
Casino Henry Netherby Environment Plan Summary – State Waters

Licensed Pipeline VIC/PL37(v)

CONTROLLED DOCUMENT
(CHN-EN-EMP-0006)

Revision 0 – April 2018

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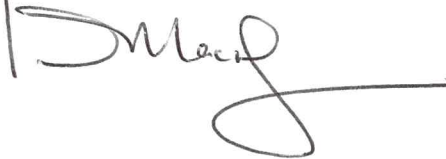
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Revision History

Rev	Issue Date	Revision summary	Originator	Reviewer	Approver
0	30/04/2018	Issued to DEDJTR for acceptance	J Earnshaw	B Edwards J Hinks	I. MacDougall

Approvals

This Casino-Henry-Netherby Environment Plan has been approved by Cooper Energy for the Operations and Maintenance Phase.

Name	Signature	Date
Iain MacDougall General Manager Operations Cooper Energy Limited		30/4/18

1 Introduction

1.1 Background

Gas and condensate is currently produced from the Casino, Henry, Netherby (CHN) gas fields located in Production Licence Areas VIC/L24 (Casino) and VIC/L30 (Netherby and Henry), (Figure 2-1). Gas and condensate is produced via four subsea wells and transported through a subsea pipeline to the Iona Gas Plant for processing.

The offshore facilities consist of:

- Four subsea production wells (Casino-4, Casino-5, Henry-2 and Netherby-1).
- A 32.6-km subsea pipeline (Casino pipeline) connecting the Casino wells to the Iona Gas Plant.
- A 22-km subsea pipeline (Casino to Pecten East pipeline) tying in to the Casino Pipeline, carrying gas from the Henry-2 and Netherby-1 wells, with an additional section to a potential production well in the Pecten reservoir (not yet drilled; drilling and construction would be subject to a separate EP if and when that is planned).
- A 31.2-km electro-hydraulic umbilical (EHU) cable connecting the Casino wells to the onshore Iona Gas Plant. The umbilical contains three lines, carrying chemicals, electrical power and hydraulic fluids.
- A 22-km EHU cable (extension of the umbilical above) connecting the Henry and Netherby wells to the Iona Gas Plant.

1.2 Scope

The scope of this EP summary covers the operations and maintenance activities of the offshore CHN Pipeline in State waters only as covered by Pipeline Licence Vic/PL37(v) that extends from median low water mark (MLW) to 3 nautical miles (Nm).

The EP summary covering the offshore infrastructure and pipelines within Commonwealth waters (beyond 3 Nm) has been submitted and accepted by NOPSEMA and is available on their website at <https://www.nopsema.gov.au/assets/epdocuments/A565933.pdf>

It is anticipated that the EP will be in place for a period of up to 5 years.

Operations and maintenance activities include:

- Monitoring and control of flow and pressure through the wells and pipelines;
- Injection of chemicals and cycling of valves;
- Undertaking inspection, maintenance and repair (IMR) activities on the pipeline and associated subsea infrastructure (e.g., Remotely Operated Vehicle (ROV));
- Diver-based inspections and interventions; and
- Internal line inspection (ILI), including pigging activities.

1.3 Nominated Titleholder and Liaison Person

In accordance with the OPGGS(E)R Regulation 18(2) and Regulation 15 of the OPGGSR Regulation 15, details of the titleholder and liaison person for this EP are provided in Table 1-1.

Table 1-1: Titleholder and Liaison Person

Titleholder Details	Liaison Person
<p>Licenced Pipeline VIC/PL37(v)</p> <p>Cooper Energy (CH) Pty Ltd Level 8, 70 Franklin Street, Adelaide SA 5000 Phone: (08) 8100 4900 ABN: 14 149 682 628</p>	<p>The Titleholder's nominated liaison person is:</p> <p>Iain MacDougall General Manager Operations</p> <p>Cooper Energy Limited Level 8, 70 Franklin Street, Adelaide SA 5000 Phone: (08) 8100 4900 Email: iainm@cooperenergy.com.au</p>

2 Activity and Location Details

2.1 Activity Location

The Casino pipeline, installed in 2005, connects the CHN wells to the onshore Iona Gas Plant, and is regulated under Pipeline Licence Vic/PL37 and Vic/PL37(V). The Vic/PL37(V) pipeline extends from the HDD shoreline crossing, within the HDD section of pipeline, to 3 nm from the shoreline. The HDD exit is located approximately 800m from the shore in 18 m water depths and the pipeline route initially follows the Minerva Pipeline offshore and offset at a distance of 150 m prior to diverging south-west towards Casino-5. The pipeline then runs west-northwest and passes south of the Casino-4 and Casino-5 wells by an offset of approximately 30 m from the wells and terminates at the Casino pipeline end manifold (PLEM).

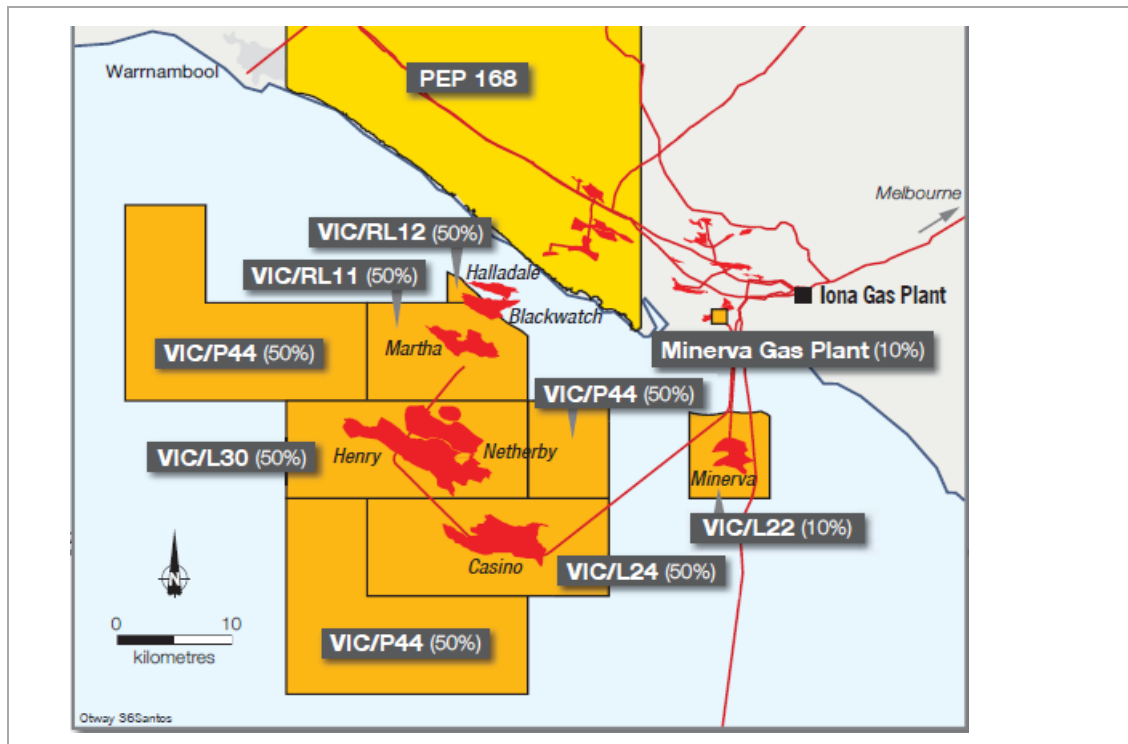


Figure 2-1: CHN location

Pipeline coordinates are provided in Table 2-1.

Table 2-1: Coordinates of the Casino pipeline

Location point	Latitude	Longitude
HDD Entry	38° 36' 55.88"	142° 57' 49.43"
HDD Exit	38° 37' 46.54"	142° 57' 46.02"
Pipeline End (3Nm)	38° 39' 59.26"	142° 57' 37.11"

GDA 94, GRS80, UTM Zone 55

2.2 Field Characteristics and Production

The condensate of the CHN reservoirs is classified as a Group 1 (non-persistent) oil. Netherby condensate is highly evaporative when released into the environment, with zero estimated residual (persistent) components (Table 2-2). It has a pour point of -54°C (when fresh).

Table 2-2: Physical characteristics of the Netherby condensate

Characteristic	Volatiles (%)	Semi-volatiles (%)	Low volatiles (%)	Residuals (%)	Density (kg/m ³)	Dynamic viscosity (%)
Boiling point (°C)	<180	180-265	265-380	>380	774 @ 16 °C	0.14 @ 25 °C
Aromatics	MAHs	2-ring PAHs	3-ring PAHs	≥4 rings		
Aliphatics	C ₄ – C ₁₀	C ₁₀ – C ₁₅	C ₁₅ – C ₂₀	>C ₂₀		
Netherby condensate	84	14	2	0		
Non-persistent				Persistent		

Production from the CHN assets varies day-to-day dependent on monthly/daily nominations, however typical daily average gas production is around 45 Terajoules (TJ) per day and 24 barrels (bbl) of condensate per day.

2.2.1 Onshore and Subsea Operations

While the activities occurring within the Iona Gas Plant are excluded from the scope of this EP, brief details are provided for contextual purposes.

The Iona Gas Plant receives raw gas from the CHN fields via a 12-km long onshore pipeline (PL251). The operation, monitoring and control of the CHN wells are conducted remotely from the Plant through control via the EHU. All well functions are monitored and controlled from the gas plant control room through a Master Control System (MCS) via a Subsea Control Module (SCM) located at each wellhead. All subsea control systems are electro-hydraulic. The Hydraulic Power Unit (HPU) and the Electrical Power Unit (EPU) at the Iona Gas Plant provide the hydraulic and electric power to the subsea controls. The EHU cable is linked to each wellhead via a subsea Umbilical Termination Assemblies (UTAs) located at each tree take-off point. The connection between the UTAs and the trees is by electro-hydraulic flying leads.

Isolation of the pipeline occurs at the offshore wells, the onshore Main-Line Valve (MLV) site and at the inlet to the Iona Gas Plant upstream of the Casino Slug Catcher. Isolation valves are function tested annually, and leak tested as part of any planned shutdown. There are also sub-surface safety and wellhead isolation valves that are function tested and leak tested every 12 months.

2.2.1.1 Corrosion Control

Corrosion control within the CHN assets is currently achieved through pH adjustment of the MEG system by injection of sodium hydroxide (NaOH) at the Iona Gas Plant. As above MEG has an 'E' non-CHARM OCNS rating.

2.2.2 Infrastructure Integrity Management

The CHN Integrity Management Plan (IMP) (CHN-PI-IMP-0001) covers the management, monitoring and inspection activities for the CHN assets. The IMP uses Risk Directed Asset management (RDAM) techniques which provides a methodology for determining risk levels, as a result of a loss of integrity, are identified against the modes of degradation / failure together

with the likelihood of such a failure mode occurring. Items monitored as part of the CHN IMP include:

- Water samples and analyses
- Hydraulic Fluid Pressure/Consumption monitoring
- Internal Corrosion Direct Assessment (ICDA)
- In-line Inspections (ILI)
- Pipeline ROV surveys

External corrosion in the HDD section is monitored as part of the routine inspection of the HDD shore crossing. This includes checking CP potentials at the onshore end every 6 months during the onshore CP survey and at the offshore end during scheduled offshore ROV surveys.

2.2.3 Maintenance and Repair Activities

The following inspection, maintenance and repair (IMR) activities are undertaken or may be undertaken on the CHN assets:

- Inline inspections (ILI) of the offshore pipelines (onshore launch/receipt only for HDD section);
- Inspection and repair work using Remote Operated Vehicle (ROV), Side Scan Sonars (SSS), Field Support Vessels (FSV) and/or diving from a Dive Support Vessel (DSV), such as:
 - Periodic general visual inspection (GVI) surveys to assess the condition of the pipeline, umbilical and wellheads undertaken by ROV;
 - Non-destructive testing (NDT) of the offshore pipeline typically undertaken by ROV;
 - Pipeline span/structure (e.g. PLEM, UTAs) scour rectification;
 - Marine growth removal;
 - Rectification of an electrical or hydraulic fault associated with the EHU and associated connected equipment;
 - Replacement and repairs of depleted or damaged cathodic protection anodes on an as-needs basis;
 - Pipeline repair which may, depending upon the damage the pipeline has sustained, include:
 - Composite wrap application
 - Bolted clamps (both grouted and ungrouted)
 - Pipeline cut-out and replacement by welded connection
 - Pipe cut-out and replacement by mechanical connector

All chemicals utilised in pipeline repair will meet the requirements of the Chemical Selection, Management and Dangerous Goods Risk Control Practice (COE-MS-RCP-0049).

All maintenance activities are expected to be of short duration, lasting from 2-7 days dependent on activity type and weather conditions.

2.2.4 Inline Inspections (Pigging)

The CHN pipeline undergoes in-line inspections by launching and retrieving a bi-directional pig from the MLV station onshore primarily to establish the integrity of the HDD section of VIC/PL37(v).

2.3 Support Vessels

2.3.1 General

IMR activities are undertaken with the aid of a survey vessel. Vessels are contracted from international or national suppliers when required and will vary depending on the proposed activity and vessel availability.

Depending on the IMR activities required vessels are likely to be at sea between seven and nine days. No vessel refuelling will be undertaken at sea.

Any vessels used will have the necessary certification/registration and be fully compliant with the relevant MARPOL and SOLAS convention requirements specific for the vessel's size and purpose.

2.4 Logistics Support

Depending upon the size of the vessel, helicopters may be used in the field in support of offshore campaign operations, including:

- Personnel transfers between heliports and field vessels;
- Occasional transportation of equipment to/from the field vessel; and
- Heavy weather emergency evacuation, search and rescue, and day and night time Medivac operations.

3 Description of the Existing Environment

The ‘environment that may be affected’ (EMBA) for the asset operations has been established through hydrocarbon spill modelling as the greatest area that could potentially be impacted in the event of the largest credible spill of hydrocarbons, which is a result of a vessel diesel spill.

It is to be noted that the position of the pipeline shore crossing and offshore pipeline alignment was carefully selected to avoid environmental sensitivities (e.g. reef structures) as part of project definition and in response to the following consultation feedback:

- HDD was co-located with the Minerva and Otway Gas project shore crossing given the known geotechnical conditions from previous HDD activities and support by key stakeholders;
- Bathymetry east of Casino and near Minerva indicated significant areas of sandy seafloor which was confirmed with commercial fishermen during consultation and via the offshore bathymetry survey;
- Offshore pipeline alignment avoided main lobster grounds by being co-located with Minerva and Otway Gas project pipelines thereby limiting snagging hazards to one corridor. Commercial fishermen identified their preference for this alignment option over others.

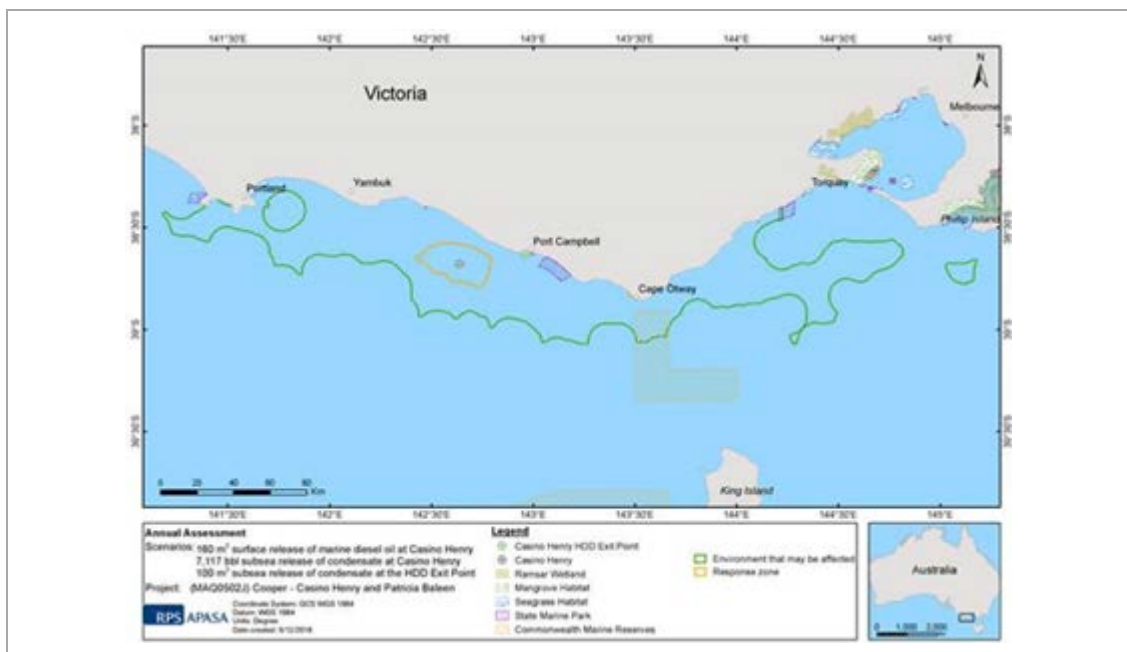


Figure 3-1: CHN petroleum activity EMBA

3.1 Regional Setting

The CHN assets are located in the Otway marine bioregion (NOO, 2002) as classified by the Interim Marine and Coastal Regionalisation for Australia (IMCRA). This bioregion extends from Cape Otway (Vic) 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 very steep to moderate offshore gradients, high wave energy and cold temperate waters subject to upwelling events (i.e., the Bonney Upwelling) (IMCRA, 1998). Currents are generally slow, but moderately

strong through the entrance to Bass Strait. Upwelling water is nutrient rich and corresponds with increases in the abundance of zooplankton, which attracts baleen whales and other species (including EPBC-listed species) that feed on the plankton swarms (krill). Shoreline habitats of the Otway coastline include penguin colonies, fur seal colonies and bird nesting sites.

3.2 Physical Environment

3.2.1 Bathymetry

The Casino gas field Environmental Report (Santos, 2004) reflects that the seabed along the pipeline route in water depths <60 m consisted of large tracts of fine to coarse grained sand with little or no epifauna and that infaunal communities of bivalves, polychaetes and crustaceans probably dominate in the open sand habitat. From the horizontal directional drilling (HDD) exit point (18 m water depth) to approximately 60 m water depth, the seabed is classified as sand or fine gravel. Beyond 60 m water depth, out to the Casino well sites, the seabed is characterized by outcrops of hard substrate with very low relief and structural complexity separated by gullies of sand or fine gravel (Santos, 2004).

The coastal geology comprises precipitous or undercut cliffs up to 60 m high of Port Campbell Limestone overlaying the Gellibrand Marl. Strong wave action is very effective in eroding these relatively soft, horizontally bedded rocks, causing development of a deeply indented coastline with narrow, elongated bays and headlands. Shore platforms are poorly developed and beaches are generally narrow.

3.2.2 Climate

The EMBA is typical of a cool temperate region with cold, wet winters and warm dry summers. The regional climate is dominated by sub-tropical high pressure systems in summer and sub-polar low pressure systems in winter. The low pressure systems are accompanied by strong westerly winds and rain-bearing cold fronts that move from south-west to north-east across the region, producing strong winds from the west, north-west and south-west.

3.2.3 Winds

Bass Strait is located on the northern edge of the westerly wind belt known as the Roaring Forties. In winter, when the subtropical ridge moves northwards over the Australian continent, cold fronts generally create sustained west to south-westerly winds and frequent rainfall in the region (McInnes & Hubbert, 2003). In summer, frontal systems are often more shallow and occur between two ridges of high pressure, bringing more variable winds and rainfall.

Occasionally, intense mesoscale low-pressure systems occur in the region, bringing very strong winds, heavy rain, and high seas. These events are unpredictable in occurrence, intensity, and behaviour, but are most common between September and February (McInnes & Hubbert, 2003). Wind speeds in the area are typically in the range of 10–30 km/hr, with maximum gusts reaching 100 km/hr.

3.2.4 Tides

Tides are semi-diurnal with some diurnal inequalities (Jones & Padman, 2006; Easton, 1970), generating tidal currents along a north-east/south-west axis, with speeds generally ranging from 0.1 to 2.5 m/s (Fandry, 1983). The maximum range of spring tides in western Bass Strait is approximately 1.2 m. Sea level variation in the area can arise from storm surges and wave set up (Santos, 2004).

3.2.5 Currents

Winds tend to be the primary factor driving currents in western Bass Strait, predominantly from west to east. Bottom currents can exceed 0.5 m/s in nearshore areas during storms (BHP-

Santos, 1999; cited in Santos, 2004). Current velocities through Bass Strait are highly correlated with local wind stress (Butler *et al.*, 2002a; cited in Santos, 2004). In the Port Campbell area, the predominant south-westerly swell direction means that there are minimal longshore currents as most waves reach the shore parallel to the coast. Therefore, in waters less than 10 m deep, water movements are influenced mainly by orbital motion waves and localised wave-generated currents (BHP-Santos, 1999; cited in Santos 2004).

During winter, the South Australian current moves dense, salty warmer water eastward from the Great Australian Bight into the western margin of the Bass Strait. In winter and spring, waters within the strait are well mixed with no obvious stratification, while during summer the central regions of the straight become stratified (RPS APASA, 2016).

3.3 Coastal Environment

The coastline of the EMBA is briefly described in terms of its physical attributes. This description is based on OSRA mapping and Parks Victoria (2013) park notes, together with Google Maps satellite photography and local knowledge. The description of the coastline is discussed moving in an easterly direction from Cape Nelson (~100 km west of the Casino pipeline) to Anglesea (~130 km to the east of the Casino pipeline). OSRA mapping of this section of the Victorian coastline are provided in Appendix 4 of the Offshore Victoria Oil Pollution Emergency plan (VIC-ER-EMP-0001).

The Cape Nelson to Portland coastline is dominated by intertidal rocky shorelines backed by steep rocky cliffs. Portland to Port Fairy is dominated by sandy beaches, with small areas of intertidal rocky shore and sub-tidal rocky reef closer to Port Fairy. The Port Fairy to Lady Bay (Warrnambool) coastline is dominated by sandy beaches, while the section of coast between Warrnambool and Cape Otway (covering a distance of ~100 km) is dominated by intertidal rocky shore (backed by steep rocky cliffs) and sub-tidal rocky reefs, interspersed with small sections of sandy beach. These sandy beaches are nesting sites for hooded plovers.

Intertidal rocky shores stretch east to Marengo, with forest of the Great Otway National Park reaching the cliffs. From Marengo east to Anglesea, the coastline is dominated by long stretches of sandy beach interspersed with intertidal rocky shores and sub-tidal rocky reefs. The coastline immediately west of Kennett River to west of Lorne again has forest of the Great Otway National Park reaching the coastal cliffs.

3.3.1 Coastal Areas of Importance

Key coastal areas of outstanding natural and/or socio-economic values, and considered to be areas of protection priority in the event of a large hydrocarbon spill have been identified and fully described in the EP and include:

- Cape Bridgewater-Cape Nelson-Portland area
- Lady Julia Percy Island
- Portland to Warrnambool coast
- The Bay of Islands Conservation Park
- The Arches Marine Sanctuary
- The Twelve Apostles
- Dinosaur Cover
- Apollo Bay to Aireys Inlet area

3.4 Biological Environment

3.4.1 Benthic Assemblages

Benthic communities across Bass Strait are determined by the seafloor habitat and have a wide distribution with high diversity. A series of benthic surveys were conducted by the Victorian Museum on the continental shelf of the Bass Strait between 1979 and 1984 (Poore et al., 1985; Wilson & Poore, 1987).

Infauna communities were reported to be rich and diverse, and benthic invertebrate communities were identified as some of the most diverse soft sediment ecosystems, comprising mainly sponges, octocorals, ascidians and bryozoans.

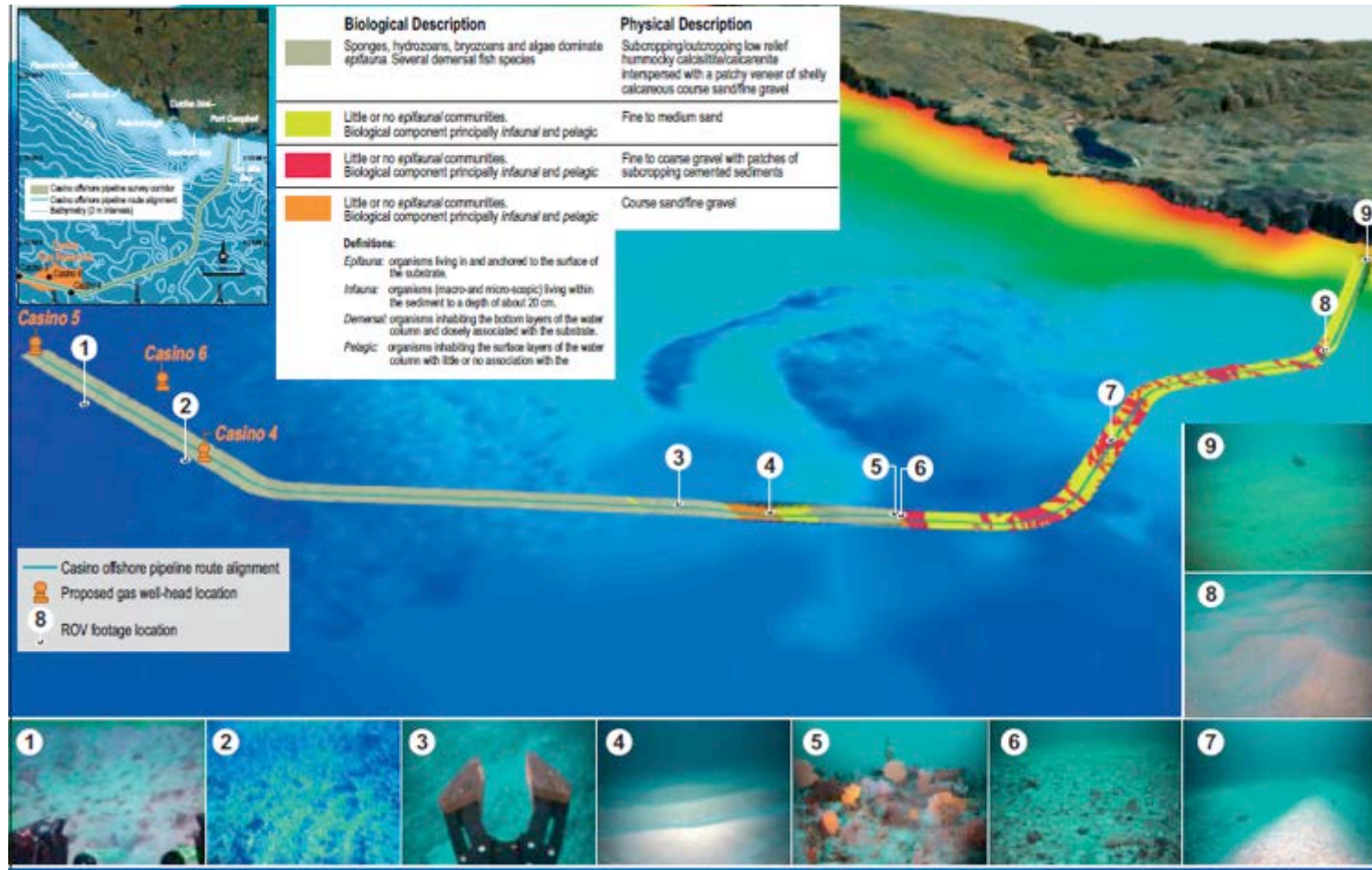
The offshore pipeline traverses mainly sandy seabed and occasionally patchy sponge gardens of varying density cover. The alignment was selected to avoid environmental impacts to significant environmental features such as nearshore and significantly raised relief reef habitats. The shore-crossing, installed by HDD, also avoided key impacts to near-shore reefs and coastal habitats (Santos, 2004). The HDD exit point is in 18 m water depths.

