3D Oil Limited

Flanagan 3D Marine Seismic Survey (Otway Basin) Environment Plan Summary

(T/49P)

Date: 6th August 2014

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Revision History

0	06/08/2014	EP Summary Issued for Internal Review	LC	CP	AA
Rev	Date	Description	By	Review	App.

Abbreviations

Abbreviation	Meaning
°C	Degrees Celcius
µm	Micrometres
µPa	Micropascals
3D	Three Dimensional
3D Oil	3D Oil T49P Pty Ltd
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
AIS	Automated Identification System
ALARP	As Low as Reasonably Practicable
AMSA	Australian Maritime Safety Authority
ARPA	Automatic Radar Plotting Aid
BBL	Barrel
BOD	Biological Oxygen Demand
CO_2	Carbon Dioxide
DAFF	Department of Agriculture, Fisheries and Forests (now Department of Agriculture)
dB	Decibels
DEPI	Department of Environment and Primary Industries (Victoria)
DoI	Department of Industry
DPIPWE	Department of Primary Industries Parks Water and Environment (Tasmania)
DTPLI	Department of Transport, Planning and Local Infrastructure (Victoria)
EP	Environment Plan
EPA	Environment Protection Authority
EPBC	Environment Protection and Biodiversity Conservation
EPO	Environmental Performance Outcome
FLO	Fishing Liaison Officer
g/m^2	Grams per Metre Square
GAB	Great Australian Bight
GHG	Greenhouse Gas
Hz	Hertz
IMAS	Institute of Marine and Antarctic Studies
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMS	Invasive Marine Species
kHz	Kilohertz
km	Kilometres
km/h	Kilometres per hour
lb	Pounds

Abbreviation	Meaning
LTI	Lost time injury
m	Metres
m^3	Cubic metres
m/s	Metres per second
MARPOL	International Convention for the Prevention of Pollution From Ships
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
mm	Millimetres
MMO	Marine Mammal Observer
MPA	Marine Protected Area
m/s	Metres per Second
MSS	Marine Seismic Survey
NE	Northeast
NES	National Environmental Significance
nm	Nautical mile
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NO_x	Mono-nitrogen oxides
NW	Northwest
ODS	Ozone Depleting Substance
OIW	Oil in Water
OPEP	Oil Pollution Emergency Plan
OPGGSA	Offshore Petroleum and Greenhouse Gas Storage Act 2006
PCFA	Port Campbell Fishermen’s Association
ppb	Parts per Billion
Ppm	Parts per million
psi	Pounds per square inch
PTS	Permanent Threshold Shift
RCC	Rescue Coordination Centre
rms	Root Mean Square
RWDC	Restricted Work Day Case
SE	Southeast
SEL	Sound Exposure Level
SETFIA	South East Trawl Fishing Industry Association
SIV	Seafood Industry Victoria
SOPEP	Shipboard Oil Pollution Emergency Plan
SO_x	Sulphur oxide
SPL	Sound Pressure Level
SSA	Southern Shark Alliance
SSF	Sustainable Shark Fishing Association
STCW95	Standards of Training Certification and Watch-keeping

Abbreviation	Meaning
SW	Southwest
TTS	Temporary Threshold Shift
WNW	West-Northwest
ZPI	Zone of Potential Impact

1 Introduction

3D Oil T49P Pty Ltd (3D Oil) is proposing to undertake the Flanagan 3D Marine Seismic Survey (MSS) in the Commonwealth waters of the Otway Basin, Tasmania. The MSS area is located approximately 45km northwest of King Island (Tasmania), 45km southwest of Cape Otway (Victoria) and 70km south southeast of Port Campbell (Victoria) in Commonwealth Exploration Permit Area T/49P.

The purpose of the Flanagan MSS is to better define subsurface geology within T/49P and more accurately define potential prospective petroleum targets for exploration drilling. This is consistent with work-plans submitted to the Commonwealth Department of Industry (DoI) as part of the permit award.

3D Oil, as titleholder of T/49P, has prepared an Environment Plan (EP) for this activity in accordance with the requirements of the *Offshore Petroleum & Greenhouse Gas (Environment) Regulations 2009*. The EP 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 & Greenhouse Gas (Environment) Regulations 2009.*

2 Activity Location

The Flanagan 3D MSS activity, shown on a regional basis in **Figure 2-1**, will be undertaken within T/49P and adjacent Permit T/30P (Otway Basin) via an access authority obtained from the National Offshore Petroleum Titles Administrator (NOPTA).

The Flanagan 3D MSS data acquisition area covers an area of approximately 1120 square kilometres and is located entirely within Commonwealth waters of the Otway Basin. The MSS data acquisition area is defined by coordinates shown in **Table 2-1**. The seismic vessel will execute turns up to 15km outside this defined MSS area and will work within a 'Vessel Operational Area' of approximately 2100 square kilometres defined by coordinates provided in **Table 2-2**. It is expected the vessel will operate in a NE-SW direction when acquiring seismic data and during acquisition will maintain a minimum distance of approximately 45km from each of the Victorian and King Island coastlines. MSS acquisition will be undertaken in water depths ranging from 70-200m. Vessel turning areas (i.e. operational area) will be in water depths of approximately 70m to 1000m.

The MSS vessel will deploy and retrieve equipment in areas where interference to commercial shipping and fishing will be low (as determined by Vessel Master) or the MSS vessel may mobilise directly from an adjacent survey area with equipment already deployed. Fisheries interaction will be managed by close cooperation between the 3D Oil Offshore Representative, Fishing Liaison Officer (FLO), the local fishing fleet and the accompanying support vessels to identify any conflicting fishing activities.

Figure 2-1: Regional Location of the Flanagan 3D MSS

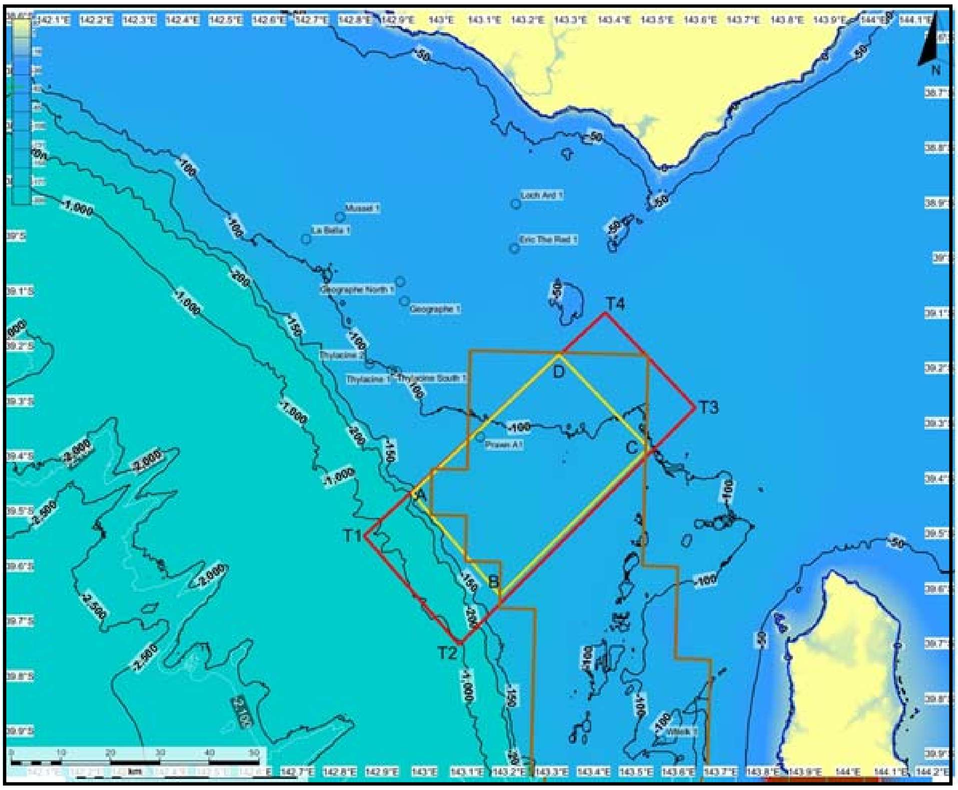


Table 2-1 Flanagan 3D MSS ‘Data Acquisition’ Boundary Coordinates

Location Point	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
A	39	27	35.87	142	57	22.13
B	39	38	30.72	143	10	05.38
C	39	22	01.00	143	30	28.78
D	39	12	09.15	143	16	33.71

Table 2-2 Flanagan 3D MSS ‘Vessel Operational Area’ Boundary Coordinates

Location Point	Latitude			Longitude		
	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
T1	39	32	22.67	142	50	50.73
T2	39	44	01.27	143	04	28.52
T3	39	17	30.00	143	36	54.26
T4	39	07	23.82	143	23	54.77

3 Seismic Program Activity Description

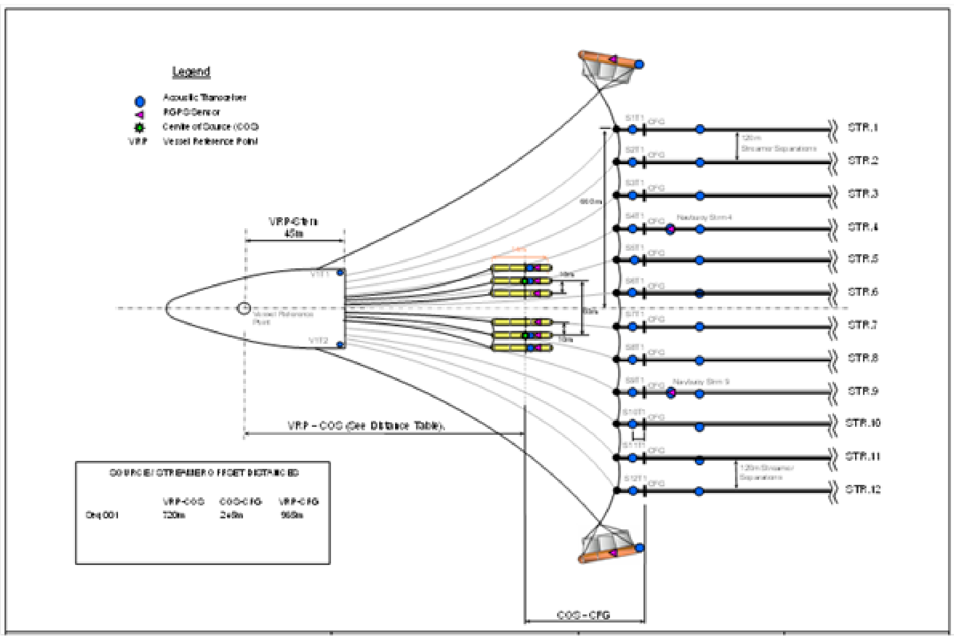
The proposed Flanagan 3D MSS program is scheduled for 1st November to 31st December 2014 with the activity expected to take approximately 30 days. Commencement and completion dates depend on vessel availability/schedule and weather conditions. Seismic acquisition will be undertaken on a 24 hour, 7 days per week basis dependent on weather conditions and operational efficiency.

The activity will be undertaken by an experienced seismic contractor utilising a purpose-built seismic vessel, towing equipment along a series of pre-determined seismic lines within the survey area. The vessel will, while acquiring seismic, travel at an average speed of approximately 8–9 km/h (4–4.5 knots). As the vessel travels along the survey lines, a series of acoustic pulses, activated at approximately 18.75m or 25m intervals (approximately every 9-11 seconds), will be directed down through the water column into the seabed via two source arrays. These acoustic pulses transmit through the subsurface; reflect at geological boundaries and transmit back to the surface where they are detected by sensitive hydrophones, arranged along a number of cables (streamers) towed behind the survey vessel. Data collected by the hydrophones is stored in on-board computers for processing and analysis, allowing the structure of the underlying geological strata to be mapped and potential hydrocarbon reservoir targets to be identified.

This seismic equipment comprises a dual source array, of volume up to 3500 cubic inches operating at pressures of 2000psi and will be towed at approximately 6m water depth. Reflected sound waves will be detected by hydrophones in up to 14 streamers of length up to 6000m, each separated by 100m, towed at a depth of approximately 6-50m behind the seismic vessel. These hydrophone streamers are solid streamers (minimal liquid content). The MSS vessel will traverse the survey area along defined transects (or seismic lines) approximately 500-720m apart (dependent on number of streamers). The Flanagan MSS will have an average seismic line length of approximately 40km and is expected to run in a NE-SW orientation.

The towing diagram, for a two source array/twelve streamer configuration, is provided in **Figure 3-1.**

Figure 3-1: Typical Two source array/Twelve streamer 3D MSS Towing Diagram



Prior to commencement of MSS operations, 3D Oil (via the Australian Hydrographic Office (AHO)) will issue a Notice to Mariners for the program, to notify vessels of the activity which may be operating in nearby waters. The seismic vessel will be accompanied by two support vessels including possibly one locally hired scout/chase vessel. Additionally, the MSS vessel and streamers will display appropriate navigational safety measures such as day shapes, lights and reflective tail buoys to indicate that the vessel is in tow and restricted in its ability to manoeuvre. A visual and radar watch will be maintained on the bridge at all times by trained and competent crew (STCW95).

Portland or the Port of Geelong is anticipated to be used as a logistics/supply base for the activity. During the MSS there will be two vessels servicing the seismic vessel for logistical, safety and equipment management support. Where possible these vessels will be sourced locally. The main functions of these support vessels are to escort the MSS vessel; to scout ahead of the MSS vessel for marine hazards or whales; to maintain a safe distance between the towed array and other vessels; to manage interactions with shipping and fishing activities; to act in an emergency-response capacity and, on a secondary basis, supply the MSS vessel with logistical supplies.

The vessels will not anchor at sea unless required in an emergency. Refuelling of vessels at sea is not favoured and has been included in the EP only as a contingent activity.

Although a crew change may not be required during this 30 day survey (crew changes occur every 35 days), one crew change could be necessary. If a crew change is required it will preferably occur during a port call. Personnel transfer by vessel or helicopter may occur. Helicopter transfer, if required, is anticipated from Essendon during daylight hours in acceptable wind and sea conditions. Night transfer may be required in the event of an operational emergency, medical evacuation or other non-routine circumstance (for example impending bad weather conditions). There will be no helicopter refuelling on-board the seismic vessel.

The seismic vessel will operate under an approved Shipboard Oil Prevention Emergency Plan (SOPEP) which details actions to be taken in the event of a shipboard emergency or oil spill in accordance with MARPOL 73/78 Annex I requirements.

4 Receiving Environment

4.1 Physical Environment

Climate: The climate of the region is temperate with cool, wet winters and warm, dry summers. The area has a mean monthly maximum temperature of 21.3°C (February) and a mean monthly minimum temperature of 7.5°C (July). The annual average rainfall is 861mm, predominantly falling between May and October. Wind roses for the November-December period identify that winds predominate from the south/west sector however winds from the east also occur. In March winds from the south-east predominate.

Oceanography: The major ocean current which influences water flows in the Flanagan MSS region is the Zeehan Current which flows from the eastern end of the Great Australian Bight (GAB), skirts the western end of Bass Strait and then along the west coast of Tasmania tracing the edge of the continental shelf. Near the seabed, currents run parallel with the coast and can exceed 0.5m/s when generated by a storm. Close to the shore where water depths are less than 10m, the currents are of variable speed and are often strong. Current speeds are estimated to range from 0.5-1m/s, measured at the adjacent Thylacine Field.

Between the eastern edge of the GAB and the western edge of Bass Strait, a consistent coastal upwelling occurs when seasonal winds (summer-autumn) push surface waters offshore. This is known as the Bonney upwelling (occurring from Cape Dombay to Cape Nelson) where nutrient-rich waters provide a source of food for many marine species.

The Otway coastline is typically high energy, with wave energy dependent on orientation to prevailing swell direction and cross shelf width. The western region is typified by high deep-water wave energy, attenuated by a steep offshore to near-shore gradient and offshore reefs which provide for moderate to low energy conditions. In the region, swell waves and sea waves occur throughout the year. Swell waves approach from the SW (approx. 60%) and the SSW (approx. 30%). Dominant sea waves are from the SSW (approx. 27%), the SW (approx. 25%) and WSW (approx. 12%). During storms wave heights of 6-8m and sometimes over 10m can occur in the region.

Tidal range is micro-tidal (i.e. ≈ 0.8-1.2m range), throughout much of the area, however tidal ranges and velocities vary rapidly in that part of the region forming the western entrance to Bass Strait (IMCRA, 1998).

Bathymetry & Seabed: The Flanagan MSS area is located on the outer edge of the Australian continental shelf (this is no planned acquisition over slope areas). The seabed slopes gradually upwards in a northerly and easterly direction across the shelf to a depth of about 30m within 1km of the coastline. The Victorian coastline in the region is generally comprised of steep cliffs fronted by narrow sandy beaches and inter-tidal platforms. The western coastline of King Island is a high energy coastline with high winds and large seas and consists of sea cliffs with sandy beaches. Penguin and mutton bird rookeries are present at Cataraqui (SW King Island).

