Very Unlikely					

Table 5-4: Definition of Risk and Management Response

Category	Description & Response
High	**High Risk:** Work cannot proceed as currently planned. Urgent remedy and resources required for immediate risk reduction. If risk is to be accepted temporarily then approval from the CEO must be obtained and the Board consulted.
Medium	**Medium Risk:** Risk reduction measures need to be implemented in keeping with other priorities. Generally acceptable level of risk where further risk reduction is shown not to be practicable.
Low	**Low Risk:** Risks are sufficiently low to be acceptable (i.e. at ALARP). Manage for continuous improvement by application of best practice.

5.1.1 Environmental Hazard Identification

Identification of hazards associated with the survey activity involved the collection of information on the activity and identification of potential environmental hazards within the environmental context of the activity. This includes all hazards from routine (i.e. operational) and potential non-routine incidents.

Environmental hazard identification was undertaken via brainstorming and peer reviews utilizing industry experts covering different subject areas associated with geophysical/geotechnical activities. This has included survey proponents, Company representatives and environmental specialists. Information utilized included the following:

- Survey program details including equipment, activity location, timing of activity and the proposed support activities;
- An understanding of the vessel activities/operations during the period and the possible threats to marine species and habitats;
- The environmental sensitivity of the receiving environment with respect to species distribution, subsea habitat types and location of environmentally sensitive areas (i.e. fauna breeding, resting, etc.,) undertaken as part of literature reviews; and
- Feedback from marine and coastal stakeholders to understand possible socio-economic activities which may conflict with operations via communication and consultation activities.

Within this context a listing of credible activity-related environmental hazards and possible impacts were identified for the survey program.

5.1.2 Risk Assessment

Credible hazards were then risk assessed by the following technique:

- Impact severity was assessed according to the consequence definition contained in **Table 5-1**. Impact attributes such as: quantities emitted, concentrations released and time scale of release were considered in determining the severity. In assessing consequence the 'worst credible'[18] impacts in the context of the environmental sensitivities of the area was assigned;
- Likelihood was allocated according to the likelihood categories contained in **Table 5-2.** The likelihood of environmental impact was based on available quantitative incident databases, expertise of experienced professionals based on industry experience and professional judgment. Likelihood also considered how frequently the activity is performed.

[18] This allows for the conservative identification of 'reportable incidents'.

Controls (preventative and mitigative) were then identified to either eliminate and/or minimize impacts. The assessment preferentially adopted control measures in the upper section of the controls hierarchy[19]. On the basis of the control implementation, impact and likelihood was reassessed and a residual risk ranking assigned. The environmental risk raking therefore represents residual risk levels which reflect the likelihood of occurrence of the *worst credible environmental impact end-point* (hence conservative) taking into account the implemented controls.

Risks were ranked using the CHPL Qualitative Risk Matrix in **Table 5-3**. Where residual risks were found to be intolerable (high) or within the ALARP region (medium), the hazard was reassessed for elimination potential and/or additional controls implemented until the residual impact and risk was at ALARP (i.e. *if a measure is practicable and it cannot be shown that the cost of the measure is grossly disproportionate to the benefit gained, the measure is considered reasonably practicable*).

Acceptable Level (Risk and Impact) Demonstration

CHPL adopted the following criteria in determining whether impact and risk levels were acceptable:

- The principles of Ecologically Sustainable Development (ESD) are fulfilled;
- Hibiscus Heath Safety & Environment (HSE) Policy Principles are achieved;
- All relevant Commonwealth and State legislative criteria are achieved;
- The activity does not contravene management plans or result in unacceptable impacts to protected matters under the EPBC Act 1999;
- Stakeholders have been provided information sufficient to understand and respond to relevant interests which are then addressed;
- Risk and impact have been demonstrated to be ALARP.

It should be noted that the CHPL qualitative risk methodology also defines risk criteria whereby risk levels are considered to be acceptable.

ALARP Demonstration

Under-pinning the risk assessment at all times are the key principles of environmentally-safe design (i.e. adoption of the hierarchy of controls); options analysis to ensure during program design that the most environmentally-sound practice is adopted; and the adoption of industry standards and codes. Demonstration of ALARP within the EP includes one or a combination of the following approaches:

- *Hazard/Risk Criteria Approach:* The CHPL qualitative risk matrix defines risk criteria which it considers is at a level which is ALARP;
- *Hierarchy of Controls*: Controls identification according to the hierarchy which ensures that reliable, effective controls are selected in preference to administrative controls;
- *Comparative Options Assessments*: Evaluation of a range of control measure options describing the relative merits and drawbacks, with the selection of options which are practicable;
- *Comparison with International/Industry Codes and Standards*: Adoption of relevant activity design standards, operational standards, management system frameworks and operational procedures against recognized national, international and industry standards or codes of practice; and
- *Cost Benefit Analysis*: Numerical assessment of costs relating to the control measure, the expected risk reduction expected and the cost of the measure to be implemented.

[19] Controls hierarchy (a key principle underpinning the ALARP principle (NOPSEMA, 2012)) consists of:

- **Elimination:** Complete removal of the hazard;
- **Prevention:** Preventing the hazardous event occurring;
- **Reduction:** Reducing the consequence should the event occur;
- **Mitigation:** Practices to mitigate the consequences once realized.

5.2 GEOPHYSICAL & GEOTECHNICAL ENVIRONMENTAL HAZARDS

A total of seventeen (17) environmental hazards with the potential to impact the environment, were identified for the survey activities. These can be grouped into the following broad categories:

- Mobilization of Survey Vessel to Survey area:
  - Introduction of Invasive Marine Species (IMS) from biofouling and ballast water discharges;
- Physical presence of the Survey Vessel[20]:
  - Disruption to commercial fishing activities and third party vessel movement;
- Sound impacts to the marine environment[21]:
  - Discharge of acoustic sound sources in the survey area;
  - Sound from operation of vessels;
- Seabed Disturbance Activities;
  - Coring Activities (Benthic Habitat/Seabed Impacts);
  - Coring Chemical/Fluid Discharges;
- General vessel operations:
  - Routine waste discharges from the survey vessel:
    - Oily bilge water discharge;
    - Sewage discharges;
    - Food-scrap discharges; and
  - Air Emissions (combustion sources);
- Non-Routine events;
  - Accidental hydrocarbon spill due to collision with another vessel or vessel integrity incident;
  - Chemical/oil spill through deck drain system;
  - Solid non-biodegradable/hazardous waste overboard incident;
  - Towed Equipment entanglement/loss in the marine environment;
  - Hydraulic line liquid release from subsea equipment; and
  - Collision with a cetacean.

5.2.1 Invasive Marine Species (IMS) Introduction

Background Information and Potential Impacts

Potential sources of IMS introduction into the survey areas include both vessel hull or niche biofouling and ballast water exchange during survey activities (as applicable). If an IMS is introduced and survives in the new environment, colonization may result in a range of ecological impacts including increased competition with native species and changes in ecosystem function. Colonization requires favorable environmental conditions for the particular IMS, including water temperature, water depth and habitat range.

The survey vessel contracted for the geophysical/geotechnical survey is expected to mobilise from ports within Australia and possibly outside the Twofold Shelf IMCRA bioregion. Where possible the vessel will be sourced and will mobilise from local ports within the Twofold Shelf bioregion.

[20] Lighting on-board vessel will be limited to navigation lighting and workplace safety requirements. The WSH and Sea Lion locations are not in proximity to sensitive location such as turtle or seabird nesting beaches (i.e. ~7-14km from shore). This hazard, and its possible impact, is considered ALARP on this basis.

[21] No helicopter operations will occur for these survey activities.

Adopted Control Measures

The survey vessels will conform to the following requirements:

- Ballast water exchange in accordance with the requirements of *EPA Protocol for Environmental Management: Domestic Ballast Water Management in Victorian Waters* (Publication 949.4, 2013);
- For vessels sourced outside the Twofold Bay bioregion, vessels are risk assessed in accordance with the *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (Commonwealth of Australia, 2009); and corrective actions arising from the assessment implemented prior to mobilization such that the risk of IMS introduction from biofouling is assessed as low;
- All in-water equipment has been removed from the water, inspected and cleaned prior to deployment in the survey area.

Environmental Risk Assessment

The National Database for Marine Pest incursions (DAFF, 2012) indicates no known pests have been introduced to the waters surrounding the proposed survey area. Should an IMS be introduced to and colonise the area, it may have a major environmental impact (Consequence 4). The survey area lies in water depths between 24-40m and does not preclude colonization (i.e. sufficient light penetration).

With the adoption of the listed ballast water management and biofouling control measures, the likelihood of IMS introduction is considered to be very unlikely. The residual environmental risk is therefore assessed as **medium.**

5.2.2 Disruption to Marine Stakeholders (excludes Commercial & Recreational Fishing)

Background Information and Potential Impacts

AMSA has identified that only local traffic will be present in the survey area (i.e. no major shipping lands) with the area located within the "Area to be Avoided" in Bass Strait which restricts commercial vessel entry into the area. Vessel traffic will be limited to commercial fishing (refer below), recreational vessels and possibly oil service vessels.

The presence of the survey vessel in VIC/P57 and VIC/L31 may disrupt third party commercial (oil service vessels) and recreational vessel activities in the area and may require local vessels to deviate from planned routes leading to minor increases in transit times and small increases in fuel consumption.

Adopted Control Measures

The following actions will be implemented to ensure that shipping is aware of the survey activities to avoid spatial conflicts:

- Consultation with AMSA has been undertaken to establish controls to prevent spatial disruption to commercial vessels;
- A Notice to Mariners will be issued via the AHO for the duration of the activity; and
- The AMSA RCC will be notified two weeks prior to commencement of the survey activity to allow for AUSCOAST warnings to reduce the potential for marine activity conflicts.

Additionally the following measures will be adopted:

- Vessels maintain a 24/7 watch with trained crew (STCW95 competent); and
- Appropriate navigation safety equipment (radio, AIS, navigation lighting, sound signals, etc.) is available on-board to ensure early detection of third party vessels.

Environmental Risk Assessment

It is possible the presence of the survey vessel may cause some temporary localized diversion to marine stakeholders in the area. As the survey area is located in open waters and given the low vessel intensity in the area, impacts to this marine user group is not expected to be significant (minor impact – Consequence 2).

With control measures implemented it is expected that third party commercial and recreational vessels can accommodate and plan transit routes such that deviation due to the presence of the survey is unlikely. The residual risk is assessed as **low.**

5.2.3 Disruption to Commercial/Recreational Fishing Activities

Background Information and Potential Impacts

Fisheries present in the survey area include the Commonwealth Trawl Sector (predominantly Danish Seine), GHaT (Gillnet), low levels of Victorian Scallop fishing, low levels of Victorian Ocean/Inshore Trawl Fishery and low levels of Rock Lobster Fishery. The presence of the survey vessel in VIC/P57 and VIC/L31 may disrupt commercial fishing activities which are known to occur in the area.

Recreational fishing in the area is expected to be low given the distance of the survey from Lakes Entrance.

Adopted Control Measures

To avoid spatial conflict with fisheries at the time of the survey, adopted control measures include the following (*in addition to the controls listed above for Marine Stakeholder Disruption*):

- Consultation during the planning phase of the survey has provided information to marine stakeholders and identified 'relevant' affected fishery stakeholders for continued liaison associated with survey activities;
- CHPL will reconfirm the details of the survey with fishing groups two weeks prior to activity and request additional feedback; and
- Mobilisation/demobilisation notifications will be issued to all relevant fishing industry stakeholders with consultation continuing during the survey period.