The following benthic environments occur between the shore and the well sites, based on ROV surveys conducted in 2004 for the development phase of the Casino project (Santos, 2004):

- Intertidal environment (0 to 2 m):
 - Rock platform.
 - Cliff face.
 - Sandy beach.
- Shallow environments (2 to 8 m):
 - Contiguous kelp reefs.
 - Patch sandy reefs.
 - Sand.
- Mid-depth environment (8 to 20 m):
 - *Eklonia*-dominated reef.
 - Sand
- Deep environment (20 to 70 m):
 - Sponge-dominated reef.
 - Sand.

These benthic environments are described in more detail below. Figure 3-2 illustrates the benthic habitats along the Casino pipeline as described herein.

Figure 3-2: Seabed habitat classification of the Casino Pipeline route



3.4.2 Plankton

The seasonal Bonney Coast upwelling contributes to locally productive pelagic habitats that exhibit a range of zooplankton such as copepods, decapods, krill and gelatinous zooplankton. Of particular importance in the region is the coastal krill, *Nyctiphanes australis*, which swarms throughout the water column of continental shelf waters primarily in summer and autumn, feeding on microalgae and providing an important link in the blue whale food chain.

3.4.3 Invertebrates

The marine invertebrates in the region include:

- Porifera (e.g., sponges);
- Cnidarians (e.g., jellyfish, corals, anemones, seapens);
- Bryozoans (microscopic filter feeders);
- Arthropods (e.g., sea spiders);
- Crustaceans (e.g., rock lobster, krill);
- Molluscs (e.g., bivalves, sea slugs, gastropods, abalone);
- Echinoderms (e.g., urchins, sea cucumbers); and
- Annelids (e.g., polychaete worms).

Studies by the Museum of Victoria (Wilson and Poore, 1987; Poore *et al.*, 1985) found that invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions. Results of sampling in shallower inshore sediments reported high diversity and patchy distribution (Parry *et al.*, 1990). In these areas crustaceans, polychaetes and molluscs were dominant.

3.4.4 Fish

Fish species present in the EMBA are largely cool temperate species, common within the South Eastern Marine Region.

Thirty-six fish species are listed as having the potential to occur within the EMBA on the EPBC Act PMST (30 of which are pipefish, pipehorses and seahorses) (Table 3-1).

Table 3-1: EPBC Act-listed fish species that may occur in the EMBA

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Freshwater							
<i>Galaxiella pusilla</i>	Dwarf galaxias	V	-	-	T	-	RP
<i>Nannoperca obscura</i>	Yarra pygmy perch	V	-	-	-	-	RP
Oceanic							
<i>Carcharodon carcharias</i>	Great white shark	V	Yes	-	T	D	RP
<i>Isurus oxyrinchus</i>	Shortfin mako shark	-	Yes	-	-	-	-
<i>Lamna nasus</i>	Porbeagle shark	-	Yes	-	-	-	-
<i>Prototroctes maraena</i>	Australian grayling	V	-	-	T	-	RP
Pipefish, pipehorses, seadragons							

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Heraldia nocturna</i>	Upside-down pipefish	-	-	Yes	-	-	-
<i>Hippocampus abdominalis</i>	Bigbelly seahorse	-	-	Yes	-	-	-
<i>Hippocampus breviceps</i>	Short-head seahorse	-	-	Yes	-	-	-
<i>Hippocampus minotaur</i>	Bullneck seahorse	-	-	Yes	-	-	-
<i>Histiogamphelus briggsii</i>	Briggs' crested pipefish	-	-	Yes	-	-	-
<i>Histiogamphelus cristatus</i>	Rhino pipefish	-	-	Yes	-	-	-
<i>Hypselognathus rostratus</i>	Knife-snouted pipefish	-	-	Yes	-	-	-
<i>Kaupus costatus</i>	Deep-bodied pipefish	-	-	Yes	-	-	-
<i>Kimblaesus bassensis</i>	Bass Strait pipefish	-	-	Yes	-	-	-
<i>Leptoichthys fistularius</i>	Brushtail pipefish	-	-	Yes	-	-	-
<i>Lissocampus caudalis</i>	Australian smooth pipefish	-	-	Yes	-	-	-
<i>Lissocampus runa</i>	Javelin pipefish	-	-	Yes	-	-	-
<i>Maroubra perserrata</i>	Sawtooth pipefish	-	-	Yes	-	-	-
<i>Mitichthys mollisoni</i>	Mollison's pipefish	-	-	Yes	-	-	-
<i>Mitichthys semistriatus</i>	Half-banded pipefish	-	-	Yes	-	-	-
<i>Mitichthys tuckeri</i>	Tucker's pipefish	-	-	Yes	-	-	-
<i>Notiocampus ruber</i>	Red pipefish	-	-	Yes	-	-	-
<i>Phycodurus eques</i>	Leafy seadragon	-	-	Yes	-	-	-
<i>Phyllopteryx taeniolatus</i>	Common seadragon	-	-	Yes	-	-	-
<i>Pugnaso curtirostris</i>	Pug-nosed pipefish	-	-	Yes	-	-	-
<i>Solegnathus robustus</i>	Robust pipehorse	-	-	Yes	-	-	-
<i>Solegnathus spinosissimus</i>	Spiny pipehorse	-	-	Yes	-	-	-
<i>Stigmatopora argus</i>	Spotted pipefish	-	-	Yes	-	-	-
<i>Stigmatopora nigra</i>	Black pipefish	-	-	Yes	-	-	-
<i>Stigmatopora olivacea</i>	A pipefish	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Stipecampus cristatus</i>	Ringback pipefish	-	-	Yes	-	-	-
<i>Urocampus carinirostris</i>	Hairy pipefish	-	-	Yes	-	-	-
<i>Vanacampus margaritifer</i>	Mother-of-pearl pipefish	-	-	Yes	-	-	-
<i>Vanacampus phillipi</i>	Port Phillip pipefish	-	-	Yes	-	-	-
<i>Vanacampus poecilolaemus</i>	Australian long-snout pipefish	-	-	Yes	-	-	-

Definitions

<i>Listed threatened species:</i>	A native species listed in Section 178 of the <i>EPBC Act</i> as either extinct, extinct in the wild, critically endangered, endangered, and vulnerable or conservation dependent.
<i>Listed migratory species:</i>	A native species that from time to time is included in the appendices to the Bonn Convention and the annexes of JAMBA, CAMBA and ROKAMBA, as listed in Section 209 of the <i>EPBC Act</i> .
<i>Listed marine species:</i>	As listed in Section 248 of the <i>EPBC Act</i> .

Key to acronyms

<i>EPBC Act status (as at December 2016):</i>	V	Vulnerable
	E	Endangered
	CE	Critically Endangered
<i>FFG Act status (as at December 2016):</i>	T	Threatened
<i>BIA:</i>	A	Aggregation
	D	Distribution (i.e., presence only)
	F	Foraging
	M	Migration
<i>Recovery plans:</i>	CA	Conservation Advice
	CMP	Conservation Management Plan
	RP	Recovery Plan

3.4.5 Cetaceans

Thirty-one cetacean species (24 whales, 7 dolphins) are listed under the EPBC Act PMST as possibly occurring within the EMBA, of which five whales are threatened (Table 3-2). Three of these species are also listed as threatened under the FFG Act. The Victorian State waters section of the CHN pipeline (VIC/PL37(v)) alignment is a BIA for migrating and resting southern right whales. No other BIA are overlapped by the VIC/PL37(v) pipeline.

Table 3-2: EPBC Act-listed cetacean species that may occur in the EMBA

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Whales							
<i>Balaenoptera acutorostrata</i>	Minke whale	-	Yes	Yes	T	-	-
<i>Balaenoptera bonaerensis</i>	Antarctic minke whale	-	Yes	Yes	-	-	-
<i>Balaenoptera borealis</i>	Sei whale	V	Yes	Yes	-	-	CA
<i>Balaenoptera edeni</i>	Bryde's whale	-	Yes	Yes	-	-	-
<i>Balaenoptera musculus</i>	Blue whale (pygmy)	E	Yes	Yes	T	F	RP
<i>Balaenoptera physalus</i>	Fin whale	V	Yes	Yes	-	-	CA
<i>Berardius arnuxii</i>	Arnoux's beaked whale	-	Yes	Yes	-	-	-
<i>Caperea marginata</i>	Pygmy right whale	-	Yes	Yes	-	-	-
<i>Eubalaena australis</i>	Southern right whale	E	Yes	Yes	T	A, M	CMP
<i>Globicephala macrorhynchus</i>	Short-finned pilot whale	-	-	Yes	-	-	-
<i>Globicephala melas</i>	Long-finned pilot whale	-	-	Yes	-	-	-
<i>Hyperoodon planifrons</i>	Southern bottlenose whale	-	-	Yes	-	-	-
<i>Kogia breviceps</i>	Pygmy sperm whale	-	-	Yes	-	-	-
<i>Kogia simus</i>	Dwarf sperm whale	-	-	Yes	-	-	-
<i>Megaptera novaeangliae</i>	Humpback whale	V	Yes	Yes	T	-	CA
<i>Mesoplodon bowdoini</i>	Andrew's beaked whale	-	-	Yes	-	-	-
<i>Mesoplodon hectori</i>	Hector's beaked whale	-	-	Yes	-	-	-
<i>Mesoplodon layardii</i>	Strap-toothed whale	-	-	Yes	-	-	-
<i>Mesoplodon mirus</i>	True's beaked whale	-	-	Yes	-	-	-
<i>Physeter macrocephalus</i>	Sperm whale	-	Yes	Yes	-	-	-
<i>Pseudorca crassidens</i>	False killer whale	-	-	Yes	-	-	-
<i>Tasmacetus shepherdii</i>	Shepherd's beaked whale	-	-	Yes	-	-	-
<i>Ziphius cavirostris</i>	Cuvier's beaked whale	-	-	Yes	-	-	-
Dolphins							
<i>Delphinus delphis</i>	Common dolphin	-	-	Yes	-	-	-
<i>Grampus griseus</i>	Risso's dolphin	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Globicephala melas</i>	Long-finned pilot	-	-	Yes	-	-	-
<i>Lagenorhynchus obscurus</i>	Dusky dolphin	-	Yes	Yes	-	-	-
<i>Lissodelphis peronii</i>	Southern right whale dolphin	-	-	Yes	-	-	-
<i>Orcinus orca</i>	Killer whale	-	Yes	-	-	-	-
<i>Tursiops aduncus</i>	Indian Ocean bottlenose dolphin	-	-	Yes	-	-	-
<i>Tursiops truncatus</i>	Bottlenose dolphin	-	-	Yes	-	-	-

Definitions and key to acronyms as per Table 5.1

3.4.6 Pinnipeds

Table 3-3 lists the two pinniped species that may occur within the EMBA.

Table 3-3: EPBC Act-listed pinniped species that may occur in the EMBA

Scientific name	Common name	EPBC Act status			FFG Act status	BIA within the EMBA?	Recovery plan etc in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Arctocephalus forsteri</i>	New Zealand fur seal	-	Yes	Yes	-	-	-
<i>Arctocephalus pusillus</i>	Australian fur seal	-	Yes	Yes	-	-	-

Definitions and key to acronyms as per Table 5.1

OSRA mapping for the region indicates the presence of seal colonies and haul-out sites along the coast within the EMBA. These species prefer resting/haul out sites that are rocky and isolated, common along the southwest coastline.

3.4.7 Reptiles

Three species of marine turtle listed as endangered under the EPBC Act may occur within the EMBA (Table 3-4).

Table 3-4: EPBC Act listed reptile species that may occur in the EMBA

Scientific name	Common name	EPBC Act status			FFG Act listed?	BIA within the EMBA?	Recovery plan etc in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Loggerhead turtle	<i>Caretta caretta</i>	E	Yes	Yes	-	-	Yes – combined for all turtle species
Green turtle	<i>Chelonia mydas</i>	V	Yes	Yes	-	-	
Leatherback turtle	<i>Dermochelys coriacea</i>	E	Yes	Yes	CE	-	

Definitions and key to acronyms as per Table 5.1

3.4.8 Avifauna

A diverse array of seabirds and terrestrial birds utilise the Otway region and may potentially forage within or fly over the EMBA, resting on islands during their migration. Infrequently and often associated with storm events, birds that do not normally cross the ocean are sometimes observed over the Otway shelf, suggesting the birds have been blown off their normal course or are migrating.

Bird species listed by the EPBC Act PMST as occurring in the EMBA (Table 3-5) are described in this section. Species listed in the PMST that are exclusively terrestrial or wetland species (and not seabirds or shorebirds) or are migratory and only overfly coastal waters (i.e. no suitable resting, nesting or feeding sites) are not listed in Table 3-5 or described in this section as the EMBA only extends to the high water mark on the shoreline.

Table 3-5: EPBC Act Listed avifauna that may occur in the EMBA

Scientific name	Common name	EPBC Act status			FFG Act listed?	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Seabirds (exclusively)							
<i>Diomedea antipodensis</i>	Antipodean albatross	V	Yes	Yes	-	F	RP
<i>Diomedea epomophora</i>	Southern royal albatross	V	Yes	Yes	T	-	RP
<i>Diomedea exulans</i>	Wandering albatross	V	Yes	Yes	T	-	RP
<i>Diomedea sanfordi</i>	Northern royal albatross	E	Yes	Yes	-	-	RP
<i>Haliaeetus leucogaster</i>	White-bellied sea-eagle	-	-	Yes	T	-	-
<i>Halobaena caerulea</i>	Blue petrel	V	-	Yes	-	-	CA
<i>Larus novaehollandiae</i>	Silver gull	-	-	Yes	-	-	-
<i>Macronectes giganteus</i>	Southern giant-petrel	E	Yes	Yes	T	-	RP
<i>Macronectes halli</i>	Northern giant-petrel	V	Yes	Yes	T	-	RP
<i>Morus capensis</i>	Cape gannet	-	-	Yes	-	-	-
<i>Morus serrator</i>	Australasian gannet	-	Yes	Yes	-	F	-
<i>Pachyptila turtur subantarctica</i>	Fairy prion (southern)	-	-	Yes	-	-	CA
<i>Pelecanoides urinatrix</i>	Common diving-petrel	-	-	Yes	-	-	-
<i>Phoebastria fusca</i>	Sooty albatross	V	Yes	Yes	T	-	RP
<i>Pterodroma leucoptera leucoptera</i>	Gould's petrel	E	-	-	-	-	RP
<i>Pterodroma mollis</i>	Soft-plumaged petrel	V	-	Yes	-	-	RP

Scientific name	Common name	EPBC Act status			FFG Act listed?	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Puffinus carneipes</i>	Flesh-footed shearwater	-	Yes	Yes	-	-	CA
<i>Puffinus tenuirostris</i>	Short-tailed shearwater	-	-	Yes	-	F	-
<i>Thalassarche bulleri</i>	Buller's albatross	V	Yes	Yes	T	F	RP
<i>Thalassarche bulleri platei</i>	Northern Buller's albatross	V	Yes	Yes	-	-	RP
<i>Thalassarche cauta cauta</i>	Shy albatross	V	Yes	Yes	T	F	RP
<i>Thalassarche cauta steadi</i>	White-capped albatross	V	Yes	Yes	-	-	RP
<i>Thalassarche chrysostoma</i>	Grey-headed albatross	E	Yes	Yes	T	-	RP
<i>Thalassarche impavida</i>	Campbell albatross	V	Yes	Yes	-	F	RP
<i>Thalassarche melanophris</i>	Black-browed albatross	V	Yes	Yes	-	F	RP
<i>Thalassarche salvini</i>	Salvin's albatross	V	Yes	Yes	-	-	RP
<i>Thalassarche</i> sp. nov.	Pacific albatross	V	Yes	Yes	-	-	RP
<i>Thalassarche steadi</i>	White-capped albatross	V	Yes	Yes	-	-	RP
Shorebirds/coastal wetland species							
<i>Arenaria interpres</i>	Ruddy turnstone	-	Yes	Yes	-	-	-
<i>Calidris alba</i>	Sanderling	-	Yes	Yes	-	-	-
<i>Calidris canutus</i>	Red knot	E	Yes	Yes	-	-	CA
<i>Calidris ferruginea</i>	Curlew sandpiper	CE	Yes	Yes	T	-	CA
<i>Catharacta skua</i>	Great skua	-	-	Yes	-	-	-
<i>Charadrius bicinctus</i>	Double-banded plover	-	Yes	Yes	-	-	-
<i>Charadrius mongolus</i>	Lesser sand plover	E	Yes	Yes	-	-	CA
<i>Charadrius ruficapillus</i>	Red-capped plover	-	-	Yes	-	-	-
<i>Eudyptula minor</i>	Little penguin	-	-	Yes	-	-	-
<i>Heteroscelus breviceps</i>	Grey-tailed tattler	-	Yes	Yes	T	-	-
<i>Pandion haliaetus</i>	Osprey	-	Yes	Yes	-	-	-
<i>Phalacrocorax fuscescens</i>	Black-faced cormorant	-	-	Yes	-	-	-
<i>Pluvialis fulva</i>	Pacific golden plover	-	Yes	Yes	-	-	-
<i>Sterna albifrons</i>	Little tern	-	Yes	Yes	T	-	-
<i>Sterna bergii</i>	Crested tern	-	Yes	Yes	-	-	-
<i>Sternula nereis nereis</i>	Australian fairy tern	V	-	-	T	-	CA

Scientific name	Common name	EPBC Act status			FFG Act listed?	BIA within the EMBA?	Recovery plan etc. in place?
		Listed threatened species	Listed migratory species	Listed marine species			
<i>Thinornis rubricollis</i>	Hooded plover	V	-	Yes	T	-	CA

Definitions and key to acronyms as per Table 5.1

3.4.9 Marine Pests

In the South-east Marine Region, 115 marine species are known to be introduced, and an additional 84 are considered to be possible introductions or 'cryptogenic' species. Eleven species are considered to be invasive marine species (IMS) (NOO, 2002), though no information specific to the Otway Basin is provided.

Invasive marine species are marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish. More than 200 non-indigenous marine species including fish, molluscs, worms and a toxic alga have been detected in Australian coastal waters (AMSA, 2010).

3.4.10 Marine Viruses

A virus, the Abalone Viral Ganglioneuritis (AVG), has been detected in wild abalone populations in southwest Victoria and was confirmed as far east as White Cliffs near Johanna, and west as far as Discovery Bay Marine Park (DPI, 2009). The virus can be spread through direct contact, through the water column without contact, and in mucus that infected abalone produce before dying. The last confirmation of active disease in Victoria was from Cape Otway lighthouse in December 2009 (Victoria State Government, 2016).

Strict quarantine controls need to be observed with diving or fishing activities in southwest Victoria when the virus has been detected in the area (A Clarke, DELWP, pers. comm., 2016). Given the lack of detected AVG in Victorian waters, controls outlined in the Biosecurity Control Measures for AVG: A Code of Practice (Gavine et al., 2009) are not active.

3.5 Conservation Values

The conservation values and sensitivities in and around the CHN asset area include:

- Victorian Protected Areas - Marine
 - Twelve Apostles Marine National Park
 - The Arches Marine Sanctuary
 - Merri Reefs Marine Sanctuary
 - Marengo reefs Marine Sanctuary
 - Eagle Rock Marine Sanctuary
 - Point Addis Marine National Parks
- Victorian Protected Areas - Terrestrial
 - Port Campbell National Park
 - Bay of Islands Coastal Park
 - Great Otway National Park



Figure 3-3: Victorian Protected Marine Areas

3.5.1 Commonwealth Marine Reserves (Apollo)

The CHN assets are located within the South-east Commonwealth Marine Reserves (CMR) Network, which was established to represent the various seafloor features of the region.

The Apollo CMR is intersected by the EMBA but is in Commonwealth Waters

3.5.2 Commonwealth Heritage

There are no marine or coastal places on the Commonwealth Heritage list in the vicinity of the EMBA. The closest site is Swan Island in Port Phillip Bay, approximately 150 km east-northeast of the CHN assets (DoEE, 2016e).

3.5.3 Matters of NES

3.5.3.1 World Heritage Properties

There are no World Heritage Properties in the EMBA. The closest sites are onshore in Melbourne (Royal Exhibition Building and Carlton Gardens), Victoria (193 km northeast) and Naracoorte (Australian Fossil Mammal site), South Australia (260 km northwest) (DoEE, 2016g).

3.5.3.2 National Heritage Places

The nearest places of National Heritage to the CHN assets are all located onshore and do not have marine or shoreline components. These are:

- Great Ocean Road;
- Budj Bim National Heritage Landscape (Mt Eccles Lake Condah Area) – located 100 km northwest; and
- Budj Bim National Heritage Landscape (Tyrendarra Area) – located 102 km west-northwest (DoEE, 2016h).

3.5.3.3 Wetlands of International Importance

There are no marine or coastal Wetlands of International Importance (Ramsar-listed wetlands) in the EMBA. The closest sites are Livinia on King Island (141 km southeast) and the Western District Lakes (50 km northeast) (DoEE, 2016i).

3.5.4 Other Important Ecological Features

3.5.4.1 Key Ecological Features

Key Ecological Features (KEFs) are elements of the Commonwealth marine environment that based on current scientific understanding, are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity.

The National Conservation Values Atlas indicates that the EMBA intersects the Bonney Upwelling KEF (53 km) northwest of the CHN assets. The area may also contain the "Shelf Rocky Reef and Hard Substrates" KEF identified in the South-east Regional Profile (DoE, 2015b).

3.5.4.2 Threatened Ecological Communities

Threatened Ecological Communities (TECs) provide wildlife corridors and/or habitat refuges for many plant and animal species, and listing a TEC provides a form of landscape or systems-level conservation (including threatened species). The giant kelp marine forests of South East Australia are the only listed marine TEC listed as endangered, which may occur in the EMBA and is protected under the EPBC Act. The terrestrial Subtropical and temperate coastal saltmarsh TEC, listed as vulnerable is also listed as likely to occur in the area.

3.5.4.3 Nationally Important Wetlands

Nationally important wetlands are considered important for a variety of reasons, including their importance for maintaining ecological and hydrological roles in wetland systems, providing important habitat for animals at a vulnerable stage in their life cycle, supporting 1% or more of the national population of any native plant or animal taxa or for its outstanding historical or cultural significance (DoEE, 2016j).

In Victoria, management of wetlands is regulated under various pieces of legislation, including the EPBC Act 1999, FFG Act 1988, Planning and Environment Act 1987, Catchment and Land Protection Act 1994 and Water Act 1989.

The only nationally important wetland present within the EMBA due to its connection with the ocean (an open river mouth) is the Lower Aire River Wetlands (VIC158), located near Glenaire and to the immediate west of Cape Otway.

3.6 Cultural Heritage

3.6.1 Maritime Archaeological Heritage

The stretch of coastline adjacent to the coastline of the middle part of the EMBA area is known as the 'Shipwreck Coast' because of the number of shipwrecks present with most wrecked during the late nineteenth century. The strong waves, rocky reefs and cliffs of the region contributed to the loss of these ships. The wrecks represent significant archaeological, educational and recreational (i.e., diving) opportunities for locals, students, and tourists (Flagstaff Hill, 2015). 8 Shipwrecks are adjacent to the CHN assets.

3.6.2 Aboriginal Heritage

Aboriginal groups inhabited the southwest Victorian coast as is evident from the terrestrial sites of Aboriginal archaeological significance throughout the area. During recent ice age periods (the last ending approximately 14,000 years ago), sea levels were significantly lower and the coastline was a significant distance seaward of its present location, enabling occupation and travel across land that is now submerged.

Coastal Aboriginal heritage sites include mostly shell middens, some stone artefacts, a few staircases cut into the coastal cliffs, and at least one burial site. The various shell middens

within the Port Campbell National Park and Bay of Islands Coastal Park are close to coastal access points that are, in some cases, now visitor access points (ParksVic, 1998).

3.7 Socio-economic Environment

3.7.1 Settlements

The coastal communities of Apollo Bay, Princetown, Port Campbell, Peterborough, Warrnambool, Port Fairy and Portland all provide services to the commercial and recreational fishing industries in southwest Victoria. Portland is Victoria's western-most commercial port, and is a deep-water port with breakwaters sheltering a marina and boat ramp. The Port of Warrnambool has a breakwater and yacht club, and provides shelter for commercial fishing boats. Port Fairy has both harbour and fish processing facilities, but is not suitable for use by large vessels, nor is Port Campbell.

Port Campbell is the nearest town to the CHN assets. At the time of the 2011 census, the population of Port Campbell was 618. The town has a median age of 37, a median weekly household income of \$1,097 and an unemployment rate of 5.4% (ABS, 2016). Dairy cattle farming is the town's largest employment type (19.3%), followed by tourist accommodation (10.6%), sheep, beef and grain farming (5%) and cafes, restaurants and food services accounting for 4.7% (ABS, 2016).

3.7.2 Native Title

The National Native Title Tribunal (NNTT) database identifies a claim exists over the adjacent coastal shoreline by the Eastern Maar people. This claim, registered in 2013, extends seaward 100 m from the mean low-water mark of the coastline (NNTT, 2016a). There is currently no determination registered over the area of the claim (still active) in the National Native Title Register.

3.7.3 Shipping

The South-east Marine Region is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes. Commercial vessels use the route when transiting between ports on the east, south and west coasts of Australia, and there are regular passenger and cargo services between mainland Australia and Tasmania (NOO, 2004). Agricultural products and woodchips are transported from the Port of Portland to receiving ports in the Gulf of St Vincent, South Australia, and through Bass Strait to Melbourne and Sydney (NOO, 2004).

AMSA indicates that there are no designated shipping lanes in the vicinity of the CHN assets, however local commercial fishing vessels utilise the area frequently (Figure 5-20). AMSA has provided information regarding shipping routes and density for the area, with the highest density shipping occurs in the southern-most part of Vic/L30 and Vic/L24. Ship tracking data from AMSA (2016-7) provides details of the shipping traffic in the area. The CHN assets are located at the northern extremity of areas with high traffic volumes.

3.7.4 Recreational Fishing

Recreational fishing includes rock, beach, boat and estuary fishing, using rod and line. Fishing licences are required for inland and ocean fishing. Fishing charter operators provide deeper water recreational fishing opportunities (such as tuna fishing).

3.7.5 Tourism

Recreational and tourism activities are extremely valuable foundations for the local and regional economy. Key activities include sight-seeing, surfing and fishing however, these are generally land-based or near-shore activities and are not impacted by the CHN asset operations.

The CHN assets are located in an area of the Otway coastline which is located on the Great Ocean Road, one of the most famous drives in the world. Tourism activities include surfing, recreational fishing, diving and snorkelling.

3.7.6 Commercial Fishing

The offshore CHN assets are overlapped by the jurisdiction of several Commonwealth and State-managed fisheries, as outlined below.