The seabed within the MSS area is expected to comprise of a patchwork of flat pavement type limestone with patches of coarse mobile sand, large sand waves and higher outcrops of limestone reef based upon information obtained at the adjacent Thylacine development. Literature has identified the area as having a 'gravelly, muddy sand' classification with 1-20% gravel, 60-80% sand and 0-20% mud on the shelf area.

4.2 Biological Environment

The Flanagan MSS area lies within the **Otway marine bioregion** extending from Cape Otway (Victoria) to Cape Jaffa (South Australia) and includes the western islands of Bass Strait such as King Island. The characteristics of the Otway coastline and marine environment include offshore gradients varying from very steep to moderate, high wave energy and cold temperate waters subject to upwelling events (i.e. the Bonney Upwelling). Upwelling water is nutrient rich and corresponds with increases in the abundance of zooplankton which attracts Baleen Whales and other species which feed on the plankton swarms (krill). Shoreline habitats of the Otway coastline include penguin colonies, fur seal colonies and bird nesting sites.

Benthic Fauna: The Otway continental margin is a swell-dominated, open, cool-water carbonate platform which can be divided into depth-related zones:

- Shallow Shelf: Consisting of exhumed limestone substrates that host dense encrusting mollusc, sponge, bryozoan and red algae assemblages;
- Middle Shelf: A zone of swell wave shoaling and production of mega-rippled bryozoan sands;
- Deep Shelf: Accumulations of intensely bioturbated, fine bioclastic sands; and
- Shelf edge/top of Slope: Nutrient-rich upwelling currents support extensive, aphotic bryozoan/sponge/coral communities.

South-east Australia has one of the richest macrophyte floras in the world (409 genera with 1124 species) and the benthic algal communities include more than 200 species of which 165 species are rare. The seafloor within the adjacent Apollo Marine reserve has many rocky reef patches interspersed with areas of sediment and in places has rich benthic fauna dominated by sponges.

Fish: Fish fauna of temperate Australia consists of between 550-600 species which live inshore and on the continental shelf area and include both bony fish and sharks/rays with the composition and distribution of fish strongly influenced by the depth and structure of the environment. Forty-five species of fish are of commercial significance in the general South-east marine region including Tuna species (Yellow fin, Southern Bluefin, Skipjack), Shark species (Blue, Gummy, and School), warehou, whiting, bream, gemfish, trevally, perch and snapper.

Crustaceans in the area include microscopic zooplankton, shrimps, crabs and lobster. Of particular importance in the region is krill which swarms at the surface of inner continental shelf waters, primarily in summer and autumn, which is the food source for marine mammals such as the Blue Whale. Southern Rock Lobster and Giant Crab also support sustainable commercial fisheries across the continental shelf and upper slope areas.

Squid species may also be present in the area. Hatchlings have been collected in late spring to summer over a broad area of the southern Australian continental shelf from 28ºS in southern Queensland to 34ºS in the western GAB.

The White Shark (*Carcharodon carcharias),* with an Environment Protection and Biodiversity Conservation (EPBC) listing as threatened (vulnerable) and migratory, is widely distributed throughout temperate and sub-tropical regions in the northern and southern hemispheres. It is primarily found in coastal and offshore areas of the continental shelf and islands, however has been caught in varying depths up to 1280m. White sharks are generally observed between the coast and the 100m depth contour with areas of frequent encounter around seal colonies particularly when juveniles are present. Australian Fur Seal colonies are located at some distance from the MSS area (closest is Reid Rocks (Tasmania) approximately 110km SE). Two additional EPBC-listed migratory shark species, the Shortfin Mako (*Isurus oxyrinchus*) and Porbeagle (*Lamna nasus*) are also identified as having habitat likely to occur in the area.

Twenty-six species of Pipefish, Pipe horse, Seahorse and Sea Dragon species are listed as having possible habitat in the MSS area. These species exist over a broad geographical range but their distribution is limited to suitable habitat which is determined by the species' camouflage, size, food source, behaviour and reproduction. Species can inhabit seagrass and macro-algal habitats, reef habitats, and broken bottom habitats (described as a mixed mosaic of margins of seagrass meadows, shelly or rubbly bottom and sandy bottom with patchy seagrass or detritus, and disturbed areas). Many pipefish, seahorse and the sea-dragon species lie in shallow bays and coastal waters, especially seagrass beds, and on reefs covered with macro-algae where they are well camouflaged. Pipe-horses can be found in deeper continental shelf waters but little information on their distribution is available. No critical habitats have been identified for pipe-horse species in the Flanagan MSS area.

Cetaceans: The eastern GAB is an important foraging habitat for the Blue Whale (*Balaenoptera musculus)* with the species present in the area between November-May. Blue whales surveys taken in the period 2001-2007 identified that Blue Whales are usually restricted to the western and central Otway Basin in November and December with increases in the eastern Otway during January to April. Most sightings occur in water depths less than 200m. More recent observations during MSS activities during November-December have identified Blue Whale entry into the eastern Otway Basin with aggregation along the shelf-break in proximity to the Flanagan MSS area.

The Southern Right Whale *(Eubalaena australis)* is seasonally present in the region, using coastal water sites for calving between mid-May and mid-November. Key breeding areas in Victorian waters include Warrnambool located approximately 110km NW of the Flanagan MSS area, with Port Fairy and Portland also acting as seasonal calving habitats. During calving, the whales are generally within 2km of the shoreline with calving occurring in waters less than 10m deep.

The *Humpback Whale (Megaptera novaeangliae)* is found throughout Australian Antarctic waters and Commonwealth offshore waters. The Humpback Whale feeds on krill primarily during the summer months in Antarctic waters. Two migratory populations of Humpback Whale – a west coast and east coast population are present in offshore waters. These populations have tropical calving grounds along the mid-to-northern parts of the east coast (Great Barrier Reef between 14^{o}-27^{o}S) and west coast (Southern Kimberley area) migrating north from June to August (peak period) and south to the Southern Ocean feeding grounds from September to November (peak period). Migratory pathways are distinct along the eastern and western Australian coastlines with a lower presence in the Great Australian Bight. The exact timing of the migration can vary depending of water temperature, sea ice and predation risk. The proposed MSS area is not located in biologically significant areas (breeding, feeding or migration) for the Humpback Whale.

A number of other whale species may have a presence in the Flanagan MSS area at the time of the survey although encounter rates are not expected to be high. These include the Brydes' Whale *(Balaenoptera edeni),* Antarctic Minke Whale (*Balaenoptera bonaerensis*), Pygmy Right Whale *(Caperea marginata),* Killer Whale *(Orcinus Orca),* False Killer Whale (*Pseudorca crassidens*), Sperm Whale (*Physeter macrocephalus*), Pygmy Sperm Whale (*Kogia breviceps*), Dwarf Sperm Whale (*Kogia simus*), Minke Whale (*Balaenoptera acutorostrata*), Arnoux's Beaked Whale (*Berardius arnuxii),* Andrew's Beaked Whale (*Mesoplodon bowdoini),* Blainville's Beaked Whale *(Mesoplodon densirostris),* Hector's Beaked Whale *(Mesoplodon hectori),* Strap-toothed Beaked Whale *(Mesoplodon layardii),* True's Beaked Whale *(Mesoplodon mirus),* Cuvier's Beaked Whale *(Ziphius cavirostris),* Long-finned Pilot Whale *(Globicephala melas)* and the Short-finned Pilot Whale *(Globicephala macrorhynchus).*

It is possible five dolphin species, the Dusky Dolphin (*Lagenorhynchus obscurus),* Risso's Dolphin (*Grampus griseus)*, the Common Dolphin (*Delphinus delphis)*, the Southern Right Dolphin (*Lissodelphis peronnii*) and Bottlenose Dolphin (*Tursiops truncates)* may also be encountered in the MSS area during survey activities.

New Zealand Fur Seal: New Zealand Fur Seal (*Arctocephalus forsteri*) colonies are present in adjacent Otway coast regions to the Flanagan MSS area. Colonies are occupied all year round however pupping season for the species is November to January with peaks in December. Current breeding locations for the NZ Fur Seal have been identified in Victoria at Cape Bridgewater (located 185km WNW); Lady Julia Percy Island (located 140km NW); Kanowna Island (located 240km east) and the Skerries (Victoria). Female fur-seals dive usually to 80m during early lactation and later in their lactation they will dive to depths of 20-200m at distances 80-100km from shore with males expected to dive to over 200m.

Australian Fur Seal: The Australian Fur Seal (*Arctocephalus pusillius* breeds on islands in Bass Strait (four colonies in Victoria and five colonies in Tasmania) with a range that extends from South Australia, to Tasmania and New South Wales. The largest breeding sites are Lady Julia Percy Island (located 140km NW), Seal Rocks (located 170km ENE) in Victoria and at Reid Rocks (located 110km SE) in Tasmania. Colonies are occupied year-round, but activity is greatest during the summer breeding season (late October to late December). The diet of Australian Fur Seals is principally fish – red-bait, leatherjackets and jack mackerel (winter) and cephalopods (summer). The Australian Fur Seal can dive to depths of 200m and forages over a wide area.

Reptiles: Three species of Turtle, the Green Turtle (*Chelonia mydas*), Loggerhead Turtle (*Caretta caretta*) and Leatherback Turtle (*Dermochelys coriacea*) may transit through the survey area. The Green Turtle is primarily a tropical species feeding on shallow benthic habitats containing seagrass and/or algae including coral and rocky reefs, and inshore seagrass beds. Nesting beaches are found in the northern tropical areas of Australia. The Loggerhead Turtle inhabits coral and rocky reefs, seagrass beds and muddy bays throughout eastern, northern and western Australia in water depths from near-shore to 55m. Nesting is mainly concentrated on sub-tropical beaches. The Leatherback Turtle is found in tropical and temperate waters and is regularly found in the high latitudes of all oceans including waters offshore from NSW, Victoria, Tasmania and Western Australia. No major nesting areas for the Leatherback Turtle have been recorded in Australia.

Avifauna: EPBC-listed albatross and petrel bird species may have foraging habitat within the Flanagan MSS area. These bird species are among the most oceanic of all seabirds, and seldom come to land unless breeding. Albatross have widespread distribution through the southern hemisphere and feed mainly on cephalopods, fish and crustaceans, using surface feeding or plunge diving to seize their prey mainly at the edge of the continental shelf. Albatross are colonial, usually nesting on isolated islands and foraging across oceans in the winter months. No breeding colonies or nesting areas are located in proximity to the Flanagan MSS area. The closest breeding island to the MSS area is Albatross Island (Tasmania) [Shy Albatross] (approx. 150km SE).

Petrels are oceanic with widespread distribution throughout the southern hemisphere. They are colonial and breed on sub-Antarctic and Antarctic islands in a circumpolar band generally between 40^{O}S and 60^{O}S. Petrels feed on small fish, cephalopods (octopus, squid & cuttlefish) and crustaceans along the edge of the continental shelf and open waters. No breeding colonies or nesting areas for listed petrel species are located within or adjacent to the proposed Flanagan MSS area. The closest breeding island to the MSS area is Maatsuyker Island (Tasmania) [Soft Plumaged Petrel] (approx. 530km SSE).

The flesh-footed Shearwater (*Puffinus carneipes)* is likely to forage within the MSS area. From early September to late May, this species may forage up to 100km offshore along the south-coast continental shelf and slope. The species breeds at 41 islands in south-west WA, on Smith Island (~150 pairs) off the south-east coast of the Eyre Peninsula and Lord Howe Island. The Flesh-footed Shearwater feeds on small fish, cephalopod molluscs (squid, cuttlefish, nautilus and argonauts), crustaceans (barnacles and shrimp), other soft-bodied invertebrates and offal.

Fairy Penguins (*Eudyptula monor*) inhabit temperate waters and breeding colonies exist from Portland to Gabo Island. The species feeds mainly on pelagic shoaling fish, cephalopods and occasionally crustaceans. Prey is captured by pursuit diving typically to a depth of 10-20m for an average of 24 seconds, but dives as deep as 60m have been recorded. The species tends to forage within 5-20km of the coast during the breeding season however may take longer trips of up to 75km at other times. Nesting colonies occur in burrows on sandy or rock islands, often at the base of cliffs or in sand dunes adjacent to marine areas. Mating occurs between August and October with eggs laid in September and October. From this point until chick hatching, parents alternate between incubation duties and foraging at sea, with chick feeding occurring from December into January.

4.3 Social Environment

The landfall areas surrounding the Flanagan MSS predominantly support commercial fishing, commercial shipping, oil and gas operations and small amounts of coastal tourism (charter vessel activity).

The routes of two yacht races lead along the west Otway coast, Melbourne to Port Fairy (during Easter period), and Melbourne to Adelaide (December). The proposed Flanagan MSS activities are not expected to impact upon these activities given the distance from the coastline.

Commercial Shipping: AMSA has identified that the main east–west and west–east international trading route from Bass Strait to Cape Leeuwin passes through the northern part of the Flanagan MSS area and is one of the country’s busiest shipping routes. This traffic includes international and national cargo and tanker vessels servicing Melbourne, Adelaide, Perth, Sydney and Tasmanian ports. Additionally a percentage of the traffic passes directly through the centre of the survey area tracking south of Thylacine A. Commercial shipping traffic will be encountered over the duration of the survey.

Commercial Fisheries: Commercial fishing in the region is a mixture of State and Commonwealth managed fisheries. Commercial fishing activities along the continental shelf and upper slope include otter board trawl, squid, rock lobster, giant crab, shark and bottom set long line. State fisheries which harvest scallop and abalone species occur well distant from the survey area (scallop in eastern Bass Strait and abalone very close to shorelines).

Six Commonwealth-managed and two Victorian-managed fishing areas may operate in the Flanagan MSS area. Consultation with Fishing Industry Associations and with individual fishermen, and review of fishery reports, has identified the following:

- Commonwealth Fisheries:
    - *Bass Strait Central Zone Scallop Fishery* is open from April to December and is centred on the eastern region of the fishery because of the higher costs of operating in the more remote western region and a lack of recent evidence of commercially viable beds in the area. The Flanagan MSS

area is not located within the current catch areas for this fishery. *Scallop fishermen will not be present in the Flanagan MSS area at the time of the survey.*

- *Small Pelagic Fishery* targets species including Jack Mackerel, Blue Mackerel, Redbait and the Australian Sardine which typically inhabit waters to a maximum range of 500m. Literature indicates that this fishery has operated mainly off the east coast of NSW and west of the Eyre Peninsula with no catch currently taken from the waters offshore from the Otway coastline. *Encounter with fishermen from this fishery is not expected.*
- *Southern & Eastern Scalefish & Shark Fishery*:
  - *Commonwealth Trawl Sector (CTS)*: From available literature the waters of the Flanagan MSS area are fished by both otter-board trawl and Danish seine techniques, however the presence is very low with no relative fishing intensity assigned. The otter-board trawl fishery is active to the south of the MSS area along the shelf break. *Encounter with fishermen from this fishery is possible.*
  - *Scalefish Hook Sector (SHS):* Key fishing areas for this fishery include the east and south coasts of Tasmania although some vessel activity is identified in the MSS area. *Encounter with this fishery is possible, however considered unlikely.*
  - *Gillnet Hook and Trap Sector* (GHaT): The fishery targets shark species (gummy, school and sawshark) using demersal gillnets and long lines. *Literature identifies that gillnet fishermen have a low fishing intensity within the eastern portion of the MSS area and may be encountered, while encounter with hook fishermen is possible but considered unlikely*.
- *Skipjack Tuna Fishery (Eastern)* has had no fishing effort in the fishery since the 2008-09 fishing season. *Encounter with fishermen from this fishery is not expected*.
- *Eastern Tuna and Billfish Fishery operates* with pelagic long lines with a high intensity of fishing undertaken at the shelf-break from Merimbula (NSW) to Bundaberg (Qld). There is no recorded fishing effort in the Flanagan MSS area during 2012. *Encounter with fishermen from this fishery is not expected.*
- *Southern Bluefin Tuna Fishery* operates primarily in the Great Australian Bight on or near the shelf-break to the south-west of Ceduna with the remainder caught off eastern Australia. *Encounter with fishermen from this fishery is not expected.*
- *Southern Squid Jig Fishery operations occur* in depths between 60-120m during night hours of the months January to June. Key areas are waters outside Port Phillip Heads (February to March), Portland (March to June) and north of King Island. *Given the location and proposed timing of the* Flanagan *MSS (November-December) interaction with this fishery will not occur.*

- Victorian State Fisheries:
  - *Rock Lobster (Western Zone- Apollo Bay region)* targets southern rock lobster with approximately 85% of the annual catch sourced from the western zone by 71 licence holders. The species is caught using beehive style pots on reefs in waters up to 150m deep however most of the catch comes from inshore waters less than 100m with most fishermen fishing in water depths less than 50m. A closed season applies to female lobster between 1 June and 15 November, and to both male and female lobsters between 15 September and 15 November. *Stakeholder consultation has identified that Rock Lobster fishermen may be present in the Flanagan MSS during the proposed MSS operations however usually fish in shallower water depths.*
  - *Giant Crab Fishery* targets the giant crab in deep water (150-300m) at the edge of the continental shelf (shelf-break) where bryozoan communities are present in the muddy banks of the area. A closed season applies to female crabs between 1 June–15 November; and for both male and female crabs between 15 September and 15 November. There are a small number of participants in the fishery corresponding to a low level of fishing effort. *Stakeholder consultation has identified that Giant Crab fishermen may be present in the Flanagan MSS during the proposed MSS operations*.