Environmental Risk Assessment

The presence of the survey vessel has the potential to cause some disruption to fishing activities within the survey area for a period of approximately 10-15days [weather dependent]. As the survey area occupies only ~3.164km^2 within the total fishery area and survey activities occur for a short period of time, spatial conflict with fisheries is expected to be minor (Consequence 2). With control measures implemented impacts are assessed as unlikely and the residual risk is assessed as **low.**

5.2.4 Sound Disturbance – Survey Data Acquisition

Background Information and Potential Impacts

Geophysical acoustic sources used in the survey will emit the following sound pressure levels (SPLs) and sound exposure levels (SELs):

- Mid-frequency:
  - CHIRP System – SPL: 170dB re 1µPa (2-16kHz) and SEL: ~178dB re 1µPa^2.s; and
  - Sub-bottom Profiler (boomer) – SPL: 215dB re 1µPa (0.5-2KHz) and SEL: ~172dB re 1µPa^2.s.
- High Frequency:
  - Multi-beam Echo Sounder (MBES) – 220dB re 1µPa (200kHz); and
  - Side Scan Sonar System – 205dB re 1µPa (120kHz to 410kHz).

Sound sources produce both pressure waves and activate motion of the 'medium' particles. Often there is reference to the acoustic near-field and far-field. In water at some distance from the sound source the pressure component dominates, though particle motion is still present. Equally for the near-field, close to the source or reflecting objects the particle motion component predominates and is much higher[22]. For a 500Hz signal this near-field/far-field transition point is approximately 0.5m from the source, for a 100Hz signal the distance is approximately 2.8m[23].

Attenuation of sound sources with distance varies according to the source propagation levels, the depth of water and the nature of the seabed. For example, pulses travelling upslope and along rock or sand bottoms are attenuated faster than those radiated alongshore or downslope[24]. There is a significant difference in the 'travel' effects of low frequency sources and multi-beam/side-scan surveys which operate at higher frequencies. Higher frequency emissions utilized in multi-beam operations tend to dissipate to safe levels over a relatively short distance despite having similar sound source levels to low frequency sources[25]. Low frequency sources, while the direction is downwards, can horizontally propagate and be detected at great range. The low frequency (<200Hz) of seismic airgun arrays tends to produce a larger acoustic footprint in the marine environment[26].

Impacts to Cetaceans: Cetaceans are considered to be sensitive to sound in the marine environment given their use of sound for communication, prey capture, predator avoidance, navigation, and their physical makeup (i.e. large gas-filled organs) which make them vulnerable to both disturbance and physiological damage from high magnitude underwater sound.

Baleen whales are considered the most sensitive of the marine mammals to acoustic sound due to their use of low-frequency signals (Frequency Range: 12 Hz to 8 kHz but predominantly less than 1 kHz) for communication[27]. Literature indicates that Baleen whales seem to react to sound frequencies up to 28 kHz but do not react to pingers, acoustic tags and echo-sounders at 36 kHz and above[28]. *Odontocetes* (i.e. sperm whales, killer whales, and dolphins) produce echo clicks that have the highest source levels of any recorded marine mammal sound ranging from 220-230 dB re 1µPa at frequencies up to 30 kHz (APPEA, 2006). Mohl (2004)[29] identified that Sperm Whale clicks bear some resemblance to sonar (i.e. 235 dB re 1µPa [or 196 dB re 1µPa^2.s]) in the frequency range 5-20 kHz although Sperm whales emit a very narrow beam of energy compared with the wide radiation pattern of sonars[30]. The majority of *Odontocetes* have their highest sensitivity to sound in the ultrasonic range (>20 kHz) although most have a moderate sensitivity from 1kHz-20kHz.

[22] Tasker, M.L., Amundin, M., Andree, M., Hawkins, A., Lang, W., Merck, T., Scholik-Schlomer, A., Tellman, J., Thomsen, F., Werner, S., Zakharia, M., (2010) – Marine Strategy Framework Directive, Task Group 11 Report – Underwater Noise and Other Forms of Energy, Joint Report prepared under the Administrative Arrangement between JRC and DG ENV (No 31210-2009/2010) the memorandum of Understanding between the European Commission and ICES managed by DG MARE and JRC's own Institutional Funding available at http://ec.europa.eu/environment/marine/pdf/10-Task-Group-11.pdf

[23] Popper, A N, 2008 – Effects of mid- and high- frequency sonars on fish. Report prepared for the US Department of the Navy Naval Undersea Warfare Centre by Environmental Bioacoustics LLC, Rockville, MD, and Newport, RI.

[24] Richardson, W J, Greene Jr, C R, Malme, C I, Thomson, D H, (1995) – Marine Mammals and Noise, Academic Press

[25] Department of the Environment, Heritage and Local Government (DEHLG), 2007 – Code of Practice for the Protection of Marine Mammals during Acoustic Seafloor Surveys in Irish Waters, Version 1.1 downloaded on 21st February 2013 at http://www.iwdg.ie/downloads/AcousticSurveys.pdf

[26] *Ibid*

[27] McCauley, R.D., 1994, *Seismic Surveys* in *Environmental Implications of Offshore oil and Gas Development in Australia- The Findings of an Independent Review*, Swan, J.M., Neff, J.M., and Young, P.C.,(Eds), Australian Exploration Association, Sydney, pp.19-121

[28] Richardson et al, 1998 cited in O'Brien, J., Berrow, S and Wall, D., (2005) – The Impact of Multi-beam on cetaceans: A review of best practice, The Irish Whale and Dolphin Group downloaded on 20th February 2013 at http://old.iwdg.ie/downloads/Multibeam.pdf

[29] ICES, (2005) – Report of the Ad-hoc Group on the Impacts of Sonar on Cetaceans and Fish (AGISC) (2nd Edition, ICES CM 2005/ACE:06 downloaded on February 21st 2013 at http://ec.europa.eu/environment/nature/conservation/species/whales_dolphins/docs/ices_second_report.pdf

[30] Ibid

Australian regulatory thresholds adopt a precautionary SEL threshold set in the EPBC Policy 2.1 – *Interaction between offshore seismic exploration and whales* (2008) of 160 dB re 1µPa^2.s. This is a conservative level at which whales may incur physical damage (i.e. Temporary Threshold Shift (TTS) in hearing). As identified in those policy documents the controls are around intense low-frequency air-gun sources which have most energy concentrated in the 10-200Hz range and lower levels in the 200-1000Hz range. On this basis, the geophysical equipment proposed for this survey in the mid-frequency range may have sound impacts above 160dB re 1µPa^2.s within 5m of the operating reflection (boomer) source and approximately 8m from the CHIRP system source.

The following behavioural responses, based upon low frequency acoustic sound in Baleen whales has been observed[31]:

- Humpback whale pods avoidance behaviour began at a received SEL of 126 dB re 1µPa^2.s (~140dB re 1µPa[32]); and
- Deliberate approaches by single mature whales approaching often at speed, circling or partly circling the vessel at the 100-400 m range, then swimming off (received SEL of 165 dB re 1µPa^2.s or SPL ~180dB re 1µPa).

Based on these observed values for low frequency sounds avoidance behaviour by Baleen whales might be expected at approximately 1.5km (boomer) and possibly at similar distances for the CHIRP system; however the latter system does operate at higher frequencies. The MBES is considered outside the hearing frequency of Baleen Whales and behavioural impacts are not expected.

Richardson et al. (1995) identified that Odontocetes do react to echo sounders and other transducers producing sound in the animals' optimum hearing range. This included Sperm whales ceasing to call when exposed to sounds in the 6 kHz to13kHz range at quite low intensities but this reaction varies with different studies. Continuous pulsing from an echo sounder seemed to produce less reaction compared to short sequences of sound pulses followed by longer pauses. Reaction thresholds in dolphins, porpoises and Delphinids can be as low as 110-130 dB re 1µPa but responses diminish with time even for levels as high as 170 dB re 1µPa[33]. This variation may be caused by habituation or changes in whales' behaviour state, as seems to occur with baleen whales. Antarctic killer whales have been observed to approach and swim alongside vessels operating echo sounders at 12, 18, 38, 120 and 200 kHz[34].

Turtles: Electro-physical studies have indicated that the best hearing range for marine turtles is between 100–700 Hz[35] with best hearing between 250-700Hz[36] . Studies indicate that turtles may begin to show behavioural responses to an approaching low frequency seismic array at received sound levels of approximately 166dB re 1µPa, and avoidance at around 175dB re 1µPa [37].

[31] McCauley, R.D, Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J., and McCabe, K., 2000, *Marine Seismic Surveys- A Study of Environmental Implications*, APPEA Journal, pp 692-708

[32] McCauley et al (2000) identifies that converting between 'equivalent energy' units and rms values is valid since the rms pressure (in dB re 1 µPa) is equal to the 'equivalent energy' measure minus 10*log10 (air gun pulse duration, in seconds). For measurements referenced in McCauley's paper the rms pressure in dB re 1 µPa was equal to the 'equivalent energy' plus 11.4 to 14.6 dB, depending on the source and local environment over which the measurements were taken. Note that the correction is positive since the air gun signal duration is always less than one second

[33] Richardson, W J, Greene Jr, C R, Malme, C I, Thomson, D H, (1995) – Marine Mammals and Noise, Academic Press

[34] International Council for Science Scientific Committee on Antarctic Research (SCAR) 2002 – Impacts of Marine Acoustic Technology on the Antarctic Environment accessed at http://www.geoscience.scar.org/geophysics/acoustics_1_2.pdf on 3rd February 2008

[35] McCauley, R.D., 1994, *Seismic Surveys* in *Environmental Implications of Offshore oil and Gas Development in Australia- The Findings of an Independent Review*, Swan, J.M., Neff, J.M., and Young, P.C.,(Eds), Australian Exploration Association, Sydney, pp.19-121.

[36] LGL Limited., (2003) - *Environmental Assessment of Marine Seismic Testing Conducted by the R/V Maurice Ewing in the Northern Gulf of Mexico, May – June 2003* downloaded on 28th October 2008 at http://www.nmfs.noaa.gov/pr/pdfs/permits/ldeo_gom.ea.pdf

[37] Ibid

Pinnipeds: Studies[38] have identified that Phocid Seals (e.g. gray seals) have a hearing range between 1 kHz-50 kHz with sensitivity dropping above 50 kHz. Otariid Seals (fur seals and sea lions) have a lower hearing sensitivity than Phocid Seals below 1 kHz; and similar hearing between 1 kHz and 36-40 kHz (their high frequency cut-off). Additional studies[39] also identified for Californian Sea Lions, relatively poor underwater hearing at frequencies below 1000Hz.

Sound exposures in the low frequency range that elicit TTS in pinnipeds under water have been measured for Harbour Seals, Californian Sea Lions and Northern Elephant Seals. Studies[40] identified that, under test conditions, TTS occurred in Harbour Seals at 183dB re 1µPa^2.s, in Sea Lions at 206dB re 1µPa^2.s and the Northern Elephant Sea at 204dB re 1µPa^2.s. Studies[41] identified that there was no measurable TTS following exposure of two Californian Sea Lions to sound levels of 183dB re 1µPa or 163dB re 1µPa^2.s. The threshold for onset of mild TTS for a Harbour Seal has been estimated at a SEL of 171dB re 1µPa^2.s[42] however TTS onset would occur at appreciably higher received levels in Californian Sea Lions (or Fur Seals) than in Harbour Seals (estimated at 194dB re 1µPa^2.s)[43]. Acoustic sources utilised in the survey which are in the hearing frequencies range of Fur Seals have lower SELs than 194dB re 1µPa^2.s.

Studies undertaken on Sea Lion behavioural response to mid-frequency (3.2-3.5kHz) sonar identified that a received SPL of 170dB is considered the "mid-frequency" threshold whereby adult Sea Lions start to experience behavioural responses[44]. SPLs within 170dB re 1µPa are expected in close proximity to the CHIRP system sound source and within 250m of the Boomer sound source (estimated based upon spherical spreading).

Fur Seals may be encountered during survey activities, however given the high SELs that may induce TTS in hearing (~194dB re 1µPa^{2}s) and the observed thresholds at which behavioural changes may occur (170dB re 1µPa) the proposed survey is not expected to result in physiological impacts but may lead to localised displacement for the short duration of the survey.