3.7.6.1 Commonwealth-managed Fisheries

Commonwealth fisheries are managed by AFMA, with Commonwealth fisheries operating from 3 nm of baseline out to 200 nm (the extent of the Australian Fishing Zone, AFZ). The offshore CHN assets are located within an area encompassed by several Commonwealth-managed fisheries, these being:

- Bass Strait Central Zone Scallop.
- Eastern Tuna and Billfish.
- Skipjack (eastern).
- Small Pelagic (western sub-area).
- Southern and Eastern Scalefish and Shark.
- Southern Bluefin Tuna.
- Southern Squid Jig.

3.7.6.2 State-managed Fisheries

Victorian fisheries are managed by DEDJTR (Fisheries) and may overlap Commonwealth fisheries areas. The offshore CHN asset lies within an area encompassed by several State-managed fisheries, these being:

- Victorian Rock Lobster.
- Victorian Giant Crab
- Abalone.
- Wrasse.
- Scallop.
- Snapper.

3.7.7 Petroleum Exploration and Production

Other than the CHN assets, there are no other petroleum related assets in proximity to the state waters pipeline

3.7.8 Defence Activities

The Defence Force uses offshore areas for training operations including live firing, bombing practice from aircraft, air-to-air and air-to-sea or ground firing, anti-aircraft firing, firing from shore batteries or ships, remote controlled craft firing, and rocket and guided weapons firing.

Five training areas are located more than 150 km east of the CHN assets, in and around Port Phillip Bay and Western Port Bay.

4 Environmental Impact and Risk Assessment Methodology

This section describes the environmental impact and risk assessment methodology employed for the operations and maintenance of the CHN assets, adopting Cooper Energy’s risk assessment framework and toolkit. This framework is consistent with the approach outlined in ISO 14001 (Environmental Management Systems), ISO 31000:2009 (Risk Management) and HB203:2012 (Environmental Risk Management – Principles and Process). Figure 4-1 provides the process adopted for managing impacts and risks associated with the petroleum activity.



Figure 4-1: AS/NZS ISO 31000 – Risk Management Methodology

4.1 Hazard Assessment Methodology

For this activity, the environmental hazards, impacts and risks have been identified and risk-assessed undertaking the following steps:

- Defining the activity and associated environmental hazards (planned and unplanned);
- Identifying the environmental and social values at risk within, and adjacent to, the petroleum activity area;
- Establishing the credible environmental impact of the hazard to receptors and determining the maximum credible impact for each hazard associated with the proposed activity (the impact of the hazard given no control measures, i.e., inherent impact or risk). Impacts are assessed across a number of dimensions (environment, safety, reputation, financial);
- For environmental hazards with the potential to impact the environment, identifying the likelihood of occurrence of the impact;
- Identifying control measures to eliminate or reduce the level of impact and/or the likelihood of the impact occurring; and
- Assigning a level of residual impact or risk (after control measures are implemented) utilizing Cooper Energy’s qualitative risk matrix. In accordance with Cooper Energy’s acceptance criteria, the impacts and risks will continue to be reassessed until it is demonstrated the impact or risk is reduced to a level which is as low as reasonably

practicable (ALARP) and is acceptable according to Cooper Energy's acceptance criteria.

For the CHN assets, environmental hazard identification and assessment has considered the following:

- Activities that will occur during the operations and maintenance of the CHN assets and the equipment and vessels to will be utilized in those activities;
- 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.) undertaken as part of literature reviews; and
- Feedback from marine stakeholders to understand socio-economic activities that may conflict with CHN asset activities via communication and consultation activities.

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

For this activity, Cooper Energy has determined that impacts and risks are defined as follows:

- **Impacts** result from activities that by their very nature will result in a change to the environment or a component of the environment, whether adverse or beneficial. Impacts are an inherent part of the activity. For example, there will be underwater sound emissions with associated impacts as a result of vessel activity.
- **Risks** result from activities where a change to the environment or component of the environment may occur as a result of the activity (i.e., there may be consequences if the incident event actually occurs). Risk is a combination of the consequences of an event and the associated likelihood of its occurrence. For example, a hydrocarbon spill may occur if a vessel's fuel tank is punctured by a collision incident during the survey. The risk of this event is determined by assessing the consequence of the impact (using factors such as the type and volume of fuel and the nature of the receiving environment) and the likelihood of this event happening (which may be determined qualitatively or quantitatively).

4.1.1 Control Measures

For each identified impact and risk, control measures are identified to reduce the impact or risk. Although commonly used for Occupational Health and Safety (OHS) hazard control, the hierarchy of controls philosophy is a useful framework to identify controls that are effective (Figure 4-2) and is used in this assessment process.

Multiple controls selected from this hierarchy provide a depth (number) and breadth (control type) to prevent an impact or risk from occurring. Control types listed in the upper section of the hierarchy are recognised as being more effective in terms of functionality, availability, reliability, survivability, independence and compatibility given their inherent design characteristics.

Figure 4-2: Hierarchy of Control


Control type	Effectiveness	Operations and maintenance examples
Eliminate		<i>Eliminate the impact or risk.</i> Hydraulic lines are replaced with electrical umbilicals.
Substitute		<i>Change or substitute the impact or risk for a lower one.</i> Chemicals selected are OCNS 'Gold' or 'Silver' compared with 'Purple'
Engineer		<i>Engineer out the impact or risk</i> Design criteria for equipment can withstand possible threats.
Isolate		<i>Isolate the environment from the impact or risk</i> No anchoring within sensitive areas.
Administrative		<i>Provide instructions or training to people to lower impact or risk</i> At-sea refuelling procedures or pre-wok Job Hazard Analyses (JHA).

Table 4-1: Definition of Consequence

Consequence descriptor	Environment	Regulatory, reputation, community and media	Financial/Legal
5. Critical	Severe long-term impact on highly-valued ecosystems, species populations or habitats. Significant remedial/recovery work to land/water systems over decades (if possible at all).	Critical impact on business reputation &/or international media exposure. High-level regulatory intervention. Potential revocation of License/Permit. Operations ceased.	Catastrophic structural failure/damage/loss. Financial loss >\$50 M. Public inquiry, major litigation, prosecution with damages/fines >\$50 M. Custodial sentence for a Cooper Manager
4. Major	Extensive medium to long-term impact on highly-valued ecosystems, species populations or habitats. Remedial, recovery work to land or water systems over years (~5-10 years).	Significant impact on business reputation and/or national media exposure. Significant regulatory intervention. Operations ceased.	Major structural failure/damage/loss. Financial loss >\$25 M. Major litigation or prosecution with damages or fines of >\$25 M + significant costs.
3. Moderate	Localised medium-term impacts to species or habitats of recognized conservation value or to local ecosystem function. Remedial, recovery work to land/water systems over months/year.	Moderate to small impact on business reputation. Potential for state media exposure. Significant breach of regulations, attracting regulatory intervention.	Moderate structural failure/damage/loss. Financial loss >\$10 M. Litigation or prosecution costing >\$10 M. Investigation by regulatory body.
2. Minor	Localised short-term impacts to species/habitats of recognised conservation value but not affecting local ecosystem functioning. Remedial, recovery work to land, or water systems over days/weeks. No significant impacts to third parties.	Some impact on business reputation and/or industry media exposure. Breach of regulations - event reportable to authorities.	Minor structural failure/damage/loss Financial loss >\$5 m Major breach of regulation with punitive fine Involvement of Senior Management.

Consequence descriptor	Environment	Regulatory, reputation, community and media	Financial/Legal
1. Negligible	Temporary localised impacts or disturbance to plants/animals. Nil to negligible remedial/recovery works on land/water systems.	Minimal impact on business reputation. Negligible media involvement. No regulatory breaches or reporting.	Insignificant structural failure/damage/loss. Financial loss <\$5 m. Breach of regulation with investigation or report to specialist with possible prosecution and fine.

Table 4-2: Definition of likelihood

Likelihood	Description
A. Almost certain	Common event, expected to occur in most circumstances within Cooper Energy operations (i.e., several times a year).
B. Likely	Event likely to occur once or more during a campaign, ongoing operations or equipment design life.
C. Possible	Infrequent event that may occur during a campaign, ongoing operations or equipment design life.
D. Unlikely	Unlikely event, but could occur at sometime within Cooper Energy operations (has occurred previously in similar industry).
E. Remote	Rare event. May occur in exceptional circumstances of Cooper Energy operations (not heard of in recent similar industry history).

Table 4-3: Cooper Energy Qualitative Risk Matrix

LIKELIHOOD	1	2	3	4	5
Almost Certain	M	M	H	H	H
Likely	M	M	M	H	H
Possible	L	M	M	H	H
Unlikely	L	L	M	M	H
Remote	L	L	L	M	M

Table 4-4: ALARP Determination for consequence and risk

Impact	Negligible	Minor	Significant	Major	Critical
	Broadly acceptable	Tolerable if ALARP			Intolerable
Risk	Low	Medium		High	
	Broadly acceptable	Tolerable if ALARP			Intolerable

Table 4-5: Management response to impact and risk determination

Category	Description & Response
High	Intolerable risk (in particular at level A5 MAE) - Urgent Executive Management action immediately required, operations not to proceed without Executive Management oversight and approval. Unless specific corrective action(s) taken, possible curtailment of operations, isolate activity or task.

High	<p>Of material interest to the Board, Board advised of corrective action, project does not continue or commence without the support of the Board.</p> <p><u>Notification:</u> Board of Directors (notified by Managing Director).</p>
Medium	<p>Tolerable if ALARP, if all reasonably practicable risk reduction measures have been implemented.</p> <p>Local Senior Management responsibility and approval is required, if not yet ALARP, improve existing controls and/or implement new control(s) operational planning, management responsibility and actions must be specified, corrective & preventative action plan required.</p> <p><u>Notification:</u> Managing Director (notified by Executive Management).</p>
Low	<p>Tolerable risk that can be managed by routine procedures; accept risk.</p> <p>Senior Management/Supervisor decision required. Reporting & decision making at management level.</p> <p>Managed by routine Standard Operating Procedures (SOPs) and onsite management responsibility, approval and monitoring.</p> <p><u>Notification:</u> Executive Manager (notified by Manager/Superintendent/Supervisor).</p>

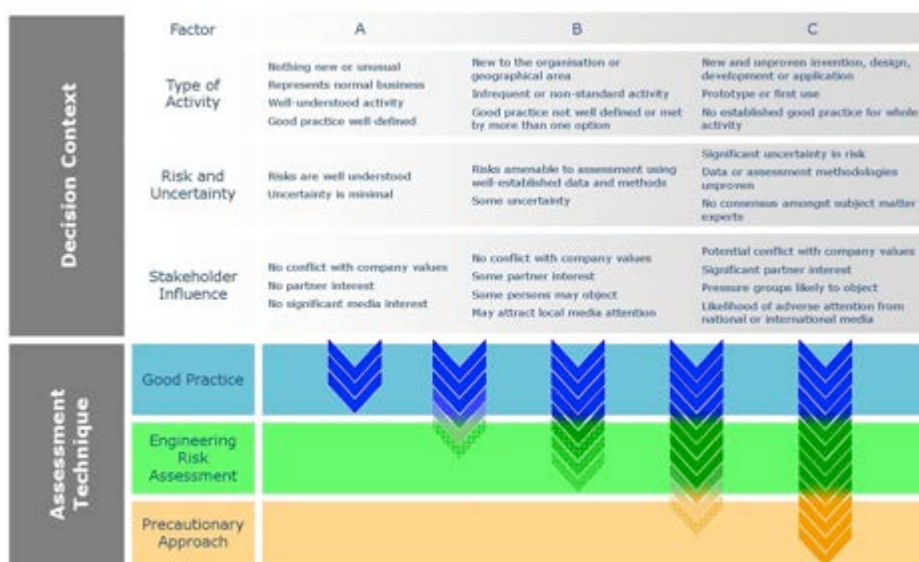


Figure 4-3: Impact and risk 'uncertainty decision-making framework

4.2 ALARP Criteria

The ALARP model adopted for this assessment is dependent upon the:

- A. Residual impact or risk level (provided in Figure 5-3). For higher level impact and risk residuals ALARP assessments consider options for alternative (replacement) controls; additional controls to reduce the environmental impact/risk; and improvements to already adopted controls to increase their effectiveness.
- B. Uncertainty in impact/risk (shown diagrammatically in Figure 5-4). Based upon the level of uncertainty associated with the assessment of impact or risk, the following framework, adapted from the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014) provides the decision-making framework to establish ALARP. This framework provides appropriate tools, commensurate to the level of uncertainty or novelty associated with the impact or risk (referred to as the Decision Type A, B or C). The decision type is selected based on an informed decision around the uncertainty of the risk. Decision types and methodologies to establish ALARP are outlined in Table 5-6.

Table 4-6: ALARP decision-making based upon level of uncertainty

Decision type	Description	Decision-making tools
A	Risks classified as a Decision Type A are well-understood and established practice	<p>Legislation, codes and standards: Identifies the requirements of legislation, codes and standards that are to be complied with for the activity.</p> <p>Good Industry Practice: Identifies further engineering control standards and guidelines that may be applied over and above that required to meet the legislation, codes and standards.</p> <p>Professional Judgement: Uses relevant personnel with the knowledge and experience to identify alternative controls. When formulating control measures for each environmental impact or risk, the 'Hierarchy of Controls' philosophy, which is a system used in the industry to identify effective controls to minimise or eliminate exposure to impacts or risks, is applied.</p>
B	Risks classified as a Decision Type B are typically in areas of increased environmental sensitivity with some stakeholder concerns. These risks may deviate from established practice or have some life-cycle implications and therefore require further analysis using the following tools in addition to those described for a Decision Type A.	<p>Risk-based tools such as cost based analysis or modelling: Assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the risk assessment process.</p> <p>Company values: Identifies values identified in Cooper's HSEC Policy.</p>
C	Risks classified as a Decision Type C will typically have significant risks related to environmental performance. The risks may result in significant environmental impact; significant project risk/ exposure; or may elicit strong stakeholder awareness and negative perception. For these risks, in addition to Decision Type A and B tools, company and societal values need to be considered by undertaking broader internal and external stakeholder consultation as part of the risk assessment process.	<p>Societal Values: Identifies the views, concerns and perceptions of relevant stakeholders and addresses relevant stakeholder concerns as gathered through consultation.</p>

Table 4-7: Cooper Energy acceptability criteria

Test	Question	Acceptability demonstrated
Policy compliance	Is the proposed management of the risk or impact aligned with Cooper Energy's HSEC Policy?	The impact or risk must be compliant with the objectives of the company's policies.
Management System Compliance	Is the proposed management of the impact or risk aligned with the HSEC Management System?	Where specific procedures and work instructions are in place for management of the impact and risk in question, acceptability is demonstrated.
Commonwealth and State legislative criteria	Is the impact or risk or impact being managed in accordance with existing Australian, State and/or international laws?	Compliance with specific laws is demonstrated.
Stakeholder expectations	<p>Have stakeholders raised any objections or claims about adverse impacts associated with the activity, and if so, have merits of the objection been assessed?</p> <p>For those objections and claims with merit, have measures been put in place to manage those concerns?</p>	Stakeholder concerns must have been adequately responded to and closed out.

Test	Question	Acceptability demonstrated
Environmental context	<p>Is the impact or risk being managed pursuant to the nature of the receiving environment (e.g., sensitive or unique environmental features generally require more management measures to protect them than environments widely represented in a region)?</p> <p>Have applicable objectives and actions within marine reserve management plans, species recovery plans, threat abatement plans or conservation advices been addressed?</p>	<p>The proposed impact or risk controls, performance outcomes and performance standards must be consistent with the nature of the receiving environment.</p> <p>Compliance with objectives and actions contained in relevant plans.</p>
Environmentally Sustainable Development (ESD) Principles (refer below)	<p>Does the proposed risk/impact comply with the APPEA Principles of Conduct (APPEA, 2008), requiring integration of ESD principles into company decision-making, and Government policy frameworks that integrate ESD principles into implementation strategies?</p>	<p>The overall operations are consistent with the APPEA Principles of Conduct and Commonwealth environmental strategy documents.</p>
Environmental impact & risk (ALARP)	<p>Are there any further reasonable and practicable controls that can be implemented to further reduce the impact or risk?</p>	<p>There is a consensus within Cooper that residual risk has been demonstrated to ALARP.</p>

5 Environmental Impact and Risk Assessment

This section presents the evaluation of the environmental impact assessment (EIA) and environmental risk assessment (ERA) completed for the CHN assets using the methodology described in Section 6, as required by OPGGS(E)R Regulations 13(5) and 13(6) and OPGGSR Regulation 15(3) and 15(4).

This section also presents the environmental performance outcomes, performance standards and measurement criteria for each of the identified environmental hazards. Where measurement criteria associated with *performance outcomes or performance standards* are not met, a recordable incident is documented and will be reported to NOPSEMA or DEDJTR ERR (see Section 8.8). The following legislative and guideline definitions are used in this section:

- Environmental performance outcome (EPO) – a measureable level of performance required for the management of the environmental aspects of the activity to ensure the environmental impacts or risks will be of an acceptable level;
- Environmental performance standard (EPS) – a statement of performance required of an adopted control measure; and
- Measurement criteria – defines the measure by which environmental performance will be measured to determine whether the EPO has been met.

A summary of the residual rankings for all impacts and risks identified and assessed in this Section are summarised in Table 5-1. Note that many of these are not applicable to state water activities and so are not detailed further in the EP summary.

Table 5-1: CHN assets operations and maintenance environmental impact and risk rankings summary

#	Environmental impact or risk	Residual impact or risk ranking
Impacts		
1	Discharge of hydraulic fluids	Negligible
3	Discharge of gas	Negligible
4	Discharge of production chemicals	Negligible
5	Removal of marine growth from subsea infrastructure	Negligible
6	Underwater sound disturbance (vessel)	Minor
7	Atmospheric emissions (vessel)	Negligible
8	Light emissions (vessel)	Negligible
9	Treated sewage and grey water discharges (vessels)	Negligible
10	Cooling and brine water discharges (vessels)	Negligible
11	Putrescible waste discharges (vessels)	Negligible
12	Bilge water discharges (vessels)	Negligible
Risks		
13	Discharge of contaminated deck drainage (vessels)	Low
14	Production chemical release	Low
15	Displacement of third-party vessels (vessels)	Low
16	Introduction of invasive marine species (vessels)	Medium
17	Vessel strike with megafauna (vessels)	Low
18	Accidental release of waste (vessels)	Low
19	Loss of equipment to the marine environment	Low
20	Condensate spill	Low
21	Diesel spill (vessels)	Low

IMR Campaign Timeframes (Non-Emergency):

A range of environmental receptors in the Otway basin are seasonally present or have seasonal sensitivities (i.e. spawning) and as such, environmental impact and risk depends upon their presence. The selection of IMR campaign timeframes can also reduce the impacts and risks of vessel-based activities.

As part of the pre-campaign planning a risk assessment will be undertaken to assess project, safety and environmental impacts and activity risks to ensure ALARP and acceptability criteria are met.

This process will involve personnel who can supply relevant information to the activity and/or are the key decision makers for the project. Information which will be provided into the assessment process will include:

- Vessel availability;
- Safe weather windows in which to operate;
- Seasonal environmental and socio-economic sensitivities within the region; and
- Location of the IMR activity against the expected location of these sensitivities.

The methodology to select the timeframe with the lowest environmental impact/risk associated with IMR activities will be done on a case-by-case basis as follows:

- The available activity windows (depend on vessel availability and safe weather conditions) will be defined;
- For each sensitivity within that window, identify the environmental and socio-economic impacts/risk of undertaking the activity in that period;
- Compare the environmental and socio-economic impacts for each period;
- From this comparison establish if there is a clear timeframe where impacts/risks to all environmental and socio-economic sensitivities can be minimised;
- If there is no clear timeframe the preferred timeframe will be defined by a qualitative comparison of severity of impacts and risks to sensitivities giving priority to:
 - Environmental sensitivities over socio-economic factors (refer below to rationale).
 - Threatened species over non-threatened species.

If timeframes are assessed as equally good, there may not be a preferred activity window between options available.

This assessment shall be documented and attached to the pre-campaign risk assessment.

Socio-economic impacts:

- Commercial fishing has access to larger marine areas than the area occupied by the CHN facilities. CHN facilities have been aligned to avoid habitats where commercial fisheries (i.e. lobster and abalone) operate. On the basis of this marine availability, Cooper considers that there is more flexibility in fishing options and fishing activities can exercise discretion as opposed to marine fauna.
- Impacts and risks from CHN activities are not expected to have substantial impacts to tourism in the area given the nature of the operations and hydrocarbon handled in the CHN facilities. Additionally, tourists visiting the Port Campbell area are attracted by its landscapes and scenery which will not be significantly impacted by the risks identified by CHN operations.¹

¹ A consequence of moderate (3) is assigned to tourism impacts resulting from a diesel spill. This consequence has been assigned based upon a business reputation risk and not environmental impact.

5.1 IMPACT: Seabed Disturbance

5.1.1 Hazard

The following activities have the potential to disturb the seabed:

- Dropped objects;
- Disturbance to infrastructure (storm damage, over trawl, etc.);
- Erosion/sediment build up along the pipelines;
- Laying down of subsea infrastructure (e.g. repair activities);
- Lifting (and subsequent replacement) of EHU or installation of pipeline span supports;
- Vessel anchoring; and
- Preparing site for pipeline repair.

5.1.2 Known and Potential Environmental Impacts

The known and potential impacts of the above-mentioned hazards are:

- Localised turbidity of the near-seabed water column;
- Temporary disturbance to benthic habitats and fauna from this turbidity;
- Smothering cause by dropped objects or seabed disturbances;
- Permanent displacement of a small area of seabed habitat by subsea infrastructure; and
- Subsea infrastructure will act as artificial habitat for benthic fauna colonization.

EMBA

The EMBA for seabed disturbance, given the intermittent and small area of the disturbance associated with maintenance activities is expected to be localised around the activity site (anywhere along the pipelines and around the wellheads).

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Benthic species and filter-feeding epifauna (e.g. sponges, macroalgae and other rocky hard substrate species such as bryozoans (water depths > 60 m));
- Pelagic and demersal species (plankton, finfish); and
- Pinnipeds.

5.1.3 Evaluation of Environmental Impacts

Operations

The infrastructure associated with the pipelines, which are not buried, has the potential to act as a water obstruction and will cause minor and localised alterations to the hydrodynamic regime directly around infrastructure, such as localised scouring/erosion or deposition of sediment leading to a build-up against infrastructure over time. Erosion/scouring is monitored by the regular inspections of the pipeline, and measures in place to reduce freespan (e.g., concrete mattresses and grout bags). Given the relatively small area of the pipeline, impacts to the seabed are highly localised and are expected to have a negligible consequence.

Maintenance and Repair

During maintenance activities, the seabed in the immediate vicinity of the CHN assets may be disturbed due to the lifting of the EHU for inspection, placement of small structures associated with the ROV or diving works, placement of grout bags and concrete mattresses to assist with free-span of pipelines, air/water lifting of built up sediment and minor excavation of the

seabed. Non-routine activities such as removal of seabed sedimentation beneath the pipeline to prepare for repair activities would also disturb the seabed on a localised basis.

Where temporary 'wet parking' of equipment (e.g., ROV basket or clump weight) is required, a benign seabed location will be chosen (typically a sandy flat location which is representative of the seabed in the majority of the asset area or an area which limits impacts to hard substrate benthic habitats in water depths > 60m). These items of equipment are light weight, left on the seabed temporarily, and do not leave a permanent foot print on the seabed (negligible consequence). Trained and competent ROV operators will ensure that this equipment placement and any ROV activities are undertaken with a minimum level of disturbance to the seabed.

For repair activities on sandy substrate, an estimated 0.5m of seabed sediment beneath the affected length of pipeline would require removal though this would be minimised to enable repair activities to proceed. Repairs would be undertaken in 'sections' so as to not exceed the free-span anomaly criteria for the pipeline as specified in the IMP (typically 10's m) as appropriate to the damage incurred. This would most likely be undertaken by low-pressure water-jetting and in accordance with a Permit-to-Work authority to control levels of seabed disturbance. For sections of the pipeline in sand habitats with sparse epi-faunal habitats, pipeline repair activity may cause temporary localised disturbance however recolonization by adjacent benthic fauna is expected to be rapid (negligible consequence).

Pipeline repair activities may also include the cutting of pipe with a diamond cutter or rotary milling tool which creates a minor amount of metal fragments which will be dispersed locally near the pipeline cutting sites. This metal will corrode over time however by-products are inert, impacts very localised and not expected to interfere with benthic habitats including the sponge reef present along the alignment (negligible consequence).

All activities listed above may result in a localised increase in the turbidity of the water column, and subsequent deposition of suspended sediment on the seabed. In turn this could have a localised ecosystem disruption through reduction in benthic productivity. The benthic environment along the pipelines is primarily comprised of sand and gravel seabed containing sparse epifaunal habitats common to Bass Strait, and remobilization of sediments is constant in these high energy marine environments. The benthic fauna in these areas adapt to these conditions and on this basis any localised increase in turbidity to is expected to be temporary and rapidly recoverable (negligible consequence).

The lifting of the EHU or other existing infrastructure will result in the loss of artificial habitat and may displace marine benthic invertebrates utilising the artificial habitat created by the infrastructure. As this is an artificial habitat that would have been colonised relatively recently, it is expected that any benthic invertebrates colonising the equipment such as the EHU will be capable of re-settling elsewhere, or remaining with the habitat when re-laid.

Pipeline Freespan Rectification

Grout bag installation will involve pumping grout (cement and water) through a hose from the vessel to fill grout bags underwater. Minor leakage of grout may occur during filling of the bags and when the hose is flushed with seawater at the completion of operations, dispersing residual grout into the marine environment. The volume of grout involved is expected to be very low (generally < 50 L).

The release of grout may create a localised increase in the turbidity of the water column, and a localised alteration to sediment composition and/or smothering of the benthos. All cement chemicals are assessed and meet the required standards detailed in the Cooper Energy Chemical Selection, Management and Dangerous Goods Risk Control Practice (COE-MS-RCP-0049).

The level of turbidity associated with this small volume is expected to be minimal given that the cement is designed to set rapidly in the marine environment and will therefore not disperse widely. The turbidity resulting from this activity would not be expected to exceed natural levels in the area. Installation of grout bags is expected to be undertaken within a very short duration of time (less than 1 day) and rapid recovery/recolonization of any benthic biota

disturbed by settling cement material is expected to occur from adjacent areas following sedimentation or sediment remobilisation (URS, 2001).

The volume of grout that may be released to the marine environment is very low and the potential affects would be restricted to the immediate vicinity of the operation. The benthic habitats present along the pipeline, including hard substrate habitats are not expected to be impacted by these small release volumes, particularly with the rapid remobilisation of sediments which occurs in the region. Given the very small extent of effects and the non-toxic nature of the grout, the consequences to benthic communities are expected to be temporary, localised and recoverable (negligible consequence).

Vessel Anchoring

While most vessels involved in maintenance activities will use dynamic positioning (DP) or station-keeping during operation particularly in the deeper areas of the pipeline alignment, anchoring may be required by some vessels for specific activities, or in case of an emergency. Anchoring is expected to be restricted to the shallower waters along the pipeline where strong currents present a safety hazard for longer duration activities (e.g. diving). Shallow habitats along the pipeline are located in the mid-water depth range and consist of predominantly sandy habitats with intermittent patch reefs dominated by the brown alga.

Anchoring activities (except for emergency anchoring) will be planned and undertaken in accordance with approved procedures after a new or existing ROV survey of the anchoring area confirms:

- Intermittent patch reef or hard substrate habitats are not present in the anchor deployment area; or
- If anchoring must occur in these habitats, areas of lower sensitivity (i.e. lower coverage of epifauna) are preferentially targeted and anchoring techniques implemented to reduce impacts to ALARP.