Oil and Gas Development: Offshore developments within the Otway Basin include the:

- Minerva Development, operated by BHP Billiton, located approximately 65km NNE of the nearest Flanagan MSS boundary;
- Casino Development, operated by Santos, located approximately 74km NW of the nearest Flanagan MSS boundary; and
- Otway Gas Development (Thylacine and Geographe), operated by Origin Energy, located approximately 20km NNW of the nearest MSS boundary.

Given the distance of the proposed Flanagan MSS from these facilities, no impacts are expected.

Cultural 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 Flanagan MSS area. The National Shipwreck Database indicates that the shipwreck Tubal Cain (1862) may lie in the south western portion of the MSS area. Other shipwrecks in close proximity include the *John Ormerod* (1861), which lies approximately 85km west of the MSS area and the *Black Watch (1867)*, which lies approximately 45km ESE of the MSS area.

Conservation Values and Sensitivities: While no areas of high conservation significance are present in the Flanagan acquisition area, there are sensitive habitats in the region. The nearest conservation areas to the Flanagan MSS area are:

- The **Apollo Marine Protected Area** (MPA) located adjacent to the north-east Flanagan MSS acquisition boundary (and within the MSS vessel turning area). The Apollo Marine Reserve exemplifies the continental shelf ecosystem seabed habitats which extend from South Australia to the west of Tasmania including the Otway Depression, an undersea valley which joins the Bass Basin to the open. It is a relatively shallow reserve, exposed to large swell waves propagating from the south-west and strong tidal flows. The area is a foraging area for seabirds, dolphins, seals, Blue Whales and white sharks.
- The **Zeehan MPA** located approximately 16km south of the closest MSS boundary. The Zeehan MPA encompasses a number of major seabed habitats including rocky limestone banks containing extensive invertebrate communities providing important seabed habitats for a variety of commercially important fish species including giant crab. The Zeehan MPA contains a series of four submarine canyons which control currents influencing biodiversity and productivity on the reserve’s outer shelf and upper slope. A variety of seabirds have been observed foraging in the reserve, including the fairy prion, shy albatross, silver gull, and short-tail shearwater together with white sharks.

5 Environmental Impact & Risk Assessment

In accordance with the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* R14 (3) & R14 (3A), environmental hazard identification and risk assessment has been undertaken to evaluate the potential sources of environmental and social impact associated with the Flanagan MSS activity. This included an assessment of impacts and 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 Flanagan MSS 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 MSS. 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 3D Oil. The 3D Oil 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 3D Oil 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; Tier 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 a few months; Tier 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; Tier 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

Likelihood	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: 3D Oil Qualitative Risk Matrix

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

Table 5-4: Definition of Risk and Management Response

Category	Description & Response
High	**High Risk:** Considered intolerable. 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 environmental hazards involves the review of all activities within the environmental context of the activity (routine or potential emergency conditions). This is undertaken via brainstorming and peer reviews utilising industry experts which cover different areas of seismic operation. Reviewers have included seismic vessel representatives, experienced seismic proponents, company representatives and environmental specialists. Information utilised within the hazard identification process includes:

- MSS program details including acoustic array/streamer details/equipment type, proposed location and timing of survey and the support activities which are proposed (e.g. escort vessel, possible wastes generated from seismic acquisition (e.g. lithium batteries, possible fluid discharges from streamers, etc.,);
- An understanding of general vessel activities/operations during periods of MSS acquisition and non-seismic acquisition 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. breeding, resting, etc.,); and
- Consultation feedback from marine stakeholders to understand possible socio-economic activities.

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

5.1.2 Risk Assessment

Identified credible hazards were then risk assessed. For each hazard, the inherent risk (no controls) was determined by the following technique:

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

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

Controls (preventative and mitigation) were then identified and documented to either eliminate or minimize impacts. The assessment favoured control measures in the upper section of the controls hierarchy[2]. Based on implementation of the controls identified, impact and likelihood was reassessed and a residual risk ranking assigned. The residual environmental risk ranking therefore represents the likelihood of occurrence of the *worst credible environmental impact end-point* taking into account the implemented controls.

Where residual risks were found to be intolerable (high) or within the ALARP region (medium), they were reassessed for elimination potential and/or additional controls until the residual impact and risk associated with the hazard was 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 (Impact & Risk) Demonstration

3D Oil adopted the following criteria in determining whether impact and risk levels were acceptable:

- The principles of Ecologically Sustainable Development (ESD) are fulfilled;
- 3D Oil Health Safety & Environment (HSE) Policy objectives are achieved;
- All relevant Commonwealth and State legislative criteria are met;
- The activity does not contravene management plans or result in unacceptable impacts to protected matters under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*;
- Stakeholders have been provided information sufficient to understand and respond to relevant interests which are then addressed; and
- Risk and impact have been demonstrated to be ALARP.

It should be noted that the 3D Oil qualitative risk methodology also defines risk criteria whereby risk levels are considered to be acceptable.

ALARP Demonstration

Under-pinning the 'controls' identification are the key principles of environmentally-safe design (i.e. adoption of the hierarchy of controls); options analysis to ensure the most environmentally-sound practice is adopted (e.g. survey timing); and 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 3D Oil Qualitative Risk methodology defines risk criteria which it considers is at a level which is ALARP;
- *Hierarchy of Controls*: Controls identification according to a hierarchy which ensures reliable, effective controls are selected in preference to administrative controls;
- *Comparative Options Assessment of Risks, Costs and Benefits*: Evaluation of a range of control measure options describing the relative merits and drawbacks, with the selection of options which are practicable;
- *Comparison with Standards and Codes:* Adoption of relevant activity design standards, operational standards, management system frameworks and operational procedures against recognised 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 and the cost of the measure to be implemented.

[2] Controls hierarchy (a key to achieving ALARP (NOPSEMA, 2012)) guidescontrol selection. Control measures higher on the following ranking are preferred:

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

5.2 Flanagan MSS Environmental Hazards

A total of eighteen hazards, with the potential to impact the environment, were identified for the Flanagan MSS. These can be grouped into the following broad categories:

- Mobilisation of the seismic and support vessels to the proposed survey area:
    - Introduction of non-indigenous invasive marine species (IMS) from ballast water discharge or biofouling.
- Physical presence of the Seismic Vessel:
    - Disruption to commercial fishing activities;
    - Disruption to commercial shipping; and
    - Light pollution due to 24 hour activities.
- Seismic acquisition:
    - Discharge of acoustic source pulses in the proposed MSS area;
    - Sound from operation of vessels; and
    - Sound from operation of helicopters.
- General vessel operations:
    - Routine waste discharges from the seismic and support vessels (oily water, sewage, food-scraps); and
    - Air emissions.
- Non-Routine events:
    - Accidental hydrocarbon spill due to collision with another vessel;
    - Chemical/oil spill through deck drain system;
    - Oil spill during refuelling at sea;
    - Solid non-biodegradable/hazardous waste overboard incident;
    - Seismic streamer perforation and liquid loss to the marine environment;
    - Seismic streamer loss in the marine environment; 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 MSS area include both vessel hull or niche biofouling and ballast water exchange during MSS activities. If an IMS is introduced and survives in the new environment, colonisation may result in a range of ecological impacts including increased competition with native species and changes in ecosystem function. Colonisation requires favourable environmental conditions for the particular IMS, including water temperature, water depth and habitat range.

The MSS vessel contracted for the Flanagan MSS may either mobilise from Australian or International waters to the Flanagan MSS area. If the MSS vessel mobilises from International waters it will not go directly to the Flanagan MSS area but will dock initially at an Australian port where it will undergo customs/quarantine inspections as required by regulatory authorities. Where possible, the survey support/escort vessels will mobilise from Australian and local Otway Basin waters.

Adopted Control Measures

Prior to entry into Otway Basin waters, the MSS Vessel and support/escort vessel (as applicable) will conform to the following requirements:

- Ballast water exchange to occur in accordance with the Australian Ballast Water Management Guidelines (DAFF, 2013); and
- A risk assessment for the seismic vessel(s) (as required) will be undertaken 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 (dry-docking, cleaning and anti-fouling paint application (as required)) will be implemented prior to entry into Otway Basin waters such that the risk of IMS introduction from biofouling is assessed as low.
- All in-field equipment (e.g. streamers) will be removed from the water, inspected and cleaned prior to deployment in Otway Basin waters.

Risk Assessment

The National Database for Marine Pest incursions (DAFF, 2012) indicates no known pests have been introduced to the waters surrounding the proposed MSS area. Should an IMS be introduced to and colonise the area, it may have a major environmental impact (Consequence 4 - ecosystem disruption). However as the MSS will be undertaken in oceanic waters of depths between 70-1000m, light limitations would be expected to inhibit the success of any IMS colonisation.

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 Commercial Fishing Activity (Spatial Conflicts)

Background Information and Potential Impacts

The Flanagan MSS area is located within the following Commonwealth and Victorian state fishing management areas. Review of fisheries literature and information obtained during consultation activities with fishery stakeholders has identified the following:

- Commonwealth Fisheries:
  - Bass Strait Central Zone Scallop Fishery (*fishery will not be present in the MSS area*);
  - Small Pelagic Fishery (*not expected in the Flanagan MSS area*);
  - Southern and Eastern Scalefish and Shark Fishery:
    - Commonwealth Trawl Sector (*possible but unlikely presence of fishermen in MSS area*);
    - Scale-fish Hook Sector (*possible but unlikely presence of fishermen in MSS area);*
    - Gillnet Hook & Trap Sector (*gillnet fishermen may be encountered, while encounter with hook fishermen is possible but considered unlikely);*
  - Southern Squid Jig Fishery (*not expected to be present at time of Flanagan MSS*);
  - Eastern Tuna and Billfish Fishery (*no encounter expected in the Flanagan MSS area*);
  - Skipjack Tuna Fishery (*not expected to be present in MSS area*); and
  - Southern Bluefin Tuna Fishery (SBTF) (*not expected to be present within the MSS area*).
- Victorian State Fisheries:
  - Giant Crab Fishery (*possible presence in MSS area*); and
  - Southern Rock Lobster Fishery (*possible presence in MSS area – northern sector*).

Adopted Control Measures

To avoid spatial conflict with fisheries operating in the Flanagan MSS area at the time of the survey, adopted control measures include the following:

- Consultation during the planning phase of the Flanagan MSS has provided information to marine stakeholders and identified 'relevant' affected fishery stakeholders and the seasonality of their activities. A Fisheries Liaison Officer (FLO) will be engaged to converse with individual fishermen;
- The AHO will be notified of the Flanagan MSS activity two weeks prior to the MSS commencement and a Notice to Mariners will be issued for the duration of MSS activity;
- Mobilisation/demobilisation notifications will be issued to all relevant fishing industry stakeholders with consultation continuing during the survey period;
- The AMSA Rescue Coordination Centre (RCC) will be notified two weeks prior to commencement of the MSS activity to allow for AusCoast warnings to be issued to minimise the potential for marine activity conflicts;
- Routine bulletins will be provided to fishermen who fish in the area providing updated details on MSS activities together with expected duration of vessel operations in that section. Changes to schedule will be relayed to relevant fishermen;
- Support/escort vessels will scout within the MSS area to ensure that spatial conflicts between seismic and fishing vessels are avoided; and
- Compensation for temporarily displaced or damaged fishing equipment will be considered and paid to affected fishermen in accordance with management plans for fisheries interaction.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and presence in the area.

Environmental Risk Assessment

The presence of the MSS activity has the potential to disrupt fishing activity present in the area for a period of approximately 30 days. Literature identifies low intensity and catches within the Flanagan MSS area. Given the small area of the MSS compared with the overall size of the fishery and the limited period of acquisition (30 days), spatial conflicts are considered minor for the fisheries present (Consequence 2). With industry standard controls implemented, spatial conflict with fisheries is considered very unlikely and on this basis the residual risk is assessed as **low.**

5.2.3 Disruption to Commercial Shipping Activity (Spatial Conflicts)

Background Information and Potential Impacts

AMSA has identified the main east–west and west–east international trading routes from Bass Strait to Cape Leeuwin passes through the northern and central sections of the Flanagan MSS area and is a busy route by Australian standards. This traffic includes international and national cargo and tanker trade services. Commercial shipping will be encountered during the Flanagan MSS and is of primary concern to AMSA.

The presence of the MSS activity and maintenance of a requested 'safe distance' around the MSS vessel and array may disrupt commercial shipping vessels in portions of the Flanagan MSS area over a period of approximately 30 days. The 'safe distance' control is implemented to prevent interference/collision with vessels or towed equipment and to prevent interruptions to survey activities. This may require commercial vessels to deviate from planned routes to avoid the survey activities, increasing transit times and resulting in small increases in fuel consumption.

Adopted Control Measures

As per fishing activities, the following actions will be undertaken to ensure that commercial shipping is aware of the MSS activities to avoid spatial conflicts:

- Consultation with AMSA has been undertaken to establish controls to prevent spatial disruption to commercial vessels;
- The MSS Vessel master will define a 'safe distance' to be implemented as a separation between third party vessels and MSS vessel/equipment. Marine crews shall adopt this distance and communicate with third party vessels on this basis;
- A Notice to Mariners will be issued via the AHO for the duration of the activity;
- The AMSARCC will be notified two weeks prior to commencement of the MSS activity to allow for AusCoast warnings to be issued to minimise the potential for marine activity conflicts; and
- Support/escort vessels will scout within the MSS area to ensure that possible spatial conflicts are avoided, and if encountered alerts (i.e. flares) will be used to identify potential hazards.

Additionally the following measures will be adopted:

- Vessels maintain a 24/7 watch with trained crew (STCW95 competent); and
- Appropriate navigation safety equipment (radar, radio, AIS, day shapes, tail buoys, ARPA, etc.) is available on-board to ensure early detection of third party vessels with implementation of vessel diversion (as necessary).

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and presence in the area.

Environmental Risk Assessment

It is possible the presence of the seismic/escort vessels in the Flanagan MSS area may cause some temporary localised diversion to commercial shipping in the area (Consequence: 2). As the survey will take place for a limited period (30days) and with the controls implemented, it is expected that commercial vessel disruption is very unlikely to occur during the MSS acquisition period. On this basis, the residual risk is assessed as **low**.

5.2.4 Artificial Lighting Impacts

Background Information and Potential Impacts

Lighting is required for safety and navigational purposes on the seismic and support vessels during MSS activities. Lighting provides for marine safety to ensure clear identification of the vessels to other marine users, and allows for safe movement of personnel during hours of darkness. For intermittent periods during night hours, spot lighting may be required for in-sea equipment inspection, deployment, and retrieval (this will mainly involve the use of spot-lights focusing aft of the vessel towards the source and deflectors). The use of such lighting is minimized as far as possible. It should be noted that prevailing sea state conditions in the region may (and usually do) preclude in-water night-hour inspections on a personal safety basis.

Marine lighting has the potential to affect marine fauna, notably marine turtles (particularly during breeding season on nesting beaches), fish and seabirds.

Adopted Control Measures

Vessel lighting will be controlled via the following:

- Use of standard navigational identification features (e.g. lighting, beacons, signals) to align with the navigation safety requirements;
- Deck lighting which is required for workplace safety minimises the amount of direct light spill onto marine waters; and
- Night hour in-sea equipment inspection activities are be minimised as far as possible.

A pre-mobilisation inspection will identify any opportunities to reduce stray light spill to the marine environment. These opportunities will be actioned prior to mobilisation.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and presence in the area.

Environmental Risk Assessment

High levels of marine vessel lighting can attract and disorient species resulting in species behavioural changes in the vicinity of the light source. Potential impacts to marine fauna present in the MSS area, such as fish, squid and seabirds, are expected to be restricted to localised and temporary attraction due to the constant movement of the vessel. It is understood that bird strikes have been recorded on fishing vessels in the Southern Ocean where powerful lights are used in back-deck activities[3]. However bird mortality arising from these events is generally low. As the seismic vessels do not utilise such lighting, impacts arising from light emissions are considered to be similar to impacts of light emissions from passing commercial shipping and fishing vessels, and is expected to have negligible impact to species transiting through the MSS area (Consequence: 1).

In-sea inspection activities, if they occur, will be for short periods of time. The use of spot-lights is minimised as far as possible and will have minor impacts (Consequence 2) to species while operational.

Given the limited duration of MSS acquisition and constant movement of the vessel, permanent alteration to marine species foraging patterns or behavioural impacts are considered to be very unlikely. On this basis the residual environmental risk to marine species from light spill is assessed as **low**.

5.2.5 Seismic Operation – Acoustic Disturbance

Background Information and Potential Impacts

Acoustic Modelling: Acoustic modelling undertaken by Origin Energy in adjacent Exploration Permits VIC/P43 and T/30P for the Astrolabe 3D MSS analysed a duel source array of 4130 cubic inches operating at 2000psi (larger than the proposed Flanagan MSS source array). These acoustic modelling results are considered indicative, although larger than expected from the Flanagan MSS, given the similarity between the two survey locations and bathymetry (i.e. both located on the continental shelf). The study indicated that the Sound Exposure Level (SEL) attenuates more rapidly in the inshore direction; propagates a greater distance in the downslope direction and shows variability with depth and distance from source.