Sharks: Limited research has been conducted on shark responses to marine sound. Sharks are known to be highly sensitive to low frequency sounds between 40-800 Hz sensed solely through the particle-motion component of an acoustic field. Hearing studies show that elasmobranchs detect sound from 50Hz to 500Hz even though they do not possess swim bladders[45]. As elasmobranchs (sharks and rays) do not possess air bladders which have a disparity of acoustic impedance between water and gas filled chambers, the species is not thought to be susceptible to physiological trauma associated with sound pressure levels[46]. Free ranging sharks are attracted to sounds possessing specific characteristics –

[38] International Council for Science Scientific Committee on Antarctic Research (SCAR) 2002 – Impacts of Marine Acoustic Technology on the Antarctic Environment accessed at http://www.geoscience.scar.org/geophysics/acoustics_1_2.pdf on 3rd February 2008

[39] Kastak, D. and Schusterman, R.J., 1998 – Low Frequency Amphibious Hearing in Pinnipeds: Methods, Measurements, Noise and Ecology. J. Acoust.Soc.Am. 103(4) April 1998

[40] *Kastak et al 2005; cited in* Southall, B.L, Bowles, A.E, Ellison, W.T, Finneran J.J., Gentry, R.L., Greene, C.R., Kastak, D, Ketten, D.R., Miller, J.H. Nachigall, P.E. Richardson, W.J, Thomas, J.A., Tyack, P.L., 2007 – Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations downloaded on 22nd May 2012 at http://csi.whoi.edu/sites/default/files/literature/Full%20Text%20Part%20I_1.pdf

[41] Finneran et al, 2003 cited in Southall, B.L, Bowles, A.E, Ellison, W.T, Finneran J.J., Gentry, R.L., Greene, C.R., Kastak, D, Ketten, D.R., Miller, J.H. Nachigall, P.E. Richardson, W.J, Thomas, J.A., Tyack, P.L., 2007 – Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations downloaded on 22nd May 2012 at http://csi.whoi.edu/sites/default/files/literature/Full%20Text%20Part%20I_1.pdf

[42] Southall, B.L, Bowles, A.E, Ellison, W.T, Finneran J.J., Gentry, R.L., Greene, C.R., Kastak, D, Ketten, D.R., Miller, J.H. Nachigall, P.E. Richardson, W.J, Thomas, J.A., Tyack, P.L., 2007 – Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations downloaded on 22nd May 2012 at http://csi.whoi.edu/sites/default/files/literature/Full%20Text%20Part%20I_1.pdf

[43] Kastak et al, 2005; cited in LGL Limited, 2009 – Environmental Assessment of a Marine Geophysical Survey by the RV Marcus G. Langseth in the Commonwealth Waters if the Northern Mariana Islands (April-June 2010) downloaded on 21st May 2012 at http://www.nsf.gov/geo/oce/envcomp/attachment_1_marianas_ea_final.pdf

[44] Houser, D.S., Martin, S.W., Finneran, J.J. – Behavioural Responses of California Sea Lions to mid-frequency (3250-3450Hz) Sonar Signals, Marine Environmental Research: 92(2013) 268-278

[45] Normandeau Associates, Inc. 2012 - Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound-Generating Activities. A Literature Synthesis for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management. Contract # M11PC00031. 153 pp

[46] Ibid

irregular pulse, broadband frequency below several hundred hertz and transmitted with a sudden increase in intensity (i.e. resembling struggling prey). Studies have also observed that sharks can withdraw immediately if the sound is increased by 20 dB or more above the previous transmission[47]. However, sharks are not known to be attracted by continuous signals or higher frequency sources (which they cannot hear)[48].

Given the wide-ranging habitat of shark species which might be present in the survey area and the sound characteristics of survey activity (i.e. regular, continuous and above frequencies sensitive to sharks) the impact to shark species is, at most, short-term localised avoidance of the survey area.

Fish: Fish have evolved two sensory systems to detect acoustic signals – the ear for the detection of sound above 20Hz to 1 kHz or more; and the lateral line for detection of hydrodynamic signals (water motion) from less than 1Hz to about 200Hz[49] [50]. As discussed above, fish are able to detect particle motion when the source is nearby due to the substantial attenuation of the particle motion signal as it propagates away from the sound source[51]. Some species (e.g. salmon and tuna) are primarily sensitive to the to the particle motion of the field[52]. For fish with swim bladders, most are expected to show resonant frequencies between 100 and 500Hz[53].

Studies[54] identified that fish are sensitive within a restricted range of frequencies and even the most sensitive of fish have poor hearing above 2-3 kHz with the majority of fish sensitive to sound at relatively low frequencies (i.e. 100-1000Hz). Fish responses to mid and high frequency sounds are therefore expected to be limited however there is some overlap with the frequency range of the 'boomer' and CHIRP systems.

Woodside studies undertaken at Scott Reef on tropical reef fish during low frequency seismic surveys, identified fish exposed to acoustic pulses shown no structural abnormalities, tissue trauma or lesions, or auditory threshold changes (highest SEL exposure of 190dB re 1µPa^2.s). *Fish are not expected to be exposed to these SELs during the operation of the acoustic equipment.*

Pearson et al (1992) observed the following behaviours in benthic fish to noise:

- A startled response at ~200-205dB re 1µPa. At this point most fish flee the sound of the array (i.e. sudden flexions of the body followed by rapid swimming or a series of shudders with each air gun discharge);
- An alarm response at ~180dB re 1µPa. This includes increased general activity and changes in schooling of the species; and
- A subtle behavioural response at ~160dB re 1µPa.

On the basis of the observed SPLs for low frequency sources it is expected that the Boomer system may lead to behavioural (displacement) impacts within 500m (based upon spherical spreading) of the operating source, with only minor displacement in close proximity to the operating CHIRP system source

[47] Myrberg, A.A., 2001. - The acoustical biology of elasmobranchs. *Environmental Biology of Fishes*, 60(3), p.31-45, Available at: http://www.springerlink.com/index/J14611J202771866.pdf

[48] Popper, A N, 2008 – Effects of mid- and high- frequency sonars on fish. Report prepared for the US Department of the Navy Naval Undersea Warfare Centre by Environmental Bioacoustics LLC, Rockville, MD, and Newport, RI.

[49] Equipment to be used on the survey does not emit these frequencies.

[50] Popper, A N, 2008 – Effects of mid- and high- frequency sonars on fish. Report prepared for the US Department of the Navy Naval Undersea Warfare Centre by Environmental Bioacoustics LLC, Rockville, MD, and Newport, RI.

[51] Ibid

[52] Ibid

[53] UNEP, 2012 – Scientific Synthesis on the impacts of underwater noise on marine and Coastal Biodiversity Habitats, Convention on Biological Diversity, Sixteenth Meeting, Subsidiary Body on Scientific, Technical and Technological Advice, Montreal 2012

[54] ICES, (2005) – Report of the Ad-hoc Group on the Impacts of Sonar on Cetaceans and Fish (AGISC) (2nd Edition, ICES CM 2005/ACE:06 downloaded on February 21st 2013 at http://ec.europa.eu/environment/nature/conservation/species/whales_dolphins/docs/ices_second_report.pdf

Studies undertaken on *low frequency* acoustic sound from seismic surveys (i.e. at much higher acoustic source levels than systems utilised in this survey) identified lethal effects for some plankton at close range to an operational source (<10m distance) and to injure fish eggs, larvae and fry within ~5m of source[55] however, mortality to adult fish and invertebrates directly exposed to operating seismic sources have not been observed[56]. It should be noted that the eggs and larvae were in very close proximity to the airgun array where the particle motion component of the signal would be exceedingly large[57]. The lowest sound pressure level where lethal effects have been observed is 220dB re 1µPa with no lethal effects observed at 214dB re 1µPa[58].

Additional studies undertaken on juvenile and larval fish (herring, atlantic cod, saithe and wolf fish) responses to mid-frequency sonar (1.5-6.5kHz) observed survival, development and behaviour effects[59] . Fish were exposed to sound levels between 150-189dB re 1µPa at frequencies of 1.5 kHz, 4 kHz and 6.5 kHz. There were no effects on fish behaviour during or after exposure to sound (other than some startled or panic movements by herring for sounds at 1.5 kHz) and there were no effects on behaviour, growth or survival of fish kept as long as 34 days post exposure. On the basis of this information it is possible that localised effects, based upon sound pressure levels, may be experienced by the Boomer system in close proximity to the source (~16m based on spherical spreading). The CHIRP system which operates at a maximum SPL below 170dB re 1µPa is not expected to significantly impact juvenile or larval fish.

Invertebrates:

No physical structures (e.g. gas filled cavities which function as swim bladders) have been identified in aquatic invertebrates that are stimulated by the pressure component of sound, however, invertebrates do appear to be most sensitive to the vibration (i.e. mechanical disturbances of the water) or particle motion component of the acoustic signal[60] believed to be through external sensory hairs and internal statocysts[61]. Researchers have found sensory hairs located on the claws of the Australian freshwater crayfish to be most sensitive to water vibration frequencies between 150-300Hz. Sensory hairs frond on different body parts of the American lobster can detect low frequency underwater sounds from 20-300Hz[62].

The statocyst is a complex sensory organ found in most marine invertebrates and primarily provides orientation cues that allow an animal to maintain its position in the water column. Some researchers also believe that this organ also functions to detect low frequency, particle motion components of sound. Cephalopods containing this organ show a sensitivity to sound between 30-500Hz (Longfin squid). Auditory brainstem response studies performed found oval squid and common octopus to be sensitive to sounds from 400-1500Hz and 400-1000Hz respectively. In studies where the sensory function of the statocyst was chemically blocked or surgically altered, sensitivity to acoustic stimuli was not observed[63].

[55] Popper, A N, 2008 – Effects of mid- and high- frequency sonars on fish. Report prepared for the US Department of the Navy Naval Undersea Warfare Centre by Environmental Bioacoustics LLC, Rockville, MD, and Newport, RI.
[56] McCauley, R.D., 1994, *Seismic Surveys* in *Environmental Implications of Offshore oil and Gas Development in Australia- The Findings of an Independent Review*, Swan, J.M., Neff, J.M., and Young, P.C.,(Eds), Australian Exploration Association, Sydney, pp.19-121.
[57] Ibid
[58] International Council for Science Scientific Committee on Antarctic Research (SCAR) 2002 – Impacts of Marine Acoustic Technology on the Antarctic Environment accessed at http://www.geoscience.scar.org/geophysics/acoustics_1_2.pdf on 3rd February 2008
[59] Popper, A N, 2008 – Effects of mid- and high- frequency sonars on fish. Report prepared for the US Department of the Navy Naval Undersea Warfare Centre by Environmental Bioacoustics LLC, Rockville, MD, and Newport, RI.
[60] Breithaupt, B.U. (2002) – Sound perception in aquatic crustaceans. PP548-558 in K. Wiese ed. The Crustacean Nervous System, Springer-Verlag, Berlin-Heidelberg, Germany.
[61] University of Rhode Island (URI) (2014) – Discovery of Sound in the Sea – How do Marine Invertebrates Detect Sound, University of Rhode Island, Department of Oceanography accessed on 4th December 2014 at http://www.dosits.org/animals/soundreception/invertebrateshear/

[62] Ibid
[63] Ibid

Most studies relating to sound impacts in the marine environment have focussed on marine mammals and *low-frequency* (200Hz), *high intensity* seismic survey acoustic arrays. Accordingly, field studies relating to sound impacts, particularly in the higher frequency ranges, on marine invertebrates are scarce. The few studies that have been completed have primarily focussed on the impact of seismic surveys on marine invertebrates, mainly crustaceans and cephalopods. A critical review of 20 studies completed in 2004 found only nine to be quantitative and within these the effects on marine invertebrates were mixed and no clear conclusions could be made[64]. While low frequency, high intensity acoustic sources are not proposed for the survey's geophysical component there is some relevance of data which allows for the benchmarking possible impacts.