Direct contact by vessel anchors and anchor wires/chains can damage seabed habitats. Given the predominantly sandy nature of the seabed and the controls adopted, no long-term or significant impacts are predicted to benthic habitats from anchoring. Further, it is expected that any localised impacts from anchoring would rapidly recolonise and recover following any disturbance. This temporary impact will be negligible on a regional scale and the consequences are therefore negligible.

5.1.4 Impact Assessment

Pre-campaign risk assessment:

Prior to any offshore IMR campaign a pre-campaign risk assessment will be undertaken to assess project, safety and environmental impacts and risks associated with the activity which will ensure that all environmental impacts and risks associated with the activity are at ALARP and acceptable levels.

Information which will be provided into the risk assessment includes the following:

- IMR scope and methodology adopted;
- The location, timing and equipment to be used in the survey;
- Details of the environmental sensitivities to be encountered in the activity location;
- Review of available ROV footage to confirm the expected seabed condition in the activity location; and
- Stakeholder specific issues and concerns.

The impact and risk assessment will be documented and reflect the elimination or mitigation controls established in the workshop. The environmental impact and risk for the activity will be demonstrated to be ALARP and acceptable.

Table 5-2: EIA for seabed disturbance associated with routine maintenance activities

Aspect:	IMR activities impacting on the seabed
Impact summary	Localised turbidity of the near-seabed water column, temporary disturbance to benthic habitats and fauna from turbidity, habitat smothering, permanent displacement of small areas of seabed and infrastructure acting as an artificial substrate for benthic fauna colonisation.
Extent of impact	Localised (to area of maintenance activities), generally immediately adjacent to wellheads or pipeline.
Duration of impact	Temporary (minutes to weeks – rapid recovery of benthic sediments and fauna).
Level of certainty of impact	HIGH. Observed changes to seabed characteristics due to the placement of infrastructure have been observed during the life of the development. Seabed habitats are not sensitive in the region of the CHN development.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement.</i>

5.2 IMPACT: Removal of Marine Growth from Subsea Infrastructure

5.2.1 Hazard

The following activities will result in the removal of marine growth attached to subsea infrastructure:

- High-pressure water jetting;
- Brushing with plastics and/or wire brushes;
- Scraping with rotary polymer scrapers (Flexiclean or equivalent); and
- Grit-blasting.

As part of ongoing maintenance and to facilitate inspections, or to enable pipeline repairs, the removal of marine growth from infrastructure using inspection or work-class ROVs and/or divers may be required. Marine growth may be removed with high-pressure water jetting, brushing or scraping or a combination of these. Only sections of infrastructure with encrusting organisms that make maintenance activities difficult (e.g., access to subsea tree valves), need to be repaired (e.g. clamp/wrap installation) or require inspection using specialised equipment (e.g. Combi-Crawler) would be considered for marine growth removal. This is expected to occur infrequently for inspection and maintenance activities (once every few years at most) and rarely for pipeline repair.

5.2.2 Known and Potential Environmental Impacts

The known impacts of this activity are:

- A temporary and localised reduction in water quality (i.e., increased turbidity due to sand or marine growth debris discharge);
- The dislodgment (and possible death) of marine growth (macro-algae and epi-fauna such as sponges, ascidians and molluscs) attached to the subsea infrastructure; and
- Settling of sand used for blasting on the seabed.

EMBA

Given the small areas which may be targeted for marine growth removal, impacts are expected to be extremely localised around the cleaning location and recoverable.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Benthic species (especially those encrusting organisms being removed);

- Filter-feeding epifauna (e.g. sponges, macroalgae and rocky hard substrate species such as bryozoans (water depths > 60 m));
- Pelagic and demersal species (plankton, fin fish).

5.2.3 Evaluation of Environmental Impacts

Temporary and localised reduction in water quality

Sand or water blasting will cause localised and temporary turbidity due to disturbance to surrounding sediments and the dislodgment of marine growth. This is unlikely to affect benthic productivity around the CHN assets due to the short lengths and periods over which marine growth removal will be conducted at any location. Given much of the pipeline alignment is in sandy seabed environments with sparse epifauna, disturbance to benthic habitats are expected to be temporary and localised to the immediate vicinity of the infrastructure. Additionally, water column quality will return to pre-activity levels rapidly due to strong ocean bottom currents and the natural effects of dilution. The consequences of this impact are considered negligible.

Dislodgment of marine growth

The dislodgement and/or death of biota caused by blasting will have, at worst, a short-term impact on biodiversity and productivity around the assets. The biota that originally colonised the infrastructure is representative of fauna from nearby stable substrates (e.g., rocky reef) and it is likely these habitats will again form the 'sink' for species recolonising infrastructure that has had marine growth removed. The consequences of this impact are considered negligible.

Additional sand settlement on seabed

Water blasting will be given preference to grit blasting of sub-sea infrastructure.

The use of sand (beach sand, and not for example garnet) will not have long-term impacts given that the seabed around the asset is predominantly sand. No chemicals will be added to the sand. Discharged sand will settle on the seabed and become congruous with its surrounds. Any small flakes or particles of paint that may be dislodged from the infrastructure due to blasting which settle on the seabed are not expected to form a physical impediment to biota settling on or in the seabed sediments. For sand substrates and rocky hard substrate habitats with sparse epifauna given the dynamic nature of the seabed environment (rapid sand removal) and limited area affected, the impact is considered negligible.

Sand blasting at more sensitive habitats may have greater impacts. Sponges are an important component of benthic ecosystems worldwide and as sessile suspension feeders, may be impacted by changes in sediment levels. Bell et al (2015) in a review of the current literature on sediment impacts to sponges identified that sediment may have the following impacts:

- Direct ingestion of fine particles can block or clog filtering apparatus and impact on physiological processes (i.e. reduce feeding);
- Larger sediment particles can scour external surfaces;
- Increasing sedimentation creates turbidity and reduces light penetration which will affect phototrophic species; and
- Larvae may be prevented from settling if suitable collection substrates are covered by sediment.

Bell et al, (2015) also identify that sponges can adapt to tolerate high levels of sedimentation and many species are commonly found in environments experiencing high levels of suspended and settled sediment. Sedimentation is identified as a threat to the Bass Strait sponge beds located approximately 70 km to the east of the CHN Development (Butler et al, 2002).

It is also noted that sponge species present along the CHN pipeline alignment have adapted to a high energy, high sediment resuspension environment. This has been observed in drilling

activities in the Otway marine environment where rapid sediment resuspension and transport has been observed (Currie & Issacs, 2005).

A pre-campaign risk assessment will assess potential environmental impacts and risks from IMR activities and identify environmental controls which are ALARP and acceptable. A possible control adopted for these areas is to utilise techniques such as water jetting, brushing or scraping in these more sensitive areas to reduce impacts. With such techniques adopted predicted impacts to sponges is expected to be localised and recoverable (negligible consequence).

Impacts to Matters of NES:

Seabed disturbance will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance:

There are no other areas of conservation significance within the environment affected for seabed disturbance. The Shelf Rocky Reef and Hard Substrate KEF may lie within the localised environment affected.

5.2.4 Impact Assessment

Table 5-3 presents the risk assessment for the removal of marine growth during maintenance activities.

Table 5-3: EIA for the removal of marine growth

Activity:	Removal of Marine Growth
Impact summary	Reduction in water quality. Loss of encrusting marine biota.
Extent of impact	Localised (to area being cleaned).
Duration of impact	Water quality – temporary (due to rapid dispersion and dilution). Loss of biota – short-term. Biota will recolonise infrastructure rapidly (ongoing).
Level of certainty of impact	HIGH. Activity is localised with only local species affected. Recovery will be rapid based upon observed marine growth over the lifetime of the asset.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.3 IMPACT: Underwater Sound Disturbance (Vessel & Helicopter)

5.3.1 Hazard

The following vessel activities have the potential to create underwater sound that may disturb marine fauna:

- Engine noise transmitted through the vessel hull; and
- Propeller/thruster noise;
- Use of side-scan sonar; and
- ROV.

Vessels

Shipping sound generally dominates ambient noise at frequencies from 20 to 300 Hz (Richardson et al. 1995). High frequency components of the sound source spectrum rapidly

dissipate with distance from the sound source allowing the lower frequency wavelengths to travel further distances.

Vessels engaged for maintenance activities will generally generate low levels of machinery noise and will be of a similar nature to other vessels operating in the region.

The sound levels and frequency characteristics of underwater noise produced by vessels are related to ship size and speed. When idle or moving between sites, vessels generally emit low-level noise. Tugboats, crew boats, supply ships, and many research vessels in the 50-100 m size class typically have broadband source levels in the 165-180 dB re 1 μ Pa range (Gotz *et al.*, 2009). In comparison, underwater sound levels generated by large ships can produce levels exceeding 190 dB re 1 μ Pa (Gotz *et al.*, 2009) and vessels up to 20 m size class typically 151-156dB re 1 μ Pa (Richardson *et al.*, 1995).

McCauley (1998; McCauley and Duncan, 2001) examined the sound from a 64 m, 2,600 tonne rig tender vessel underway, which had a broadband source level of 177 dB re 1 μ Pa @ 1m (units not specified) in approximately 110m water depth. The use of thrusters or main propellers under load produced very high levels of cavitation noise. During these activities, the measured vessel noise was broadband in nature, with the highest level measured at 137 dB re 1 μ Pa (units not specified) at 405 m astern; levels of 120 dB re 1 μ Pa (units not specified) recorded at 3-4 km; and the noise audible at up to 20 km against a 'natural background level' of 90 dB re 1 μ Pa (units not specified). IMR vessels will have a smaller sound footprint given the smaller size vessel.

Helicopters

Helicopters are only likely to be used in a medical evacuation situation, and are not planned to be used for personnel transfers during IMR activities.

Helicopter operations produce strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson *et al.*, 1995). Sound generated from helicopter operations is typically below 500 Hz and sound pressure in the water directly below a helicopter is greatest at the surface but diminishes quickly with depth. Reports for a Bell 214ST (stated to be one of the noisiest) identify that noise is audible in the air for four minutes before the helicopter passed over underwater hydrophones. The helicopter was audible underwater for only 38 seconds at 3 m depth and 11 seconds at 8 m depth (Green 1985a; cited in Richardson *et al.*, 1995).

Sound levels from helicopters are not expected to cause physical damage to marine fauna, however temporary behavioural changes (avoidance) in species (cetaceans, turtles, fish) may be observed.

Side scan sonars

Side scan sonars operate at high frequencies typically between 100 to 500 kHz. These devices operate at frequencies similar to those used in 'fish finders' by commercial fishermen. Higher frequency emissions utilised in these operations dissipate to safe levels over a relatively short distances as the sound is rapidly absorbed by the surrounding water column (DEHLG, 2007).

5.3.2 Known and Potential Environmental Impacts

The primary concern arising from underwater sound generation is the potential non-physiological effects on marine fauna including:

- Attraction;
- Increased stress levels;
- Disruption to underwater acoustic cues;
- Behavioural changes;
- Localised avoidance; and

- Secondary ecological effects that may occur as a result of an effect on one (or more) species influencing another species, for example, by alteration of a predator–prey relationship.

EMBA

The EMBA for the impacts associated with underwater sound generated by vessels is likely to be within a radius of a few hundred metres of the vessel, dependent on the exact size of the vessel, water depth and seabed type.

The EMBA for underwater sound generated by helicopters is expected to be very localised at surface.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic species (plankton, fin fish);
- Cetaceans; and
- Pinnipeds.

5.3.3 Evaluation of Environmental Impacts

Vessel sound

Increased levels of underwater noise generated by vessels supporting ROV/diving activities, particularly from vessel (DP) thrusters, have the potential to disturb noise sensitive marine fauna.

Activities that generate underwater noise can affect marine fauna by interfering with aural communication, eliciting changes in behaviour or, in extreme cases, by causing physiological damage to auditory organs. The potential for noise from anthropogenic sources to impact fauna depends on a range of factors, including the intensity and frequencies of the noise, prevailing ambient noise levels and the proximity of noise sensitive species.

Studies reviewed by Richardson et al. (1995) identify the following reactions of marine fauna to vessel presence/sound:

- Sea lions (an octariid seal similar to fur seals) in water tolerate close and frequent approaches by vessels and sometimes congregate around fishing vessels. However, the amount of evidence is slender and it is not known whether these animals are affected or are stressed by these encounters (Peterson and Bartholomew, 1967; cited in Richardson et al, 1995).
- Dolphins of many species tolerate or even approach vessels but sometimes members of the same species show avoidance. Reactions appear to be dependent on the dolphin's activity at the time - resting dolphins tend to avoid boats, foraging dolphins ignore them and socialising dolphins may approach vessels (B. Wursig, pers.obs.; cited in Richardson et al, 1995). Dolphins also reduce the energy costs of travel by riding the bow and stern waves of vessels (Williams et al, 1982; cited in Richardson et al, 1995).
- Killer whales rarely showed avoidance to boats within 400 m (Duffus and Dearden, 1993; cited in Richardson et al, 1995), however further analysis showed subtle tendencies to swim faster especially if more than one boat was nearby and tend to move toward less confined waters (Kruse, 1991; cited in Richardson et al, 1995).
- Sperm whales were observed to avoid out-board motored whale-watching vessels up to 2 km away with behavioural changes including altered surfacing/respiration dive patters and more erratic surface movements. Near those boats, surface times tended to be reduced with fewer blows per surfacing, shorter intervals between successive

blows and increasing frequency of dives without raised flukes (J. McGibbon, in Cawthorn 1992; cited in Richardson et al, 1995).

- Baleen whales seem to ignore weak vessel sounds and move away in response to strong or rapidly changing vessel noise. Avoidance was particularly strong when vessels approached directly (Watkins, 1986; cited in Richardson et al, 1995). Some whales are attracted to noise from idling outboard motors and are not seriously disturbed by small vessels however calling behaviour may change to reduce masking by boat noise.
- Studies undertaken into Hawaiian humpbacks reaction, mostly to small vessels, identified that behaviours varied according to social groupings of whales (e.g. mothers, calves, etc.). Overall humpbacks tended to avoid vessels and sometimes directed threats toward them. The various effects often occurred when vessels were 500-1000 m away (Bauer, 1986; Bauer and Herman, 1986; cited in Richardson et al, 1995).

Sound sensitive species may be present in the CHN area during IMR activities. While sound levels generated by the IMR vessel are not expected to be sufficient to damage fauna, it is considered that localised and short-term displacement of sound sensitive species around the IMR vessel may occur. It is noted the Victorian State waters section of the CHN pipeline (VIC/PL37(v)) alignment is a BIA for migrating and resting southern right whales. Avoidance effects demonstrated by these species will be localised, short-term and not significant at a population level (minor consequence).

Vessel sound on benthic fauna (e.g. lobsters and sponges) will be similar to fishing vessels present in the area and given the low levels of sound emitted, not expected to have any physiological or behavioural impacts on these species.

Flight sound

Increased underwater and airborne noise from helicopter movements has the potential to cause impacts to birds along flight paths due to behavioural disturbance, and behavioural changes in cetaceans. Airborne noise from helicopters generally only penetrates water at angles greater than 26° (Richardson *et al.*, 1995). Generally, this only results in a temporary change in behaviour (e.g., diving, tail slaps) in whales, which return to normal behaviour once the helicopter has passed (Richardson *et al.*, 1985; Richardson and Malme, 1993), and occasional overflights are thought to have no long term impact on cetaceans (NMFS, 2001).

The majority of activity will be located offshore and therefore avoid sensitive nearshore areas (e.g., shorebird resting and breeding sites). With the very low level of helicopter movement expected to be required, significant disruption to seabirds or cetaceans from helicopter sound is very low (negligible consequence).

Impacts to Matters of NES

Underwater sound from vessels, helicopters and ROV operations will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA for underwater sound. Underwater sound will not have any impacts to other areas of conservation significance.

5.3.4 Impact Assessment

Table 5-4 presents the impact assessment for underwater sound.

Table 5-4: EIA for underwater sound

Aspect:	Vessel Sound Disturbance
Impact summary	Behavioural changes (e.g., startle response) in sound-sensitive species, especially cetaceans.
Extent of impact	Localised.

Duration of impact	Temporary (duration of vessel, helicopter or ROV presence).
Level of certainty of impact	HIGH. Significant research has been undertaken on the impacts of underwater sound on biological receptors.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.4 IMPACT: Atmospheric Emissions (Vessels)

5.4.1 Hazard

The use of fuel (specifically marine-grade diesel) to power engines, generators and mobile and fixed plant (e.g., ROV, crane), will result in gaseous emissions of greenhouse gases (GHG) such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), along with non-GHG such as sulphur oxides (SO_x) and nitrous oxides (NO_x). Combustion emissions will be expelled from exhaust stacks several metres above deck level to ensure adequate aerial dispersion.

5.4.2 Known and Potential Impacts

The known and potential environmental impacts of atmospheric emissions are:

- Localised and temporary decrease in air quality due to particulate matter from diesel combustion; and
- Contribution to the global GHG effect.

EMBA

The EMBA for atmospheric emissions associated with vessel activities is the local air shed – with rapid dispersion around the discharge point due to the local wind regime.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Seabirds.

5.4.3 Evaluation of Environmental Impacts

Localised and temporary decrease in air quality from diesel combustion

The combustion of diesel fuel can create continuous or discontinuous plumes of particulate matter (soot or black smoke) and the emission of non-GHG, such as NO_x and SO_x. Inhaling this particulate matter can cause or exacerbate health impacts to humans exposed to the particulate matter, such as offshore project personnel or residents of nearby towns (e.g., respiratory illnesses such as asthma) depending on the amount of particles inhaled. Similarly, the inhalation of particulate matter may affect the respiratory systems of fauna. Along the CHN assets, this is limited to seabirds overflying the vessel/s.

Particulate matter released from the vessel/s is not likely to impact on the health or amenity of the nearest human coastal settlements (e.g., Port Campbell and Peterborough), as offshore winds will rapidly disperse and dilute particulate matter. This rapid dispersion and dilution will also ensure that seabirds are not exposed to concentrated plumes of particulate matter from vessel exhaust points.

Contribution to the GHG effect

While these emissions add to the GHG load in the atmosphere, which adds to global warming potential, they are relatively small on a global scale, and temporary, representing an insignificant contribution to overall GHG emissions. The IMR vessel would typically consume

0.3m³ of fuel per day which is 0.000000155% of the National Greenhouse Gas inventory for 2014 (DoEE, 2017a).

Impacts to Matters of NES

Atmospheric emissions from vessels undertaking maintenance inspections or activities will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the atmospheric emissions EMBA. Atmospheric emissions will not have any impacts to other areas of conservation significance.

5.4.4 Impact Assessment

Table 5-5 presents the risk assessment for atmospheric emissions.

Table 5-5: EIA for atmospheric emissions

Aspect:	Air Emissions (Vessel)
Impact summary	Air pollution and contribution to the GHG effect.
Extent of impact	Localised (local air shed).
Duration of impact	Short-term (emissions rapidly dispersed and diluted).
Level of certainty of impact	HIGH. The impacts of atmospheric impacts from air emissions are well studied and regulated.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.5 IMPACT: Light Emissions (Vessels)

5.5.1 Hazard

Light emissions will occur for the duration of any vessel-related activities, such as:

- Vessel operations – navigational and vessel deck lighting, kept on 24 hours a day for maritime safety and crew safety purposes; and
- ROV operations – underwater light when submerged to illuminate an area of interest (e.g., the pipeline).

During the activity, the vessel/s will generate light while in the activity area. Lighting is used for marine safety to ensure clear identification of vessels to other marine users and to allow activities to be undertaken 24 hours a day. Spot lighting may also be used on an as-needed basis, for example for a specific task such as ROV inspection, deployment and retrieval. Lighting will typically consist of bright white (i.e., metal halide, halogen, fluorescent) lights, and are not dissimilar to other offshore activities in the region, including fishing and shipping.

5.5.2 Known and Potential Impacts

The known and potential environmental impacts of artificial lighting offshore are:

- Localised light glow that may act as an attractant to light-sensitive species (e.g., seabirds, squid, turtle hatchlings), in turn affecting predator-prey dynamics; and
- Attraction of light-sensitive species during breeding periods (e.g., turtle hatchlings).

EMBA

The EMBA for light emissions associated with vessel activities will be localised based upon the limited low-intensity light sources on-board the vessel.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Fish (e.g., squid); and
- Seabirds.

5.5.3 Evaluation of Environmental Impacts

Localised light glow that may act as an attractant to light-sensitive species

Seabirds may be attracted to vessels at night due to the light glow. Bright lighting can disorientate birds, thereby increasing the likelihood of seabird injury or mortality through collision with infrastructure, or mortality from starvation due to disrupted foraging at sea (Wiese *et al.*, 2001).

Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie *et al.*, 2008) and that lighting can attract birds from large catchment areas (Wiese *et al.*, 2001). The light may provide enhanced capability for seabirds to forage at night. There are no actions within the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-16 (DESWPC, 2011a) that are compromised by light emissions from this project.

Fish and zooplankton may be directly or indirectly attracted to lights. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan *et al.*, 2001), with traps drawing catches from up to 90 m (Milicich *et al.*, 1992). Lindquist *et al.* (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by the platforms' light fields. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. Shaw *et al.* (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas.

There is no evidence to suggest that artificial light sources adversely affect the migratory, feeding or breeding behaviours of cetaceans. Cetaceans predominantly utilise acoustic senses to monitor their environment rather than visual sources (Simmonds *et al.*, 2004), so light is not considered to be a significant factor in cetacean behaviour or survival.

Underwater light from using an ROV is unlikely to cause environmental impacts. While the ROV dives, fauna in different strata of the water column will be exposed to light for only very brief moments, and usually for a few minutes at a time near the seabed where the ROV conducts most of its work. Observations of ROV inspections at the seabed (Pinzone, pers. obs., 2013) indicate that fauna is not negatively impacted by the bright light source, and other than some fauna exhibiting inquisitiveness, fish and other fauna continue to behave normally.

Attraction of light sensitive species during breeding periods

Light pollution along, or adjacent to, turtle nesting beaches poses a particular issue for turtles because it alters critical nocturnal behaviours, particularly the selection of nesting sites and the passage of adult females and emerging hatchlings from the beach to the sea (Limpus, 2009 in DSEWPC, 2011). There are no turtle rookeries along the Otway coast, so lighting will not impact turtle hatchlings.

Impacts to Matters of NES

Light emissions will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the light emissions EMBA. Light emissions will not have any impacts to other areas of conservation significance.

5.5.4 Impact Assessment

Table 5-6 presents the impact assessment for light emissions.

Table 5-6: EIA for light emissions

Aspect:	Vessel Lighting
Impact summary	Localised light glow that may act as an attractant to light-sensitive species (e.g., birds, squid).
Extent of impact	Localised (small radius of light glow around vessel).
Duration of impact	Temporary (short duration of vessel activity).
Level of certainty of impact	HIGH. The impacts of light on light-sensitive species are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.6 IMPACT: Treated Sewage and Grey Water Discharges (Vessels)

5.6.1 Hazard

The use of ablution, laundry and galley facilities by vessel crew will result in the discharge of sewage and grey water. While the number of on-board the vessel/s at any one point in time is currently unknown, this activity is likely to result in the discharge of several hundred litres of treated sewage and greywater each day.

5.6.2 Known and Potential Impacts

The known and potential environmental impact of treated sewage and grey water discharges is:

- Temporary and localised reduction in surface water quality (i.e., increase in the nutrient content) around the vessel/s.

EMBA

The EMBA for sewage and grey water discharges associated with vessel activities is likely to be the top 10 m of the water column and a 50 m radius from the discharge point. This is based on modelling of continuous wastewater discharges (including treated sewage and greywater) undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which found:

- Rapid horizontal dispersion of discharges occurs due to wind-driven surface water currents;
- Vertical discharge is limited to about the top 10 m of the water column due to the neutrally buoyant nature of the discharge; and
- A concentration of a component within the discharge stream is reduced to 1% of its original concentration at no less than 50 m from the discharge point under any condition (Woodside, 2008).

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish; and
- Seabirds.

5.6.3 Evaluation of Environmental Impacts

Sewage discharges will meet the requirements of MARPOL Annex IV. Vessels usually treated sewage/grey water through a sewage treatment plant (STP) to a tertiary level; or if not treated, comminuted and disinfected and discharged from the vessel while en-route at distances greater than 4 nm from shore; or discharged from the vessel while en-route at distances greater than 12 nm from shore.

Nutrients in sewage, such as phosphorus and nitrogen, may contribute to eutrophication of receiving waters (although usually only still, calm, inland waters and not offshore waters), causing algal blooms, which can degrade aquatic habitats by reducing light levels and producing certain toxins, some of which are harmful to marine life and humans. Pathogens are also an issue if ingested (not an issue with STP or comminution and disinfection treatment options).

Grey water (used water from the galley, dishwashers, showers, hand basins and laundry) can contain a wide variety of pollutant substances at different strengths, including oil and some organic compounds, hydrocarbons, detergents and grease, metals, suspended solids, chemical nutrients, food waste, coliform bacteria and some medical waste. Grey water is also treated through the STP, so pollutants would be largely removed from the discharge stream.

The effects of treated sewage and sullage discharges on the water quality at Scott Reef were monitored for a drill rig operating near the edge of the deep-water lagoon area at South Reef. Monitoring at stations 50, 100 and 200 m downstream of the rig and at five different water depths confirmed that the discharges were rapidly diluted in the upper 10 m water layer and no elevations in water quality monitoring parameters (e.g., total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station (Woodside, 2011). Conditions associated with this example at Scott Reef are considered conservative given the high numbers of personnel on-board a drill rig compared with vessels undertaking IMR activities, and the environment much less dispersive than vessels that are in constant movement in Bass Strait.

Discharges of treated sewage and grey water will be rapidly diluted in the surface layers of the water column and dispersed by currents. The biological oxygen demand (BOD) of the treated effluent is unlikely to lead to oxygen depletion of the receiving waters (Black *et al.*, 1994), as it will be treated prior to release. On release, surface water currents will assist with oxygenation of the discharge.

Given the low volumes of the discharges, the treatment of the discharge, the high dilution and dispersal factor, and short discharge period, the risk of treated sewage and grey water discharged from vessels having an adverse effect on marine life is very low (negligible consequence).

Impacts to Matters of NES

The discharge of treated sewage and grey water will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by sewage and grey water discharges. This discharge will not have any impacts to other areas of conservation significance.

5.6.4 Impact Assessment

Table 5-7 presents the impact assessment for treated sewage and grey water discharges.

Table 5-7: EIA for treated sewage and grey water

Aspect:	Vessel Sewage Discharge
Impact summary	Increase in nutrient content of surface waters, which may modify feeding habits of pelagic fish and seabirds.
Extent of impact	Localised (about 10 m vertically and 50 m horizontally).
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of sewage and grey water discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.7 IMPACT: Cooling Water and Brine Discharges (Vessels)

5.7.1 Hazard

Seawater is used as a heat exchange medium for cooling machinery engines on vessels. Brine is created through the vessels desalination processes for potable water generation.