Key findings from the study were:

- SELs below 160dB re 1µPa^2.s are expected to be achieved within approximately 1km of the source array;
- SELs at 3km from the acoustic array are approximately 145db re 1µPa^2.s;
- SELs at 50km (inshore coastal) are approximately 94dB re 1µPa^2.s; and
- Spectral SEL density indicated that the SEL at each frequency is below 120dB re 1µPa^2.s/Hz at a distance of 3km from the acoustic source.

[3] Black, A (2004) – Short Note on Light Induced Seabird Mortality on vessels operating in the Southern Ocean: Incidents and Mitigation Measures, Antarctic Science 17(1): 67-68

A study[4] undertaken for a similar MSS located in the Otway Basin in proximity to Logan's Beach, utilising a combination of measured survey sound levels from past MSS data of similarly sized acoustic arrays (3147 cubic inches) and modelled data, established sound exposures for adjacent shorelines. Results identified that there was significant attenuation of sound levels from offshore MSS locations to sensitive near-shore aggregation areas (e.g. Southern Right Whales at Logan's Beach). Received sound levels from that survey's acoustic source identified the sound was not detectable if the MSS vessel was located more than 20km from the sensitive aggregation area. The nearest point of the Flanagan MSS data acquisition area to Logan's Beach (Warrnambool) is approximately 112km.

Response to Acoustic Sound:

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

Baleen whales (e.g. Blue, Southern Right & Humpback whales) are considered the most sensitive of the marine mammals to seismic arrays due to their use of low-frequency signals (Range: 12Hz-8kHz but predominantly less than 1kHz) for communication[5]. Their low frequency hearing capability is believed to overlap the sound output frequency of the marine seismic and the potential for disturbance in this species is considered higher than for toothed whales ('odontocetes').

Little is known about the sound levels at which hearing damage or physical injury occurs in cetaceans. There have only been two studies which have measured hearing Temporary Threshold Shift (TTS) onset levels in cetaceans in response to airgun-like pulses. One study[6] identified a TTS in hearing for a beluga whale at 186dB re 1µPa^2.s and another observed no TTS in one bottlenose dolphin at approximately 188dB re 1µPa^2.s. Given observed decay in sound levels from seismic array sources, cetaceans would need to be in very close proximity to the source in order to sustain physical damage.

The threshold of 160dB re 1µPa^2.s has been adopted as the acoustic level whereby damage to whales may occur based upon *EPBC Policy Guidelines 2.1 - Interaction between offshore seismic exploration and whales.* While this SEL is expected to occur within 1km of the source array, a 2km buffer has been adopted in this EP for the low-power zone.

Behavioural responses to acoustic sound in Baleen whales range from tolerance at low/moderate acoustic levels, to graduated behavioural responses at higher levels including shifts in respiratory and diving patterns.

The results of aerial surveys undertaken during MSS activities on feeding Blue Whales in EPP32 (west of Kangaroo Island in the Kangaroo Island Upwelling area) by Santos in 2003 identified Blue Whales feeding within 2.4km of an operating seismic vessel[7]. The received SPL or SEL by the feeding blue whale could not be established from this report.

Behavioural studies conducted near eastern gray whales in the Bering Sea and off California exposed to air gun pulses[8] indicated that:

- Approximately 10% of gray whales moved away from the air gun(s) when received levels of air gun sound were ≥163 dB re 1 µPa (rms) (or SEL level of 156dB re 1µPa^2.s); and
- Sound would, in the Bering Sea, attenuate to <163 dB re 1 µPa (rms) by 4 to 5 km from the seismic vessel[9].

[4] CMST, 2007 – Prediction of underwater noise transmission from the proposed Casino seismic survey in western Victorian waters (CMST Project 588, Report R2007-09), A Report for Santos Limited

[5] 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

[6] Gedamke, J., Gales, N., & Frydman, S., 2011 – Assessing the risk of baleen whale hearing loss in seismic surveys: The effect of uncertainty and individual variation, Australian Marine Mammal Centre, Australian Antarctic Division, J. Acoust. Soc. Am 129(1), January 2011 (DOI: 10.1121/1.3493445)

[7] Morrice, M.G., Gill, P.C., Hughes, J., and Levings, A.H. (2004) – Summary of Aerial Surveys Conducted for the Santos Ltd EPP-32 Seismic Survey 2-13 December 2003

[8] Malme and Miles 1985; cited in Johnson, S.R., Richardson, W.J., Yazvenko, S.B., Blokhin, S.A., Gailey, G., Jenkerson, M.R., Meier, S.K., Melton, H.R., Newcomer, M.W., Perlov, A.S., Rutenko, S.A., Wursig, B., Martin, C.R., & Egging, D.E. (2007) – A western gray whale mitigation and monitoring program for a 3D seismic survey, Sakhalin Island, Russia, Environ. Monit. Assess. Nov 2007; 134(1-2) 1-19, doi: 10.1007/210661-007-9813-0

[9] The specific distance depends on the particular configuration of air guns and on site-specific sound propagation conditions.

It was notable that, in the Bering Sea, most displaced feeding gray whales returned to their original locations and resumed feeding within one hour after the seismic source was shut down[10]. This SEL was utilised in developing preventative controls for the 2001 Odoptu MSS which was located in proximity to western gray whale feeding areas (Sakhalin islands). The SEL was used as a control threshold which prevented displacement from, and allow for whale abundance and distribution assessment within, the feeding grounds during the MSS program (i.e. the threshold established a 'feeding buffer zone'). Statistical analyses undertaken from monitoring results obtained before, during and after the survey (aerial, vessel-based) established no significant difference in gray whale feeding activity relative to seismic activity at a 95% confidence interval[11]. It was observed that about 5-10 gray whales may have moved to a different part of the feeding area, however this is consistent with the distributional shifts by western gray whales previously observed.

Consistent with these thresholds, Richardson et al (1995)[12] summarised potential zones of avoidance and behavioural disturbance in Baleen whales in response to seismic surveys with received levels ranging from 150-170dB re 1µPa (rms).

The Flanagan MSS adopts a SEL of 156dB re 1µPa^2.s as the threshold where possible changes to Blue whale feeding behaviour might be expected. Acoustic modelling identifies that SELs of ~145dB re 1µPa^2.s are achieved within 3km of the acoustic source. A 3km buffer distance from the operating acoustic source is therefore considered appropriate to prevent behavioural impacts to feeding Blue whales.

McCauley et al (2000) observed the following behavioural changes in migrating Humpback Whales:

- When exposed to an operating seismic vessel with a 2863 cubic inch array, stand-off behaviour of humpbacks was observed at approximately 3km where received sound was in the range 157-164dB re 1µPa(rms) (~143-153dB re 1µPa^2.s) which is consistent with standoff level observed in gray and bowhead whales (150-180dB re 1µPa (rms) or ~136-169dB re 1µPa^2.s)[13];
- When female humpbacks were exposed to a single operating airgun within the Exmouth Gulf the following observations were made:
    - For pods containing a cow-calf pair and possibly mature females, consistent avoidance behaviour began at 1.22-4.4km (mean air gun level of 126dB re 1µPa^2.s[14]) with a startled response seen in one trial at 3.18km (98dB re 1µPa^2.s); and
    - Deliberate approaches by single mature whales approaching often at speed, circling or partly circling the vessel at the 100-400m range, then swimming off (maximum received SPL at 100m of 179dB re 1µPa (rms) or SEL of 165dB re 1µPa^2.s).

Thresholds involving pods (mother and calf) are considerably less than those observed from an operating seismic vessel outside the Exmouth Gulf. It is believed that the differences in behavioural state at the time of exposure accounted for the differences in response levels. Pods within the Exmouth Gulf were invariably resting which is an important behavioural state for cow-calf pods. It is believed that the animals were more sensitive to sound in this state when compared with animals involved in migration behaviour.

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[10] Johnson, S.R., Richardson, W.J., Yazvenko, S.B., Blokhin, S.A., Gailey, G., Jenkerson, M.R., Meier, S.K., Melton, H.R., Newcomer, M.W., Perlov, A.S., Rutenko, S.A., Wursig, B., Martin, C.R., & Egging, D.E. (2007) – A western gray whale mitigation and monitoring program for a 3D seismic survey, Sakhalin Island, Russia, Environ. Monit. Assess. Nov 2007; 134(1-2) 1-19, doi: 10.1007/210661-007-9813-0

[11] Yazvenko et al, 2007; cited in Johnson, S.R., Richardson, W.J., Yazvenko, S.B., Blokhin, S.A., Gailey, G., Jenkerson, M.R., Meier, S.K., Melton, H.R., Newcomer, M.W., Perlov, A.S., Rutenko, S.A., Wursig, B., Martin, C.R., & Egging, D.E. (2007) – A western gray whale mitigation and monitoring program for a 3D seismic survey, Sakhalin Island, Russia, Environ. Monit. Assess. Nov 2007; 134(1-2) 1-19, doi: 10.1007/210661-007-9813-0

[12] Richardson, W. J., Greene, C. R., Maime, C. I. and Thomson, D. H., 1995 - Marine Mammals and Noise, Academic Press, San Diego, California

[13] Richardson, W. J., Greene, C. R., Maime, C. I. and Thomson, D. H., 1995 - Marine Mammals and Noise, Academic Press, San Diego, California

[14] 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.

Additional observations also indicate that rapidly changing vessel noise often evokes a strong avoidance response, while a slow non-aggressive vessel approach can result in little response from cetaceans[15]. Soft-start procedures which 'ramp-up' acoustic sources also facilitate this expected response behaviour and protect whales from sudden acoustic sound which may be damaging. It is expected that with acoustic sources operational, most baleen whales will practice avoidance (as per above behavioural observations) and not position themselves at a range whereby physical damage from sound will occur. It is considered that avoidance behaviour represents only a minor effect to the individual or species unless the avoidance results in displacement of species from nursery, resting or feeding areas.

Odontocetes (i.e. toothed cetaceans such as sperm whales, killer whales and dolphins) produce echo clicks that have the highest source levels of any recorded marine mammal sound ranging from 220-230dBA at 1µPa@1m at frequencies between 10-100kHz. Most toothed whale social sound frequencies are well above the low frequency range where marine seismic is concentrated. The majority of toothed whales have their highest hearing sensitivity to sound in the ultrasonic range (>20,000Hz) although most have a moderate sensitivity from 1000-20,000Hz.

A review[16] of the effects of seismic on marine mammals in United Kingdom (UK) waters during the period 1998-2000, identified for surveys with large airgun arrays, that small odontocetes (dolphins and porpoises) had the strongest avoidance response to low frequency sound. Several species were seen less often during periods of seismic acquisition, remaining further from the air-guns and showing altered behaviour (e.g. less bow-riding, orienting away from vessel, faster swimming). Stone also identified in the same study that Killer Whales also showed some localised avoidance to seismic surveys. Key observations from the study identifies that differences in response to an operational/non-operational source are seen within 2-3km from the source array with little difference beyond that range.

Observations on Sperm Whale behaviour in the Gulf of Mexico[17] associated with seismic surveys found no horizontal avoidance of MSS activity by Sperm Whales, however found a decrease in foraging activity during full array acquisition for a small number of Sperm Whales studied.

Beaked whales are also known to be sensitive to high-energy, mid-frequency (*not used in this survey*) military sonars (i.e. ping energy 221-235 dB re 1µPa^2.s between 2.6 to 8.2 kHz of long duration ~1 second). Mass strandings of beaked whales are thought to be related to the use of this equipment in areas where there was the presence of a shelf-break very close to the coast and there was a documented presence of a beaked whale foraging in this deep water habitat[18].

Turtles: Marine Turtles have a hearing range between 100–700Hz[19] with best hearing between 250-700Hz. Studies indicate that turtles may begin to show behavioural responses (i.e. increase in swimming behaviour) to an approaching seismic array at received sound levels of approximately 166dB re 1µPa (rms), and avoidance at around 175dB re 1µPa (rms) From measurements of a vessel operating a typical airgun array (2678 cubic inches, 12 elements) in 100-120m of water, sound levels would create behavioural changes at approximately 2km and avoidance at 1km[20].

[15] URS (2001) – Review of Environmental Impacts of Petroleum Exploration and Appraisal Activities in Commonwealth Waters, Report prepared for the Department of Science & Resources
[16] Stone, C.J. 2003 –The Effect of Seismic Activity on Marine Mammals in UK Waters 1998-2000, JNCC Report No 323
[17] Jochins, A.E., 2008 – Sperm Whale Seismic Study in the Gulf of Mexico Synthesis Report downloaded on 22nd May 2012 at http://www.data.boem.gov/PI/PDFImages/ESPIS/4/4445.pdf
[18] ICES, (2005) – Report of the Ad-hoc Group on the Impacts of Sonar on Cetaceans and Fish (AGISC) (2nd Edition 0, ICES CM 2005/ACE:06
[19] 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
[20] LGL Ltd., (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

Pinnipeds: Phocid Seals (e.g. gray seals) have a hearing range between 1kHz-50kHz with sensitivity dropping above 50kHz. Otariid Seals (fur seals and sea lions) have a lower hearing sensitivity than Phocid Seals below 1kHz and similar hearing between 1kHz and 36-40kHz (their high frequency cut-off)[21]. Californian Sea Lions have relatively poor underwater hearing at frequencies below 1000Hz (i.e. sound thresholds required were greater than 100dB re 1µPa)[22].

Sound exposures that elicit TTS in pinnipeds under water have been measured in Harbour Seals at 183dB re $1\mu Pa^2.s$, in Sea Lions (representative of Fur Seals) at 206dB re $1\mu Pa^2.s$ and the Northern Elephant Seal at 204dB re $1\mu Pa^2.s$. All animals showed full recovery in 24hours[23]. Additional studies identified that there was no measurable TTS following exposure of two Californian Sea Lions to sound levels of 183dB re 1µPa or 163dB re $1\mu Pa^2.s$, however the two test animals did show avoidance responses at these levels. Southall et al (2007) has estimated that SEL thresholds of 186dB re $1\mu Pa^2.s$ (or 218dB re 1µPa (peak)) may induce Permanent Threshold Shift (PTS) in harbour seals. The threshold for onset of mild TTS for a Harbour Seal has been estimated at a SEL of 171dB re $1\mu Pa^2.s$ and it is expected that TTS onset would occur at appreciably higher received levels in Californian Sea Lions (or Fur Seals) than in Harbour Seals. It is estimated from available modelling that sound levels of 163dB re $1\mu Pa^2.s$, a threshold whereby no TTS is evident in Sea Lions, lies within close proximity to the operating source (~500m).

Behavioural observations of pinnipeds during seismic monitoring studies have noted that some pinnipeds show avoidance reactions to airguns, but their avoidance reactions are generally not as strong or consistent as those of cetaceans. The behaviour of seals during a near-shore seismic program in Alaska[24] observed that approximately 79% of seal sightings occurred within 250m of the seismic vessel, and that there was partial avoidance of the zone at less than 150m from the vessel during full array seismic, but seals did not move much beyond 250m.

Sharks: Limited research has been conducted on shark responses to seismic surveys. Sharks are known to be highly sensitive to low frequency sounds between 40-800Hz sensed solely through the particle-motion component[25] of an acoustic field. Free ranging sharks are attracted to sounds possessing specific characteristics – irregular pulse, broadband frequency and transmitted with a sudden increase in intensity (i.e. resembling struggling prey). Studies have also observed that sharks can withdraw immediately if sound intensity suddenly increases by 20dB re 1µPa (10 times) or more above the previous transmission[26].

Trauma from acoustic sources to marine species appears dependent on the presence of a swim bladder, a gas filled chamber which assists with buoyancy or as an aid in hearing. Because of the disparity of acoustic impedance between water and gas filled chambers, vibrations in water may induce trauma in species with swim bladders. Many adult fish do not possess a swim-bladder and so are not susceptible to this trauma. This includes Elasmobranchs (sharks and rays), many pelagic fish, flatfishes and lizardfish. It must also be mentioned that fish attacks on seismic streamers from large pelagic species is not uncommon as evidenced by damaged hydrophone streamers (shark-bites)[27].

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[21] 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

[22] 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

[23] Southall, B. L., A. E. Bowles, William T. Ellison, J. J., J. J. Finneran, R. L. Gentry, C. R. G. Jr., D. Kastak, D. R. Ketten, J. H. Miller, P. E. Nachtigall, W. J. Richardson, J. A. Thomas, and P. L. Tyack., 2007 - Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals 33:1-521

[24] Harris, R.E, Miller, G.W, Richardson, W.J, 2001 – Seal Responses to Airgun Sounds during Summer Seismic Surveys in the Alaskan Beaufort Sea, Marine Mammal Science, 17(4): 795-812 (October 2011)

[25] This is most dominant in the near-field of the survey in close proximity to the acoustic source.