- **Crustaceans**: Very little is known about the detection and use of sound by aquatic invertebrates. The limited data available indicates that decapods (lobster, shrimp and crab) do sense low frequency sound[65]. Tautz and Sandeman (1980)[66] identified that crayfish sensory hairs on their chelae are sensitive to water vibration frequencies between 150-300Hz (*frequency range is below equipment to be utilised in the survey*) which aids in the detection of potential predators/prey[67].

  During the 1960s, when explosive charges were used as the acoustic source for seismic surveys reports indicated that 25lb charges killed a variety of fish species, but when discharged 14m above rock lobster pots no discernible damage occurred to the rock lobsters[68]. This is consistent with other studies identifying the remarkable resistance of crustaceans to high force explosive events. Studies undertaken into the effects of thirty-three (33) seismic surveys on catch rates of Rock Lobsters[69] in western Victoria between 1978 and 2004 identified that there was no evidence indicating a decline in Rock Lobster catch rates for the period both on a long-term and short-term basis.

  Studies[70] which exposed captive adult male and egg-carrying female snow crabs (*Chioncetes opilio*) to variable sound pressure levels (SPL) (191-221dB re $1\mu Pa_{0-p}$) and Sound Energy exposures (SEL) (130-187dB re $1\mu Pa^2.s$) at 2m distance. Neither acute nor chronic (12 week post exposure) mortality was observed for adult crabs. Stress indicators in the adult male snow crab were monitored immediately after sound exposure and at various intervals after exposure. No significant acute or chronic differences in various stress indicators (proteins, enzymes, cell type count) were found between exposed and unexposed animals.

  Studies[71] also investigated behavioural effects of 8 tagged snow crab exposed to sound (200 discharges at a SPL of 191dB re $1\mu Pa_{0-p}$ and 130dB re $1\mu Pa^2.s$ over a period of 33 minutes). None of the tagged animals immediately left the area after exposure with five captured in the fishery in the following year and the remainder within 35km of the release location. A subsequent study on caged snow crabs exposed to airgun sound (SPL ~202dB re $1\mu Pa_{0-p}$ and 150dB re $1\mu Pa^2.s$) at a depth of 50m identified that the species did not exhibit any overt startled response.

[64] UNEP, 2012 – Scientific Synthesis on the impacts of underwater noise on marine and Coastal Biodiversity Habitats, Convention on Biological Diversity, Sixteenth Meeting, Subsidiary Body on Scientific, Technical and Technological Advice, Montreal 2012

[65] Popper, A N, 2008 – Effects of mid- and high- frequency sonars on fish. Report prepared for the US Department of the Navy Naval Undersea Warfare Centre by Environmental Bioacoustics LLC, Rockville, MD, and Newport, RI.

[66] Moriyasu, M., Allain, R., Belnhalima, K., Claytor, R., (2004) – Effects of Seismic and Marine Noise on Invertebrates: A Literature Review, Canadian Science Advisory Secretariat Research Document 2004/126 available at http://131.89.128.67/includes/docs/pdfs/shared/edusafety/systemworks/dcpp/moriyasu_et_al_2004_effects_of_seismic_and_marine_noise_on_invertebrates_a_literature_review.pdf

[67] Popper, A N, 2008 – Effects of mid- and high- frequency sonars on fish. Report prepared for the US Department of the Navy Naval Undersea Warfare Centre by Environmental Bioacoustics LLC, Rockville, MD, and Newport, RI.

[68] Parry, G.D, & Gason, A, (2006) – The Effect of Seismic Surveys on Catch Rates of Rock Lobsters in Western Victoria, Australia, Fisheries Research 79(2006) 272-284

[69] Ibid

[70] Christian, J.R, and Bocking, R.C., 2010 – *Appendix D: Review of the effects of air gun sounds on marine invertebrates and fish*, Programmatic EIS/OEIS, NSF-Funded Marine Seismic Research downloaded on 2nd January 2013 at http://www.nsf.gov/geo/oce/envcomp/usgs-nsf-marine-seismic-research/app-d-seismic-effects-on-inverts-fish.pdf

[71] Ibid

Pilot studies have been undertaken on the effects of air gun noise on adult lobster (*Homarus americanus*)[72] to explore for biological impacts (survival, food consumption, turnover rate, serum protein and serum calcium) when exposed to low level acoustic exposures (202dB re 1µPa (peak-peak)) and high level (227dB re1µPa (peak-peak)). Exposure of lobster to these acoustic levels had no effect on mortality, damaged sensory systems or loss of appendages. Some sub-lethal impacts were observed within the population with respect to feeding (increased), serum biochemistry (decrease) and histopathology results which may possibly (not confirmed) be related to 'organ stress'[73]. It was identified that further study was required to determine how the sub-lethal parameters may translate into species impacts.

It is also noted that in an interim report[74] issued by the Institute of Marine and Antarctic Studies (IMAS) into recent studies on the acoustic impacts to adult lobsters from low frequency sounds associated with a 45in^3 airgun (operating at 2000psi) towed at a depth of 5.2m (SEL 200dB re 1µPa^2.s) in a total of 10m of water identified the following:

- All lobsters recovered from the field work were alive and no lobsters from either the control or exposed treatment group died in the aquaculture facility during the study;
- No differences were found in haemolymph pH (stress-related marker) between control or exposed animals;
- Condition indices (Hepatopancreas index (HPI) and Bundle Index) were no different between control and exposed animals;
- Three behavioural tests (tail flips, tail gape, and up-righting test) were performed with the first two showing no difference between control and exposed groups. Righting results identified that control lobsters were able to right themselves significantly faster than exposed lobsters. This may indicate damage to the statocyst organ and is being evaluated.

La Bella et al (1996)[75] reported no apparent change in catch rates for Norway Lobsters in an area prospected the day before at sound source levels of 210dB re 1µPa (corresponding to levels of 149dB re 1µPa at the species location).

On the basis of the above studies mortality or behavioural impacts to adult crustaceans are not expected from the geophysical equipment utilised in this survey.

Little information is available on sound impacts to early life stages of lobster, however there is some literature on crab species. Studies [76] conducted experiments with air-guns on early life stages of Dungeness crabs (*Cancer magister*). No statistically significant differences were found in immediate survival rates, long-term survival rates or time to moult between the exposed and control larvae, even within 1m of the source.

Christian et al (2003)[77] undertook a study into potential seismic impacts to reproductive biology of female snow crabs including observation of developmental differences in fertilized eggs between control and test groups. Crabs were exposed at a distance of 2m from a single 40in^3 air-gun of 200

[72] Payne, J.F., Andrews, C.A., Fancey, L.L., Cook, A.L. and Christian, J.R. 2007. Pilot Study on the Effect of Seismic Air Gun Noise on Lobster (Homarus Americanus), Environmental Studies Research Funds Report No. 171. St. John's, NL. 34 p

[73] The author warns against over-interpretation of these results given these are initial studies which are exploratory in nature pointing to the need for additional research to determine what these implications mean to the species.

[74] Semmens, J, (2014) – Milestone Progress Report – Assessing the Impacts of Marine Seismic Surveys on South East Australian Scallop and Lobster Fisheries, FRDC Project number 2012/008

[75] Moriyasu, M., Allain, R., Belnhalima, K., Claytor, R., (2004) – Effects of Seismic and Marine Noise on Invertebrates: A Literature Review, Canadian Science Advisory Secretariat Research Document 2004/126 available at http://131.89.128.67/includes/docs/pdfs/shared/edusafety/systemworks/dcpp/moriyasu_et_al_2004_effects_of_seismic_and_marine_noise_on_invertebrates_a_literature_review.pdf

[76] Pearson, W.H., Skalski, J.R., Sulkin, S.D., Malme, C.I. (1994) – Effects of Seismic Energy Releases on the Survival and Development of Zoeal Larvae of Dungeness Crab, Marine Environmental Research 38 (1994) 93-112

[77] Christian, J.R., Mathieu, A., Thomson, D.H., While D., Buchanan, R.A. (2003) – Effect of Seismic Energy on Snow Crab (*Chionoecetes opilio*) Environmental Research Funds Project No. 144, Calgary, 106p

shots at 10 second intervals (received peak sound pressure levels of approximately 216dB re 1µPa). Twelve weeks after this exposure, the fertilized eggs showed a 1.6% higher mortality compared with the control group, and 25.7% fewer eggs had developed to the next developmental stage in the exposed group. The study states that there is considerable heterogeneity in egg development stages in egg-bearing females.

Results for lobster larvae exposed to low frequency acoustic sources from the recent IMAS studies included the following[78]:

- No differences in fecundity between control and exposed lobsters;
- A small but significant difference in the length of the larvae was observed in the exposed lobsters. No difference was found in width or dry mass of the larvae and no hatches were found to suffer from high mortality rates or deformities;
- No energy difference was identified between larvae from control and exposed lobsters;
- Larval activity/survival between control and exposed lobster groups was not significant.

- **Scallops:** As is the case for crustaceans, there is little available literature relating to scallops hearing and associated sound impacts. Studies undertaken on the Japanese scallop identified the species contained cilia along the entire perimeter of its mantle edge and electro-physical experiments have shown that the mantle margin is sensitive to mechanical stimuli[79]. Behavioural studies undertaken by Moir (1977)[80] on *P. magellanicus* identified an 'abdominal sense organ' may also be sensitive to mechanical vibration identifying sensitivities between 10-1000Hz with a maximum sensitivity to vibration in the frequency range 200-300Hz. Franzen (1995)[81] showed tellinid bivalves (*Macoma balthica*) are sensitive to frequencies of 50-200Hz.

  Recent studies undertaken by IMAS to determine the impact of seismic acoustic sources to adult scallops involved the use of a 45in^3 Sercel G Gun II operating at 2000psi with an estimated SEL of 200dB re 1µPa^2.s towed at a depth of 5.2m over scallop beds located in water depths of 10m (i.e. very close proximity). The trial consisted of passing a seismic vessel (positioned at 1000m from the test animals) with the airgun deployed but not operational (i.e. control group); and further seismic runs with the air-gun operational with the scallops exposed to 1, 2 or 4 runs. Exposed scallops were sampled at 0, 14 and 120 days post exposure. Received sound levels to scallops have not yet been fully analysed however interim results have provided the following information[82]:

  - Adult mortality rates were experienced in all seismic runs – Control: 8.3%; 1 Pass: 16.7%; 2 Pass: 15% and 3 Pass: 13.3%. The interim paper identifies that additional analysis is required to determine if there is any statistical significance between the observed mortality rates however the study indicates that mortality of the control group occurred at the commencement of the trial (handling stress) whereas exposed scallop mortalities were recorded at 14 and 120 days[83];
  - Recessing time (i.e. substrate burial rates) were assessed and identified that the rate of scallop recessing was inversely proportional to the level of exposure (i.e. control animals were the slowest to recess) thought to be a "hiding" response to a stressor;

[78] Semmens, J, (2014) – Milestone Progress Report – Assessing the Impacts of Marine Seismic Surveys on South East Australian Scallop and Lobster Fisheries, FRDC Project number 2012/008
[79] Motavkin, P.A. (1990) – The Yeso Scallop or Japanese Common Scallop (Mizuhopecten yessoensis) (Jay), Canadian Translation of Fisheries and Aquatic Sciences No: 5501 published by the Institute of Marine Biology, Vladivostok: Far East Science Centre, Academy of the USSR, 1986, 244p
[80] Ibid
[81] Ibid
[82] Semmens, J, (2014) – Milestone Progress Report – Assessing the Impacts of Marine Seismic Surveys on South East Australian Scallop and Lobster Fisheries, FRDC Project number 2012/008
[83] It is noted that this study does not align with the 56day survey results observed by Harrington et al (2010). An observed difference between studies is the proximity of the acoustic source to the scallop stock.

- Haemolymph pH testing was undertaken to determine the acute stress response in scallops. These results showed substantial differences between Day 0 and Day 14, however by Day 120 all results were similar across treatments and higher than levels previously recorded (i.e. Day 0, Day 14) which is currently attributed to differing life stages and changing (increasing) water temperature. It was identified that further statistical analysis is required to determine the significance of these results;
- Additional measurements were made measuring adductor muscle mass; shell length, width and height; and whole animal mass, wet tissue mass and shell mass. None of these measurements showed any statistical difference between control and exposure level.