Seawater is used as a heat exchange medium for cooling machinery engines and other equipment. Seawater is drawn up from the ocean, where it is de-oxygenated and sterilised by electrolysis (by release of chlorine from the salt solution) and then circulated as coolant for various equipment through the heat exchangers (in the process transferring heat from the machinery), and is then discharged to the ocean at depth (not at surface). Upon discharge, it will be warmer than the ambient water temperature and may contain low concentrations of residual biocide and scale inhibitors if they are used to control biofouling and scale formation.

The maximum cooling water discharge rate for the vessels that may be used during inspection and maintenance activities is unknown. Also unknown is the temperature at which the heat exchangers are designed to discharge the cooling water at (generally several degrees Celsius above ambient sea temperature).

Brine water (hypersaline water) is created through the desalination process that creates freshwater for drinking, showers, cooking etc. This is achieved through reverse osmosis (RO) or distillation resulting in the discharge of seawater with a slightly elevated salinity (~10-15% higher than seawater). The freshwater produced is then stored in tanks on board. Upon discharge, the concentration of the brine, based on other modern vessels, is likely to range from 44-61 ppt, which is 9-26 ppt higher than seawater salt concentration (35 ppt). Brine concentration is dependent on throughput and plant efficiency, with brine concentrations unable to be determined until sea trials.

5.7.2 Known and Potential Impacts

The known and potential environmental impact of cooling water and brine discharges are:

- Temporary and localised increase in sea water temperature, causing thermal stress to marine biota;
- Temporary and localised increase in sea surface salinity, potentially causing harm to fauna unable to tolerate higher salinity; and
- Potential toxicity impacts to marine fauna.

EMBA

The EMBA for cooling water and brine discharges associated with vessel activities is likely to be the top 10 m of the water column and a 100 m radius from the discharge point.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton; and
- Pelagic fish.

5.7.3 Evaluation of Environmental Impacts

Temporary and localised increase in sea water temperature

Once in the water column, cooling water will remain in the surface layer, where turbulent mixing and heat transfer with surrounding waters will occur. Prior to reaching background temperatures, the impact of increased seawater temperatures down current of the discharge may result in changes to the physiological processes of marine organisms, such as attraction or avoidance behaviour, stress or potential mortality.

Modelling of continuous waste water discharges (including cooling water) undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex found that discharge water temperature decreases quickly as it mixes with the receiving waters, with the discharge water temperature being less than 1°C above background levels within 100 m (horizontally) of the discharge point, and will be within background levels within 10 m vertically (Woodside, 2008).

Temporary and localised increase in sea surface salinity

Brine water will sink through the water column where it will be rapidly mixed with receiving waters, and disbursed by ocean currents. Walker and MacComb (1990) found that most marine species are able to tolerate short-term fluctuations in water salinity in the order of 20-30%, and it is expected that most pelagic species passing through a denser saline plume would not suffer adverse impacts. Other than plankton, pelagic species are mobile and would be subject to slightly elevated salinity levels for a very short time as they swim through the 'plume.'

Potential toxicity impacts

Scale inhibitors and biocide are likely to be used in the heat exchange and desalination process to avoid fouling of pipework. Scale inhibitors are low molecular weight phosphorous compounds that are water-soluble, and only have acute toxicity to marine organisms about two orders of magnitude higher than typically used in the water phase (Black *et al.*, 1994). The biocides typically used in the industry are highly reactive and degrade rapidly and are very soluble in water (Black *et al.*, 1994).

These chemicals are inherently safe at the low dosages used, as they are usually 'consumed' in the inhibition process, ensuring there is little or no residual chemical concentration remaining upon discharge.

Impacts to Matters of NES

The discharge of cooling water and brine will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by cooling water and brine discharges. This discharge will not have any impacts to other areas of conservation significance.

5.7.4 Impact Assessment

Table 5-8 presents the risk assessment for cooling water and brine discharges.

Table 5-8: EIA for cooling water and brine discharges

Aspect:	Cooling water and Brine Discharge
Impact summary	Increase in temperature and salinity of surface waters.
Extent of impact	Localised (about 10 m vertically and 100 m horizontally).
Duration of impact	Temporary (rapid dispersion, dilution and cooling - minutes).
Level of certainty of impact	HIGH. The impacts of cooling water and brine discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.8 IMPACT: Putrescible Waste Discharges (Vessels)

5.8.1 Hazard

The generation of food waste from the vessel galley will result in the discharge of macerated putrescible waste.

It is expected that the average volume of putrescible waste discharged overboard from the vessel will vary depending on the number of Persons on Board (POB) and the types of meals prepared, but would be in the order up to 10 kg/day.

5.8.2 Known and Potential Impacts

The known and potential environmental impacts of putrescible waste discharge are:

- Temporary and localised increase in the nutrient content of surrounding surface waters; and
- Increase in scavenging behaviour of marine fauna and seabirds.

EMBA

The EMBA for putrescible waste discharges associated with vessel activities, given the small intermittent volumes released and the dynamic marine environment is expected to be localised around the discharge point.

As per MARPOL Annex V, putrescible wastes cannot be discharged within 3 Nm from the coastline and so will not be discharged in State Waters.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish; and
- Seabirds.

5.8.3 Evaluation of Environmental Impacts

The overboard discharge of macerated food wastes has the result of creating a localised and temporary increase in the nutrient load of the surface waters. This may in turn act as a food source for scavenging marine fauna or seabirds, whose numbers may temporarily increase as a result. However, the rapid consumption of this food waste by scavenging fauna, and its physical and microbial breakdown, ensures that the impacts of putrescible waste discharges are insignificant.

Impacts to Matters of NES

The discharge of putrescible waste will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by putrescible waste discharges. This discharge will not have any impacts to other areas of conservation significance.

5.8.4 Impact Assessment

Table 5-9 presents the risk assessment for putrescible waste discharges.

Table 5-9: EIA for putrescible waste discharges

Aspect:	Food-scrap discharges from vessel
Impact summary	Increase in nutrient content of surface waters, which may lead to scavenging behaviour of pelagic fish and seabirds.
Extent of impact	Localised around discharge point
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of putrescible waste discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.9 IMPACT: Bilge Water Discharges (Vessels)

5.9.1 Hazard

Bilge tanks receive fluids from closed deck drainage and machinery spaces that may contain contaminants such as oil, detergents, solvents, chemicals and solid waste. An oily water separator (OWS) then treats prior to discharge overboard in order to meet the MARPOL requirement of no greater than 15 ppm oil-in-water (OIW) overboard.

5.9.2 Known and Potential Impacts

The known and potential environmental impacts of the discharge of bilge water discharges are:

- Temporary and localised reduction of surrounding surface water quality; and
- Acute toxicity to marine fauna through ingestion of contaminated water (in the event of malfunction of the OWS).

EMBA

The EMBA for treated bilge discharges associated with vessel activities, given the small intermittent volumes released and the dynamic marine environment is expected to be localised around the release point.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton; and
- Pelagic fish.

5.9.3 Evaluation of Environmental Impacts

Temporary and localised reduction of surface water quality

Small volumes and low concentrations of oily water (<15 ppm) from bilge discharges may temporarily reduce water quality. The bilge water will be rapidly diluted, dispersed and biodegraded to undetectable levels.

Acute toxicity to marine fauna

Small volumes and low concentrations of oily water from bilge discharges may temporarily reduce water quality are not expected to induce acute or chronic toxicity impacts to marine fauna or plankton through ingestion or absorption through the skin.

Impacts to Matters of NES

The discharge of bilge water will not have a ‘significant’ impact to any of the matters of NES applicable to this project

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by bilge water discharges. This discharge will not have any impacts to other areas of conservation significance.

5.9.4 Impact Assessment

Table 5-10 presents the risk assessment for bilge water discharges.

Table 5-10: EIA for treated bilge water discharge

Aspect;	Treated Bilge Water Discharge (Vessel)
Impact summary	Pollution of surface waters. Acute toxicity to marine fauna exposed to pollution.
Extent of impact	Localised (about discharge point).
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of oily water discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.10 RISK: Discharge of Contaminated Deck Drainage (Vessels)

5.10.1 Hazard

The following activities may result in the discharge of contaminated deck drainage water to the ocean:

- Deck washing, ocean spray, ‘green’ water and rain that capture minor contaminants such as oil, grease and detergents on the deck prior to draining overboard; and
- A chemical, oil or grease spill or leak on deck that is washed overboard.

Generally, all deck drains in non-hazardous areas drain directly overboard (and are not routed to the bilge water tank for treatment).

5.10.2 Known and Potential Impacts

The known and potential environmental impacts of the discharge of contaminated deck water discharges are:

- Temporary and localised reduction of surrounding surface water quality; and
- Acute toxicity to marine fauna through ingestion of contaminated water.

EMBA

The EMBA for contaminated deck drainage associated with vessel activities, given the small intermittent volumes released and the dynamic marine environment is expected to be localised around the release point.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton; and
- Pelagic fish.

5.10.3 Evaluation of Environmental Impacts

Temporary and localised reduction of surface water quality

Traces of chemicals discharged to the ocean through open deck drainage and bilge discharges have a very low potential to temporarily reduce water quality and cause physiological damage to marine fauna that may ingest or absorb chemicals. Given the absence of sensitive habitat types in the water column of the EMBA for these discharges, the greatest risk will be to plankton and pelagic fish. Only trace quantities of contaminants would be expected in deck drainage discharges, and these would be rapidly diluted, dispersed and degraded to undetectable levels.

Acute toxicity to marine fauna

Given the very small volumes of such chemicals or hydrocarbons (oil, grease) that may be accidentally discharged overboard, the high rates of dilution and dispersion in the open ocean environment and the temporary nature of vessel activities, it is not expected that these very small quantities of hydrocarbons would induce acute or chronic toxicity impacts to marine fauna or plankton through ingestion or absorption through the skin.

Impacts to Matters of NES

The discharge of deck drainage will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by contaminated deck drainage discharges. This discharge will not have any impacts to other areas of conservation significance.

5.10.4 Risk Assessment

Table 5-11 presents the risk assessment for contaminated deck drainage discharges.

Table 5-11: Risk assessment for contaminated deck drainage discharges

Aspect:	Discharge of deck water (Vessel)
Impact summary	Pollution of surface waters. Acute toxicity to marine fauna exposed to pollution.
Extent of impact	Localised (about discharge point).
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	HIGH. The impacts of oily water discharges on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.11 RISK: Production Chemical Release

5.11.1 Hazard

The following unplanned activity has the potential to result in production chemicals being discharged to the ocean:

- Partial or full failure of the EHU due to:
 - Reverse flow of gas to umbilical (non-return valve failure).
 - Impact:
 - Dropped objects.
 - Anchoring or trawling.
 - Fatigue:
 - Earthquake.
 - Free span.
 - Storm damage.

The maximum volume of product of each chemical held in the EHU is:

- 4 m³ of MEG (including scale inhibitor) (has an 'E' and 'D' non-CHARM OCNS rating respectively);
- 1.3 m³ of methanol (has an 'E' non-CHARM OCNS rating); and
- 6 m³ per core of hydraulic fluid (has a 'D' non-CHARM OCNS rating) (4 cores - 24 m³ total inventory).

5.11.2 Known and Potential Impacts

The known and potential impacts of the release of low-toxicity, highly diluted chemicals (MEG, methanol, corrosion inhibitor and hydraulic fluid) are:

- A temporary and localised reduction in water quality; and
- Toxicity to exposed marine fauna and benthic species.

EMBA

Given the small volumes of chemical released and the rapid dilution which will be experienced in the high energy marine environment of the Otway Basin, the EMBA for chemical release is expected to be localised around the discharge point.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Benthic species including filter-feeding epifauna such as sponges, macroalage and rocky hard substrate species such as bryozoans (water depths > 60 m);
- Pelagic and demersal fish; and
- Plankton.

5.11.3 Evaluation of Environmental Impacts

Temporary and localised reduction of water quality

The low volume of low toxicity chemicals that may be released from the EHU to the ocean has a very low potential to temporarily reduce water quality and cause physiological damage to marine and benthic fauna that may ingest or absorb chemicals. The greatest risk will be to plankton and pelagic fish as the plume of chemicals disperse or to benthic fauna immediate adjacent to the leak site. This limited volume discharge would be rapidly diluted, dispersed

and degraded rapidly to undetectable levels rapidly in the dispersive Otway marine environment.

Toxicity to marine fauna

EHU: The low environmental toxicity of each chemical in the EHU, combined with their low concentrations, small volumes and the action of rapid dispersion and dilution in the open ocean will ensure no acute or chronic toxicity impacts to marine or benthic fauna or plankton through ingestion or absorption (negligible consequence).

Impacts to Matters of NES

The discharge of production chemicals will not have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by a production chemical discharge. This discharge will not have any impacts to other areas of conservation significance.

5.11.4 Risk Assessment

Table 5-12 presents the risk assessment for an unplanned production chemical release.

Table 5-12: ERA for unplanned production chemical release

Aspect:	Production Chemical Release
Impact summary	Marine pollution, potentially leading to impacts to marine and benthic fauna.
Extent of impact	Localised around release site
Duration of impact	Temporary (rapid dispersion and dilution – hours).
Level of certainty of impact	HIGH. The impacts of production chemicals on the marine environment are well studied.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP demonstrated via compliance with legislation, codes and standards; adoption of good industry practice and application of professional judgement</i>

5.12 RISK: Displacement of Third-Party Vessels

5.12.1 Hazard

The physical presence of a vessel/s undertaking IMR activities may have an adverse effect on third-party vessel operators, such as commercial fishing vessels and commercial shipping (noting that vessel presence for maintenance activities will be a rare occurrence).

Note that this section deals with interference in a socio-economic sense; collision hazard (and consequent diesel spill impacts) is addressed in Section 3.7.3.

Also note that interference with commercial and/or recreational divers and swimmers is not considered credible because:

- Divers – there are no recognised dive sites in the immediate vicinity of the assets.
- Swimmers – the assets are located too far from the shore.

The CHN assets are located on the northern extremity of commercial shipping lanes.

5.12.2 Known and Potential Impacts

The known and potential impacts of interference with commercial fishing vessels are:

- Displacement/disruption to transiting commercial shipping (route deviation);
- Damage to or loss of fishing equipment; and

- Loss of commercial fish catches.

EMBA

The EMBA for interference with third-party vessels is likely to be the immediate area around the two interacting vessels or fishing equipment.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Commercial fish species;
- Fishing equipment; and
- Third-party vessels.

5.12.3 Evaluation of Environmental Impacts

Disruption to third-party vessels

Vessels undertaking IMR activities will potentially exclude other third party marine users during the activity on the CHN pipeline.

The consequence of displacing other users is considered negligible given the low usage of the area by fishermen and the location of the CHN assets at the northern extremity of commercial shipping areas. It is relevant to note that in the initial placement of the CHN pipeline, the corridor considered and minimised alignment with lobster fishing areas.

Other fisheries which may be present in the CHN asset area are the Victorian wrasse and snapper fishery; the Commonwealth trawl sector and shark gillnet fishery. Fishing intensity plots for the Commonwealth fisheries identify that they have a low presence in the area. Fishing intensity for state fisheries could not be obtained.

On the basis of this available information, while disruption is possible (minor consequence), with awareness controls implemented, disruption is considered remote.

In the event of spatial conflict the worst-case outcome is a collision. Should the force of a collision be enough to breach a vessel hull (which is unlikely to the low speed or stationary nature of a support vessel undertaking IMR activities), a diesel spill may eventuate (this is addressed in Section 5.18).

Damage to or loss of fishing equipment and loss of catch

Consultation with relevant fishers since the gas fields have become operational has revealed no material concerns regarding the minor loss of area available to commercial fishing.

Interactions between the IMR vessel/s and other vessel traffic is likely to be minimal, mostly because of the slow moving and stationary nature of the IMR vessel, its high visibility (due to size and navigational warnings) and ease of manoeuvrability to avoid a collision. Due to this visibility, it is also unlikely that fishing gear (such as lobster pots or trawl nets) would be damaged, as fishing vessels would detour around the IMR vessel/s once communication between the vessels is made.

Given the short duration of each IMR campaign, the risk of damage to fishing equipment and loss of catch (negligible consequence) is considered unlikely.

Impacts to Matters of NES

The potential interference with third-party vessels will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA for potential interference with third-party vessels. This activity will not have any impacts to other areas of conservation significance.

5.12.4 Risk Assessment

Table 5-13 presents the risk assessment for interference with third-party vessels.

Table 5-13: ERA for displacement of third-party vessels

Aspect:	IMR Vessel Presence
Impact summary	Vessel collision, vessel navigation disruptions, exclusion from commercial fishing grounds, loss of commercial fish catches.
Extent of impact	Highly localised (immediate area around vessels).
Duration of impact	Short-term (minutes to hours for a third-party vessel detour).
Level of certainty of impact	HIGH. Impacts associated with commercial fishing and shipping in the area is well understood. Measures implemented have been and will continue to be effective in mitigating this risk.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.13 RISK: Introduction of Invasive Marine Species

5.13.1 Hazard

The following activity has the potential to result in the introduction of IMS around the CHN assets:

- Discharge of vessel ballast water containing foreign species;
- Translocation of foreign species through biofouling of the vessel hull, niches (e.g., sea chests, bilges, strainers); or
- ROV equipment.

While on location, the vessel/s may ballast and de-ballast to improve stability, even out vessel stresses and adjust vessel draft, list and trim, with regard to the weight of equipment on board at any one time. The Commonwealth Biosecurity department indicates that ballast water is responsible for 20-30% of all marine pest incursions into Australian waters (DAWR, 2015a). The DAWR (formerly AQIS) declares that all saltwater from ports or coastal waters outside Australia's territorial seas presents a high risk of introducing foreign marine pests into Australia (AQIS, 2011).

Biofouling is the accumulation of aquatic micro-organisms, algae, plants and animals on vessel hulls and submerged surfaces. More than 250 non-indigenous marine species have established in Australian waters, with research indicating that biofouling has been responsible for more foreign marine introductions than ballast water (DAWR, 2015b).

5.13.2 Known and Potential Impacts

The known and potential impacts of IMS introduction (assuming their survival, colonisation and spread) include:

- Reduction in native marine species diversity and abundance;
- Displacement of native marine species;
- Socio-economic impacts on commercial fisheries; and
- Changes to conservation values of protected areas.

EMBA

The EMBA for IMS introduction is the site of the vessel, though this can increase to widespread suitable environments if colonisation occurs.

Receptors within the EMBA

Receptors most at risk within this EMBA, either as residents or migrants, are:

- Benthic species (because their ability to move to other suitable areas is more restricted than demersal and pelagic species);
- Filter-feeding epifauna (e.g. sponges, macro-algae and rocky hard substrate species such as bryozoans (water depths > 60 m)).

5.13.3 Evaluation of Environmental Impacts

Successful IMS invasion requires the following three steps:

1. Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
2. Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., project area).
3. Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

IMS are likely to have little or no natural competition or predation, thus potentially outcompeting native species for food or space, preying on native species or changing the nature of the environment. It is estimated that Australia has over 250 established marine pests, and it is estimated that approximately one in six introduced marine species becomes pests (DoEE, 2017b).

Marine pest species can also deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia's fishing industry being potentially vulnerable to marine pest incursion. For example, the introduction of the Northern Pacific seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries (DSE, 2004). Marine pests can also damage marine and industrial infrastructure, such as encrusting jetties and marinas or blocking industrial water intake pipes. By building up on vessel hulls, they can slow the vessels down and increase fuel consumption.

Contracted vessels for IMR activities are likely to be sourced from within Australia (typically Victoria) but if international vessels are contracted they will be required to be compliant with Australian quarantine entry requirements as detailed in Table 5-14.

As part of vessel contractor pre-selection, vessel contractor's mobilising vessels from international locations or domestic vessels mobilising from ports outside the IMCRA Otway bioregion, the contractor will undertake an IMS risk assessment in accordance with the Biofouling Risk Assessment Tool developed by the WA Department of Fisheries (or equivalent assessment tool) to ensure that the risk of IMS introduction is low.

The Victorian Environment Protection (Ships Ballast Water) Regulations 2006 protects Victorian territorial seas (to 12 nm from the Victorian coastline) from discharges of high risk domestic ballast water to ensure the risk of IMS introduction is low. Domestic ballast water is ballast that originates from Australian ports or from territorial seas (to 12 nm of coastline) within Australia. Approval from the Victorian EPA is required to discharge any domestic ballast water anywhere within Victorian territorial seas. This includes, but is not limited to domestic ballast water discharges in Victorian ports.

Impacts to Matters of NES

The introduction (and possible colonisation and spread) of IMS will not have a 'significant' impact to any of the matters of NES applicable to this project

Impacts to other areas of Conservation Significance

The introduction, colonisation and spread of IMS may impact on areas of conservation significance, as outlined in the box below.

KEFs (Bonney Upwelling / Shelf Rocky Reefs and Hard Substrates)	Nationally Important Wetlands	State Marine Parks	Coastal protected areas
X / ✓	X	✓	X
The spread of IMS into the KEF would have no effect on the Bonney upwelling. The spread of IMS may have impact on biodiversity of non-location specific rocky reef and hard substrate areas	Marine IMS are unlikely to spread to and survive within fresh-water or brackish coastal wetlands.	The diverse benthic communities of The Arches Marine Sanctuary may be at risk of IMS spread (2.8 km east of pipeline) (see Section	Coastal protected areas are likely to be outside the influence of marine IMS.

5.13.4 Risk Assessment

Table 5-14 presents the risk assessment for the introduction of IMS.

Table 5-14: ERA for the introduction of IMS.

Aspect:	Vessel Activity (biofouling and ballast discharge)
Impact summary	Predation of native marine species and the possible loss of diversity and abundance of native marine species.
Extent of impact	Localised (isolated locations around the assets if there is no spread) to widespread (if colonisation and spread occurs).
Duration of impact	Short-term (IMS is detected and eradicated, or IMS does not survive long enough to colonise and spread) to long-term (IMS colonises and spreads).
Level of certainty of impact	HIGH: Impacts associated with IMS introduction have been extensively studied and the vectors of introduction established. Corresponding regulatory guidelines controlling these vectors have been established. The oil and gas industry takes a precautionary approach to IMS introduction by its adoption of all relevant Government Guidelines.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well-understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.14 RISK: Vessel Strike with Megafauna

5.14.1 Hazard

The movement of vessels undertaking IMR activities has the potential to result in collision with megafauna, this being cetaceans and pinnipeds.

5.14.2 Known and Potential Impacts

The known and potential impacts of vessel strike to air-breathing marine megafauna are:

- Injury; and
- Death.

EMBA

The EMBA for vessel strike with air-breathing marine megafauna is the immediate area of the vessel.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Cetaceans (whales and dolphins); and
- Pinnipeds.

5.14.3 Evaluation of Environmental Impacts

Cetaceans and pinnipeds are naturally inquisitive marine mammals that are often attracted to offshore vessels, and dolphins commonly 'bow ride' with offshore vessels. The reaction of whales to the approach of a vessel is quite variable. Some species remain motionless when in the vicinity of a vessel (e.g., narwhals) while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson *et al.*, 1995).

Peel *et al.* (2016) reviewed vessel strike data (2000-2015) for marine species in Australian waters and identified the following:

- Whales including the humpback, pygmy blue, Antarctic blue, southern right, dwarf minke, Antarctic minke, fin, bryde's, pygmy right, sperm, pygmy sperm and pilot species were identified as having interacted with vessels. The humpback whale exhibited the highest incidence of interaction followed by the southern right whale. Several these species may migrate through the waters of the CHN assets.
- Dolphins including the Australian humpback, common bottlenose, indo-pacific bottlenose and Risso's dolphin species were also identified as interacting with vessels. The common bottlenose dolphin exhibited the highest incidence of interaction. Several these species may reside in or pass through the waters of the CHN assets.
- There were no vessel interaction reports during the period for either the Australian or New Zealand fur seal. There have been incidents of seals being injured by boat propellers, however all indications are rather than 'boat strike' these can be attributed to the seal interacting/playing with a boat, with several experts indicating the incidence of boat strike for seals is very low.
- All turtle species present in Australian waters are identified as interacting with vessels. The green and loggerhead species exhibited the highest incident of interaction. The presence of turtles around the CHN assets is considered remote.

Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat coincide (WDCS, 2006). There have been recorded instances of cetacean deaths in Australian waters (e.g., a Bryde's whale in Bass Strait in 1992) (WDCS, 2006), though the data indicates this is more likely to be associated with container ships and fast ferries. The Whale and Dolphin Conservation Society (WDCS) (2006) also indicates that some cetacean species, such as humpback whales, can detect and change course to avoid a vessel. The Australian National Marine Safety Committee (NMSC) reports that during 2009, there was one report of a vessel collision with an animal (species not defined) (NMSC, 2010).

The DoE (2015) reports that there was two blue whale strandings in the Victoria in the Bonney Upwelling with suspected ship strike injuries visible.

When the vessels are stationary or slow moving, the risk of collision with cetaceans is extremely low, as the vessel sizes and underwater noise 'footprint' will alert cetaceans to its presence and thus illicit avoidance.

Laist *et al* (2001) identifies that larger vessels moving in excess of 10 knots may cause fatal or severe injuries to cetaceans with the most severe injuries caused by vessels travelling faster than 14 knots. Vessels undertaking IMR activities will either be travelling very slowly or be stationary, thus minimising the risk of injury to cetaceans and pinnipeds.

Impacts to Matters of NES

Vessel strike with megafauna will not have a 'significant' impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by vessel strike with megafauna. This risk will not have any impacts to other areas of conservation significance.

5.14.4 Risk Assessment

Table 5-15 presents the risk assessment for vessel strike with air-breathing marine megafauna.

Table 5-15: ERA for vessel strike to megafauna

Aspect:	Vessel strike to megafauna
Impact summary	Injury or death of cetaceans and/or pinnipeds.
Extent of impact	Limited to individuals coming into contact with the vessel.
Duration of impact	At a population level, impact is considered short-term
Level of certainty of impact	HIGH. Injury may result in the reduced ability to swim and feed. Serious injury may result in death. Impacts from cetacean and pinniped strikes have been studied and the impacts are well documented resulting in the new draft strategy document.
Impact decision framework context	A (nothing new or unusual, represents business as usual, well understood activity, good practice is well defined). <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.15 RISK: Accidental Release of Waste Overboard

5.15.1 Hazard

The handling and storage of materials and waste on board a vessel has the potential for accidental overboard disposal of hazardous and non-hazardous materials and waste.

Small quantities of hazardous and non-hazardous materials will be used and waste created, and then handled and stored on the vessel/s. In the normal course of operations, solid and liquid hazardous and non-hazardous materials and wastes will be stored on the vessel until it is disposed of via port facilities for disposal at licensed onshore facilities. However, accidental releases to sea are a possibility, especially in rough ocean conditions when items may roll off or be blown off the deck.

The following non-hazardous materials and wastes will be disposed of to shore, but have the potential to be accidentally dropped or disposed overboard due to overfull bins or crane operator error:

- Paper and cardboard;
- Wooden pallets;
- Scrap steel, metal, aluminium, cans;
- Glass; and
- Plastics.

The following hazardous materials may be used and waste generated through the use of consumable products and will be disposed to shore, but may be accidentally dropped or disposed overboard:

- Hydrocarbon-contaminated materials (e.g., oily rags, pipe dope, oil filters);
- Batteries, empty paint cans, aerosol cans, fluorescent tubes, printer cartridges;
- Contaminated personal protective equipment (PPE); and
- Acids and solvents (laboratory wastes).