[26] 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

[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

Fish: Anatomical features important in determining the level of acoustic sound impact on fish include the presence of a swim bladder (more susceptible if present). Large fish with a swim bladder of resonate frequency in the order of several hundred hertz may be more sensitive to seismic sounds, and fish with a mechanical coupling of swim-bladder to ear will be most susceptible to ear trauma from the transmission of sound[28]. Hence larger benthic fish such as emperors, sea bream, snappers and perch should be more at risk than pelagic fish such as mackerels and some tuna species which do not have a swim-bladder, or smaller reef fish that lack swim-bladder to ear linking. Most fish can hear in the frequency range 100-1000Hz but there is significant variance according to species outside that range. Within this range, minimum hearing thresholds vary widely, with the hearing specialists having best sensitivity as low as 50dB re 1µPa, and non-hearing specialists having best sensitivities as high as 110dB re 1µPa.

Lethal effects from acoustic sources have been shown to occur for some plankton at close range to an operational acoustic source (<10m distance) and fish eggs (~5m) however, mortality to adult fish and invertebrates directly exposed to acoustic sources has not been observed. Woodside studies[29 30 31] undertaken at Scott Reef on tropical reef fish during MSS activities identified:

- No lethal or sub-lethal effects on fish. Behavioural responses were observed at close range with general movement from the water column to the seabed, however normal feeding behaviour returned within 20 minutes of the MSS vessel passing and when the vessel was beyond a distance of 1.5km;
- Fish exposed to acoustic pulses showed no structural abnormalities, tissue trauma or lesions, or auditory threshold changes (highest exposure level 190dB re 1µPa^2.s). However, a small number of damaged hair cells (less than 1% of fish hearing capacity) were observed in fish exposed to acoustic sound; and
- No significant decreases in the diversity and abundance of fish after the MSS were detected compared with the long term temporal trend before the MSS.

Reef fish are considered 'site –attached' and there is reluctance for the species to move away from their specific habitat. Therefore physiological impacts are expected to be greater for these fish than for pelagic fish which are non-site attached.

It has been observed that acoustic sound can lead to behavioural responses in fish however the nature and extent of the response varies. McCauley (1994) applying the behavioural observations of benthic fish to sound observed by Pearson et al (1992)[32], in a simple spherical spreading model, indicated for an array (source sound pressure level 250dB re 1µPa-m) approximate distances at which behavioural changes in fish would be observed include:

- A startled response (at ~200-205dB re 1µPa) at approximately 178-316m directly beneath the array whereby fish flee the sound of the array;
- An alarm response (at ~180dB re 1µPa) at distances of 630-2000m where there is an increase in general activity and changes in schooling of the species; and
- A subtle behavioural response (at ~160dB re 1µPa) at a distance of 2.1-12km.

[28] 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
[29] Woodside Petroleum Limited, 2012a – Browse LNG Development, Maxima 3D MSS Monitoring Program Information Sheet 1 – Impacts of Seismic Airgun Noise on Fish Behaviour: A Coral Reef Case Study
[30] Woodside Petroleum Limited, 2012b – Browse LNG Development, Maxima 3D MSS Monitoring Program Information Sheet 2 – Impacts of Seismic Airgun Noise on Fish Pathology, Physiology and Hearing Sensitivity: A Coral Reef Case Study
[31] Woodside Petroleum Limited, 2012c – Browse LNG Development, Maxima 3D MSS Monitoring Program Information Sheet 2 – Impacts of Seismic Airgun Noise on Fish Diversity and Abundance: A Coral Reef Case Study
[32] Pearson, W.H., Skalski, J.R., and Malme, C.I, 1992 – Effects of sounds from a geophysical survey device on the behaviour of captive rockfish (Sebastes spp.) Can. J. Fish. Aquatic Sci. 49(7): 14343-56-

The impacts of these behavioural changes in fish have been reported to lead to smaller commercial fishery catches. Catch studies undertaken on redfish species[33] identified reduced catches after MSS activity resulting from fish increasing their depth range and being drawn into seabed structures. On this basis, it was observed that fish with an affinity for the seabed appear less likely to disperse compared with pelagic fish species located in less unique bank areas. Other studies[34] also identified decreased catches within, and adjacent to, the immediate seismic area that lasted for at least five days after seismic acquisition ceased, however others[35] have produced results which indicate some catches increase and remain high after MSS, others decrease while others were not affected.

Fisheries and Oceans Canada (2004) reviewed scientific information available on the impacts of MSS on fish and concluded that the ecological significance on fish is expected to be low, except where there may be a dispersion of spawning aggregations or deflections in migration paths, however, the magnitude of effects will be dependent on the biology of the species and the extent of the dispersion or deflection.

The Zeehan MPA, located approximately 16km south of the closest Flanagan MSS boundary, is identified as a nursery ground for blue warehou (*Seriolella brama*) and ocean perch (*Helicolenus spp*.) due to the high larval concentrations present. Review of these species spawning characteristics identify the MSS time-frame is not within the spawning period for the blue warehou and larval densities (and hence spawning aggregations) of ocean perch are located further south along the Tasmanian coastline. The Flanagan MSS activity, in the period November-December, will not affect spawning aggregations of these species.

Crustaceans: Crustaceans, such as crabs and lobster, do not possess gas-filled cavities and hence are at lesser risk of physiological damage compared with marine mammals and fish with air bladders[36]. Field studies relating to MSS impacts on invertebrates are scarce. During the 1960s, when explosive charges were used as a source for MSS, studies 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. This is consistent with other studies identifying the remarkable resistance of crustaceans to high force explosive events. Studies undertaken into the effects of 33MSSs on catch rates of Rock Lobsters 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[37].

Limited research has been undertaken on the effects of marine seismic on marine invertebrate larvae. Available research for crustacean species includes:

- Pearson et al[38] conducted experiments with air-guns on early life stages of Dungeness crabs (*Cancer magister*). From a seven air-gun array (acoustic sound levels of 231dB re 1µPa and capacity 13.8litres) Pearson exposed early stage II zoeal crab larvae to acoustic sound at 1m, 3m and 10m. The study was specifically designed so that exposures were at the high end realistically expected during a typical survey operation. 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[39] undertook research of seismic impacts to 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 40 cubic inch air-gun of 200 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

[33] DNV Energy, 2007 – Effects of seismic surveys on fish, fish catches and sea mammals, Report 2007-0512, Cooperation Group – Fishing Industry and Petroleum Industry
[34] DNV Energy, 2007 – Effects of seismic surveys on fish, fish catches and sea mammals, Report 2007-0512, Cooperation Group – Fishing Industry and Petroleum Industry
[35] Boertmann, D., Tougaard, J., Johansen, K. & Mosbech, A., 2010 - Guidelines to environmental impact assessment of seismic activities in Greenland waters, 2nd edition, National Environmental Research Institute, Aarhus University, Denmark. 42 pp., NERI Technical Report no. 785. http://www.dmu.dk/Pub/FR785.pdf
[36] 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
[37] 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
[38] 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
[39] Christian, J.R., Mathieu, A., &, Buchanan, R.A. (2004) – Chronic effect of seismic energy on Snow Crab (*Chionoecetes opilio*) Environmental Research Funds Project No. 158, Calgary

the next developmental stage in the exposed group. It should be noted that these crabs were exposed at very close distances to the air-guns. Snow crabs (as per Rock Lobsters) in natural situations are not this close to a seismic array or these received levels because the eggs are held by the adult females beneath their tails on the seabed. *No impacts to lobster eggs are expected from the Flanagan MSS due to the water depths (~70-200m) in the survey acquisition area*.

Adopted Control Measures

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

- All field crew are inducted into the environmental sensitivities of the Flanagan MSS area including marine fauna interaction protocols;
- The acoustic source size will be the smallest required to achieve survey objectives for the Flanagan MSS;
- Throughout the MSS, standard management controls[40] detailed in the *EPBC Act Policy Statement 2.1* (Part A), adopting a 2km low power zone and 3km observation zone will be adopted. As a diversity of whales may be encountered during the MSS, the EPBC Policy 2.1 (Part A) Procedures apply to:
    - All Baleen Whales; and
    - Larger toothed whales such as Sperm Whale, Killer Whale, Pilot Whale and False Killer Whales and Beaked Whales.

  These procedures will not be applied to dolphins or porpoises.
- A total of four dedicated Marine Mammal Observers (MMOs) will be utilised for the duration of the survey with at least two MMOs on-board the MSS vessel at all times, and one MMO on-board the scout and support vessel. At least one MMO will be observing for the presence of whales in the survey area on the MSS vessel during all daylight hours. An MMO/crew member will observe for whales on the scout vessel during all daylight hours.
- During daylight hours when whales are known to be in the area of the operations (i.e. as a result of surveys or previous sightings), the scout vessel will scout the area 5-10km ahead (30-60min) of the MSS vessel to assist with managing MSS vessel interactions.
- At night-time and other times of low-visibility[41]:
    - Start-up operations of the acoustic source (including soft-start procedures) may be commenced provided there have not been:
        - Three or more whale instigated power-down or shut-down activities; or two or more Blue Whale instigated power-down or shut-down situations during the preceding 24hour period; or
        - The MSS or scout vessel has been in the vicinity (approximately 10km) of the proposed start-up position for at least two hours under good visibility conditions within the preceding 24 hour period and no whales have been sighted;
    - Operations may continue if there have not been three or more whale instigated power-down or shut-downs during the preceding 24 hour period;
    - If the survey experiences three or more Blue Whale instigated shutdowns or power-downs per day for three consecutive days, the seismic operations must not be undertaken thereafter at night-time or during low visibility conditions until there has been a 24hr period, which included seismic operations during daylight hours and good visibility conditions, during which there are no Blue whale instigated shutdown or power-down events;

[40] This includes the following (in accordance with Policy Statement requirements): Pre start-up visual observation, soft start procedures, start-up delay if whales observed, operational procedures, power-down and stop work procedures.
[41] "Low visibility" is defined as periods where the observation zone cannot be observed out to 3km (e.g. during fog or periods of high wind).

- If a feeding Blue Whale is sighted by a MMO:
  - A minimum buffer distance of 3km will be maintained between the operating acoustic source and the feeding Blue whale sighted. The acoustic array will be powered-down if a feeding Blue whale is observed at or within 3km from the array;
  - Night-time or low visibility seismic operations must not be undertaken until there has been a 24hour period which included seismic operations during good visibility conditions where there are no sightings of feeding Blue whales within 3km from seismic operations;
  - If a feeding Blue Whale is sighted by an MMO during seismic operations within any area that will be surveyed during the following night, night-time or low visibility seismic operations within 3km of the sighting must not be undertaken until a MMO has confirmed through inspection during daylight hours that no feeding blue whale is present within 3km of the location of the sighting;
  - If the seismic vessel is diverted from any line due to the presence of a feeding Blue Whale in the survey path, reacquisition of that missed section of line cannot be undertaken until a MMO confirms, through inspection during daylight hours, that no blue whales are present within 3km of the missed section;
- The 3D Oil Project Manager may, if with vessel-based surveillance activities informing the survey, the MSS vessel experiences a significant number of line modifications due to the presence of whales, undertake where there is merit aerial surveys to provide additional information on whale behaviour in the area;
- The acoustic source will be shut-down during line turns except for soft-start/ramp-up procedures which need to be observed for data acquisition over the next seismic line;
- Detailed reports of all cetacean sightings will be recorded and submitted to both the Commonwealth Department of Environment (DOE) and NOPSEMA.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and presence in the area.

Environmental Risk Assessment

Cetaceans: Literature indicates that high acoustic sound levels might be expected to cause physiological and behavioural impacts to cetaceans particularly in close proximity to the seismic source (i.e. Consequence 3). However, with the adopted preventative controls (e.g. soft-start and power-down/shut-down procedures implemented at respective buffer distances) which recognise SEL thresholds for both physiological and behavioural impacts, and undertaking MSS activity during November/December when cetacean presence is expected to be low; cetacean impacts are considered very unlikely and the residual environmental risk is assessed as **low**.

Turtles: As per cetaceans, it is possible without controls, that physiological and behavioural impacts (Consequence 3) to turtle species may occur, particularly in close proximity to the 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 considered very unlikely physiological or behavioural impacts will be experienced. The residual environmental risk is assessed as **low**.

Pinnipeds: While Fur Seals may be encountered during the MSS, given their poor hearing below 1000Hz, the high SELs that may induce TTS in hearing (only in close proximity to operating acoustic source), and the observed species avoidance characteristics in proximity to the operating seismic sources, it is considered with soft-start procedures adopted, physiological impacts to this wide-ranging species (Consequence 2) is very unlikely. The residual environmental risk is assessed as **low**.

Shark Impacts: No physiological impacts to species are expected given the species physiology. Given the species has a wide-ranging habitat and given the species known avoidance responses to sudden increases in sound by 20dB re 1µPa, it is possible, but unlikely the MSS activities may result in localised avoidance of the MSS activity (Consequence 2). Given the open ocean environment of the MSS, free-ranging sharks are not expected to be significantly impacted as they transit through the region and the residual environmental risk is assessed as **low**.

Fish Impacts: Physiological impacts to adult fish are considered very unlikely given the adopted soft-start procedures. It is possible that localised (& temporary) displacement of fish stock might occur, however this is considered negligible based upon the large continental shelf area available to fish at a population level (i.e. Consequence 1). The residual environmental risk to adult fish is considered **low**.

Based upon available literature it is possible that fish larvae which may be present in close proximity to the operating acoustic source (~10m) may suffer mortality/damage impacts. This impact is considered negligible at a population level (Consequence 1) given the limited period and area utilised in the MSS. The residual environmental risk is assessed as **low**.

Crustacean Impacts: Available scientific studies identify that acoustic sound has negligible impacts (i.e. physical or behavioural impacts) to adult crustaceans (Consequence 1). Impact at a population level, given the large area of the fishery, and temporary and small area of the MSS is considered unlikely and the residual risk is considered **low**.

The Flanagan MSS is scheduled to be undertaken in November-December 2014 for a period of 30days. The MSS acquisition activities will cover an area of approximately 1120km^2 and will utilize acoustic equipment which is towed at depths of approximately 6m. Impacts to the population of SRL larvae from the Flanagan MSS are expected to be insignificant (i.e. Consequence 1) on the following basis:

- Research performed on larvae of crustacean species (i.e. Dungeness Crab) identified that there was no significant difference in larvae’s immediate or long-term survival rates or time to moult when exposed to acoustic sources. This research is considered applicable to the Southern Rock Lobster;
- The Flanagan survey area is a very small proportion of the total Southern Rock Lobster fishery area where larvae may be present; and
- Larvae will only be present in the upper water layers (where acoustic source is present) during night hours (~10-11hours per day) hence limited exposure.

Given the degree of exposure presented by the Flanagan survey activities (i.e. duration, areal extent and presence of larvae in the water column) it is very unlikely that these negligible impacts will translate into impacts to Southern Rock Lobster at a population level. The residual risk is assessed as **low.**

Marine Bird Impacts: Studies have indicated that acoustic disturbance to seabirds could be a potential problem if birds were diving in close proximity to the acoustic source (~5m)[42]. As identified above fish may be displaced from the immediate area around an operating array which would result in an associated displacement of seabirds forging on fish species.

As the timing of the Flanagan MSS (November-December) occurs during the Penguin breeding season when the birds forage in close proximity to nesting colonies (~5-20km), the birds are not expected to be in proximity to the MSS area. Acoustic SELs at these distances (~30-50km) are expected to be of the order of 120dB re 1µPa^2.s (or 160dB re 1µPa) (max). These sound levels are equivalent to fishing vessels which may be operational within the area.

As no biologically significant areas are present in the Flanagan MSS for nominated marine bird species, displacement-related impacts are considered very localized and temporary (Consequence 1) and very unlikely to have an impact at a population level. The residual environmental impact is assessed as **low**.

[42] Macduff-Duncan, C.R. & Davies, G. (1995) – Managing Seismic Exploration in a Near-shore Environmentally Sensitive Area, Offshore Europe Conference, Aberdeen, Scotland, 5-8 September 1995

5.2.6 Vessel Operation – Acoustic Disturbance

Background Information and Potential Impacts

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[43]. Studies[44] 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)[45]. On this basis, potential sound impacts from the MSS survey vessels are unlikely to be greater than that from existing vessels operating in the vicinity of the Flanagan MSS area (i.e. commercial shipping). The MSS vessel will be generally operating at a low speed 4-4.5knots during the survey, although the support vessels may operate at faster speeds in order to effectively patrol the requested clearance area around the MSS vessel.

Sound levels from vessel operations 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. Sound levels which might be expected to cause significant disturbance in marine fauna would be confined to the immediate vicinity of the vessels; within a radius of a few metres of the sound source.

Adopted Control Measures

The following controls have been 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).

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and presence in the area.

Environmental Risk Assessment

Sound from the operation of vessels during the MSS, based upon available literature, is expected to be contained locally (i.e. 'negligible' impacts – Consequence: 1) and avoidance impacts to sound sensitive marine fauna if present are possible during the survey. The residual environmental risk is assessed as **low**.

[43] 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

[44] 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

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

5.2.7 Helicopter Operation – Acoustic Disturbance

Background Information and Potential Impacts

Helicopters may be used for crew change or medical emergencies during survey activity.