Aguilar de Soto et al (2013)[84] has published a study identifying anthropogenic noise created by low frequency sound caused body malformations and delayed development to scallop larvae. This study, undertaken in a tank setting, utilised a filtered acoustic signal between 0-200Hz and an inter-pulse interval of 3 seconds with a SEL of 161-165dB re 1µPa^2.s. While scientific results identified significant impacts to larvae, the researchers identified in the discussion that "*the small size of the scallop larvae and the absence of strong tissue density gradients in the early development phases lead us to propose that the observed damage is related to particle motion rather than the pressure components of the noise exposure*". As identified previously, the particle motion component of the sound is significant in the near-field and for a 100Hz signal would be in the order of 2.8m from the acoustic source. Given the size of the tank utilised for the study (dimensions not fully disclosed but length 2m and depth 1.3m) all larvae would be located in the 'near-field' and these observed results would be considered consistent with the observed mortality impacts to fish eggs in close proximity (~5m) to an acoustic array (i.e. near-field or very localised impacts) (refer Popper, 2008).

Adopted Control Measures

The following controls have been adopted to avoid or minimise impacts to marine fauna in the region:

- The survey will adopt the Part A Standards Management Procedures of the *EPBC Policy Statement 2.1 – Interaction between Offshore Seismic Operations and Whales* (2008) using a 1km low power zone[85] during the use of the reflection (boomer) and CHIRP system to minimise impacts to whales;
- Two trained resources in fauna observation (one Marine Mammal Observer) will undertake whale observation, distance estimation and reporting during daylight hours of the geophysical survey;
- All crew on-board the survey vessel shall be provided with an induction containing controls which must be adopted to protect whales during the survey;
- Start-up Procedures:
    - Visual observations for whales must be undertaken in the 3km observation zone by a suitably trained cetacean observers for at least 30 minutes before the commencement of soft-start procedures;
    - Soft-start procedures may only commence if no whales have been sighted within the low power or shutdown zone during the prestart-up visual observations. Soft start procedures will be used each time the boomer source is initiated gradually increasing power over a 30 minute period;

[84] Aguilar de Soto, N, Delorme, N., Atkins, J., Howard, S., Williams, J., & Johnson, M. (2013) – Anthropogenic noise causes body malformations and delays development in marine larvae, Scientific Report 3, 2831, DOI:10.1038/srep02831 (2013) available at http:/www.nature.com/srep/2013/131003/srep02831/full/srep02831.html

[85] All acoustic sources will be below 160dB re 1µPa^2.s at 1km. Boomer survey is in the lower frequencies which may impact baleen whales.

- Visual observation by trained crew will be maintained during soft starts;
- If a whale is sighted within the observation zone an additional trained crew members should be brought to the bridge to monitor. If the whale enters to low-power zone (<1km), the source should be powered down to the lowest possible setting, and in the shutdown zone (<500 m) the acoustic source shut-down completely;
- Start-up can only resume after the whale has moved outside the low power zone or when 30 minutes have elapsed since the last whale sighting.

- Operating procedures: While the boomer system is operating the following procedures will be implemented:
  - Visual observations of the observation zone[86] must be maintained continuously to identify is there are any whales present;
  - If a whale is sighted within the observation zone an additional trained crew member should be brought to the bridge to continuously monitor the whale while in sight;
  - If a whale is sighted within the shutdown zone[87] the acoustic source must be shut down completely.

  The acoustic source may be re-started when the whale is observed to have moved out of the shutdown zone or when 30 minutes have elapsed since the last sighting.

- Low visibility operating procedures: During periods of low visibility (where the observation zone cannot be viewed out to 3km), including night-time, the acoustic source may be utilised as described above, provided that during the preceding 24 hour period:
  - There have not been three or more whale instigated shut-down situations; or
  - If operations were not underway during the preceding 24hrs, the vessel has been in the vicinity of the proposed start-up position for at least 2hrs (under good visibility) within the preceding 24hr period and no whales were sighted; and

- Detailed reports of all cetacean sightings will be provided to DOE by the WSH Project Manager after completion of the survey.

Environmental Risk Assessment

Cetaceans: Literature indicates that high acoustic sound levels (i.e. SEL above 160 dB re 1µPa^2.s) might be expected to cause injury to cetaceans. These types of sound levels would only occur in close proximity to the boomer and CHIRP sources however they would be considered a significant impact (Consequence 3 given their NES classification) in accordance with the CHPL Qualitative Risk Matrix.

The survey area is not located in critical habitat (feeding, aggregation) for cetacean species; and is located in oceanic waters where species migration pathways are unlikely to be limited by survey activities. Species encounter rates, if present, is expected to be transient. With control measures identified in the EPBC Policy 2.1 – *Interaction between Offshore Seismic Exploration and Whales* (2008) (Part A) exposure of whales to unacceptable sound levels is considered very unlikely and the residual environmental risk to the species is assessed as **low**.

Turtles: As per cetaceans, it is possible without controls, that physiological and behavioural (Consequence 3) impacts to turtle species is possible, particularly in close proximity to the boomer acoustic source. However with the adoption of soft-start procedures; the observed behavioural responses (i.e. avoidance) of turtles to operating seismic arrays; and the low expected encounter rate of turtle species in the area; it is very unlikely physiological or behavioural impacts will be experienced. The residual environmental risk is **low**.

[86] Observation Zone: A 3km horizontal radius from the acoustic source.
[87] Shutdown Zone: A 500m horizontal radius from the acoustic source

Pinnipeds: Australian and New Zealand Fur Seals may be present within the survey area on a transitory basis (foraging) during the survey period. Literature indicates that Sea Lions (similar to Fur Seals) require substantial SEL levels (~194dB re 1µPa^2.s) for TTS to be realised. These SELs are not expected from acoustic equipment however possible behavioural impacts may be observed. On this basis, impacts would be considered to be minor (Consequence 2 as the species does not have an NES classification). Given the observed species 'avoidance' characteristics to mid-frequency sources in excess of 170dB re 1µPa and the adoption of ramp-up protocols for the boomer system, the likelihood of TTS impact is considered very unlikely and the residual environmental risk is assessed as **low**.

***Shark Impacts*:** Given the wide-ranging habitat of shark species which might be present in the survey area; and their lack of attraction to continuous signals or higher frequency sounds, the impact to shark species is, at most, expected to be localised avoidance of the survey area. Given the open ocean environment of the survey area minor displacement may be expected as they transit through the region (Consequence 2). As the vessel is constantly moving during geophysical activities, permanent displacement impacts are considered very unlikely and the residual risk is assessed as **low**.

Fish Impacts: Popper (2008) has identified that most fish species have poor hearing above 2-3 kHz. On the basis of predicted SPLs, localised and low level behavioural impacts to adult fish leading to temporary displacement of species may be realised. The impacts to fish are considered minor (Consequence 2), with permanent displacement considered very unlikely. The residual risk to fish species is considered **low**.

***Lobster Impacts*:** Based upon the results from recent IMAS studies[88] the geophysical acoustic sources to be utilized are not expected to cause mortality impacts to adult lobsters or larvae. On this basis a negligible impact (Consequence 1) is assigned. Given the small survey area, temporary nature of the survey activities and the limited presence of lobsters in the area due to the known sandy substrates present, exposures are considered very unlikely. The residual risk to lobsters (adult and larvae) is assessed as **low**.

Scallop Impacts: No low frequency airgun sources are to be utilised within the proposed geophysical survey. The Boomer system with a source level of 215dB re 1µPa or SEL ~172dB re 1µPa^2.s operates in the frequency range 0.5-2kHz which overlaps scallop 'sound detection' frequencies (30-1000Hz), however the Boomer source operates at SEL levels which are significantly below those utilised in the IMAS study and the Boomer equipment will not be operated in close proximity to scallop beds (i.e. 4.8m where near-field particle motion effects are expected to be substantial). On this basis, impacts to scallops, if present in the survey area are expected to be localised (i.e. Consequence 2). Given the limited area of the survey, the low abundance and limited recruitment of scallop stock within the survey area[89] impacts at a fishery level are considered very unlikely and the residual risk is assessed as **low**.

Should the survey be undertaken during the scallop spawning period (August to October), it is possible that very localized impacts to scallop eggs/larvae may occur in the 'near-field' of operating sources based on the work of Aguilar de Soto et al (2013). On this basis a minor (Consequence 2) is conservatively assigned to possible impacts, however given the small survey area, the small acoustic sources to be used in the survey, and the limited temporal overlap of the survey with spawning periods, impacts to scallops at a population level are considered very unlikely. The residual risk to scallops from the proposed survey is assessed as **low**.

[88] Semmens, J, (2014) – Milestone Progress Report – Assessing the Impacts of Marine Seismic Surveys on South East Australian Scallop and Lobster Fisheries, FRDC Project number 2012/008

[89] The 2012 Scallop Fishery Report identified that the scallop abundance in the survey area was low and limited recruitment had occurred to the area over preceding years.

5.2.6 Sound Disturbance – Vessel Operation

Background Information and Potential Impacts

Vessel sound levels are not expected to be high enough to cause physical damage to marine fauna, however temporary behavioural changes (avoidance) in species (cetaceans, turtles, fish) may be observed. It is expected that sound levels which might be expected to cause disturbance (avoidance) to marine fauna, if present would be expected to be confined to the immediate vicinity of the vessels; within a radius of a few metres of the sound source.

Typically, marine vessels produce low frequency sound (i.e. below 1 kHz) from the operation of machinery on-board; from hydrodynamic flow noise around the hull; and from propeller cavitation, which is typically the dominant source of sound. Most sounds associated with vessels are broadband (i.e. contain a broad range of frequencies), though, tones are also associated with the harmonics of the propeller blades[90]. Studies[91] have identified that for a rig tender vessel underway with a broadband source level of 177dB re 1µPa, the measured vessel noise was broadband in nature, with the highest level measured at 137 dB re 1µPa at 405 m astern; levels of 120 dB re 1µPa recorded at 3-4km; and the noise audible at up to 20 km against a 'natural background level' of 90 dB re 1µPa.

Usually, the larger the vessel or the faster a vessel moves results in more sound emissions. Depending on the vessel, source levels can range from less than 160dB (trawlers) to over 200dB re 1µPa @1m (super-tankers)[92].

Adopted Control Measures

The following controls will be adopted to avoid or minimise impacts to marine species from sound disturbances associated with vessel operations:

- Vessel propulsion systems undergo regular preventative maintenance and routine inspection against manufacturers specifications;
- Proximity distances and low speeds will be adopted in accordance with the EPBC Regulations 2000 (Part 8) for cetaceans (including dolphins and porpoises) to avoid behavioural impacts during transits in the operational area;
- All crews will complete an environmental induction covering the requirements for cetacean/vessel interaction consistent with EPBC Regulations 2000 (Part 8).

Environmental Risk Assessment

Sound emissions from the operation of the survey vessel may create temporary behavioural impacts (i.e. avoidance) to marine fauna in the immediate vicinity of the vessel (Consequence 1) and avoidance impacts in sound sensitive marine fauna, if present, is possible during the survey. On this basis the residual environmental risk posed by vessel sound is assessed as **low**.

[90] Skjoldal H.R., Cobb, D., Corbett, J., Gold,M.,Harder, S., Low, L.L.,Noblin, R., Robertson, G. Scholic-Schlomer, A.M., Sheard, W., Silber, G., Southhall, B., Wiley, C. Wilson, B and Winebrake, J., 2009 - Arctic Marine Shipping Assessment. Background Research Report on Potential Environmental Impacts from Shipping in the Arctic http://www.pame.is/images/stories/AMSA/AMSA_Background_Research_Documents/Environmental_Impacts/6-1-Environmental-Impacts-from-Current-and-Future.pdf

[91] McCauley R.D., 1998 - Radiated underwater noise measured from the drilling rig Ocean General, rig tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. Report to Shell Australia

[92] Whale and Dolphin Conservation Society (WDCS), 2003 - *Oceans of Noise,* [Online],. Available from: http://ww.wdcs.org/stop/pollution/index.php

5.2.8 Coring Activities (Benthic Habitat/Seabed Impacts)

Background Information and Potential Impacts

The benthic habitats of the survey area, based upon previous surveys for Sea Lion and WSH area and feedback from fisheries, consists primarily of soft sediment habitats. These habitats are widespread within Bass Strait.