5.15.2 Known and Potential Impacts

The known and potential impacts of the release of accidental disposal of hazardous and non-hazardous materials and waste to the ocean are:

- Marine pollution (litter and a temporary and localised reduction in water quality);
- Injury and entanglement of marine fauna and seabirds; and
- Smothering or pollution of benthic habitats.

EMBA

The EMBA for accidental disposal of hazardous and non-hazardous materials and waste may possibly extend for kilometres from the release site (as buoyant waste drifts with the currents) or localised for non-buoyant items that drop to the seabed.

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Benthic species and habitat;
- Pelagic fish;
- Pinnipeds; and
- Seabirds and shorebirds.

5.15.3 Evaluation of Environmental Impacts

Hazardous Materials and Waste

Hazardous materials and wastes released to the sea cause pollution and contamination, with either direct or indirect effects on marine organisms. For example, chemical spills can impact on marine life from plankton to pelagic fish communities, causing physiological damage through ingestion or absorption through the skin. Impacts from an accidental release would be limited to the immediate area surrounding the release, prior to the dilution of the chemical with the surrounding seawater. In an open ocean environment such as the CHN assets, it is expected that any minor release would be rapidly diluted and dispersed, and thus temporary and localised.

Solid hazardous materials, such as paint cans containing paint residue, batteries and so forth, would settle on the seabed if dropped overboard. Over time, this may result in the leaching of hazardous materials to the seabed, which is likely to result in a small area of substrate becoming toxic and unsuitable for colonisation by benthic fauna. Given the size of materials release it is expected that only very localised impacts to benthic habitats across the pipeline alignment would be affected and unlikely to contribute to a significant loss of benthic habitat or species diversity.

All hazardous waste will be disposed at appropriately licensed facilities, by licenced contractors, so impacts such as illegal dumping or disposal to an unauthorised onshore landfill that is not properly lined are unlikely to result from the project.

Non-hazardous Materials and Waste

Discharged overboard, non-hazardous wastes can cause smothering of benthic habitats as well as injury or death to marine fauna or seabirds through ingestion or entanglement (e.g., plastics caught around the necks of seals or ingested by seabirds and fish). For example, the TSSC (2015a) reports that there have been 104 records of cetaceans in Australian waters impacted by plastic debris through entanglement or ingestion since 1998 (humpback whales being the main species).

If dropped objects such as bins are not retrievable by ROV, these items may permanently smother very small areas of seabed, resulting in the loss of benthic habitat. However, as with most subsea infrastructure, the items themselves are likely to become colonised by benthic fauna over time (e.g., sponges) and become a focal area for sea life, so the net environmental

impact is likely to be neutral. This would affect extremely localised areas of seabed and would be unlikely to contribute to the loss of benthic habitat or species diversity.

Impacts to Matters of NES

The accidental disposal of hazardous and non-hazardous materials and waste to the ocean will not have a ‘significant’ impact to any of the matters of NES applicable to this project

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by accidental disposal of hazardous and non-hazardous materials and waste to the ocean. This discharge will not have any impacts to other areas of conservation significance.

5.15.4 Risk Assessment

Table 5-16 presents the risk assessment for accidental disposal of hazardous and non-hazardous materials and waste overboard.

Table 5-16: ERA for accidental disposal of waste overboard

Aspect:	Release of solid/non-hazardous water overboard to the marine environment
Impact summary	Localised decrease in water quality with possible toxicity impacts to marine biota (e.g. fish plankton). Injury or damage to individual marine fauna through ingestion of plastics. Localised seabed smothering or contamination by non-buoyant solid hazardous waste.
Extent of impact	In general, localised impacts around point of discharge. Non-buoyant waste may sink to the seabed near where it was lost. Buoyant waste may float long distances with ocean currents and winds.
Duration of impact	Short-term (water quality impact). Longer term (seabed smothering, species ingestion).
Level of certainty of impact	HIGH. Impacts from waste disposal overboard (particularly plastics) has been well studied and documented. This is verified through the production of regulatory guidelines for threat abatement from marine debris.
Impact decision framework context	A. Nothing new or unusual, represents business as usual, well understood activity, good practice is well defined. <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.16 RISK: Equipment Loss to the Marine Environment

5.16.1 Hazard

IMR activities utilise ROVs to undertake visual inspections of subsea facilities. This equipment or vessel equipment utilised in IMR activities may be dropped overboard or lost to the environment during IMR activities.

5.16.2 Known and Potential Impacts

The known and potential impacts of equipment loss to the environment are:

- The presence of a marine hazards leading to impacts on third party vessels or equipment (e.g. fishing nets);
- Benthic habitat impacts through physical contact (refer Section 5.1).

EMBA

The EMBA for equipment loss is likely to be highly localised (non-buoyant materials) or may extend for kilometres from the release site (for buoyant or neutrally buoyant materials).

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Benthic species and habitat; and

- Pelagic species (fish, pinnipeds, cetaceans).

5.16.3 Evaluation of Environmental Risk

It is possible that during the use of ROVs during survey activities, the control umbilical is caught in the IMR vessel propeller and severed. In such an event the ROV would drift (in neutrally buoyant) or sink to the seabed smothering the benthos within its footprint (typically small footprint).

In the event of seabed contact impacts to benthic species would be very localised (negligible consequence). With control measures adopted to prevent the loss of equipment it is considered unlikely this event would occur and the risk is assessed as LOW.

Neutrally buoyant equipment can present a hazard to other marine users which operate in the area (e.g., fishermen). Collision with equipment may cause damage to fishing vessels/ equipment with damage estimated at <\$5M (negligible consequence). Again, with control measures adopted, it is considered unlikely this event would occur and the risk is assessed as LOW.

Impacts to Matters of NES

Dropped equipment and materials to the marine environment will not have a 'significant' impact to any of the matters of NES applicable to this project,

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by lost equipment to the marine environment. This incident will not have any impacts to other areas of conservation significance.

5.16.4 Environmental Risk Assessment

Table 5-17: Equipment loss to the environment ERA

Aspect	Release of equipment to the marine environment
Impact summary:	Marine hazard causing potential damage to third party vessels. Localised benthic habitat disturbance.
Extent of impact:	Localised if lost to seabed. Possible to drift long distances if neutrally buoyant.
Duration of impact:	Short-term (equipment retrieved). Longer term (equipment lost)
Level of Certainty of Impact:	HIGH: Equipment loss during surveys has occurred within the industry with causal factors well understood and controls developed to prevent loss. Impacts within the affected environment can be reasonably derived.
Uncertainty: Impact Decision Framework	A: Nothing new or unusual; represents business as usual; well understood activity; good practice well defined. <i>ALARP to be demonstrated on adherence to legislation, industry codes and good professional judgement</i>

5.17 RISK: Gas Condensate Loss of Containment

5.17.1 Hazard

A release of hydrocarbons (Netherby condensate which is representative of condensate from the CHN assets as per Section 2.2) may occur from the CHN assets due to several reasons as identified in the CHN Environmental Impact and Risk Register (CHN-EN-RAS-0001). These include:

- Pipeline leaks:

- Gasket failure.
- Valve body failure.
- Dropped objects.
- Anchoring or trawling.
- Internal and external corrosion.
- Pipeline ruptures:
 - Earthquake.
 - Gasket failure.
 - Valve body failure.
 - Failure of flange studs.
 - Internal and external corrosion.
 - Pipeline fatigue due to free span.
 - Storm damage.
 - Impact damage from dropped objects, anchoring or fish trawling.

These hazards were identified during the design of the asset. As such the pipelines and wellheads have been designed to withstand or protect against foreseeable threats such as trawling, snagging (e.g. wellhead/PLEM protective structures) and corrosion.

The CHN Pipeline Safety Case details the design of the pipeline and how it is maintained to ensure its ongoing integrity. A summary of these aspects is detailed in Section 2.2.2).

Maximum Hydrocarbon Releases

An assessment of the maximum credible release rates from the CHN assets has been undertaken by Cooper Energy based upon known reservoir conditions, pipeline inventories during normal operation and possible failure modes of the infrastructure. The following maximum credible scenarios were identified:

- Pipeline Release Inventory:

The maximum hydrocarbons liquids retention within the CHN pipeline has been estimated at 100 m³. This is based upon flow assurance studies (Santos, 2016) and fluid modelling studies (Santos, 2010) on the CHN pipeline.

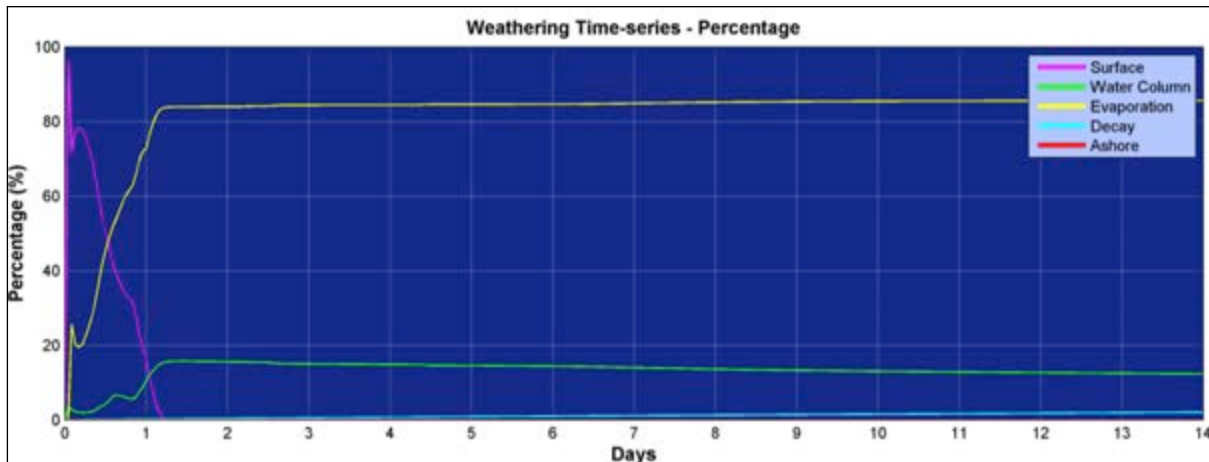
In a pipeline rupture situation, on sensing a low-low pressure downstream of the production choke valves the MCS will trip individual wells and shutdown the SSSV almost immediately. Additionally, in a rupture situation, it is unlikely the full pipeline inventory will be released given the seabed hydrostatic pressure present of 200-700 kPa(g) (or 20-70 m water depth).

Weathering Behaviour of Netherby-1 Condensate:

Figure 5-1 provides details on the weathering characteristics of Netherby condensate for a pipeline release of 100 m³ over a 24-hour period. As identified in this figure, the condensate rapidly evaporates on release such that surface residues are only present a few hours after the release ceases.

Simulations undertaken for the gas plume from a well failure indicated that due to the high gas to condensate ratio (~500,000:1) in the hydrocarbon released a highly turbulent gas plume would develop within 9 seconds following the well failure at the seabed. Condensate liquids within the gas plume will get substantial lift through the 62-m water column, liberating water-soluble aromatics and entrained oil droplets in the order of tens to hundreds of microns in diameter in near-surface waters (i.e. top 5 m) (APASA, 2013).

Figure 5-1: Predicted weathering and fate graph of Netherby Condensate based upon a 100 m³ subsea release over 24 hours (APASA, 2013).



Thresholds utilised within the 2013 OSTM adopted industry standard thresholds of 10ppb (99% species protection); 100ppb (95% species protection) and 400 ppb (50% species protection). Cooper Energy has adopted the more robust OSPAR (2012) toxicity criteria for entrained phase oil effect levels – 70.5 ppb (95% species protection) and 804 ppb (50% species protection) and utilised the work by Tsvetnenko (1998) published in ANZECC (2000) of 7ppb (99% species protection) for the predicted no effects concentration (PNEC) of hydrocarbons in marine waters.

The hydrocarbon thresholds utilised for impacts assessment purposes together with their justification is provided in Table 5-18.

Table 5-18: Hydrocarbon thresholds for impacts assessment purposes

Threshold	Supporting Literature
SEA SURFACE OILING	
LOW: 0.5-10 g/m ² (0.5-10µm)	This threshold provides a measure of visual extent of an oil slick on the surface and while the threshold is not at a level which measures ecological impacts, it does define a threshold of 'community concern' particularly around high tourism areas. Threshold has been selected to define socio-economic impacts and the surface oil EMBA.
MODERATE: 10 - 25 g/m ² (10 - 25µm)	Minimum thickness of oil that could impart a lethal dose to wildlife that comes into contact with surface hydrocarbons. Research has shown that harm to seabirds through preening contaminated feathers or loss of thermal protection in their feathers occurs at 10µm to 25µm (French-McCay, 2009). Threshold has been selected to define ecological impacts
HIGH: > 25 g/m ² (> 25µm)	A concentration of surface oil greater than 25 g/m ² is expected to be harmful to marine birds that come in contact with the slick. Marine birds may be affected should they come into direct contact with the hydrocarbon, and mortality may result from ingestion during preening, or from hypothermia from matted feathers.
SHORELINE OILING²	
OIL STAIN/FILM: 10-100 g/m ²	A conservative threshold to assess the potential for socioeconomic impact such as the need for shoreline clean-up on man-made features/amenities. Thresholds below 100g/m ² are considered to 'stain' shoreline fauna and are not considered to impact the species survival and reproductive capacity (French-McCay, 2009).

² Note the Santos 2013 modelling defined low level exposure at 1-10g/m²; moderate level exposure at 10-25g/m², and high exposure at >25g/m². Exposures within this assessment utilise the new threshold values.

Threshold	Supporting Literature
OIL COAT: 100-1000 g/m ²	<p>Threshold is considered enough to coat shoreline animals and likely impact their survival and reproductive capacity (French-McCay, 2009). Thus 100 g/m² (approximately equivalent to 100 µm) is considered the ecological threshold for impacts to invertebrates living on hard substrates (rocky, artificial/man-made, rip-rap, etc.) and sediments (mud, silt, sand or gravel) in intertidal habitats. French-McCay (2009) based on the work of Albers (1980) identifies a 100µm as having a significant potential to affect the survivability and breeding success of protected shoreline birds while a reduction to 50µm identified no significant reduction in hatchling success.</p> <p>Threshold is also recommended in AMSA's foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and is best remediated by natural coastal processes alone (AMSA, 2007).</p> <p><i>Threshold has been selected to define ecological impacts</i></p>
OIL COVER: > 1000 g/m ²	<p>More than 1,000 g/m² of oil during the growing season would be required to impact marsh plants. Similar thresholds have been found in studies assessing oil impacts on mangroves. Threshold is representative of higher level ecological impacts (i.e. ecosystem wide impacts).</p>
DISSOLVED AROMATIC HYDROCARBONS	
<p>LOW EXPOSURE (6 ppb – 96Hr LC₅₀): 576 ppb-hrs Very Sensitive Species (99% species protection)</p>	<p>French-McCay (2002) undertook a global review of available ecotoxicity data for multiple species across a wide taxonomic range to estimate the magnitude of toxicity effects to marine biota. This included 115 fish species, 129 crustacean species and 34 other invertebrate species which were predominantly derived from species at their most sensitive early life stages (i.e. eggs, larvae and juveniles). As early life stages are more sensitive than adults, results of the review represent conservative values.</p> <p>The outcomes of the review established lethal effects concentrations to fish and invertebrates (LC₅₀) from dissolved aromatic hydrocarbons over a period of 96hrs, under different environmental conditions. Concentrations varied from 6ppb to 400ppb with an average of 50ppb for Poly-aromatic Hydrocarbon (PAH) components. On this basis, LC₅₀ values of 6ppb (99% species protection); 50ppb (95% species protection) and 400ppb (50% species protection) represent the range of exposures which could elicit a toxic response.</p>
<p>MODERATE EXPOSURE (50 ppb – 96Hr LC₅₀): 4,800 ppb-hrs Average sensitive species (95% species protection)</p>	
<p>HIGH EXPOSURE (400 ppb – 96Hr LC₅₀): 38,400 ppb-hrs Tolerant species (50% species protection)</p>	
ENTRAINED PHASE HYDROCARBONS	
<p>LOW EXPOSURE (7 ppb – 96Hr LC₅₀): 672 ppb-hrs Very Sensitive Species (99% species protection)</p>	<p>The Predicted No Effects Concentration (PNEC) (1% affected fraction) accords with the 'trigger value' of 7ppb (Total Petroleum Hydrocarbon (TPH)) (99% species protection) (ANZECC, 2000) derived by Tsvetnenko (1998). This acts as conservative estimate of TPH water quality criteria to protect aquatic biota at constant discharge rates to the environment.</p> <p><i>This threshold has been selected to define the entrained phase EMBA.</i></p>
<p>MODERATE EXPOSURE (70.5 ppb – 96Hr LC₅₀): 6768 ppb-hrs Average sensitive species (95% species protection)</p>	<p>Scholten et al (1993; cited in Smit et al, 2008) undertook a review of No Observable Effects Concentrations (NOECs) for 26 marine organisms exposed to several types of oils. All test exposures focussed on whole-organism effects (reproduction, growth and survival) and test exposure times exceeded 7 days to represent chronic exposure of 17 marine species from five taxonomic groups. A species sensitivity distribution (SSD) curve was constructed based upon these chronic NOECs, and Predicted No Effects Concentration (PNEC) or Hazardous Concentration (HC5) of 70.5 ppb (THC) (95% species protection) and HC50 of 804ppb (50% species protection) were determined.</p> <p><i>The HC5 based upon chronic NOECs serves as the threshold for the protection of ecological structure, which is considered more sensitive than ecosystem functioning.</i></p> <p>As identified in OSPAR (2012), the HC5 (or PNEC) is considered the maximum continuous (chronic) concentration level for total hydrocarbons in Produced Formation Water discharges in the North Sea, one of the most concentrated areas in the world for oil and gas production. This 'threshold' approach is considered representative of 'weathered' entrained MDO in the water column, given the low level of aromatics within the fuel, the rapid evaporation of lighter ends on release (surface) and water-washing of entrained hydrocarbons within the marine environment in the first 24hrs.</p>
<p>HIGH EXPOSURE (804 ppb – 96Hr LC₅₀): 77,184 ppb-hrs Tolerant species (50% species protection)</p>	

Table 5-19: Condensate spill modelling summary results

	Pipeline leak (5 mm hole @ 3,500 kPa)	Pipeline rupture (300 mm [pipeline diameter] @ 3,500 kPa)
Low exposure	92% chance of shoreline contact (5 km section of shore), taking 1 hour to reach the shore, with a maximum stranding volume of 0.5 m ³ . This exposure zone would remain concentrated within an 18 km radius of the release site and a 6 km section of coastline	No visible hydrocarbons after 7 hours. Concentrated within a 2.75 km distance (ENE) of the release point with a 5% chance of shoreline contact, taking 1 hour to reach the shore, resulting in a maximum stranding volume of 1.25 m ³
Moderate exposure	No moderate zones predicted for this scenario.	Concentrated within a 1.2 km distance (ENE) of the release point with a 5% chance of shoreline contact, taking 1 hour to reach the shore, resulting in a maximum stranding volume of 1.25 m ³ .
High exposure	No high zones predicted for this scenario.	Concentrated within a 0.5 km distance (in any direction) of the release point.
DISSOLVED PHASE		
Low exposure	No exposure of any meaningful level.	Extends up to 9.3 km from the release site, with shoreline contact.
Moderate exposure	No exposure of any meaningful level.	Extends up to 3.3 km from the release site, with shoreline contact
High exposure	No exposure of any meaningful level.	No exposure of any meaningful level. Exposure to marine parks.
ENTRAINED PHASE		
Low exposure	Exposure zone extends for 4.2 km around HDD point.	A high (64%) probability of exposure at Port Campbell, with moderate probabilities at Bay of Islands (26%), Moonlight Head (30%) and Twelve Apostles Marine National Park (35%) Maximum travel distance of 37 km.
Moderate exposure	No moderate zones predicted	Low risk of exposure at Childers Cove and Bay of Island (1%), a 3% probability of exposure at Moonlight Head, 8% at the Twelve Apostles Marine National Park and a 31% probability of exposure at Port Campbell. Maximum travel distance of 9 km.
High exposure	No high exposure zones predicted.	Extends to 3 km east of the release point with a 3% chance of shoreline contact at Port Campbell.
SHORELINE		
Low exposure	No exposure above threshold.	Exposure between Port Campbell and Shelley Beach (1% probability).
Moderate exposure	No exposure.	Isolated exposure between Shelley Beach and Port Campbell (1% probability).
High exposure	No exposure.	No exposure.

5.17.2 Known and Potential Impacts

The known and potential environmental impacts of a large gas condensate spill are:

- Temporary and localised reduction of surface and water column quality;
- Injury or death of marine fauna (from physical smothering, ingestion and inhalation);
- Shoreline pollution; and
- Coastal habitat degradation

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic and demersal fish;
- Benthic species and filter-feeding epifauna;
- Marine mammals (cetaceans and pinnipeds);
- Seabirds and shorebirds;
- Tourism;
- Commercial fishing.

Habitat that may occur within this EMBA which support these species includes:

- Sandy beaches;
- Rocky shoreline;
- Submerged shelf rocky reefs and hard substrate;
- Macro-algal and seagrass beds; and
- Open water.

Protected areas or features that occur within the EMBA are:

- The Arches Marine Sanctuary;
- The Twelve Apostles Marine National Parks;
- The Port Campbell National Park;
- The Bay of Islands Coastal Park;
- Sub-tropical and Temperate Coastal Saltmarsh; and
- Giant Kelp Marine Forests of SE Australia TEC.

A summary of receptors, their locations within the CHN condensate EMBA and the type of exposure is provided in **Error! Reference source not found.**

5.17.3 Evaluation of Environmental Impacts

The sensitivity of the receptors listed in these tables is defined as per Table 5-20 below.

Please note that the impact assessment presented in this section is as specific to light hydrocarbons (i.e., gas condensate) as possible. However, the available literature generally lacks specific information regarding the impacts of condensate, and as such the impacts of hydrocarbons in general are discussed where specific information about condensate is not available.

Table 5-20: Sensitivity Criteria for receptors within the EMBA

Sensitivity	Code	Criteria
High	S1	<p>Identified marine sanctuary or reserve.</p> <p>Presence of known threatened species feeding, breeding, nesting or congregation areas.</p> <p>Areas of national significance or biological processes for species of national significance (e.g. breeding sites and National and State Parks, Commonwealth Heritage listed areas)</p> <p>Region of known sensitive habitat (mangrove, salt marshes, and sheltered tidal flats) which if impacted may have significant impacts and long recovery periods.</p>

Sensitivity	Code	Criteria
Medium	S2	<p>Region of known moderately sensitive habitats (sheltered rocky rubble coasts, exposed tidal flats, gravel beaches, mixed sand and gravel beaches) that have a medium recovery period (~ 2-5 years).</p> <p>Presence of known threatened species or cultural heritage impacted.</p> <p>Region of significant commercial activity (e.g. fishing, tourism).</p> <p>Places of public interest such as beaches.</p>
Low	S3	<p>Region of known low sensitivity habitat (fine grained beaches, exposed wave-cut platform and exposed rocky shores) which have a rapid recovery period (~ year).</p> <p>Minimal impact to marine life, business, public areas or cultural heritage items.</p>

Table 5-21: Potential impacts of hydrocarbons on benthic assemblages

General sensitivity to oiling – benthic assemblages		
<p>Benthic species are generally protected from exposure to surface hydrocarbon however may be affected by seabed releases. The primary modes of exposure for benthic communities in oil spills include direct exposure to dispersed oil (e.g., physical smothering) where seabed discharges stay at the ocean bottom or sink down from surface; through partitioning on sediments or uptake through the food chain (i.e. prey) (NRDA, 2012).</p> <p><u>Surface Hydrocarbons</u> Adult marine invertebrates and larvae usually reside within benthic substrates and pelagic waters, rarely reaching the water's surface in their life cycle (to breed, breathe and feed). Therefore, surface hydrocarbons are not considered to pose a high risk to marine invertebrates except at locations where surface oil reaches shorelines. Acute or chronic exposure, through surface contact, and/or ingestion can result in toxicological risks. Invertebrates with no exoskeleton (limits exposure) and larval forms may be more prone to impacts.</p> <p><u>Water column/seabed hydrocarbons</u> Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms. If invertebrates are contaminated by hydrocarbons, tissue taint can remain for several months, although taint may eventually be lost (e.g., lobsters lost taint within 2-5 months when exposed to a light hydrocarbon (NOAA, 2002). Exposure to microscopic oil droplets may also impact aquatic biota either mechanically (especially filter feeders) or act as a conduit for exposure to semi-soluble hydrocarbons (taken up by the gills or digestive tract) (McCay-French, 2009). Toxicity is primarily attributed to water soluble PAHs. Other possible impacts from pelagic oil include oxygen depletion in bottom waters due to bacterial metabolism of oil and light deprivation under surface oil (NRDA, 2012). Abalone is a gastropod (i.e. grazer). Direct dissolved/entrained phase contact may lead to toxic impacts or impact to food sources (i.e. algal communities). Sub-lethal concentrations lead to developmental problems (slow growth and deformities) (Fingas, 2001) or narcosis (death-like appearance). The invertebrates often recover but are more vulnerable to predators or being swept away by currents. Studies of offshore benthic seaweeds in the northwest Gulf of Mexico (GoM) prior to and after the Macondo well blowout in water depths of 55-75 m found a dramatic die-off of seaweeds after the spill (Felder <i>et al.</i>, 2014). Benthic decapod assemblages (crabs, lobsters, prawns) associated with the seaweeds showed a strong decline in abundance at both banks post-spill but definitive links to Macondo are not possible due to the influence of Mississippi River. Petroleum residues observed on Ewing Bank may have caused localized mortalities, reduced the fecundity of surviving female decapods or reduced recruitment (Felder <i>et al.</i>, 2014). Felder <i>et al.</i> (2014) also notes that freshly caught soft-sediment decapod samples caught in early and mid-2011 near the spill site exhibited lesions that were severe enough to cause appendage loss and mortality. Sub-lethal effects of crude oil emulsions on lobster larvae (reduced metabolism and respiratory activity) occur down to 1 ppm and concentrations of 100 ppm are lethal (Kennish, 1996). Recovery of benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within weeks to months of contact. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (NRC, 2003).</p>		
Potential impacts from this project		
Surface oiling	Water column/seabed	Shoreline
Not applicable.	<p>Water column impacts on larval stages are addressed under 'Plankton'. Hydrocarbons from a well release or pipeline leak scenario are likely to make contact with the seabed within a relatively close vicinity of the source of release. Modelling of a subsea gas plume conducted by RPS APASA (2016) indicates that gas and associated reservoir fluids released from the seabed are driven into the water column due to the momentum of the discharge. The OSTM results also indicate a highly localised area with a probability of contact.</p> <p><u>Offshore</u> The modelled larger offshore scenarios (pipeline rupture and well blowout) predict no exposure from aromatics however low (effects) level entrained phase may be experienced up to 7 km from the release site. Impacts by direct contact of benthic species with hydrocarbon in the offshore release area will be localised. Filter-feeding benthic invertebrates such as sponges, bryozoans and hydroids exposed to</p>	<p>There is a 1% probability of shoreline exposure to 100 g/m² at isolated areas of shoreline west of Port Campbell from a 100 m³ subsea pipeline release (no shoreline contact for the well failure scenario). Note that this is below oiling thresholds which cause ecological impacts.</p> <p>Inshore and intertidal benthic species may be exposed to condensate (albeit slightly weathered). Inshore reefs occur along this section of coastline, so it is likely that benthic communities would be exposed to very low level hydrocarbons. It is noted that the predicted area of contact is mixed sand/shore platform. Residues deposited on these areas are rapidly remobilised due to wave and tidal action so</p>