Helicopter operations produce strong underwater sounds for brief periods when the helicopter is directly overhead with the received sound levels dependent on source altitude and lateral distance, receiver depth and water depth. Sound emitted from helicopter operations is typically below 500Hz and sound pressure in the water directly below a helicopter is greatest at the surface but diminishes quickly with depth.

Sound levels reported for a Bell 212 helicopter during fly-over is 162dB re 1µPa and for a Sikorsky-61 is 108dB re 1µPa at 305m. Reports for a Bell 214 indicated that sound is audible in the air for 4 minutes before the helicopter passed over underwater hydrophones; and the Helicopter was audible underwater for only 38s at 3m depth and 11s at 8m depth[46].

Observations of cetacean behaviour associated with Helicopter presence indicates that, for bowhead whales, most individuals are unlikely to react significantly to occasional single-pass low-flying helicopters transporting personnel and equipment at altitudes above 150m[47]. Minke whales have been observed to respond to helicopters at an altitude of 230m by changing course or slowly diving[48].

Sound levels which might be expected to cause behavioural impacts in marine fauna would be confined to the immediate vicinity where helicopters are operating at lower altitudes during landing and take-off.

Adopted Control Measures

The following controls have been adopted to prevent helicopter sound impacts to cetaceans during Flanagan MSS activities:

- Helicopter crews will complete an environmental induction covering the requirements for cetaceans/vessel interaction consistent with EPBC Regulations 2000 (Part 8) to avoid behavioural impacts to marine fauna; and
- The MMOs on-board the MSS vessel will keep watch for cetaceans and will report on interactions managed in accordance with this requirement.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and presence in the area.

Environmental Risk Assessment

Sound from the operation of helicopters during the survey, based upon literature, may create localised avoidance impacts (i.e. 'negligible' impact, Consequence: 1). Given the very low levels of helicopter use expected in the survey, these impacts are considered unlikely and the residual environmental risk posed by the activity is assessed as **low**.

[46] BHPB, 2006 - Stybarrow Petroleum Development WA-255-P(2) Draft Environmental Impact Statement (Draft EIS), BHP Billiton, Perth, WA
[47] Richardson W.J. and Malme CI., 1993 - Man-made noise and behavioural responses, In: Bruns,J. J., Montague, J. J. and Cowles, C. J. (eds), The Bowhead Whale. Spec.Publ. 2, Soc Mar. Mamm., Lawrence, KS, pp. 631
[48] Leatherwood, S., Awbrey, F.T. and A. Thomas, 1982 - Minke whale response to a transiting survey vessel. Report of the International Whaling Commission 32: 795–802

5.2.8 Vessel Operation – Treated Bilge Water Discharges

Background Information and Potential Impacts

Routine drainage system discharge from survey vessels has the potential to contain hydrocarbons from vessel drainage areas. Untreated discharges may lead to localised marine pollution.

All vessels engaged on the Flanagan MSS will have bilge 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), or retain all bilge/machinery space water on-board the vessel for onshore disposal.

Treated volumes of bilge water discharged are small and intermittent. Treated bilge water will not be discharged within the Apollo MPA.

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;
    - On detection of an OIW concentration greater than 15ppm the discharge stream shuts-in or directs discharge in-board;
    - 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* **except** when present in the Apollo MPA where no discharge will occur*;*
    - 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, or the MSS vessel may incinerate oily residues on-board.
  - 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.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and vessel presence in the area.

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. This small waste stream as it enters the marine environment will be compliant with MARPOL 73/78 Annex 1 requirements; discharged, in areas outside the Apollo MPA, only while vessels are *en route*; and at distances of 45km from the nearest coastline in highly dispersive oceanic waters. Environmental impacts from the discharge is localised and temporary (i.e. 'negligible' – Consequence 1). Given the water dispersion characteristics associated with the discharge it is considered unlikely that these negligible impacts on water quality will be realised. The residual environmental risk for this discharge is assessed as **low**.

5.2.9 Vessel Operation – Sewage Discharges

Background Information and Potential Impacts

The discharge of untreated sewage to the marine environment may reduce water quality and stimulate algal and bacterial growth. This may have both visual amenity impacts and possible health risks to marine fauna.

All vessels engaged on the Flanagan MSS will have sewage 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*.

Treated volumes of sewage discharged are small and intermittent and will not be discharged in the Apollo MPA.

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 (except in the Apollo MPA area) providing visible floating solids and discolouration is not evident;
- For vessels with maceration and disinfection facilities, the discharge occurs more than 3nm from land (with no discharge in the Apollo MPA);
- For vessels without a sewerage treatment plant and maceration/disinfection equipment the vessel will discharge untreated sewage at a distance of more than 12nm from land while proceeding *en route* (**except** in the Apollo MPA);
- 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.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and vessel presence in the area.

Environmental Risk Assessment

The sewage volumes discharged are finite, small and discharged into a dynamic open ocean marine environment distant from the nearest coastline. Water quality impacts are rapidly dispersed and degraded to levels where impacts to marine species are remote.

It is possible the intermittent discharge of untreated sewage to the T/49P marine environment, may result in temporary, localised increases in organic content in marine waters immediately surrounding the vessel discharge point (i.e. minor impact, Consequence 2). However, as the receiving environment is highly dispersive and the vessel is constantly moving as the discharges occur impacts are considered unlikely. The residual environmental risk is assessed as **low**.

5.2.10 Vessel Operation – Putrescible Waste (Food-scrap) Discharges

Background Information and Potential Impacts

The discharge of food-scraps to the marine environment may reduce water quality. Marine fauna, such as fish and seabirds, attracted to the food source may also alter their natural behaviour and increase vessel interactions.

Procedures for food-scrap discharges from vessels engaged on the survey will be either:

- Macerate wastes on-board to a size which is less than 25mm prior to discharge overboard at a distance greater than 3nm from the coast in accordance with MARPOL 73/78 Annex V requirements; or

- Discharge the waste stream at sea at a distance greater than 12nm from the coast in accordance with MARPOL 73/78 Annex V requirements; or
- Freeze for storage on-board with subsequent disposal at an onshore facility.

Volumes of putrescible waste discharged are small and intermittent. Food-scrap discharges will not occur in the Apollo MPA.

Adopted Control Measures

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

- Macerators can achieve the 25mm particle size and are regularly maintained and inspected as per manufacturer's specifications;
- The vessels will operate under a Shipboard Waste Management Plan which details the requirements for collecting, storing, processing and disposing of garbage and all personnel will be trained/inducted into these requirements;
- Placards displayed on the vessel provide guidance on vessel garbage management requirements;
- Food waste disposed overboard will be recorded in the Garbage Record Book;

No other solid or hazardous waste materials (excluding oily water and sewage previously discussed) are disposed overboard.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and vessel presence in the field.

Environmental Risk Assessment

The intermittent discharge of macerated food-scraps to the marine environment (except in the Apollo MPA area) may result in temporary, localised 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 at distance from the nearest coastline while the vessel is *en-route* in the highly dispersive waters of the Southern Ocean. Within this highly dispersive environment, it is unlikely that temporary, localised marine environmental impacts will be experienced. The residual risk is assessed as **low**.

5.2.11 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, generators, incinerators (MSS vessel only) and helicopters. The fuel sources used for combustion purposes will be Marine Gas Oil (MGO) or Marine Diesel Oil (MDO) with anticipated consumption of the seismic vessel in the order of 45m^3 per day during MSS 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.

Vessels may also use Ozone Depleting Substances (ODSs) in closed system rechargeable refrigeration systems. ODS loss from these systems can contribute to ozone layer depletion.

Adopted Control Measures

Controls to reduce impacts from combustion emissions include:

- The vessels use fuel (i.e. MDO/MGO) 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 (engines, plant, incinerator) will be maintained in accordance with Manufacturer's instructions via the vessel's Planned Maintenance System to ensure optimum performance and discharge specifications;
- The MSS Vessel incinerator will meet the requirements of, and operate in accordance with, MARPOL 73/78 Annex VI (Regulation 16) conditions. If the incinerators are used, the volumes of waste incinerated will be recorded in the Garbage Record Book;
- 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 ODS include:

- Maintenance of closed system refrigeration systems on-board vessels is undertaken by suitably qualified personnel in accordance with approved procedures; and
- Vessels which utilise ODSs manage these systems in accordance with Regulation 12 of MARPOL 73/78 Annex VI to eliminate ODS emissions. Any repair or maintenance of equipment containing ODS or incidents which involve the accidental release of ODS to the atmosphere is recorded in an ODS Record Book in accordance with MARPOL 73/78 Annex VI.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and vessel presence in the area.

Environmental Risk Assessment

The fuel sources used for combustion in the Flanagan MSS will be MGO or MDO with anticipated consumption of the MSS vessel in the order of 45m^3 per day during the activity. For a 30 day MSS program this is likely to result in a total GHG contribution of 3622tonnes $CO_{2\text{-eq}}$ (0.0006% of Australia's GHG emissions for 2012 - negligible contribution – Consequence 1). The residual environmental impact is assessed as **low**.

Limited quantities of ODSs may be held on-board the survey vessels in closed circuit refrigeration systems. In addition to ozone depletion, these substances typically have high global warming potentials which contribute to GHG impacts on release. Given the limited volume contained in these closed systems, potential impacts to ozone depletion/GHG are expected to be minor (Consequence 2). Releases from these systems are considered very unlikely. The residual environmental impact is assessed as **low.**

5.2.12 Non-Routine Incident – Vessel Oil Spill (Collision, Hull Damage)

Background Information and Potential Impacts

An assessment of oil spill risks was performed for the Flanagan MSS activity. Given the nature of the activity and the number of adopted controls to prevent interference with seismic streamer equipment and acoustic interference with seismic recordings (i.e. requires a 'safe distance' clearance from third party vessels to avoid recording interference), it was determined that a third party vessel collision of sufficient energy to cause hull perforation (i.e. container ship), whilst an extremely unlikely event, was still credible. Collision between in-field vessels with sufficient energy to result in a fuel tank rupture was not considered credible.

Predictive oil spill trajectory modelling[49] was undertaken for a 250m^3 MDO spill arising from a number of possible spill incidents within the vessel operational area. MDO is a commonly used marine fuel. It is a mixture of both low and semi-volatile components (95%) and a portion of persistent hydrocarbons (5%); and contains low levels of aromatic (toxic) hydrocarbons. In the marine environment, MDO undergoes rapid spreading and evaporative loss and surface residues quickly disperse and break up.

For the purposes of assessing oil spill 'impact' thresholds, a surface oiling thickness of 10µm is nominated as the threshold whereby intersecting wildlife (i.e. cetaceans, turtles, birds, pinnipeds) may be impacted, and a surface oiling thickness of 0.5µm (barely visible sheen) is nominated as the threshold for potential amenity impacts. The shoreline impact threshold adopted was a hydrocarbon residue accumulation in excess of 100g/m^2. This oiling is considered sufficient to impact upon benthic epifaunal invertebrates on hard substrates (e.g. shoreline rocks) and sediments (mud, silt, sand or gravel).

Predictive modelling identified:

- Predictive modelling identified that surface oil in excess of 10µm remained primarily within the MSS vessel operational area, with the greatest excursion approximately 30km to the ENE. Spill thicknesses in excess of 10µm were found to be present for a maximum of 24hrs;
- Aromatic and dispersed phase compounds, localised within the upper levels of the water column (~upper 5m), did not remain in the environment for sufficient time to cause impacts to marine biota;
- No impacts to shoreline environments from accumulated hydrocarbon residues above 100g/m^2 were predicted.

Potential Impacts associated with a large MDO spill in the marine environment include:

Cetaceans: Cetaceans have smooth skins, limited pelage with limited opportunity for oil adhesion to skin, however surface oil exposure during surfacing events may lead to aspiration hazards present in fresh spills[50]. Exposure could damage mucous membranes or damage airways[51] (Consequence 3). Additionally, Baleen whales which skim the sea surface for food are more likely to ingest oil compared with the 'gulp feeders' or toothed cetaceans[52]. Adhesion of tar-like residues to the whale's baleen plates can adversely affect the feeding of the animal. Refined products, such as MDO, do not carry 'tar-like' hydrocarbon fractions and adhesion is not expected.

Cetaceans may be present in the marine waters of the Flanagan survey area at the time of the survey (November to December), however based on available published data it is expected that threatened cetacean presence in the area will be low. Surface oiling at impact threshold levels is predicted to remain in the marine environment for less than 24hrs.

Turtles: As for cetaceans, marine turtles through surfacing activities may contact a surface slick which may coat the species and allow for inhalation exposure. On contact with the slick, turtles might experience skin irritation and injury to airways or lungs, eyes and mucous membranes of the mouth and nasal cavities[53]. Evidence from the Montara crude oil spill identified that turtles may exhibit severe dermal pathologies as a result of surfacing behaviour[54] (Consequence 3). Adult sea turtles spend 1-10% of their time at the surface with each dive lasting between 30-70minutes[55] hence the opportunity for impact, if transiting through the survey area, is extremely limited.

Marine turtles may be present in the marine environment of the Otway Basin however their presence will be transitory. No nesting beaches are found in Victoria or Tasmania hence hatchlings and juveniles will not be present in the area. Surface oiling at impact threshold levels is predicted to remain in the marine environment for less than 24hrs.

[49] Asia Pacific Applied Science Associates (APASA) (2014) - Oil Spill Modelling for 3D Oil Otway Basin Seismic Survey
[50] GESAMP (2002) The 2002 Revised GESAMP Hazard Evaluation Procedure for Chemical Substances carried by Ships Rep. Stud. GESAMP No 64. 126pp ISSN 1020-4873 ISBN 92-801-5131-2 http://gesamp.imo.org
[51] AMSA, 2011b – The Effects of Maritime Oil Spills on Wildlife including Non-Avian Marine Life available at www.amsa.gov.au
[52] AMSA, 2011b – The Effects of Maritime Oil Spills on Wildlife including Non-Avian Marine Life available at www.amsa.gov.au
[53] AMSA, 2011 – The Effects of Maritime Oil Spills on Wildlife including Non-Avian Marine Life available at www.amsa.gov.au
[54] Gagnon, M.M., Rawson, C. A., 2010. Montara Well Release: Report on necropsies from a Timor Sea green sea turtle. Curtin University, Perth, Western Australia. 15 pages
[55] French-McCay, 2009 – State of the Art and Research Needs for Oil Spill Impact Modelling in proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Emergencies Science Division, Environment Canada, Ottawa, ON, Canada pp. 601-653, 2009

Pinnipeds: The Australian and New Zealand Fur Seal are present within the region. The closest breeding colony for Fur Seals is Lady Julia Percy Island (~140km NW of the survey area) and Reid Rocks (~110km SE between King Island and Tasmania). The ZPI defined by the 10µm surface oil contour does not impact on these sensitive areas however fur seals (both sexes) may be present on a transitory basis in the Flanagan MSS area foraging.

Adult fur seals have blubber and do not suffer from hypothermia if oiled. Particular types of oil residue (e.g. sticky oils such as heavy fuel oil not MDO) can 'stick' flippers to sea lion/fur seal bodies preventing escape from predators. Oil residues may also disguise scent that pups and mothers rely upon to identify each other leading to pup abandonment and starvation; and ingestion of oil may damage digestive tracts, suppress immune systems or damage mucous membranes[56] (Consequence 3). Surface oiling at impact threshold levels is predicted to remain in the marine environment for less than 24hrs. No impacts at a population level are expected.

Migratory Seabirds: Migratory albatross, petrel and shearwater species may forage or over-fly the area. Marine seabirds are vulnerable to hydrocarbon spills owing to the high potential for contact at the sea surface where they feed or rest. As most fish survive beneath floating slicks, they will continue to attract foraging seabirds. Oil-coated birds can suffer hypothermia, dehydration, drowning and starvation, and become easy prey. Ingestion of oil can be sub-lethal or acute depending on the type of oil, its weathering stage and inherent toxicity. Effects can include tissue and organ damage, altered metabolism, pneumonia and reduced reproduction capability[57] (Consequence 3). Exposure to impacts from an oil spill is dependent on the method of obtaining prey, with aerial divers such as albatross and petrel species having a lower likelihood of exposure when compared with birds which feed from the sea surface. Surface oiling at impacts threshold levels is predicted to remain in the marine environment for less than 24hrs.

Fish/Sharks: Shark and fish species inhabit all levels of the water column, are mobile and have a transient presence in the survey area. Impacts to shark/fish species would be primarily through exposure to water soluble (aromatic) fractions associated with the oil spill which lie immediately below the surface slick[58]. Adult free-swimming fish seldom suffer any long-term damage from oil spill exposure as any dissolved oil concentrations in marine waters rarely reach sufficient levels to cause harm[59]. Additionally, the dissolved phase components associated with MDO are present in the environment for short periods which are not considered sufficient exposure periods for impacts to arise (Consequence 1).

Eggs, larvae and young fish are comparatively sensitive to oil (particularly dispersed oil) however there are no case histories to suggest that oil pollution has significant effects on fish populations in the open sea. This is partly because any oil-induced deaths of young fish are often of little significance compared with huge natural losses each year through natural predation and because fish spawn over large areas[60] (Consequence 1).