The geotechnical survey activity will acquire samples of the seabed and assess shallow geology via coring using equipment described in **Section 3.** Sediment sampling and coring have the potential to disturb/smother benthic habitats, in turn creating minor ecosystem impacts across the survey area. Seabed impacts will be limited to localized areas of maximum disturbance of approximately $20m^2$ per core for coring activities; less than $0.05m^2$ per CPT and $1m^2$ per grab sample. The maximum volume of cuttings generated per core is expected to be $0.14m^3$.

Adopted Control Measures

During the survey, field personnel will adhere to equipment method statements (e.g. seabed drilling equipment) when undertaking sampling activities.

Environmental Risk Assessment

The proposed activities are expected to have a temporary impact on benthic epifauna and subsea currents will transport, or fishing activities redistribute, sediment to fill any depressions, with adjacent benthic fauna recolonizing these soft sediment habitats rapidly.

Given these factors, and the very small areas to be impacted by sampling/coring activities in the survey area, the impact of sampling to benthic communities and the seabed is considered to be localized and temporary (i.e. minor – Consequence 2). As this type of substrate rapidly recolonizes, permanent impacts to benthic habitats are considered very unlikely and the residual environmental risk is assessed as **low**.

5.2.9 Coring Chemical/Fluid Discharges

Background Information and Potential Impacts

Seabed coring equipment utilizes seawater as a coring fluid and discharges cuttings directly onto the seabed. Thickening agents may be used if difficult geology is encountered and their use may have localized impacts on water quality. No mud processing and recirculation system is utilized for this activity.

Adopted Control Measures

Chemicals utilised for coring activities will have a low environmental hazard rating such as a 'GOLD/SILVER', Non-CHARMABLE Group E or PLONOR under the UK Offshore Chemical Notification Scheme (OCNS) (CEFAS, 2013) (or equivalent assessment system).

Environmental Risk Assessment

A localized sediment cloud from the seabed is expected to be rapidly dispersed in the prevailing current. The maximum volume of cuttings/sediment released per core is expected to be approximately $0.09m^3$.

Discharges from coring activities will consist of a small volume of sediment and (possible) low concentrations of low toxicity, biodegradable, not-persistent chemical which may have temporary and localized impacts on water quality (minor impacts – Consequence 2). Given the dynamic nature of the marine environment, the small seabed area and volume of water affected; and its temporary nature, impacts to marine environment are considered very unlikely and the residual environmental risk is assessed as **low**.

5.2.10 Vessel Operation – Oily Bilge Discharges

Background Information and Potential Impacts

Operation and drainage from machinery spaces on-board the survey vessel has the potential to contain hydrocarbons from drainage areas which may be discharged to the environment. Known and potential impacts of untreated machinery drainage spaces to the marine environment are include a reduction in water quality (organics and toxics) around the discharge location; and possible ingestion by, and toxic impacts to, marine species.

The survey vessel engaged for the survey will have oily water treatment systems compliant to MARPOL 73/78 Annex I requirements in accordance with the *Protection of the Seas (Prevention of Pollution from Ships) Act 1981* (S9) (appropriate to class) or retain all bilge/machinery space water on-board the vessel for onshore disposal.

Adopted Control Measures

Controls adopted for all vessels to reduce impacts from treated bilge water discharges include:

- All shipboard operations associated with oil transfer/movement are recorded in the Oil Record Book;
- Oil-water discharges will be compliant to MARPOL 73/78 Annex I requirements as follows:
    - Where an oil-water separation system is installed :
        - Oily water passes through an oil/water treatment system which can achieve an oil-in-water (OIW) content less than 15ppm;
        - The Oil Detection Monitoring Equipment (ODME) on the discharge stream will be routinely calibrated to ensure the validity of discharge concentrations overboard;
        - Discharge occurs when the vessel is proceeding *en-route;*
        - The treatment system will be maintained in accordance with manufacturer's specifications via the vessel's Planned Maintenance System;
        - Separated whole oil will be stored in a dedicated tank for onshore disposal.
    - Where an oil-water separation system is not installed there will be no discharge of bilge water. Bilge water will be transported to shore to be treated in an approved onshore facility.

Environmental Risk Assessment

The intermittent discharge of treated bilge water at 15ppm OIW to the marine environment may result in temporary, localised increases in oil content of marine waters immediately surrounding the vessel discharge point (i.e. 'negligible' – Consequence 1).

Given this treated bilge discharge will occur at intermittent periods during the survey period; the small volumes involved; the constant vessel movement; and the assimilative/dispersive nature of the receiving environment, it is considered very unlikely that this discharge will impact water quality to the extent that toxic impacts to marine fauna will occur. The residual environmental risk for this discharge is assessed as **low**.

5.2.11 Vessel Operation – Sewage Discharges

Background Information and Potential Impacts

Survey vessels may discharge sewage to the marine environment during survey activities. All vessels engaged on the survey activities which discharge sewage will have sewerage treatment systems compliant to MARPOL 73/78 Annex IV requirements or comply with sewage discharge requirements of the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983.*

The known and potential impacts of sewage discharges to the marine environment are:

- Reduction in water quality (organics and bacteria) around the discharge location;
- Visual amenity impacts; and
- Possible Ingestion/health risk to marine species.

Adopted Control Measures

Controls adopted for all vessels to reduce impacts from sewage discharges include:

- For vessels with installed sewage treatment plants, compliant to MARPOL 73/78 Annex IV requirements, discharge may occur at any time providing visible floating solids and discolouration is not evident;
- For vessels with maceration and disinfection facilities, the discharge occurs more than 3nm from land;
- All treatment equipment is routinely maintained and inspected (Vessel's Preventative/Planned Maintenance System; and
- For vessels with treatment facilities on-board, the Vessel Masters will ensure that persons on board (POB) will not exceed the design capacity of the treatment system.

Environmental Risk Assessment

Sewage volumes discharged are finite, small and discharged into a dynamic open ocean marine environment distant from the nearest coastline. The discharge of treated sewage to the marine environment may result in temporary, localised increases in nutrient/BOD loading in marine waters immediately surrounding the discharge point. On this basis environmental impacts will be localised and temporary (i.e. negligible – Consequence 1).

Given treated sewage/grey-water discharges will occur at intermittent periods during the limited survey period; the biodegradable nature of the discharge; and the dispersive nature of the receiving environment; it is considered very unlikely that this discharge will impact water quality to the extent that impacts to marine fauna will occur. The residual environmental risk assessed for this discharge is assessed as **low**.

5.2.12 Vessel Operation – Food-scrap Discharges

Background Information and Potential Impacts

For the duration of the survey food-scraps may be discharged from the survey vessels. Vessels engaged on the survey will either:

- Macerate the waste stream on-board to a size which is less than 25mm prior to discharge overboard at a distance greater than 3nm from the territorial baseline whilst *en-route* (chartered reef or coastline) in accordance with MARPOL 73/78 Annex V requirements; or
- Freeze or store for disposal at an onshore facility.

The known and potential impacts of food-scrap discharges to the marine environment are:

- Reduction in water quality around the discharge location; and
- Marine fauna, such as fish and seabirds, may be attracted to the food source, alter their natural behaviour and increase vessel interactions.

Adopted Control Measures

Controls adopted to reduce impacts from putrescible waste discharges include:

- Macerated food-scraps (<25mm particle size) are discharged whilst en-route at a distance of at least 3nm from shore;
- Equipment is regularly maintained and inspected as per manufacturer's specifications;
- Vessels operate under a Garbage Management Plan and all personnel will be trained/inducted into these requirements;
- Placards displayed on the vessel provide guidance on vessel garbage management requirements and all personnel are inducted into these requirements.

Environmental Risk Assessment

The intermittent discharge of macerated food-scraps to the marine environment may result in temporary, localized increases in nutrient/BOD loading in marine waters immediately surrounding the discharge point (Consequence 1). This small volume, biodegradable waste stream as it enters the marine environment will be compliant with MARPOL 73/78 Annex V requirements, discharged while the vessel is *en-route* in the highly dispersive waters of Bass Strait. It is very unlikely that temporary, localized marine environmental impacts will be experienced. The residual risk is assessed as **low**.

5.2.13 Vessel Operation – Air Emissions

Background Information and Potential Impacts

For the duration of the survey fuel sources used on-board the marine vessels will emit exhaust gases to the atmosphere.

Gaseous greenhouse gas (GHG) emissions such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) together with non-GHG emissions such as NO_x, SO_x, smoke and particulates may be emitted from vessel engines and generators. The fuel sources used for combustion purposes will be Marine Diesel Oil (MDO) with anticipated consumption of the vessel in the order of $16m^3$ per day during coring activities. These types of emissions can lead to a localised reduction in air quality (e.g. health impacts) and contribute to global warming by contributing to the national GHG loading.

The Heating, Ventilation and Air Conditioning (HVAC) on-board vessels may contain refrigerant gases which may have significant Global Warming Potentials (GWP) or possible Ozone Depletion Potential (ODP). While these substances are contained within a closed operational system, release of these refrigerants during maintenance can contribute to global warming and ozone depletion.

Adopted Control Measures

Controls adopted to reduce impacts from combustion emissions include:

- The vessels use fuel (i.e. MDO) which meets MARPOL Annex VI requirements for sulphur emissions;
- Vessel engines (as required) will meet NO_x emission levels as required by MARPOL 73/78 Regulation 13;
- All combustion equipment maintained in accordance with Manufacturer's instructions;
- Proactive management of fuel usage on-board the vessels ensures consumption is monitored and benchmarked and corrective action initiated in the event of abnormally high fuel usage.

Controls adopted to prevent the accidental release of refrigerant gases include:

- Maintenance of closed system refrigeration systems on-board vessels is undertaken by suitably qualified personnel in accordance with approved procedures; and
- HVAC systems are maintained in accordance with Manufacturer's instructions via Planned Maintenance System.

Environmental Risk Assessment

Combustion Emissions: The fuel source used on-board the survey vessel for combustion purposes is Marine Diesel Oil (MDO) with anticipated consumption in the order of 16m^3 per day during coring activities (~52tonnes$_{CO2\text{-}eq}$ per day[93]) (i.e. negligible contribution – Consequence 1). As this emission will occur during the survey the likelihood is considered 'very likely' and the residual risk is assessed as **medium.**

Non-GHG emissions (SOx, NOx, particulates) from equipment emissions will be rapidly dispersed in the Bass Strait environment. Air quality impacts would be very localized (i.e. negligible contribution – Consequence 1) with associated health impacts to on-site personnel very unlikely. The residual risk is assessed as **low.**

Refrigerant Emissions: Refrigerant gases maintained on board are in closed circuit systems. Emissions on this basis will occur only during leaking equipment events or during maintenance activities. Given the finite volumes of gas available, any leak would be expected to contribute on a minor basis to GHG or ozone depletion (i.e. minor contribution – Consequence 2). With controls adopted inadvertent release is considered very unlikely and the residual risk is assessed as **low.**

5.2.14 Non-routine Incident – Oil Spill from Fuel Tank Leak/Rupture

Background Information and Potential Impacts

An assessment of oil spill hazards was performed for the survey activity.

While considered a very unlikely event due to the location of the survey, a third party vessel collision (i.e. fishing vessel/recreational vessel) with the survey vessel is possible and may result in a fuel spill.

The known and potential impacts of fuel spills to the marine environment include reduced water quality (surface oil, dissolved and entrained oil); and possible oiling or entrained phase (in-water) impacts to marine and coastal flora/ fauna present in the vicinity of the spill. Species within the spill zone include marine mammals (cetaceans, pinnipeds), migratory seabirds and shoreline birds, sharks and fish.