	<p>hydrocarbons in the water column will be at 99% species protection levels for effect and significant impacts are not expected on this basis.</p> <p><u>Near-shore</u></p> <p>The onshore pipeline rupture scenario predicts dissolved aromatics may extend to 9.3 km (low level exposure) and 3.3 km (moderate level exposures). Also moderate (effects-level) entrained hydrocarbons may extend 9 km from the spill site and low level exposures 30 km to the south-east. It is noted that based upon these results it is possible that very sensitive species (plankton, juvenile fish) may be affected by the dissolved phase plume within 9.3 km and average sensitive species affected within a 3.3 km radius. Given the HDD scenario is a limited inventory, if worst duration spill scenario this case represents worst case conditions. On this basis, worst case mortality impacts to sensitive species occurs this will be localised and limited in duration and not represent significance at a population level.</p> <p>For more tolerant species sub-lethal impacts may be experienced over this short-duration event. Tissue taint may remain for several months in some species (e.g., lobster, abalone), however, the CHN pipeline alignment has considered the presence of primary lobster and abalone habitats during installation and avoided habitat suitable for these species with the exception of the sponge reef habitat located at KP19.5. Accordingly, given the limited water column/seabed footprint associated with seabed condensate releases at CHN, and the limited amount of habitat which support these species in proximity to the pipeline, impacts are considered to be negligible on a commercial fishery basis.</p>	<p>any accumulation is likely to be short-term and temporary. Intertidal platform areas</p> <p>At 100 g/m², resident fauna such as worms, molluscs and crustaceans may suffer lethal impacts if hydrocarbons penetrate into sediments, especially in highly productive sheltered shorelines where hydrocarbon is more likely to be retained. The shorelines affected are not predicted to be sheltered. On this basis, impacts to benthic and shoreline assemblages are considered to be limited localised, and if impacts occur, areas will be rapidly recolonised by adjacent species (negligible impacts).</p>
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Table 5-22: Potential impacts of hydrocarbon on plankton (including fish larvae)

General sensitivity to oiling - plankton
<p>Plankton is found in nearshore and open waters in the water column. These organisms migrate vertically through the water column to feed in surface waters at night (NRDA, 2012). As they move close to the sea surface it is possible that they may be exposed to both surface hydrocarbons but to a greater extent, dissolved or entrained in the water column. Phytoplankton is typically not sensitive to the impacts of oil, though they do accumulate it rapidly (Hook <i>et al.</i>, 2016). Phytoplankton exposed to hydrocarbons at the sea surface, may directly affect their ability to photosynthesize (& secondary effects associated with availability of light) and impacts for the next trophic level in the food chain (e.g., small fish) (Hook <i>et al.</i>, 2016). Photosynthesis is stimulated by low concentrations of oil in the water column (10-30 ppb), but become progressively inhibited above 50 ppb. Conversely, photosynthesis can be stimulated below 100 ppb for exposure to weathered oil (Volkman <i>et al.</i>, 2004).</p> <p>Zooplankton (microscopic animals such as rotifers, copepods and krill that feed on phytoplankton) is vulnerable to hydrocarbons (Hook <i>et al.</i>, 2016). Water column organisms that come into contact with oil risk exposure through ingestion, inhalation and dermal contact (NRDA, 2012), which can cause immediate mortality or declines in egg production and hatching rates along with a decline in swimming speeds (Hook <i>et al.</i>, 2016).</p> <p>Plankton is generally abundant in the upper layers of the water column and is the basis of the marine food web, so an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. Reproduction by survivors or migration from unaffected areas is likely to rapidly replenish losses (Volkman <i>et al.</i>, 2004). Oil spill field observations show minimal or transient effects on plankton (Volkman <i>et al.</i>, 2004). Once background water quality is re-established, plankton takes weeks to months to recover (ITOPF, 2011a).</p> <p><u>Planktonic Eggs:</u> Some corals, fish and other marine organisms (e.g. abalone) are broadcast spawners eggs are released into the water column to be fertilised with the eggs then staying in the upper water column while the embryo develops. Because of their small size and high lipid content, eggs accumulate hydrocarbons from the dissolved phase rapidly and are sensitive to PAH concentrations down to 0.5µg/l. Primary commercial fish species in the area are abalone (broadcast spawners between October to April) and Rock Lobster (egg hatching between September and November). Most recruitment of lobster larvae into Victorian waters is from South Australia (i.e. rapid replacement). For lobsters it is noted that</p>

waters contain a number of larval cohorts at all times of the year. Porifera (sponges) spawn in spring/summer period. Given the rapid replacement of waters within the Otway Basin from the Leeuwin Current, larval impacts at a population level are not expected.		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
<p>Plankton and planktonic eggs found in open waters of the EMBA are expected to be widely represented within waters of the wider Bass Strait region. Plankton in the upper water column is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by dissolved and dispersed hydrocarbons.</p> <p>Once background water quality conditions are re-established, plankton populations are expected to recover rapidly due to the recruitment of plankton from surrounding waters.</p> <p>The overall impact of hydrocarbon spills on plankton is not considered to be significant in the long-term (negligible consequence).</p> <p><u>Pipeline rupture scenario</u></p> <p>In the case of a release from a pipeline rupture at the HDD site, the OSTM indicates a surface hydrocarbon extent of approximately 3 km (sheen) with greater surface thicknesses adjacent to the release location (0.5km). Moderate zones of dissolved phase hydrocarbons can also to 9.3 km which could lead to lethal impacts to plankton. In this case, sensitive mature individuals and early life stages (larvae, gametes and juveniles) may experience some mortality upon exposure. This limited footprint is not expected to have a significant impact on plankton or planktonic fish species. This exposure is temporary and recoverable (negligible consequence).</p>		Not applicable.

Table 5-23: Potential impacts of hydrocarbons on pelagic fish

General sensitivity to oiling – pelagic fish
<p>The behaviours and habitat preferences of fish species determine their potential for exposure to hydrocarbons and the resulting impacts. Demersal species may be susceptible to oiled sediments, particularly species that are site restricted. Pelagic species that occupy the water column are more susceptible to entrained and dissolved hydrocarbons, however generally are highly mobile and not likely to suffer extended exposure due to their patterns of movement. The exception would be in areas such as reefs and other seabed features where species are less likely to move away into open waters (i.e., site-attached).</p> <p>Fish are exposed to hydrocarbon droplets through a variety of pathways, including: Direct dermal contact with diffusion across their gills (Hook <i>et al.</i>, 2016)); Ingestion of contaminated prey; and Inhalation (e.g., elevated dissolved contaminant concentrations in water passing over the gills).</p> <p>Exposure to hydrocarbons can be toxic to fish. Studies have shown a range of impacts including changes in abundance, decreased size, inhibited swimming ability, changes to oxygen consumption and respiration, changes to reproduction, immune system responses, DNA damage, visible skin and organ lesions, and increased parasitism. However, many fish species can metabolise toxic hydrocarbons, reducing the risk of bioaccumulation in the food web (and human exposure to contaminants through the consumption of seafood) (NRDA, 2012).</p> <p>Sub-lethal impacts in adult fish include altered heart and respiratory rates, gill hyperplasia, enlarged liver, reduced growth, fin erosion, impaired endocrine systems, behavioural modifications and alterations in feeding, migration, reproduction, swimming, schooling and burrowing behaviour (Kennish, 1996). However, high mobile fish are unlikely to remain in the area of a spill for sufficient time to be exposed to sub-lethal doses.</p> <p>Since fish and sharks do not generally break the sea surface, surface hydrocarbons impact to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks with fish mortalities rare in open waters (Volkman <i>et al.</i>, 2004). Adult fish kills reported after oil spills occur mainly to shallow water, nearshore benthic species (Volkman <i>et al.</i>, 2004).</p> <p>Hydrocarbon in the water column can physically affect reef fish (site attached) exposed for an extended duration (weeks to months) by coating of gills/body surfaces, leading to lethal and sub-lethal effects from reduced oxygen exchange and irritation and infection. Ingestion of oil droplets/contaminated food may lead to reduced growth (Volkman <i>et al.</i>, 2004). Davis <i>et al</i> (2002) report detectable tainting of fish flesh after a 24-hour exposure at crude concentrations of 0.1 ppm, marine fuel oil concentrations of 0.33 ppm and diesel concentrations of 0.25 ppm. The majority of studies, either from laboratory trials or of fish collected after spill events find evidence of elimination of PAHs in fish tissues returning to</p>

reference levels within two months of exposure (Challenger and Mauseth, 2011; Gagnon & Rawson, 2011; Gohlke *et al.*, 2011; Jung *et al.*, 2011; Law *et al.*, 1997; Rawson *et al.*, 2011).

Squid are widely distributed, however, when squid reach maturity at 1-2 years, they move inshore to spawn in large numbers and then die after spawning. Where large numbers of squid spawn in small areas, the population could be impacted by the reduction in successful spawn. As squid are generally abundant and reach sexual maturity rapidly, recovery is expected to be rapid (1-2 years) (Minerals Management Service, 1983).

No reported studies of the impacts of oil spills on cartilaginous fish (including sharks, rays and sawfish) were found in the literature. It is not known how the data on the sensitivity of bony fishes would relate to toxicity in cartilaginous fishes. All EPBC Act-listed sharks in the EMBA are viviparous or ovoviviparous and so do not have a free-swimming larval stage.

These species are also larger than the bony fish species for which toxicity has been studied.

The assessment of effects on fish species in the Timor Sea as a result of the Montara well blowout (a light gas condensate), conducted from November 2009 to November 2010 undertaken by Gagnon & Rawson (2011), found that of the species studied (mostly goldband snapper, red emperor, rainbow runner and Spanish mackerel) were in good physical health at all sites, suggesting good health status. Gagnon & Rawson (2011) concluded that there were no detectable petroleum hydrocarbons found in the fish muscle samples, limited ill effects were detected in a small number of individual fish, and no consistent adverse effects of exposure on fish health could be detected within two weeks following the end of the well release. Notwithstanding, fishes from close to the Montara well, collected seven months after the discharge began, showed continuing exposure to hydrocarbons in terms of biomarker responses. Two years after the discharge, biomarker levels in fishes had mostly returned to reference levels, except for liver size.

Sampling from January 2010 to June 2011 by the University of South Alabama and Dauphin Island Sea Lab found no significant evidence of diseased fish in reef populations off Alabama or the western Florida Panhandle as a result of the Montara well blowout (BP, 2014).

Potential impacts from this project		
Surface oiling	Water column	Shoreline
<p>The majority of adult fish, including sharks, tend to remain in the mid-pelagic zone and are not likely to come into contact with surface hydrocarbons.</p> <p>It is possible that some near-shore species (e.g. some syngnathid species) associated with nearshore rocky reefs and rafts of floating seaweed may come into contact with surface oil if present through entrainment, however given the dynamic nature around near-shore reefs exposure is not considered to be significant.</p> <p>Any impacts from surface oiling on fish are considered to be negligible at a population level.</p>	<p>Ingestion of hydrocarbons in the water column is possible for adults and juveniles in the mid-pelagic zone, however generally these species are highly mobile and as such are not likely to suffer extended exposure. Hook <i>et al.</i> (2016) states that high concentrations of dissolved hydrocarbons are required to cause outright fish mortality.</p> <p>Large scale population level impacts of unplanned discharges on fish species, abundances or assemblage composition would be unlikely due to the wide geographical distribution of many fishes of Bass Strait and the potential for rapid recolonisation.</p> <p><u>Pipeline rupture scenario</u></p> <p>Given the location of pipeline rupture, it is likely that shallow inshore species, such as syngnathids and other site-attached species may be exposed to moderate to high levels of entrained and low to moderate levels of dissolved phase hydrocarbons. As the condensate will not have much time to weather (and lose the toxic MAH and PAH components), there may be some mortality of individuals exposed to freshly released hydrocarbons if they cannot move out of the plume.</p> <p>The area of impact is limited and short-term and while localised mortality is possible, at a population level, the impact is not expected to be significant.</p>	<p>Not applicable.</p>

Table 5-24: Potential impacts of hydrocarbons on cetaceans

General sensitivity to oiling - cetaceans
<p>A description of cetaceans in the EMBA is provided in Section 3.4.5. Cetaceans have a 'High' sensitivity rating.</p> <p>Whales and dolphins can be exposed to the chemicals in oil through:</p>

- Internal exposure by consuming oil or contaminated prey;
- Inhaling volatile oil compounds when surfacing to breathe;
- Dermal contact, by swimming in oil and having oil directly on the skin and body; and
- Maternal transfer of contaminants to embryos (NRDA, 2012; Hook *et al.*, 2016).

The effects of this exposure include:

- Hypothermia due to conductance changes in skin, resulting in metabolic shock (expected to be more problematic for non-cetaceans in colder waters);
- Toxic effects and secondary organ dysfunction due to ingestion of oil;
- Congested lungs;
- Damaged airways;
- Interstitial emphysema due to inhalation of oil droplets and vapour;
- Gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding;
- Eye and skin lesions from continuous exposure to oil;
- Decreased body mass due to restricted diet; and
- Stress due to oil exposure and behavioural changes.

French-McCay (2009) identifies that a 10-25 µm oil thickness threshold has the potential to impart a lethal dose on marine species, however also estimates a probability of 0.1% mortality to cetaceans if they encounter these thresholds based on the proportion of the time spent at surface. Direct surface oil contact with hydrocarbons is considered to have little deleterious effect on whales, possibly due to the skin's effectiveness as a barrier to toxicity, and effect of oil on cetacean skin is probably minor and temporary (Geraci & St Aubin, 1982). Cetaceans in particular have mostly smooth skins with limited areas of pelage (hair covered skin) or rough surfaces such as barnacled skin. Oil tends to adhere to rough surfaces, hair or calluses of animals, so contact with hydrocarbons by whales and dolphins may cause only minor hydrocarbon adherence.

The physical impacts from ingested hydrocarbon with subsequent lethal or sub-lethal impacts are both applicable to entrained oil. However, the susceptibility of cetaceans varies with feeding habits. Baleen whales (such as blue, southern right and humpback whales) are not particularly susceptible to ingestion of oil in the water column, but are susceptible to oil at the sea surface as they feed by skimming the surface. Oil may stick to the baleen while they 'filter feed' near slicks. Sticky, tar-like residues are particularly likely to foul the baleen plates.

The inhalation of oil droplets, vapours and fumes is a distinct possibility if whales surface in slicks to breathe. Exposure to hydrocarbons in this way could damage mucous membranes, damage airways or even cause death.

Toothed whales and dolphins may be susceptible to ingestion of dissolved and entrained oil as they gulp feed at depth. There are reports of declines in the health of individual pods of killer whales (a toothed whale species), though not the population as a whole, in Prince William Sound after the Exxon Valdez spill (heavy oil) (Hook *et al.*, 2016).

It has been stated that pelagic species will avoid hydrocarbon, mainly because of its noxious odours, but this has not been proven. The strong attraction to specific areas for breeding or feeding (e.g., use of the Warrnambool coastline as a nursery area for southern right whales) may override any tendency for cetaceans to avoid the noxious presence of hydrocarbons. So weathered or tar-like oil residues, typical of some crude oil and heavy fuel oil spills, can still present a problem by fouling baleen whales feeding systems.

Dolphin populations from Barataria Bay, Louisiana, USA, which were exposed to prolonged and continuous oiling from the Macondo oil spill in 2010, had higher incidences of lung and kidney disease than those in the other urbanised environments (Hook *et al.*, 2016). The spill may have also contributed to unusually high perinatal mortality in bottlenose dolphins (Hook *et al.*, 2016).

As highly mobile species, in general it is very unlikely that cetaceans will be constantly exposed to concentrations of hydrocarbons in the water column for continuous durations (e.g., >96 hours) that would lead to chronic toxicity effects.

Potential impacts from this project		
Surface oiling	Water column	Shoreline

<p>The modelling predicts only surface oil sheens from CHN infrastructure release scenarios, except for the HDD pipeline rupture where high exposures may be observed within 0.4km of the release location. For the near-shore pipeline rupture surface hydrocarbons would not be expected after 7 hours of the release (temporary). The HDD area is located in the BIA for nearshore migration of southern right whales and does not overlap the nearby aggregation BIA for southern right whales.</p> <p>A low-level surface sheen from offshore spills overlaps the foraging BIA for the pygmy blue whale (if the spill occurs during their main feeding period of November to May). Zooplankton is able to ingest hydrocarbon particles and rapidly process them (Volkman <i>et al.</i>, 1994), so if large quantities of affected prey were ingested, it is possible sub-lethal or chronic toxicity impacts to pygmy blue whales may occur.</p> <p>Biological consequences of physical contact with very localised areas of low concentrations of hydrocarbons at the sea surface are unlikely to lead to any long-term impacts, with temporary skin irritation and very light fouling/matting of baleen plates likely to occur (it is unknown whether the latter would affect feeding ability). Population level effects on the pygmy blue whale (or any other cetaceans species present) are considered unlikely (negligible consequence)</p>	<p>The zones of potential dissolved and entrained hydrocarbons for the pipeline rupture and well failure scenarios are highly localised.</p> <p>Cetaceans migrating through these zones, especially southern right whales during their predicted nearshore migration (mid-May to mid-July and September to mid-November), may ingest contaminated water and plankton.</p> <p>The biological consequences of physical contact with very localised areas of hydrocarbons in the water column are unlikely to lead to any long-term impacts, with temporary skin irritation being the most likely effect.</p> <p>For offshore releases the entrained phase (effects) levels are very low and effect-level impacts to whales would be unlikely.</p> <p>For the onshore release, higher concentration exposure may be experienced during coastline migrations however this would be on a very localised basis and temporary in nature.</p> <p>Population level effects on migrating southern right whales (and other species that may be present) are considered unlikely (negligible consequence).</p>	<p>Not applicable.</p>
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Table 5-25: Potential impacts of hydrocarbons on pinnipeds

General sensitivity to oiling - pinnipeds
<p><u>Sea surface oil</u></p> <p>Pinnipeds are vulnerable to sea surface exposures given they spend much of their time on or near the surface of the water. Pinnipeds are also sensitive as they will stay near established colonies and haul-out areas and are less likely to practice avoidance behaviours. Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation.</p> <p>As a result of exposure to surface oils, pinnipeds, with their relatively large, protruding, eyes are particularly vulnerable to effects such as irritation to mucous membranes and the oral cavity, respiratory surfaces, and anal and urogenital orifices. Hook et al (2016) reports that seals appear not to be very sensitive to contact with oil, but instead to toxic impact from the inhalation of volatile components.</p> <p>For some pinnipeds, fur is an effective thermal barrier because it traps air and repels water. Petroleum stuck to fur reduces its insulation value by removing natural waterproofing oils. The rate of heat transfer through fur seal pelts can double after oiling (Geraci & St. Aubin, 1988). Fur-seals are particularly vulnerable due to the likelihood of oil adhering to fur.</p> <p>Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water.</p> <p><u>In-water oil</u></p> <p>Ingested hydrocarbons can irritate or destroy epithelial cells that line the stomach and intestine, thereby affecting motility, digestion and absorption. However, pinnipeds have been found to have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt, 1982; Addison <i>et al.</i>, 1986). Volkman et al (1994) report that benzene and naphthalene ingested by seals is quickly absorbed into the blood through the gut, causing acute stress, with damage to the liver likely. If ingested in large volumes, hydrocarbons may not be completely metabolised, which may result in death.</p> <p>u</p> <p>Breeding colonies used to birth and nurse until pups are weaned are particularly sensitive to hydrocarbon spills (Higgins & Gass, 1993). Pinnipeds are further at risk because of their tendency to stay near established colonies and haul out areas and unlikely to practice oil avoidance behaviours. It is reported that most pinnipeds scratch themselves vigorously with their flippers and do not lick or groom themselves, so are less likely to ingest oil from skin surfaces (Geraci & St. Aubin, 1988). However, mothers trying to clean an oiled pup may</p>

ingest oil. The *Iron Barren* oil spill which released 550 tonnes of heavy fuel oil (in Tasmania, 1995) concluded a strong relationship between the productivity of the seal colonies and the proximity of the islands to the oil spill where the islands showed reduced pup production (Tasmanian SMPC, 1999). Pinnipeds appear to rely on scent to establish a mother-pup bond (Sandegren, 1970; Fogden, 1971). Oil-coated pups may not be recognisable to their mothers. This is a theory with studies and research indicating interaction between mothers and oiled pups were normal (Davis and Anderson, 1976; Shaughnessy & Chapman, 1984). Due to the extreme philopatry of females and limited dispersal of males between breeding colonies, the removal of a few individuals annually may increase the likelihood of decline in some of the smaller colonies. Extinction of breeding colonies further reduces genetic diversity.

Potential impacts from this project		
Surface oiling	Water column	Shoreline
<p>Localised parts of the foraging range for New Zealand fur-seals and Australian fur-seals may be temporarily exposed to low concentrations (1 – 10 g/m²) of hydrocarbon at the sea surface (silvery sheen up to metallic appearance). Exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. The extent that this results in permanent injury or mortality is unknown, but given the absence of breeding colonies and haul-out sites within the EMBA, injuries and mortality are unlikely (negligible consequence).</p>	<p>Fur-seals tend to forage in deeper waters of the CHN asset area. In these offshore areas, localised parts of the foraging range for New Zealand fur-seals and Australian fur-seals may be temporarily exposed to low (effects level) concentrations of hydrocarbon in the water column. Exposure to hydrocarbons in the water column or consumption of prey affected by the oil is unlikely to occur given the low exposure zones and rapid loss of the volatile components of condensate in choppy and windy seas (such as that of the EMBA). Impacts at the population level are not considered likely (negligible consequence). Water quality at the only seal haul-out site in the EMBA (Moonlight Head/Cape Volney) is predicted to be low level (effects level) entrained hydrocarbons. These levels of hydrocarbon are not expected to significantly impact the species.</p>	<p>Small colonies of New Zealand fur-seals and Australian fur-seals occur at Lady Julia Percy Island, outside of the EMBA and at Moonlight Head/Cape Volney which is located in the entrained phase EMBA. The OSTM indicates that shoreline stranding of hydrocarbons at these locations is not predicted. A small section of shoreline between Port Campbell and Peterborough (shelly beach) is predicted to be contacted by condensate residues above 100 g/m² from a HDD pipeline rupture however OSRA mapping indicates there are no fur-seal colonies or haul-out locations along this stretch of coastline. No impacts from shoreline hydrocarbon residues are expected.</p>

Table 5-26: Potential impacts of hydrocarbons on marine reptiles

General sensitivity to oiling – marine reptiles
<p>Marine reptiles can be exposed to hydrocarbon through ingestion of contaminated prey, inhalation or dermal exposure (Hook <i>et al.</i>, 2016). Sea turtles are vulnerable to the effects of oil at all life stages—eggs, post-hatchlings, juveniles, and adults in nearshore waters. Several aspects of sea turtle biology and behaviour place them at particular risk, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large pre-dive inhalations. Effects of oil on turtles include increased egg mortality and developmental defects, direct mortality due to oiling in hatchlings, juveniles, and adults; and negative impacts to the skin, blood, digestive and immune systems, and salt glands. Turtles may be exposed to chemicals in oil in two ways: internally – eating or swallowing oil, consuming prey containing oil based chemicals, or inhaling of volatile oil related compounds; and externally – swimming in oil or oil on skin and body. Ingested oil may cause harm to their internal organs. Oil covering their bodies may interfere with breathing because they inhale large volumes of air to dive. Oil can enter cavities such as the eyes, nostrils, or mouth. Records of oiled wildlife during spills rarely include marine turtles, even from areas where they are known to be relatively abundant (Short, 2011). An exception to this was the large number of marine turtles collected (613 dead and 536 live) during the Macondo spill in the GoM, although many of these animals did not show any sign of oil exposure (NOAA, 2011; 2013). Of the dead turtles found, 3.4% were visibly oiled and 85% of the live turtles found were oiled (NOAA, 2013). Of the captured animals, 88% of the live turtles were later released, suggesting that oiling does not inevitably lead to mortality.</p>

No nesting beaches are in proximity to the CHN EMBA.		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
<p>Marine turtles in Victoria that are not rare vagrants are deep-water species (i.e. leatherback).</p> <p>Given the limited areas of surface sheen from the offshore CHN (well blowout and PLEM rupture) it is possible some individual marine reptiles may come into contact with localised areas of low hydrocarbons. Based on the literature review above, this may result in sub-lethal impacts such as irritation of skin or cavities.</p> <p>However, due to the sparse nature of turtles within the Otway Basin, encounter is unlikely and also unlikely to impact at a population level.</p>	<p>The sparse population of marine reptiles in the EMBA combined with the localised extent of low hydrocarbon exposure from the offshore release scenarios would indicate negligible impacts to marine reptile populations from low level exposure entrained phase hydrocarbons.</p>	<p>There are no known turtle nesting beaches within the EMBA, so impacts from shoreline oiling will not occur.</p>

Table 5-27: Potential impacts of hydrocarbons on seabirds and shorebirds

General sensitivity to oiling – seabirds and shorebirds		
<p>Seabirds and shorebirds are sensitive to the impacts of oiling, with their vulnerability arising from the fact that they cross the air-water interface to feed, while their shoreline habitats may also be oiled (Hook <i>et al.</i>, 2016). Birds foraging at sea have the potential to directly interact with oil on the sea surface in the course of normal foraging activities. Species most at risk include those that readily rest on the sea surface (such as shearwaters) and surface plunging species such as terns and boobies. As seabirds are top order predators, any impact on other marine life (e.g., pelagic fish) may disrupt and limit food supply both for the maintenance of adults and the provisioning of young. In the case of seabirds, direct contact with hydrocarbons is likely to foul feathers, which may result in hypothermia reducing the ability of the bird to thermo-regulate, impairs waterproofing, may result in impaired navigation and flight performance (Hook <i>et al.</i>, 2016), and result in dehydration, drowning and starvation (DSEWPC, 2011; AMSA, 2013). Toxic effects of hydrocarbons may result when ingested as the bird attempts to preen its feathers. Whether this toxicity ultimately results in mortality will depend on the amount of hydrocarbon consumed and other factors relating to the health and sensitivity of the bird. Birds that are coated in oil also suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs. Studies of contamination of duck eggs by small quantities of crude oil have been shown to result in mortality of developing embryos. Engelhardt (1983), Clark (1984), Geraci & St Aubin (1988) and Jenssen (1994) indicated that the threshold thickness of oil that could impart a lethal dose to some intersecting wildlife individual is 10 µm (~10 g/m²). Scholten <i>et al</i> (1996) indicates that a layer 25 µm thick would be harmful for most birds that contact the slick. Shorebirds are likely to be exposed to oil when it directly impacts the intertidal zone due to their feeding habitats. Shorebird species foraging for invertebrates on exposed sand and mud flats at lower tides will be at potential risk of both direct impacts through contamination and indirect impacts through a reduction in available prey items (Clarke, 2010). Breeding seabirds may be directly exposed to oil via a number of potential pathways. Any direct impact of oil on terrestrial habitats has the potential to contaminate birds present at the breeding sites (Clarke, 2010). Bird eggs may be damaged if an oiled adult sits on the nest (Clarke, 2010). Penguins may be especially vulnerable to oil because they spend a high portion of their time in the water and readily lose insulation and buoyancy if their feathers are oiled (Hook <i>et al.</i>, 2016). The Iron Baron spill (325 tonnes of bunker fuel in Tasmania in 1995) is estimated to have resulted in the death of up to 20,000 penguins (Hook <i>et al.</i>, 2016).</p>		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
<p>A significant number of albatross, petrel and shearwater bird species, together with the Australasian gannet have BIAs within the EMBA of the offshore and nearshore CHN release scenarios. These birds forage over an</p>	<p>Impacts to birds from water column hydrocarbons is unlikely without first being exposure to surface oiling. This exposure route is not considered as significant as direct contact with hydrocarbons on the sea surface or at the shoreline.</p> <p>Penguin colonies feed in the area and may be exposed by the</p>	<p>Modelling predicts a 1% probability of shoreline exposure to 100 g/m² at isolated areas of shoreline west of Port Campbell from a 100 m³ subsea pipeline release (no shoreline contact for the well failure scenario). Note</p>