Commercial Fishing: Surface oil can foul vessels/equipment used to catch commercial fish and transfer contaminants to the catch. For fisheries operating in the Otway Basin, this would occur when demersal trawl/line and trap or pots are retrieved through surface slicks to the vessel (Consequence 2). Studies identify that fish tainting may occur at low hydrocarbon concentration exposures (~250ppb)[61]. Tainting is reversible but, whereas the uptake of oil taint is frequently rapid, the depuration process where contaminants are metabolised and eliminated is slower (weeks to months) making commercial species unpalatable. As the MDO spill is surface based, dispersion of hydrocarbons is expected only within the upper 5m of the water column and will remain in the marine environment for a short period of time.

[56] AMSA, 2011 – The Effects of Maritime Oil Spills on Wildlife including Non-Avian Marine Life available at www.amsa.gov.au
[57] AMSA, 2011 – The Effects of Maritime Oil Spills on Wildlife including Non-Avian Marine Life available at www.amsa.gov.au
[58] International Petroleum Industry Environmental Conservation Association (IPIECA) (2000) - Report Series No 8: Biological Impacts of Oil Pollution: Fisheries downloaded on 2nd July 2012 at http://cleancaribbean.org/ccc_doc/pdf/Vol8_Fisheries.pdf
[59] Source: ITOPF Technical Information Paper No 3: Oil Spill Effects on Fisheries (2010)
[60] AMSA, 2011 – The Effects of Maritime Oil Spills on Wildlife including Non-Avian Marine Life available at www.amsa.gov.au
[61] Davis, H.K., Moffat, C.F., & Shepard, N.J. – Experimental Tainting of Marine Fish by Three Chemically Dispersed Petroleum Products with Comparisons to the Braer Oil Spill, Spill Science and Technology Bulletin, Vol 7, Nos.5-6, pp.257-278, 2002

Adopted Control Measures

Control measures to prevent or reduce impacts from a third party vessel collision with a MSS vessel which results in a 250m^3 oil spill include:

- MSS vessels are class certified and carry appropriate safety audit documentation;
- Activity between in-field survey vessels will be undertaken in accordance with conditions detailed in the approved "Matrix of Permitted Operations" for the vessel;
- Navigation safety equipment (AIS, navigation lighting, day shapes, ARPA and radio) are present on all vessels and routinely maintained;
- Notification to AMSA RCC of Flanagan MSS activity who will issue AusCoast warnings;
- Notification to AHO to issue a Notice to Mariners for Flanagan MSS activity;
- Vessel operated by experienced and competent crew (STWC95) with 24/7 bridge watch;
- Availability of support/chase vessels to detect third party vessels and prevent spatial conflict with MSS vessel;
- Availability of approved and tested Vessel SOPEP and Flanagan MSS OPEP;
- Crew are drilled in SOPEP response requirements. Personnel also trained in Flanagan-specific OPEP requirements;
- Notification of the 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;
- Operational monitoring will take place in accordance with OPEP to support oil spill response and characterise environmental impacts;
- MDO rapidly evaporates, spreads to thin layers and has low persistence in the environment.

No landfall impacts identified with largest spill volume.

Inherent in the design of the MSS, 3D Oil is minimising the survey by surveying the most prospective parts of the survey area and utilising a multi-streamer vessel which minimises the acquisition period and the potential for third party vessel collisions.

Environmental Risk Assessment

Spill Event: In accordance with the 3D Oil Qualitative risk matrix, environmental consequences associated with a Tier 2 hydrocarbon spill (>10tonnes) is considered to have a major impact (Consequence 4) on the marine environment. Analysis of oil spill frequency data from vessel collision data in south-west Victorian waters (12nm-50nm from shoreline) identifies a frequency for spills over 100tonnes to be 1 event every 1000-10,000years[62]. In absolute terms oil spill frequencies in all Australian sub-regions are considered low to very low[63]. Additionally, based upon a review of the Australian Transport Safety Bureau's (ATSB) marine safety database, there have been no instances of collision, grounding or sinking of a petroleum activity related survey vessel in Australian waters for the past 30 years. On this basis, the likelihood of a collision event, resulting in a 250m^3 spill, during the Flanagan MSS is considered very unlikely with the preventative controls implemented. The residual environmental risk is therefore assessed as **medium.**

[62] 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

[63] 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

Marine Users: Hydrocarbon presence on the sea surface may create a safety hazard to other marine users. Volatilisation of hydrocarbon lighter ends may initially create conditions at the sea surface at the time of the initial release with a fire hazard potential. Safety hazards associated with the release quickly reduce with distance, and time increase, from release and the open ocean weather conditions present in the Southern Ocean will rapidly disperse hazardous conditions. On this basis safety impacts to third party marine users might only be experienced within very small distances of the spill source and possible consequences to the group are considered minor (Consequence 2). Notification of the incident to AMSA, with resultant marine warning and radio warnings (Channel 16) will minimise the likelihood of impact to third party marine users and as the distance/time from the spill increases, impacts become extremely unlikely and the residual risk is assessed as **low**.

Cetaceans and Turtles: These species may be impacted by oil spills where surface oiling is present and impacts as a result of oil spill exposure have been conservatively assessed as 'significant' (Consequence 3) given their NES status. The Flanagan MSS area may also support feeding aggregations of Blue Whale during the MSS period. Blue Whales typically feed as individuals or in groups of two and feeding Blue Whale aggregations, if present in the area, will be low density. Given MDO is not a 'sticky' hydrocarbon impacts to baleen plates (and feeding capability) are not expected. Also given the limited period MDO is available at impact thresholds, and the limited areal spread of surface oil, impacts to species at a population level are considered very unlikely during the November/December period. The residual risk to the species is assessed as **low**.

Pinnipeds: Both the Australian and New Zealand Fur Seal (adults) may be present foraging in the MSS area during survey activities although given the distance of the survey from colonies, the chance of encounter is considered low. Impacts to Fur Seals which come into contact with MDO residues are considered minor (Consequence 2) (i.e. not a NES species). MDO spills undergo rapid evaporation spreading to thin layers rapidly and surface oil thicknesses above impact thresholds are only expected during the first 24hrs after the spill event. Given the limited areal extent/duration of the spill, impacts to populations of fur seals are considered very unlikely. The residual risk to the species is assessed as **low**.

Seabirds: Marine birds can have a high probability of contact with spilled oil given the amount of time spent on or near the sea surface; and while foraging for food. As such, impact to the marine bird species through oiling has been assessed as significant (Consequence 3) given their possible NES status. As these species are transient in the MSS area, and given the limited area and timespan of possible impact (i.e. surface oil thickness >10µm) the likelihood of affecting multiple marine birds is considered very unlikely and the residual risk is assessed as **low**.

Penguins: Penguins, a marine bird species which could also be affected by marine oil spills, will not be present within the 10µm oiling zone predicted for a Flanagan MDO spill (i.e. the 10µm ZPI is primarily located within the MSS area located at least 45km from shore). The species, due to the breeding season, will tend to forage within 5-20km of the coast.

Sharks: Surface oils present during natural weathering of a hydrocarbon spill are not expected to impact shark species. Sharks are highly transient and mobile in Southern Ocean waters and exposure will be limited. It is considered a spill event may have a temporary, localised impact on shark species (Consequence 1) and given the limited duration of the event, impact to shark species is considered very unlikely. The residual risk is assessed as **low**.

Commercial Fish Species: Fish species, particularly eggs, larvae and young fish are comparatively sensitive to toxicity impacts from dispersed oils. Predictive modelling for the Flanagan MSS has identified that dissolved and dispersed phase oil exposures do not trigger environmental impact thresholds for 99% species protection. It is considered a spill event may have a temporary, localised impact on fish species (Consequence 1) and given the limited duration of the event, impact to fish species is considered very unlikely. The residual risk is assessed as **low**.

Commercial Fishing: Surface oil can foul vessels and equipment used to catch commercial fish and transfer to the catch. Notification of the incident to AMSA, with resultant marine vessel and radio warning (Channel 16) will minimise the likelihood of impact to fisheries in the area. Given the limited area and temporary nature of surface oiling only minor impacts to fishing vessels/equipment or minor displacement from the MSS area (Consequence 2) are expected. Given the temporary nature of the impact, and marine vessel warnings which would be issued in the event of a spill, impacts are considered very unlikely and the residual risk is assessed as **low**.

Spill Response Strategy:

In the event of a spill, it is expected a natural weathering and surveillance monitoring strategy will be adopted.

5.2.13 Non-Routine Incident – Chemical/Oil Spill through Deck Drainage System

Background Information and Potential Impacts

Packaged chemicals and oils are used on-board survey vessels during seismic operations. These materials are limited to small quantities of chemicals such as cleaning products, solvents, cable fluid, hydraulic oils, paints and primers, and lithium batteries. Packaged chemicals and oils can potentially leak during handling and enter the marine environment through the deck drainage system.

The volume of liquid which could be released will be small and limited to the volumes of individual containers stored on deck. Spills to the marine environment may lead to localised water quality impacts and possibly impacts to marine flora and fauna.

Adopted Control Measures

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

- Chemical/oil hazards are isolated from the deck drainage system (i.e. stored in suitable containers in appropriately bunded areas); and
- Information is available to all personnel on chemical/oil handing (i.e. Material Safety Data Sheets are available for all chemicals and hydrocarbons).

On-board deck drainage consists of two distinct areas; drainage from bunded areas (containing chemicals/oils and areas at high risk of spills); and open deck areas which handle 'uncontaminated' water runoff (wash down water, rainwater and sea-spray). To minimise the marine contamination risk from deck drainage the following controls are implemented:

- Spill kits are strategically placed near high risk spill locations on all vessels;
- Marine impacts from deck wash-down waters minimised by utilising biodegradable detergents;
- Routine inspection of bunded areas and spill kits undertaken on all vessels to ensure spill kits are adequately stocked and clearly labelled;
- All personnel are aware of appropriate hydrocarbon/chemical spill response requirements through vessel induction;
- Spills are cleaned up immediately, reported through the vessel's incident reporting system, and contaminated material contained on-board for on-shore disposal; and
- High standards of house-keeping are maintained on decks.

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

Environmental Risk Assessment

Spill Event:

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**.

Spill Response Strategy:

In the event of a spill, it is expected a natural weathering and surveillance monitoring strategy will be adopted.

Given the small spill volumes involved, the very limited area where marine impacts might be experienced; and the rapid evaporation/dispersion of MDO, impacts to marine species if present (whales, turtles, seabirds, sharks) are expected to be negligible (Consequence 1) and exposure considered very unlikely. The residual risk to these species by adopting of a natural weathering and monitoring spill response strategy is assessed as **low**.

5.2.14 Non-Routine Incident – Refuelling Spill

Background Information and Potential Impacts

A common source of oil spill in offshore marine operations is associated with refuelling (bunkering) activities. Causal pathways include hose breaks, coupling failures and tank over-fill. Spill volumes associated with offshore refuelling activities, which utilise equipment such as dry-break couplings, are estimated at the volume of the transfer hose (i.e. typically a volume less than $1m^3$). Note for the Flanagan MSS refuelling will preferentially occur in port facilities rather than at sea (i.e. at sea refuelling is a contingent activity and will be the exception). Spills to the marine environment may lead to reduced water quality and possible impacts to marine fauna and flora.

Adopted Control Measures

If refuelling activities are undertaken offshore the following controls will be applied:

- Activity will be fully supervised, in accordance with documented bunkering procedures, Job Hazard Analysis or Permit-to-Work Permit using trained personnel;
- A Toolbox meeting is undertaken before bunkering operations commence;
- Dry-break couplings are available on refuelling equipment;
- Refuelling equipment is routinely inspected, tested and maintained (i.e. fit-for-purpose);
- Tank levels are monitored so they are not over-filled;
- The transfer area will be bunded with spill kits in the event of a spill or leak; and
- OPEP/SOPEP equipment (or equivalent) is available, and tested, to respond to spill by appropriately trained personnel.

Based upon oil spill trajectory modelling undertaken for large spill scenarios and screening calculations, a refuelling spill will cover a small spatial area and will rapidly disperse/evaporate.

Environmental Risk Assessment

Spill:

The consequence associated with a refuelling spill/leak has been conservatively assessed as having minor consequences (i.e. localised marine water impacts with rapid evaporation/dispersion - Consequence 2). Given the implementation of the nominated control measures and also that refuelling at sea will be on an exception basis, spills to the marine environment are considered very unlikely and the residual environmental risk is considered **low**.

Spill Response Strategy:

In the event of a spill, it is expected a natural weathering and surveillance monitoring strategy will be adopted due to the type and volume of the hydrocarbon released.

Given the small spill volumes involved, the very limited area where marine impacts might be experienced; and the rapid evaporation/dispersion of MDO, impacts to marine species if present (whales, turtles, seabirds, sharks, pinnipeds) are expected to be negligible (Consequence 1) and exposure considered very unlikely. The residual risk to these species by adopting a natural weathering and monitoring response strategy is assessed as **low**.

5.2.15 Non-Routine Incident – Solid Non-biodegradable/Hazardous Waste Overboard

Background Information and Potential Impacts

During the Flanagan MSS, 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.

Solid, non-biodegradable waste overboard incidents have the potential to damage benthic habitats, or marine fauna may ingest (particularly turtles or marine seabirds with respect to plastics) or become entangled in the waste. Disposal of oils and chemical residues overboard reduce water quality and may expose marine fauna to toxic impacts.

Survey vessels engaged for the Flanagan MSS will operate under Vessel Garbage Management Plans compliant with MARPOL 73/78 Annex V requirements. Guidelines for the development of Garbage Management Plans revolve around three complementary principles to manage garbage: source reduction, recycling, and disposal (i.e. waste minimisation hierarchy).

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;
- For the MSS vessel allowable wastes and oily residues may be combusted in the on-board incinerator approved under MARPOL 73/78 Annex VI requirements;
- 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;
- Training and reinforcement to all crew (and other) personnel of waste management requirements; and
- Solid/hazardous waste disposal records are documented in the Garbage Record Book.

Environmental Risk Assessment

Solid non-biodegradable/hazardous wastes will be handled in accordance with the vessel's Garbage Management Plans and will work to a 'no solid non-biodegradable/hazardous waste overboard' policy. Hence under normal operation no impacts to the marine environment will occur. However, it is possible for accidental releases (e.g. small amounts of wind-blown packaging) to occur. In this instance the material will be small in volume however for materials such as plastic, fauna impacts (i.e. mortality conservatively assessed as Consequence 3 due to possible presence of NES species) may occur. 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 and the residual risk assessed as **low**.

5.2.16 Non-Routine Incident – Seismic Streamer Release

Background Information and Potential Impacts

Seismic streamer loss can create marine debris hazards leading to impacts to fisheries (equipment) or benthic habitat impacts through physical contact.

Adopted Control Measures

Controls which are adopted to prevent the loss of streamers in the marine environment include the following:

- The MSS vessel operates under approved procedures for streamer deployment and retrieval;
- Seismic streamers undergo regular inspection and maintenance system checks on bridles and harnesses for wear and damaged components. These components are replaced on an 'as required' basis and are fit-for-purpose;
- During operation a secondary retaining/attachment device is utilised to prevent streamer loss (i.e. system redundancy); and

- The streamer contains buoyancy devices which allows for support vessel surface retrieval if lost; and are fitted with marker buoys and radar reflectors which allows for rapid location and identification of the lost equipment.

Should a seismic streamer release occur during the survey, other marine stakeholders (primarily fisheries) will be notified of the incident and its' location.

<u>Environmental Risk Assessment</u>

As the streamer is fitted with buoyancy, the potential for disturbance to benthic communities is considered extremely unlikely.

Temporary loss of a seismic streamer to the marine environment may create minor impacts (interference with fishing equipment, etc.) (Consequence 2) to other marine users, if present, however with the controls adopted to prevent loss from occurring, the recovery procedures available and notification to relevant stakeholders, the likelihood of disturbance occurring is considered very unlikely. The residual environmental risk associated with this temporary impact is assessed as **low**.

5.2.17 Non-Routine Incident – Seismic Streamer Liquid Release

Background Information and Potential Impacts

Solid seismic streamer will be utilised for the Flanagan MSS. While the streamer primarily contains solid material which cannot leak, there are certain small sections within the streamer which contain hydrocarbons.

Perforation of these streamer sections due to shark-bite or third party vessel impact may lead to small amounts of hydrocarbon release. The maximum release volume to the environment is estimated to be 840litres resulting from a third party vessel impact across all streamer tail sections.

Liquid release from shark bites to streamers is much lower in volume (~60litres (max)).

<u>Adopted Control Measures</u>

Controls which are adopted to prevent the loss of hydrocarbon contained in the streamers and any associated environmental impacts to the marine environment include the following:

- Solid streamers are utilised which contain small volumes of liquid;
- As part of deployment, streamers are checked for integrity to prevent liquid leaks to the environment to ensure the equipment is fit for purpose; and
- The hydrocarbons utilised are low-odour, low aromatic hydrocarbons with low acute and chronic toxicity; moderate biodegradability; little environmental persistence; a low water solubility and are volatile hence rapidly evaporate in air.