Socio-economic uses of the area include commercial fishing, oil and gas operations and commercial shipping. Adjacent shoreline areas contain National and Coastal Parks, high value tourist beaches (i.e. Lakes Entrance) and protected shipwrecks. The Gippsland coastline is also of aboriginal cultural significance.

Adopted Control Measures

Control measures to prevent or reduce impacts from a third party vessel collision with a survey vessel include:

- Survey vessel is class certified and carry appropriate safety audit documentation;
- Navigation safety equipment (AIS, navigation lighting and radio) are present on vessel and routinely maintained;
- Notification to AMSA RCC of survey activity who will issue AusCoast warnings;
- Notification to AHO to issue a Notice to Mariners for survey activity;
- Vessel operated by experienced and competent crew (STWC95) with 24/7 bridge watch;
- Availability of approved and tested Vessel SOPEP and Survey Oil Pollution Emergency Plan (OPEP);
- Crew are drilled in SOPEP response requirements. Personnel also trained in Survey OPEP requirements;

[93] Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICCSRTE) (2013) – Australian National Greenhouse Accounts, National Greenhouse Accounts Factors, July 2013 available at http://www.climatechange.gov.au/sites/climatechange/files/documents/07_2013/national-greenhouse-accounts-factors-july-2013.pdf

- Notification in the unlikely event of a spill via radio to other marine users;
- AMSA is notified of an oil spill as soon as possible and as Combat Agency will respond to vessel-based spill in Commonwealth waters; and
- SOPEP is implemented to minimise hydrocarbon release to the environment.

Environmental Risk Assessment

In accordance with the CHPL Qualitative risk matrix, the environmental consequences associated with a significant hydrocarbon spill (>10tonnes) is considered to have a major impact (Consequence 4) on the marine environment.

Oil spill frequency data for the Gippsland Basin identifies a frequency for spills greater than 100tonne to be 1 event in 100-1000years (DNV, 2011). It should be noted that frequencies provided by DNV (2011)[94] relate to the total number of events in each sub-region of Australia relative to the Australian average. DNV (2011) identifies that in absolute terms, the frequencies in *all sub-regions* is low to very low (i.e. a frequency <0.0001 or incident interval>1 in 10,000years. On this basis, with controls implemented, the likelihood of a collision event, resulting in a significant spill is considered very unlikely with the preventative controls implemented. The residual environmental risk is therefore assessed as **low**.

5.2.15 Non-routine Incident – Chemical/Oil Spill through Deck Drain System

Background Information and Potential Impacts

Chemicals/oils used on-board during survey operations are limited to small quantities of cleaning products, hydraulic fluids, solvents and possible diesel generator fuel tanks. These chemicals/oils could potentially leak during handling and enter the marine environment through the deck drainage system.

Spills of these materials may reduce water quality at the spill location and may have toxicity impacts to flora and fauna present in the vicinity of the spill.

Adopted Control Measures

Control measures implemented on the vessel to minimise chemical handling risk include:

- Chemical/oils are stored in suitable containers in bunded areas isolated from the deck drainage system; and
- Information is available to all personnel on chemical/oil handing (i.e. Material Safety Data Sheets for all chemicals and hydrocarbons).
- Spill kits are strategically placed near high risk spill locations on vessel;
- Impacts from deck wash-down waters minimised by utilising biodegradable detergents;
- Routine inspection of storage areas undertaken to ensure spill kits are adequately stocked and clearly labelled and high levels of housekeeping are maintained;
- All personnel are aware of appropriate hydrocarbon/chemical spill response requirements through vessel induction; and
- Spills are cleaned up immediately, reported through the vessel's incident reporting system, and contaminated material contained on-board for on-shore disposal.

Vessels will utilize their SOPEP (or equivalent) to respond to vessel-sourced oil spills. Vessel spill exercises are conducted on a routine basis.

[94] Det Norske Veritas (DNV) (2011) – Final Report: Assessment of the Risk of Pollution from Marine Oil Spills in Australian Ports and Waters (Report No: PP002916 Rev 5, December 2011) – A report prepared for the Australian Maritime Safety Authority downloaded at http://www.amsa.gov.au/Marine_Environment_Protection/National_plan/Reports-Fact_Sheets-Brochures/ on 28th December 2011

Environmental Risk Assessment

Given the 'packaged' chemical/oil volumes used and stored during seismic operations are small in volume, the consequence of any chemical spills on deck which entered the marine environment are assessed as minor (i.e. localised water quality impacts - Consequence 2). With the safeguards adopted, the likelihood of chemical spills entering the environment is considered unlikely and the residual environmental risk is assessed as **low**.

5.2.16 Non-routine Incident – Solid/Hazardous Waste Overboard Incident

Background Information and Potential Impacts

During the survey small quantities of solid non-biodegradable wastes such as plastic packaging, and hazardous wastes, such as used chemical containers, batteries, waste oils, may be produced. Individual waste items are small in size/volume.

The known and potential impacts of waste overboard incidents are:

- Solid, non-biodegradable wastes have the potential to damage benthic habitats or marine fauna may ingest (particularly seabirds with respect to plastics) or become entangled in the waste; and
- Oil and chemical residues reduce water quality and may expose marine fauna to toxic impacts

Adopted Control Measures

Waste protocols adopted on the vessels will include:

- Vessels will operate in accordance with an approved Garbage Management Plan;
- Vessels will have a 'No solid or hazardous waste overboard' policy;
- All wastes are appropriately containerised (i.e. with lids to prevent wind-blown material (plastics) or rain ingress), labelled and stored in dedicated areas which are routinely inspected and maintained with high standards of house-keeping;
- Hazardous wastes (used oils, lithium batteries, chemical and metallic wastes) are segregated and stored on-board for disposal onshore in accordance with Victorian waste disposal regulations; and
- Waste storage areas are routinely inspected to ensure high levels of housekeeping.

Environmental Risk Assessment

Solid non-biodegradable/hazardous wastes will be handled in accordance with the vessel's Garbage Management Plan and will work to a 'no solid non-biodegradable/hazardous waste overboard' policy. Hence no impacts to the marine environment should occur. However, it is possible that accidental discharges of waste material (e.g. small amounts of wind-blown packaging) to the marine environment may occur. In this instance, although the material will be small in volume for materials such as plastic, fauna impacts (i.e. mortality) may occur. On this basis the impact is considered significant (Consequence: 3). With the on-board controls implemented with respect to inspection and waste containment standards, the likelihood of such an incident occurring during the survey is considered very unlikely. The residual risk is assessed as **low.**

5.2.18 Non-routine Incident – Trailing Equipment Loss to the Marine Environment

Background Information and Potential Impacts

The survey will utilise the following trailing equipment during the geophysical component of the survey:

- **Bathymetry:** MBES which is mounted on the vessel;
- **Refraction:** CHIRP/SSS system which will be towed at approximately 12.5-15m above the seabed. Known seabed obstacles within the survey location consist of two suspended conductors (Wardie & WSH-3 conductors) which are approximately 1-2m above the seabed. The survey design therefore avoids contact with these obstacles; and
- **Reflection**: Surface towed 'Boomer' system with a surface hydrophone streamer up to 60m behind the vessel.

All equipment contains beacons which can accurately position lost equipment.

Streamer and equipment loss/entanglement can create marine debris hazards in turn leading to impacts to fisheries by snagging equipment or leading to benthic habitat impacts through physical contact.

Adopted Control Measures

The following controls will be adopted:

- Equipment is deployed and operates under approved procedures;
- Seabed conditions are constantly monitored by survey personnel to identify entanglement hazards;
- Equipment used is fit-for-purpose; and
- Marine notifications (Channel 16) are made in the event of equipment loss during the survey.

Environmental Risk Assessment

Loss of equipment to the marine environment may create minor impacts to third party stakeholders (i.e. interference with or damage to fishing equipment) (Consequence 2) utilizing the area, however with the preventative controls implemented to prevent loss from occurring; and notification to relevant stakeholders, the likelihood of this these impacts being realized is considered unlikely. The residual environmental risk associated with this impact is assessed as **low**.

5.2.19 Non-routine Incident – Hydraulic Line Liquid Release from Subsea Equipment

Background Information and Potential Impacts

Subsea drilling units for coring activities rely on control umbilicals to perform subsea activities. The equipment is operated via closed control lines (i.e. no hydraulic fluid release on control valve actuation).

Hydraulic fluid releases may occur if control umbilicals (i.e. pressurized hoses) fail during subsea activities.

The known and potential impacts of hydraulic line perforation and resulting liquid loss to the marine environment are:

- Reduced water quality at the perforation location (localised surface oil, entrained oil); and
- Possible impacts to marine flora and fauna present in the vicinity of the leak.

Adopted Control Measures

The following controls will be adopted:

- Equipment is maintained in accordance with manufacturers specifications;
- Equipment tested & confirmed to be functioning correctly prior to deployment at the survey location; and
- Equipment used is fit-for-purpose.

Environmental Risk Assessment

Hydraulic fluids used in subsea drilling units, mineral oils, are poorly soluble but practically non-toxic to aquatic organisms. Given the small amounts of hydraulic fluid which might be released on a failure event and the highly dispersive Bass Strait marine environment, the impact associated with the fluid discharge is considered 'minor' (Consequence 2) and with the preventative controls adopted the incident is considered unlikely. The residual environmental risk of a spill to the environment is considered **low**.

5.2.20 Non-routine Incident - Collision with a Cetacean

Background Information and Potential Impacts

The survey vessels will be operating on a 24/7 basis for the duration of the survey, however constant movement will be occurring only for the geophysical component of the scope. All vessel movement poses a collision risk to cetacean species. The Sea Lion and WSH survey area is recognized as having habitat which may support the presence of cetaceans and it is possible that these species may transit the survey area.

Literature[95] identifies that larger vessels moving in excess of 10knots may cause fatal or severe injuries to cetaceans, with the most severe injuries caused by vessels travelling faster than 14knots.

Adopted Control Measures

The following controls will be adopted:

- Vessel operations conform to proximity conditions, speeds and management measures contained in EBPC Regulations 2000 (Part 8) during the survey; and
- Vessel crew have been inducted into the requirements of the EPBC Regulations 2000 (Part 8).

Environmental Risk Assessment

Cetaceans may transit through the survey area during the survey period. While cetaceans will tend to practice avoidance around vessels with high sound signatures and avoid acoustic sound generated from survey activities it is possible vessel strike to a cetacean can occur (Consequence 3) given their national significance.

With these control measures implemented the likelihood of collision is assessed as very unlikely. The residual risk is assessed as **low.**

[95] Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., & Podesta, M., 2001 – Collisions between Ships and Whales, Marine Mammal Science, Vol. 17, Issue 1, pp35-75

6.0 SUMMARY OF ARRANGEMENTS FOR ONGOING MONITORING OF ENVIRONMENTAL PERFORMANCE

CHPL is responsible for ensuring the survey activity is managed in accordance with the accepted Geophysical and Geotechnical Environment Plan such that the environmental performance outcomes (EPOs) are achieved. The selected survey contractor will undertake survey operations on CHPL's behalf, and, under contractual arrangements with CHPL, will implement and comply with all environmental controls and procedures nominated in this Environment Plan.

As part of contract award, CHPL will review the management system of the survey/vessel contractor against the requirements of this EP with respect to EP commitment implementation (i.e. gap assessment). Key aspects of this assessment will include contractor organisational roles and responsibility review; environmental hazard and risk assessment processes; emergency (oil) response arrangements; operational procedures available to support environmental management of hazards; management of changes procedures; crew training needs analysis and associated records; vessel induction requirements; work activity assessment processes; incident reporting, investigation and corrective action management; inspection procedures; emissions and discharge monitoring; and audit and review processes. CHPL recognises that due to the short duration of this activity and the crew's familiarity with the ship-based systems, contractor processes should be utilised wherever possible.

However, to ensure that the specific requirements of this EP are integrated and implemented within that system, gaps identified during the assessment of the contractor's management system will be documented and addressed via a bridging document which will define the agreed procedures and additional/supplemental requirements to be adopted during the survey activity.

CHPL shall adopt the following methodology to ensure compliance with, and deliver EPOs listed within, the accepted Geophysical and Geotechnical Survey EP:

- Pre-survey audits/information provision from the contractor/vessel will determine 'hardware' and procedural compliance of the contractor and vessels engaged to the EP standard requirements prior to survey commencement;
- The existing Contractor management systems will be bridged with specific EP requirements. Control measure 'custodians' will be identified for relevant control measure implementation and a daily report provided to the CHPL Offshore Representative on compliance and effectiveness (as relevant);
- An environmental induction program will advise all survey personnel of relevant environmental sensitivities; identified environmental hazards, their EPOs and relevant incident reporting requirements if not achieved, and 'reportable incidents';
- The CHPL Offshore Representative shall collate daily environmental parameters (e.g. waste streams, maritime compliance, cetacean mitigation and incident reporting outcomes) to determine EPO attainment and control measure implementation;
- The CHPL Offshore Representative will undertake an EP Compliance Audit and an EP implementation review against the Specific Bridging Plan to determine the effectiveness of the 'bridged' CHPL requirements into the Contractor/Vessel's management system; and
- The CHPL Offshore Representative will obtain all relevant records to provide verification of discharges, incidents, etc. at the completion of the survey.

7.0 OIL POLLUTION EMERGENCY PLAN RESPONSE ARRANGEMENTS SUMMARY

The Geophysical & Geotechnical Survey, as a petroleum activity in Commonwealth waters, has prepared an Oil Pollution Emergency Plan (OPEP) as part of the Environment Plan which will be implemented in the event of an oil spill during the survey activity.

All survey vessels engaged will carry approved SOPEPs as required by MARPOL 73/78 Annex I (or equivalent appropriate to class). The SOPEP is the principle working document for the vessel's crew in the event of a marine oil spill and details specific management response actions to mitigate and combat oil spills originating from vessels. SOPEPs recognise, and integrate with, the divisions of responsibility defined under the Australian National Plan for Maritime Environmental Emergencies (NATPLAN). The Australian Maritime Safety Authority (AMSA) is the legislated Combat Agency[96] for any vessel-based spill in Commonwealth waters including vessels involved with the Geophysical and Geotechnical survey. In the event of a spill, the affected Vessel Master will notify and take direction from AMSA to respond to the spill.

CHPL under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPSGGSA) is responsible for oil spill incidents from petroleum activities, however recognises AMSA's legislated responsibilities. In the unlikely event of an oil spill during survey activities, CHPL will monitor and liaise with AMSA, the affected Vessel Master, Survey Contractor and CHPL Offshore Representative, and provide assistance as required. CHPL will undertake all necessary statutory notifications under the OPGGSA. An immediate action checklist is provided within the OPEP.

Prior to survey activity commencement, a campaign-specific oil pollution emergency drill will be undertaken by all parties with an interest in the vessel operation (i.e. CHPL, Survey Contractor and engaged vessels) to ensure that oil spill response arrangements are fully understood, tested and all supporting resources are available.

During an oil spill, operational monitoring will be undertaken to provide information to the spill response, to identify environmental impacts and determine when response termination criteria have been achieved. In the event of a Level 2 oil spill from the survey vessel, CHPL will monitor for oil impacts to environmental sensitivities and, if oil is detected at levels which may cause environmental effects to the particular sensitivity, undertake any additional scientific monitoring considered necessary (e.g. marine wildlife and adjacent shorelines).

[96] The Combat Agency has responsibility to take operational control and respond to an oil spill in the marine environment.

8.0 CONSULTATION DETAILS

Stakeholder consultation associated with the WSH Development was initiated in late 2012. Consultation associated with the activity specific Geophysical and Geotechnical Survey commenced in mid-2013. All stakeholder records obtained over that period have been provided to, and assessed by, NOPSEMA as part of the Geophysical and Geotechnical EP acceptance.

8.1 DETAILS OF CONSULTATION UNDERTAKEN

Relevant persons ('stakeholders') have been identified through the following mechanisms:

- A review of relevant legislation applicable to Commonwealth waters petroleum and marine activities;
- Identification of marine user groups in the area (possible recreational/commercial fisheries, fishing industry groups, merchant shipping, oil and gas producers);
- Identification of marine 'interest groups' (i.e. technical and scientific entities); and
- Industry/company support groups.

Communication with these various entities identified bodies and relevant spokespersons that might be affected by the proposed activity and required further consultation; or additional persons to be contacted to determine possible concerns.

The following phases of consultation have been undertaken with respect to this survey activity since 2013:

- **Initial consultation** *(commenced in March to May 2013 during Development Concept phase*): Survey scope included offshore WSH Development area. Information associated with the survey was distributed by emails, face to face meetings and follow-up telephone discussions. Communication with these differing groups identified 'relevant' persons that might be reasonably impacted by the activity and hence required ongoing consultation; or additional persons to be contacted to determine possible impacts. These additional contacts were also consulted to establish interests and concerns associated with the proposed activity.
- **Phase 2 Consultation** (*commenced November 2013*): Consultation was undertaken with stakeholders who were identified as relevant from initial consultation activities. Stakeholders were contacted with respect to a timeframe change associated with the survey activities;
- **Phase 3 Consultation** (*commenced December 2013/January 2014*): Consultation was undertaken with stakeholders identified from Phase 2 consultation together with additional stakeholders identified as relevant as a result of the activity scope increase to include the Sea Lion location as part of survey activities;
- **Phase 4 Consultation** (*commenced November 2014*): Consultation was undertaken with stakeholders identified from Phase 3 consultation associated with an increased area of survey (flowline corridor between Sea Lion and WSH).

As a result of this consultation process, the following stakeholders and interested parties were consulted as part of the stakeholder engagement process for the Geophysical and Geotechnical Survey in VIC/P57 and VIC/L31:

Commonwealth Department or Agency

- Australian Fisheries Management Authority (AFMA);
- Australian Maritime Safety Authority (AMSA);
- Australian Hydrographic Office (AHO);
- National Offshore Petroleum Titles Administrator (NOPTA);
- Department of Environment (DOE);

- Department of Defence;
- Border Protection Command;
- Department of Communications (DOC); and
- National Native Title Tribunal (NNTT).

Victorian Departments or Agencies

- Department of Environment and Primary Industries (DEPI);
- Department of Transport; and
- Department of State Development, Business and Innovation (DSDBI).

Fishing Interest Groups

- Lakes Entrance Fisherman's Cooperative Pty Ltd (LEFCOL);
- South-East Trawl Fishing Industry Association (SETFIA);
- Sustainable Shark Fishing Inc. (SSF);
- Southern Shark Industry Alliance;
- Australian Southern Bluefin Tuna Industry Association (ASBTIA);
- Commonwealth Fisheries Association (CFA);
- Seafood Industry Victoria (SIV);
- Scallop Fishermen's Association/Victorian Scallop Fishermen's Association (VSFA);
- Eastern Rock Lobster Industry Association;
- VRFish; and
- Individual Cray & Inshore Trawl Fishermen.

Commercial Charter Fishing Organisations:

- Far Out Fishing; and
- Gippsland Lakes Charter Boats Association.

Adjacent Oil and Gas/Commercial Operators

- Esso Australia Resources Pty Ltd;
- Cape Energy Resources;
- Telstra; and
- Basslink.

Feedback obtained from this process has allowed a communication and engagement strategy to be developed for relevant stakeholders to determine the level, type, 'triggers' and schedule of on-going engagement throughout the Geophysical and Geotechnical Survey activity. CHPL will maintain communications with stakeholders identified in this communication and engagement strategy to ensure they are informed of relevant aspects of the survey or changes that may affect them. This will include on-going operational liaison through direct contact, reconfirmation of survey program details, announcement of survey milestones or changes to program.

8.3 MERITS OF STAKEHOLDER OBJECTIONS AND CLAIMS

An assessment of the merits of objections or claims about the adverse impact of the Geophysical and Geotechnical Survey was made, and where practicable those with merit were addressed in the survey design. The following objections and claims were identified (*note where possible these have been grouped into common themes*):

- Stakeholder Identification:
  - **NOPTA** provided a preliminary listing of stakeholders to CHPL. *All stakeholders were contacted and interests and concerns identified.*
  - **AFMA** provided a preliminary listing of stakeholders to CHPL. *All stakeholders were contacted and interests and concerns identified.*
- Activity Spatial Conflict (Marine/Defence):
  - **AMSA** advised that the survey area is within the Area to be Avoided (by Shipping) hence shipping should not be a problem for the survey. However the area is located within a fishing area and an awareness and consultation program should be initiated with them. AMSA recommended that full details of the program should be provided to AMSA RCC who will issue radio warnings. *Recommendation has been adopted within the Environment Plan for third party marine users to prevent spatial conflicts*.
  - **AHO** advised that a Notice to Mariners should be issued for the activity to advise third party marine users. *Recommendation has been adopted within the Environment Plan for third party marine users to prevent spatial conflicts.*
  - The **Department of Defence** advised that the survey area is located in a Defence Restricted Airspace (R258D) and that all activities would require notification to the Joint Aerospace Control Cell. *Recommendation has been adopted within the Environment Plan for third party users to prevent spatial conflicts*
- **Vessel Oil Spill:** The Victorian DTPLI identified, via written consultation material, that courtesy notification on a Level 2 spill in Commonwealth waters was appreciated. *This recommendation has been adopted within the oil spill notification requirements in the Oil Pollution Emergency Plan*.
- Commercial Fishing:
  - **LEFCOL**, **SETFIA** and **SSF** identified concerns during the initial and second consultation phases regarding the use of a single low-frequency (airgun) as part of the geophysical component of the survey and its associated potential for damage/displacement to fish. CHPL assessed the merit of this information and, based upon available scientific studies found that displacement impacts to fish stock associated with *large scale acoustic arrays* was species dependent and localised. Scientific literature on fish stock damage (i.e. larval fish) also identified localised impacts immediately around low-frequency sound sources. *This information was considered in the assessment of impacts to fish stock within the Environment Plan*.

    Subsequent review of geophysical equipment options available to CHPL identified that geophysical survey objectives could be achieved using mid-frequency acoustic sources and this option was selected. On this basis the low frequency airgun was removed from survey design.
  - **SSF** also identified concerns around the cumulative sound impacts of sound in the marine environment surrounding the use of low frequency air-guns and multiple survey vessels. *CHPL advised that the activity involved a single vessel and mid-frequency acoustic sources were being utilised in the survey. No further issues were raised.*

- **SETFIA** has requested notification one week prior to, and at the commencement and completion of the survey, to allow for notification to the Danish Seine Fleet. *CHPL has included this requirement in ongoing stakeholder management arrangements.*
- **VSFA** identified from consultation material provided the possibility of a significant threat to scallop stocks through the utilization of a mid-frequency acoustic source towed approximately 12-15m above the seabed. *CHPL assessed, based upon available scientific literature, possible impacts to scallop stocks from mid-frequency sources and confirmed equipment specifications with supplier. On the basis of this information CHPL considers that impacts to scallops will not be significant as a result of the mid-frequency equipment proposed for the survey. This information has been provided to the VSFA*.
- **Seafood Industry Victoria (SIV)** provided feedback during the third phase of consultation requesting the assessment of impacts to scallops associated with geophysical activities and coring activities and whether marine vibroseis has been considered as a technology to reduce sound impacts. *CHPL provided requested information and assessed the feasibility of using the marine vibroseis equipment for the geophysical portion of the survey. The equipment is not commercially available at this time and reintroduces low frequency sources to the survey which CHPL considers would not be acceptable to other fishing groups*.

9.0 CONTACT DETAILS

Further information associated with the environmental aspects of the Geophysical/Geotechnical survey may be obtained from CHPL by contacting:

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