<u>Environmental Risk Assessment</u>

Spill:

The consequence associated with a streamer perforation is considered to have temporary, localised impacts[64] (i.e. Consequence: 2) given the type of liquid, limited quantity released and the rapid dispersion experienced while the vessel is moving. Also as only small sections of the streamer contain liquid, with preventative controls implemented an incident is considered very unlikely during the MSS campaign. The residual environmental risk associated with streamer perforation is assessed as **low**.

Spill Response Strategies:

In the event of a spill, it is expected a natural weathering and surveillance monitoring strategy will be adopted due to the type and volume of the hydrocarbon released.

[64] This has been assessed on largest spill volume (i.e. third party vessel collision with streamers).

Given the small spill volumes involved, the very limited area where marine impacts might be experienced; and the rapid evaporation/dispersion of the hydrocarbon, impacts to marine species if present (whales, turtles, seabirds, sharks, pinnipeds) are expected to be negligible (Consequence 1) and likelihood of exposure considered very unlikely. The residual risk associated with the adoption of a natural weathering and monitoring response strategy is assessed as **low.**

5.2.18 Non-Routine Incident – Marine Mammal Collision

Background Information and Potential Impacts

Vessels associated with the Flanagan MSS will be operating on a 24/7 basis for the duration of the survey. All vessels pose a collision risk to cetacean species. The Flanagan MSS area is recognised as having habitats which may support the presence of cetaceans and it is possible that these species may transit the survey area during the survey period.

Studies[65] have identified 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.

The EPBC Regulations 2000 (Part 8) recognise the potential for interference and damage to cetacean species associated with vessel interactions. These regulations prescribe proximity distances between vessels and cetaceans, and also vessel management practices when a cetacean is observed, including vessel speed and vessel course change.

The MSS vessel will transit at low speeds (typically less than 5knots) during seismic acquisition. Operational acoustic sources together with vessel sound create conditions such that cetaceans avoid the immediate vessel area. Support/escort vessels generally travel at higher speeds to effectively patrol the requested clearance zone around the MSS vessel/towed array and possibly have a higher level of encounter and impact potential compared with the MSS vessel.

Adopted Control Measures

Controls which are adopted to prevent collisions with marine mammals during the survey period include the following:

- All MSS vessel operations conform to proximity distances and management measures contained in EPBC Regulations 2000 (Part 8) for cetaceans in the operational survey area;
- All crews will complete an environmental induction covering these requirements.

Environmental Risk Assessment

Cetaceans are known to transit through the Flanagan MSS area and may have a presence in the area during the MSS period. Cetaceans will avoid the areas around the operating MSS vessel and vessels with high sound signatures. A vessel strike to a cetacean has been assessed as a significant consequence (Consequence 3), however with the control measures implemented (low speed, proximity distances and vessel sound deterrents) the likelihood of collision is assessed as very unlikely. On this basis the residual environmental risk is assessed as **low.**

[65] 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 Summary of Arrangements for Ongoing Monitoring of Environmental Performance

3D Oil, as the Titleholder for petroleum activities within T/49P, is responsible for ensuring the Flanagan MSS activity is managed in accordance with the accepted Flanagan MSS EP such that environmental performance outcomes (EPOs) are achieved. The selected seismic contractor will undertake the survey operations on 3D Oil's behalf and, under contractual arrangements with 3D oil, will implement and comply with all environmental controls and procedures nominated in this EP.

To achieve this outcome, at contract award, 3D Oil will review the management system of the Seismic/Vessel Contractor against ISO14001 requirements as it relates to the implementation of commitments within the accepted EP (i.e. a gap analysis). 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. 3D Oil recognises that due to the short duration of this MSS 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 the Flanagan MSS EP are integrated and implemented into contractor systems, 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 Flanagan MSS activity.

Particular attention will be paid in the bridging document to:

- Utilise 3D Oil's Risk Management Framework for the assessment of environmental risk for the Flanagan MSS activity;
- Identify crew positions responsible for the implementation of control measures identified within this EP (i.e. control measure 'custodians') to inform on required control measure performance standard, notification requirements and delivery of records to verify performance;
- Identify 'reportable incidents' to be observed for the Flanagan MSS and the internal notification/reporting requirements to meet regulatory timeframes and content requirements;
- Identify vessel inspection programs included as a 'control measure' in this EP, ensuring the scope of the inspection addresses the relevant performance standard requirement;
- Identify EPOs for the Flanagan MSS and the required reporting, via the vessel's incident management process, where EPOs are not achieved;
- Identify crew positions who maintain records which quantify emissions and discharges and the requirement to provide these records to the 3D Oil Offshore Representative;
- Ensure all corrective actions/opportunities for improvement arising from incidents, audits, inspections, monitoring events are documented in the Vessel's on-board Vessel Action Tracking System and monitored for closure;
- Identify events associated with the survey which may result in a change which may trigger a revision to the NOPSEMA-accepted EP and the processes to be implemented to assess for necessary document revisions;
- Oil spill response arrangement for the Flanagan MSS which must be observed and the pre-survey exercise activities to be conducted.

3D Oil shall adopt the following methodology to ensure compliance with, and deliver EPOs listed within, the accepted Flanagan MSS EP:

- Pre-survey audits/information provision from the seismic contractor 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 Flanagan EP requirements. Control measure 'custodians' will be identified for relevant control measure implementation and a daily report provided to the 3D Oil 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 3D Oil 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 3D Oil Offshore Representative will undertake an EP Compliance Audit and an EP implementation review against the Flanagan Project Specific Bridging Plan to determine the effectiveness of the 'bridged' 3D Oil requirements into the Contractor's management system; and
- The 3D Oil Offshore Representative will obtain all relevant records to provide verification of discharges, incidents, etc. at the completion of the survey

3D Oil adopts a philosophy of continuous improvement. Learnings from seismic survey performance, incident investigations and field activity reviews will be documented and incorporated as improvement actions for future MSS activities.

7 Oil Pollution Emergency Plan Response Arrangements Summary

The Flanagan MSS, 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 Flanagan MSS activity.

All vessels engaged for the Flanagan MSS will carry approved Shipboard Oil Pollution Emergency Plans (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[66] for any vessel-based spill in Commonwealth waters including vessels involved with the Flanagan MSS. In the event of a spill, the affected Vessel Master will notify and take direction from AMSA to respond to the spill.

3D Oil 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, 3D oil will monitor and liaise with AMSA, the affected Vessel Master, Seismic Contractor and 3D Oil Offshore Representative, and provide assistance as required. 3D Oil 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. 3D Oil, Seismic 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 Tier 2 oil spill (>10tonnes) from Flanagan MSS vessels, 3D Oil will monitor for oil impacts to environmental sensitivities and, if oil is detected at levels which may cause environmental impact to the particular sensitivity, undertake any additional scientific monitoring considered necessary (e.g. marine wildlife and adjacent shorelines).

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

8 Consultation Details

Stakeholder consultation associated with the Flanagan 3D MSS commenced in April 2014. All stakeholder comments and records obtained over that period have been provided and assessed to NOPSEMA as part of the Flanagan MSS Environment Plan acceptance.

8.1 Details of Consultation Undertaken

Consultation associated with the Flanagan MSS has involved the following phased process:

- An initial stakeholder listing was identified through:
    - 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);
    - Identification of marine 'interest groups' (i.e. technical and scientific entities);
    - Adjacent shoreline councils; and
    - Industry/company support groups.
- Initial targeted consultation commenced in April 2014 with information associated with the Flanagan MSS distributed with follow-up telephone discussions. Communication with these differing groups identified 'relevant' persons that might be reasonably impacted by the activity and hence require 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.

  Communications/briefings with these parties and information obtained during this process has allowed for the collation of an Offshore Stakeholder listing; including their relevance to the Flanagan MSS area; and the activity triggers as relevant to the seismic activity which may initiate further consultation/ communication events.
- A second round of consultation (June 2014) with fishery stakeholders was initiated as a result of inconsistencies in feedback from individual Rock Lobster fishermen and SIV, which identified little to no spatial overlap with the Flanagan MSS area, and information provided by the Department of Environment and Primary Industries (DEPI) which identified a possible presence of Southern Rock Lobster fishermen in the northern section of the operational area. This operational boundary has been shifted to the SE to avoid shallower areas. The engagement of a Fisheries Liaison Officer (FLO) to converse with all individual fishermen confirmed fisheries presence. The vessel operational area has currently conservatively been based upon a 15km vessel lead-in distance however this will more likely be approximately 8km and will be adjusted according to fisheries feedback.

As a result of this consultation process, the following stakeholders and interested parties were consulted as part of the stakeholder engagement process for the Flanagan MSS:

Commonwealth Department or Agency

- Australian Fisheries Management Authority (AFMA)
- Australian Maritime Safety Authority (AMSA)
- Australian Hydrographic Office (AHO)

Victorian/Tasmanian Departments or Agencies

- Department of Environment and Primary Industries (VIC)
- Department of Infrastructure, Energy & Resources (DIER) Mineral Resources Tasmania (TAS)

- Victorian Department of Transport, Planning and Local Infrastructure (DTPLI) (VIC)
- Tasmanian Environment Protection Authority (EPA) (TAS)
- Department of Primary Industries Parks Water and Environment (DPIPWE) (TAS) [*Policy and Conservation Branch & Water and Marine Resources Division*]
- Corangamite Shire Council (VIC)
- Otway/Colac Shire Council (VIC)
- King Island Shire Council (TAS)

Fishery-interest Groups

- Commonwealth Fisheries Association (CFA)
- South-east Trawl Fishing Industry Association (SETFIA)
- Seafood Industry Victoria (SIV)
- Portland Professional Fishermen's Association (PPFA)
- Tasmanian Seafood Industry Council (TSIC)
- Tasmanian Scallop Fisherman's Association (TSFA)
- Tasmanian Rock Lobster Fisherman's Association (TRLFA)
- Southern Shark Alliance (SSA)
- Apollo Bay Fishermen's Cooperative
- Sustainable Shark Fishing Association (SSF)
- Warrnambool Professional Fishermen's Association
- Port Campbell Fishermen's Association (PCFA)
- Individual Fishermen (FLO Listing)

Scientific Interest Group

- Blue Whale Study Group

Recreational Groups

- Victorian Recreational Fishing (VRFish)
- Ocean Racing Club of Victoria

Oil and Gas Companies

- Origin Energy

Feedback obtained from this process has allowed for the development of a communication and engagement strategy for relevant stakeholders to determine the level, type, 'triggers' and schedule of on-going engagement throughout the Flanagan MSS. 3D Oil will maintain communications with stakeholders identified in this communication and engagement strategy component of the EP 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, and announcement of survey milestones or changes to program.

8.2 Merits of Stakeholder Objections and Claims

An assessment of the merits of objections or claims about the adverse impact of the Flanagan MSS 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*):

- **Marine Safety:** AMSA advised that the Flanagan MSS area was located in the main shipping route between Bass Strait and Cape Leeuwin. AMSA identified control measures to minimise shipping disruption and maintain marine safety. This included the following recommendations:
  - Given the length of the tow, a guard/support vessel will need to work in cooperation with the MSS vessel and maintain exceptional communications with all shipping;
  - The survey lines are planned to minimise interaction with commercial shipping;
  - Vessels must display appropriate day shapes, lights and streamers, reflective tail buoys to indicate the vessel is towing and therefore restricted in her ability to manoeuvre;
  - Visual and radar watches must be maintained on the bridge at all times;
  - AMSA RCC is to be contacted via rccaus@amsa.gov.au for Auscoast warning broadcast before operations commence; and
  - AHO must be contacted through hydro.ntm@defence.gov.au two weeks prior for issue of Notice to Mariners;
  - Post survey, information on lessons learnt with vessel interactions.

  All recommendations except the survey line alignment to minimise interaction with commercial shipping was adopted. To achieve optimum seismic data it is necessary to acquire the seismic in the "down dip" direction. The NE-SW alignment reflects these parameters and significant quality issues may arise if seismic line direction is altered. *This recommendation could not be adopted. All other controls are adopted as identified in **Section 5.2.2**, **Section 5.2.3** and **Section 5.2.12** of this Summary Environment Plan.*

  The AHO advised independently that a Notice to Mariners should be issued for the survey. *This recommendation was adopted and has been incorporated into controls in **Section 5.2.2**, **Section 5.2.3** and **Section 5.2.12**.*

- **Protected Matters (Threatened Species Impacts):**

  DPIPWE (Policy and Conservation Branch) identified a number of threatened species under Tasmanian legislation also occur in the adjacent Commonwealth areas and provided the following feedback:

  - The Department supported the period November/ December as this is outside the peak period when whales are likely to occur in the area. However encounter is possible and mitigations detailed in *EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales* should be implemented. *Mitigation measures as detailed in EPBC Policy Statement 2.1 (as practicable) have been adopted within this Environment Plan (refer **Section 5.2.5** of this EP Summary).*
  - Concern for migratory seabird species which are known to forage in the MSS area, particularly the shy albatross. The EP should outline potential impacts to seabirds from the proposed MSS activities and discuss what mitigation measures are recommended to reduce the risk. One potential issue raised is the risk of light strike from deck lighting. *This potential impact was assessed within the Environment Plan (refer **Section 5.2.4** of this EP Summary) and the information provided to DPIPWE.*

  The Blue Whale Study Group confirmed that Flanagan MSS area is within the Otway Basin Blue Whale Feeding area and recommended the use of aerial surveys to determine where whales are prior to and during the survey as this information offers the possibility of avoiding areas of greatest whale density and could save a lot of trouble with shutdowns. Information relating to Blue Whale feeding areas has been incorporated into the EP and aerial surveys will be conducted on an "as needs" basis as there is considerable variation in Blue Whale presence between the period 2001-07 and more recent seasons in 2013 (refer **Section 5.2.5** of this EP Summary).

- **Oil Spill Incident:** Both the Victorian DTPLI and Tasmanian EPA indicated that they would appreciate courtesy notifications in the event of a Tier 2 spill in Commonwealth waters. *This recommendation has been adopted within oil spill notification requirements in the Environment Plan/Oil Pollution Emergency Plan*.
- **Commercial Fishing:**
  - AFMA advised that the Commonwealth fisheries which may be affected by the Flanagan MSS include the Commonwealth Trawl Sector, the Gillnet Hook and Trap Sector and the Squid Jig Fishery. Recommendation was made to contact the Commonwealth Fisheries Association, SETFIA, SSF and SSA regarding the activity. *All recommended industry groups were contacted and information on the survey provided*.
  - DEPI advised that the Victorian Fisheries which might be affected by survey activities are the Southern Rock Lobster Fishery and the Giant Crab Fishery (handful of Licence participants in this fishery). Recommendation was to contact SIV and the Portland Professional Fisherman's Association. *All recommended industry groups were contacted and information on the survey provided*.
  - Feedback from both SETFIA, the Warrnambool Professional Fishermen's Association and the Portland Professional Fishermen's Association identified a possible presence of members within the Flanagan MSS area and identified that individual fisherman should be consulted to confirm fishing activity in the area. Organisations identified the need for a FLO to undertake this activity and provide information on an individual basis to fishermen. *This recommendation was adopted into controls identified in* ***Section 5.2.2*** *of this EP Summary.*
  - The PCFA and SIV identified they remain opposed to seismic activities until it is scientifically proven that it does not impact on fish stock, eggs and larvae. Reference was made to the Institute of Marine and Antarctic Studies (IMAS) study currently being undertaken. An intention to seek compensation for any damage to the fishery attributable to the MSS was stated.

    3D Oil assessed possible impacts to the pelagic phase of the rock lobster, and based on available scientific information for crustaceans did not expect any significant change at a population level to Southern Rock Lobster larvae from Flanagan MSS activities. 3D Oil acknowledged the further studies being undertaken by IMAS with respect to intense low-frequency sounds on commercial scallops and southern rock lobster would certainly add to the scientific knowledge base for marine invertebrates. *This information has been considered in the assessment of impacts to crustaceans from acoustic sources within the Environment Plan*.
  - The Apollo Bay Fishermen's Cooperative objected to the MSS on the grounds that it impacts Southern Rock Lobster larvae at a critical life stage (planktonic/pelagic), and suggested that a decrease in recruitment to the fishery after the Longford Gas Plant Explosion in 1998 is linked to an increase in seismic survey activity in the Otway Basin area at that time.

    3D Oil assessed the merit of this issue and, based upon available scientific literature for crustacean species, understands any impacts to pelagic larvae from seismic activity is extremely localised and would have little impact at a population level. Additional literature review identified that fishing mortality, combined with low recruitment, led to a steady decline in egg production in the Sothern Rock Lobster fishery between 2002 and 2008 and in response, total allowable commercial catches (TACCs) were reduced. The below-average recruitment was not associated with low egg production, but rather unusual oceanographic patterns affecting larval development and growth. The management response to reduce catch and thereby increase stock abundance appears to have been successful with the latest stock assessments showing improvements in stock abundance[67]. *This information has been considered in the assessment of impacts to crustaceans from acoustic sources within the Environment Plan*.

[67] Fisheries Research and Development Corporation (FRDC) (2012) – Status of Key Australian Fish Stock 2012 available at http://www.fish.gov.au/reports/crustaceans/lobsters_and_bugs/Pages/southern_rock_lobster.aspx

9 Contact Details

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