<p>extensive area and are distributed over a wide geographic area. Modelling predicts that most surface oiling occurs at surface sheens which are unlikely to affect seabirds. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with a localised area of low surface oil exposure. Contact with areas of high and medium hydrocarbon exposure is highly unlikely. As such, acute or chronic toxicity impacts (death or long-term poor health) to bird species at the individual level, let alone population level, are unlikely (minor consequence). The HDD pipeline rupture modelling predicts higher levels of surface oiling, with moderate oiling within 1.2 km of the release site. This impact is localised and predicted to last for 7 hrs only which</p>	<p>offshore release scenarios (well blowout and PLEM rupture) to large areas of low exposures of entrained hydrocarbon but given that their wide ranging foraging habitats and their nightly return to burrows at the shore, they are unlikely to remain within the entrained phase plumes. This is unlikely to be enough time to cause significant oiling, but preening once onshore may increase exposure to toxic elements. Penguin colonies within the HDD pipeline rupture EMBA are present at Murmane Bay/Flaxman Hill and Bay of Islands (containing low level entrained phase exposure); London Bridge (containing both low and moderate entrained and dissolved phase plumes) and the Twelve Apostles (containing low level entrained phase exposure). As prey is caught with rapid jabs of the penguin's beak and swallowed whole, it is possible that the penguin may ingest small volumes of low and moderate levels of dissolved phase hydrocarbons, if feeding in the localised area affected. Also prey (school fish, squid or krill) affected by the spill when ingested may lead to sub-lethal impacts. It is possible that individual birds at specific locations (e.g. London Bridge) may be affected by such a near-shore spill, however given the temporary nature of the spill, its localised footprint and the large foraging areas of penguin, individual birds may be affected but it is not considered significant at a population level.</p>	<p>that this is below oiling thresholds which cause ecological impacts. The area of shoreline predicted to be exposed to hydrocarbon loadings >100g/m² are localised and lie between Port Campbell and London Bridge on a mixed sand/shore platform shoreline. Residues deposited on these areas are rapidly remobilised due to wave and tidal action so any accumulation is likely to be short-term and temporary. For sand areas, weathered condensate residues, similar to MDO would be expected to percolate into the sub-strata of the beach, also limiting exposure to shoreline species. Hooded plovers are recorded as occurring in this area. Shorebirds foraging for food in intertidal areas, along the high tide mark and splash zone may encounter weathered hydrocarbons that may be brought back to nests. Hydrocarbon entering nests can reduce the survivability of hatchlings. Given the low levels of hydrocarbon accumulation predicted (153 g/m²), the limited area and temporary nature of exposure, it is considered that while individual birds may be affected, at a population level this is not significant (minor consequence).</p>
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Table 5-28: Potential impacts of hydrocarbons on sandy beaches

General sensitivity to oiling – sandy beaches
<p>Sandy beaches have a 'Low' sensitivity rating as they are regularly cleaned by wave action have low total organic carbon and low abundance of marine life (Hook <i>et al.</i>, 2016). The 100 ml/m² threshold (considered a 'stain' or 'film', and equivalent to 0.1 mm) is assumed as the lethal threshold for invertebrates on hard substrates and sediments (mud, silt, sand, gravel) in intertidal habitats. A threshold of 100 g/m² oil thickness would be enough to coat the animal and likely impact its survival and reproductive capacity (French-McCay, 2009). Based on this, areas of heavy oiling would likely result in acute toxicity, and death, of many invertebrate communities, especially where oil penetrates into sediments through animal burrows (IPIECA, 1999). However, these communities would be likely to rapidly recover (recruitment from unaffected individuals and recruitment from nearby areas) as oil is removed from the environment. Sandy beaches support a variety of worms, molluscs and crustaceans. Because the sand retains oil, such animals may be killed if oil penetrates into the sediments. For example, following the <i>Sea Empress</i> spill (in west Wales, 1996) many amphipods (sandhoppers), cockles and razor shells were killed. There were mass strandings on many beaches of both intertidal species (such as cockles) and shallow sub-tidal species. Similar mass strandings occurred after the <i>Amoco Cadiz</i> spill (in Brittany, France, 1978) (IPIECA, 1999). Following the <i>Sea Empress</i> spill, populations of mud snails recovered within a few months but some amphipod populations had not returned to normal after one year. Opportunists such as some species of worm may actually show a dramatic short-term increase following an oil spill (IPIECA, 1999). Long-term depletion of sediment fauna could have an adverse effect on birds or fish that use tidal flats as feeding grounds (IPIECA, 1999).</p>
Potential impacts from this project
<p style="text-align: center;">Shoreline</p>

There is a very small area between Port Campbell and Shelly Beach where the OSTM indicates that shoreline oiling may occur above 100 g/m² may occur (1% probability of contact). This area is dominated by sheer rocky cliffs with very small areas of sandy beach/rock platform. This occurs only for the pipeline rupture scenario at the HDD.

With the shortest time to reach the coast being 1 hour, the hydrocarbons will have partially weathered. Impacts to amphipods or worms on sandy beaches from smothering and oxygen depletion are unlikely to occur in the low concentrations and volumes (1.25 m³ maximum) predicted to strand ashore. Given the low viscosity of this residue it is likely to permeate into sand areas in a similar way to MDO. The tides and constant wave washing are expected to lead to rapid weathering of any hydrocarbons in the intertidal area and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline (negligible consequence).

Impacts to tourism and other human uses of the beach are unlikely. Visual impact through shoreline staining is unlikely to occur (minor consequence based upon business reputation parameter).

Table 5-29: Potential impacts of hydrocarbons to rocky shores

General sensitivity to oiling – rocky shores
<p>Rocky shores have a 'Low' sensitivity rating as hydrocarbons are generally quickly removed by incoming tides and waves. Cracks and crevices, rock pools, overhangs and other shaded areas provide habitat for soft bodied animals such as sea anemones, sponges and sea-squirts, and become places where oil can become concentrated as it strands ashore (Hook <i>et al.</i>, 2016). Rich animal communities underneath the rocks are also the most vulnerable to oil pollution.</p> <p>The vulnerability of a rocky shoreline to oiling is dependent on its topography and composition as well as its position. A vertical rock wall on a wave-exposed coast is likely to remain unoiled if an oil slick is held back by the action of the reflected waves. At the other extreme, a gradually sloping boulder shore in a calm backwater of a sheltered inlet can trap enormous amounts of oil, which may penetrate deep down through the substratum. The complex patterns of water movement close to rocky coasts also tend to concentrate oil in certain areas. Some shores are well known to act as natural collection sites for litter and detached algae, and hydrocarbons are carried there in the same way. As on all types of shoreline, most of the oil is concentrated along the high tide mark while the lower parts are often untouched (IPIECA, 1995).</p> <p>The impact of oil on any marine organism depends on the toxicity, viscosity and amount of oil, on the sensitivity of the organism and the length of time it is in contact with the oil. Even where the immediate damage to rocky shores from oil spills has been considerable, it is unusual for this to result in long-term damage and the communities have often recovered within 2 or 3 years (IPIECA, 1995). This is because oil is not normally retained on rocky shores in a form or quantity that causes long-term impacts and also because most rocky shore species have a considerable potential for re-establishing populations. Brown seaweeds, for example, are relatively insensitive to oil due to the slimy mucilage that coats all their surfaces.</p> <p>Many rocky shore animals have also been found to withstand heavy oiling, and it typically requires smothering by a viscous oil for a few tides to fatally impact barnacles and intertidal sea anemones. Limpets, littorinid snails and other grazing molluscs, however, are usually more susceptible, and a toxic oil may cause a large numbers of fatalities. This may be a direct effect or through the narcotic effect of the oil which causes the animals to lose their grip on the rock and become available to predators or die of desiccation (IPIECA, 1995). As long as the shore is not contaminated by further oiling, the spores of macroalgae also settle and grow resulting in an abnormally dense cover of seaweeds. At the same time, the juvenile limpets and snails, which settle and develop in damp and protected sub-habitats, move out onto the open rock to gradually repopulate the vacant areas. They grow quickly on the large quantities of food and gradually reduce the seaweed cover to normal levels. The whole process may take less than 2 or 3 years for the shore to look 'normal', although in some cases the balance between algae and grazers may take longer to stabilise (IPIECA, 1995).</p>
Potential impacts from this project
Shoreline
<p>There is a very small area between Port Campbell and Shelly Beach where the OSTM indicates that shoreline oiling may occur above 100 g/m² may occur (1% probability of contact). This area is dominated by sheer rocky cliffs with very small areas of sandy beach/rock platform. This occurs only for the pipeline rupture scenario at the HDD.</p> <p>With the shortest time to reach the coast being 1 hour, the hydrocarbons will have partially weathered. Impacts to amphipods or worms on sandy beaches from smothering and oxygen depletion are unlikely to occur in the low concentrations and volumes (1.25 m³ maximum) predicted to strand ashore. Given the low viscosity of this residue it is likely to permeate into sand areas in a similar way to MDO. The tides and constant wave washing are expected to lead to rapid weathering of any hydrocarbons in the intertidal area and it is unlikely that toxicity or smothering effects to exposed fauna will occur on this type of shoreline (negligible consequence).</p>

Table 5-30: Potential impacts of hydrocarbons to macro-algal communities

General sensitivity to oiling – macroalgal communities		
<p>Macroalgae are generally limited to growing on intertidal and subtidal rocky substrata in shallow waters to 10 m depth. As such, they may be exposed to subsurface and entrained and dissolved hydrocarbons, however are susceptible to surface hydrocarbon exposure more so in intertidal habitats as opposed to subtidal habitats.</p> <p>Smothering, fouling and asphyxiation are some of the physical effects that have been documented from oil contamination in marine plants (Blumer, 1971; Cintron <i>et al.</i>, 1981). In macroalgae, oil can act as a physical barrier for the diffusion of carbon dioxide across cell walls (O'Brian & Dixon, 1976). The effect of hydrocarbons however is largely dependent on the degree of direct exposure and how much of the hydrocarbon adheres to algae, which will vary depending on the oils physical state and relative 'stickiness'. The morphological features of macroalgae, such as the presence of a mucilage layer or the presence of fine 'hairs' will influence the amount of hydrocarbon that will adhere to the algae. A review of field studies conducted after spill events by Connell <i>et al</i> (1981) indicated a high degree of variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. The rapid recovery of algae was attributed to the fact that for most algae, new growth is produced from near the base of the plant while the distal parts (which would be exposed to the oil) are continually lost. Other studies have indicated that oiled kelp beds had a 90% recovery within 3-4 years of impact, however full recovery to pre-spill diversity may not occur for long periods after the spill (French-McCay, 2004).</p> <p>Intertidal macroalgal beds are more prone to oil spills than subtidal beds because although the mucous coating prevents oil adherence, oil that is trapped in the upper canopy can increase the persistence of the oil, which impacts upon site-attached species. Additionally, when oil sticks to dry fronds on the shore, they can become overweight and break as a result of wave action (IPIECA, 2002). Hook <i>et al</i> (2016) on the other hand states that kelp is typically relatively resistant to oil, though the fauna associated with it may be more sensitive.</p> <p>The toxicity of macroalgae to hydrocarbons varies for the different macroalgal life stages, with water-soluble hydrocarbons more toxic to macro-algae (Van Overbeek & Blondeau, 1954; Kauss <i>et al.</i>, 1973; cited in O'Brien and Dixon, 1976). Toxic effect concentrations for hydrocarbons and algae have varied greatly among species and studies, ranging from 0.002–10,000 ppm (Lewis & Pryor, 2013). The sensitivity of gametes, larva and zygote stages however have all proven more responsive to petroleum oil exposure than adult growth stages (Thursby & Steele, 2003; Lewis & Pryor, 2013).</p> <p>Macrophytes, including seagrasses and macroalgae, require light to photosynthesise. So in addition to the potential impacts from direct smothering or exposure to entrained and dissolved hydrocarbons, the presence of entrained hydrocarbon within the water column can affect light qualities and the ability of macrophytes to photosynthesise.</p>		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
<p>Macroalgal communities are generally restricted close to shore (see 'shoreline' column to the right).</p> <p>Offshore condensate releases are not predicted to result in surface oiling to macroalgae.</p> <p>No Giant kelp forest TEC areas are present in the offshore or HDD pipeline rupture EMBAs, however if present would be unlikely to be impacted by surface hydrocarbons as they remain submerged under the water surface.</p>	<p>Giant Kelp Forest TEC areas have not been identified within the EMBA area affected by condensate releases.</p> <p>Impacts to macro-algal communities present are likely to be similar to the general sensitivity observations noting that the rough seas of the nearshore environment will result in rapid weathering of the gas condensate residues.</p> <p>A small section of coastal waters west of Port Campbell is predicted to be exposed low to high (effect level) entrained phase hydrocarbons and low-moderate dissolved phase hydrocarbons. The section of coastline predicted by the OSTM to be contacted contains patchy subtidal rocky reef, where it is likely that macro-algal communities exist</p> <p>Given the presence of subtidal rocky reefs in the region, it is possible that within the condensate spill EMBA, these areas of higher dissolved and entrained phase may lead to localised areas of impact (expected to be sub-lethal based upon concentrations/observations listed above) for a very short period of time. Hydrocarbons are likely to weather rapidly in this area, with high-energy waves against the sheer cliffs breaking up hydrocarbons along the coast.</p> <p>From available literature affected macroalgal areas appear to regenerate quickly and any localised mortality of macro-algae is likely to lead to rapid recruitment from nearby seed stock (minor consequence).</p>	

Table 5-31: Potential impacts of hydrocarbons to coastal saltmarsh communities

General sensitivity to oiling – coastal saltmarsh communities
<p>Saltmarsh is present in areas with some type of connectivity to saline tidal influences (surface or groundwater) and are located in the upper inter-tidal environment. Oil can adhere readily to saltmarsh and recovery times are variable depending upon the level of impact. They are typically nursery areas for fish and invertebrate species. Salt marshes typically consist of fine grain often anoxic sediments held in place by the rhizomes of the plant. Damage and dieback of the plants often causes erosion of the habitat as a whole (Hook et al, 2016). Damage to saltmarsh is usually most severe in the areas closest to the shoreline. It was observed as a result of the Deepwater Horizon oil spill, oiling and plant stress where both highest within 14m of tidally inundated areas (Hook et al, 2016).</p> <p>For temperate species there is seasonal die-back, and during spring and summer (growing season) the species are more susceptible (IPIECA, 1994). Impacts are related to oil toxicity (lighter, non-weathered products causing more impacts such as MDO) or smothering (physical effect). Oil loading also determines recovery times. For light to moderate oiling with little penetration into the sediments, the plant may be killed in part, but recovery can take place from the underground systems – generally good recovery in 1-2years. Oiling of shoots with substantial penetration into the sediments with damage to underground systems may delay recovery (~7years). With thick deposits of oil, vegetation is likely to be killed by smothering and the recovery period for species can be significant (~20years) (IPIECA, 1994).</p> <p>Shoreline loadings of more than 1,000 g/m² of oil during the growing season would be required to impact marsh plants according to observations by Lin and Mendelssohn (1996). Similar thresholds have been found in studies assessing oil impacts on mangroves. Thus 1,000 g/m² is representative of higher level ecological impacts (i.e. ecosystem based impacts).</p>
Potential impacts from this project
Shoreline
<p>Areas of saltmarsh within the CHN operational EMBA vary in their connectivity with the sea and their elevation above sea level which affects their risk of being affected by a condensate spill.</p> <p>The condensate entrained phase EMBA extends from Mepunga (30 km northwest of the HDD site) to Wattle Hill (30 km southeast of the HDD site). As per Table 5-17, this geographic area covers inlets between Curdies Inlet and the Gellibrand River. Within this coastal area the only inlet identified in literature as containing saltmarsh is Port Campbell Creek however this is not confirmed on the OSRA. From literature, this saltmarsh is associated with an inland wetland and lies at elevations of at least 6masl. Tidal inundation during a spill event would not be expected to reach this vegetation given the tidal variation which occurs on the Otway coastline (~2m (max)). Elevations and an aerial photo of the area are provided below. Accordingly, given the elevation of this saltmarsh and in periods of tidal ingress should the creek be open to the sea, it is not expected that hydrocarbons would impact upon this saltmarsh herb-land.</p> <p>Maximum shoreline loadings predicted for a pipeline rupture at the HDD are 153.6 g/m² (below impact threshold).</p>

Table 5-32: Potential impacts of hydrocarbons to commercial fishing

General sensitivity to oiling – commercial fishing		
<p>Commercial fishing has the potential to be impacted through exclusion zones associated with the spill, the spill response and subsequent reduction in fishing effort. Exclusion zones may impede access to commercial fishing areas, for a short period of time, and nets and lines may become oiled. The impacts to commercial fishing from a public perception perspective however, may be much more significant and longer term than the spill itself.</p> <p>Fishing areas may be closed for fishing for shorter or longer periods because of the risks of the catch being tainted by oil. Concentrations of petroleum contaminants in fish and crustacean (i.e. lobster) and mollusc tissues (e.g. abalone) could pose a significant potential for adverse human health effects, and until these products from nearshore fisheries have been cleared by the health authorities, they could be restricted for sale and human consumption. Indirectly, the fisheries sector will suffer a heavy loss if consumers are either stopped from using or unwilling to buy fish and shellfish from the region affected by the spill. Impacts to fish stocks have the potential for reduction in profits for commercial fisheries, and exclusion zones exclude fishing effort. Davis et al (2002) report detectable tainting of fish flesh after a 24-hour exposure at crude concentrations of 0.1 ppm, marine fuel oil concentrations of 0.33 ppm and diesel concentrations of 0.25 ppm.</p> <p>The Montara spill (as the most recent [2009] example of a large hydrocarbon spill in Australian waters) occurred over an area fished by the Northern Demersal Scalefish Managed Fishery (with 11 licences held by 7 operators), with goldband snapper, red emperor, saddletail snapper and yellow spotted rockcod being the key species fished (PTTEP, 2013). As a precautionary measure, the WA DoF advised the commercial fishing fleet to avoid fishing in oil-affected waters. Testing of fish caught in areas of visible oil slick (November 2009) found that there were no detectable petroleum hydrocarbons in fish muscle samples, suggesting fish were safe for human consumption. In the short-term, fish had metabolised petroleum hydrocarbons. Limited ill effects were detected in a small number of individual fish only (PTTEP, 2013). No consistent effects of exposure on fish health could be detected within two weeks following the end of the well release. Follow up sampling in areas affected by the spill during 2010 and 2011 (PTTEP, 2013) found negligible ongoing environmental impacts from the spill.</p> <p>In the event of a spill, a temporary fisheries closure may be put in place by Fisheries Victoria (or voluntarily by the fishers themselves). Oil may foul the hulls of fishing vessels and associated equipment, such as gill nets. A temporary (short- or long-term) fisheries closure, combined with oil tainting of target species (actual or perceived), would lead to financial losses to fisheries and economic losses for individual licence holders. Fisheries closures and the flow on losses from the lack of income derived from these fisheries are likely to have short-term but widespread socio-economic consequences, such as reduced employment (in fisheries service industries, such as tackle and bait supplies, fuel, marine mechanical services, accommodation and so forth).</p>		
Potential impacts from this project		
Surface oiling	Water column	Shoreline
<p><u>Finfish (snapper, wrasse)</u> Not applicable.</p>	<p>As per the description above. Direct impact on this fishery is not considered to be significant due to the large spatial extent of the fishery itself and the localised zone of low exposure entrained hydrocarbons from offshore condensate spills and the limited area of hydrocarbon exposure from a pipeline rupture at the HDD site. As per pelagic fish section, while not expected tainting from hydrocarbon residues may be possible (minor consequence).</p>	<p>Vessels used in this fishery are not likely to use local ports.</p>
<p><u>Abalone</u> Not applicable</p>	<p>The condensate EMBA intersects an abalone habitat at Warrnambool Reef located 30 km to the NW of the HDD site. Effects at this location are limited to low-level entrained hydrocarbons. This exposure is not expected to cause any lethal or sub-lethal impacts given it is an effects-level concentration (negligible consequence).</p>	<p>No impacts predicted.</p>

<p><u>Rock lobster</u></p> <p>There is potential for lobster pot buoys to accumulate hydrocarbons if they are set at the time of a spill. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.</p>	<p>As per the description above.</p> <p>Nearshore areas fished for rock lobster are predicted by the OSTM to have low to high exposure to entrained condensate. A short-term exclusion of fishing in this area is unlikely to have a significant impact on this fishery given the abundance of similar habitat along the Otway coastline outside the condensate spill EMBA.</p> <p>While impacts to the fishery as a whole are unlikely, impacts to individual fishers working the affected may be significant if actively fishing at the time of a spill. Localised tainting may be an issued with commercial fisheries in this area (minor consequence). This impact would be temporary and recoverable (~ months).</p>	<p>Vessels used in this fishery use local ports. However, hydrocarbon coating of vessel hulls and jetty or port infrastructure is highly unlikely.</p>
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Table 5-33: Potential impacts of hydrocarbons to tourism

<p style="text-align: center;">General sensitivity to oiling – tourism</p>
<p>During an oil spill event, not only are tourist destinations affected directly in areas where the spill has impacted upon the coastline, but it also faces significant reputational impacts, particularly in those areas which are considered to be 'unspoilt' by development. Public perception strongly influences people's decisions whether to visit a destination.</p> <p>For the Deep-water Horizon spill, which was a significantly larger oil spill with significantly higher spill impacts when compared with a gas condensate release from the CHN assets, a study commissioned by the Louisiana Office of Tourism two months after the Deepwater Horizon spill incident found (CRED, 2017):</p> <ul style="list-style-type: none"> • The spill had a negative impact on people's intentions to visit Louisiana. People who had previously intended to visit the state had postponed or cancelled their trips; • Perception overshadowed actual impacts: a quarter of people thought that leisure activities (swamp tours, boating and hiking) were closed because of the spill when in fact this was not the case; • The seafood industry was particularly impacted by perceptions: for example, over half of people surveyed thought that Louisiana oysters were unsafe to eat although evidence demonstrated otherwise. <p>This resulted in significant impacts on the hospitality sector and small businesses.</p>
<p style="text-align: center;">Potential impacts from this project</p>
<p>In the event of a significant spill event from the CHN assets, it is possible that some impacts tourism perception may reduce numbers visiting the Shipwreck coastline. However, impacts associated with a spill event which is visible to the public would be limited in scale, very localised in impact and temporary in nature. The material released does not have a significant surface presence (i.e. low sheens except for a HDD pipeline rupture which is temporary and localised). In addition, visitation to the Twelve Apostles is for its aesthetics and scenery, two aspects which are not expected to be significantly affected by a limited release condensate spill. The impact to visitation is expected to be small on this basis.</p> <p>In the event of a spill, it is expected that state media exposure is possible. On a business reputation basis, this impact is assessed as a moderate consequence.</p>

5.17.4 Likelihood of LOC

The integrity of submarine pipeline system is to be ensured through all phases of life, from initial concept through to final decommissioning. There are two primary processes to achieving this:

1. Establish integrity in the concept development, design and construction phases; and
2. Maintain integrity in the operations phase.

During concept development, design and construction, integrity is established by: anticipating normal and abnormal loads to the pipeline system and proving, by calculation, the system can withstand these loads with factors of safety i.e. redundancy; verifying that the concept development and design are adequate through third party validation programs; ensuring that the materials specified by the design are delivered with the required quality e.g. pipe materials are as strong as the values used in the design calculations; ensuring that construction techniques, particularly welding, are executed with sufficient quality to maintain the design requirements for the pipeline once installed; carrying out a system pressure test to a pressure over, and above, the maximum allowable pressure of the pipeline to prove the pipeline is capable of its design intent.

During operation of the pipeline, monitoring and inspection are routinely carried out to ensure the quality of the design is maintained to ensure it remains able to withstand the normal and accidental loads anticipated. Where the design is found to be deteriorating, then corrective action is taken to maintain the design resistance to the normal and abnormal loads.

Given this philosophy to integrity and the maturity of offshore pipeline engineering and integrity management, any deterioration of the pipeline will likely to be slow and gradual and most likely detected during routine monitoring and / or inspection. Severe and / or rapid deterioration of the pipeline would indicate that the concept development, design, construction, operation and maintenance have been inadequate, which is unlikely, or alternatively external influences have changed in an extreme manner that was never anticipated, which is again unlikely. It is therefore considered reasonable that LOC incidents are more likely to be relatively low volume leaks than high volume ruptures. However, given the implementation of the CHN IMP, LOC incidents are considered remote.

5.17.5 Risk Assessment

Table 5-34 presents the risk assessment for a condensate LOC.

Table 5-34: ERA for condensate LOC

Aspect:	Condensate Loss of Containment
Impact summary	Marine pollution, potentially leading to injury or death of marine fauna or seabirds through ingestion or absorption.
Extent of impact	Localised (about 10 m vertically and 100 m horizontally from discharge point).
Duration of impact	Temporary (rapid dispersion and dilution – minutes to hours).
Level of certainty of impact	<p>HIGH.</p> <p>All parameters provided for spill modelling have been conservatively estimated to provide the largest credible spill footprint. Conservative thresholds have also been utilised to define this footprint.</p> <p>Modelling parameters are also conservative on the following basis:</p> <ul style="list-style-type: none"> • Models used are best practice and industry standard conforming to quality standards (ASTM Standard F267-07); • Modelled tides and currents have been validated against actual tides and currents; • Weathering characteristics of condensate have been based upon scientific studies and the degree of confidence is high; • Sample size has been studied by RPS-APASA and shown that variation can occur between 50 and 100 simulation runs however the variation between 100 and 200 simulations results in minimal variation.

Impact decision framework context

B. The activity is a standard operation and well understood, it is not new to the area and good practice is well defined. *ALARP demonstrated through use of probabilistic modelling has been performed to assess potential impacts.*

Control measures to be implemented to control this hazard and prevent spills to the marine environment include:

- *Navigational Requirements:* CHN wellheads and pipeline are marked on navigation charts.
- *Integrity and Maintenance of Assets:* Pipeline and well operations/maintenance are undertaken in accordance with operating guidelines and integrity management plans.
- *Field activity controls:* Offshore activities are undertaken in accordance with a campaign-specific risk assessment, approved work procedures and a PTW which incorporates relevant environmental controls.
- *Spill Source Control (pipeline):*
 - Overpressure alarms are responded to immediately in accordance with approved operating procedures.
 - Low-pressure trips are responded to immediately in accordance with the Casino Master Control System (MCS) and Alarm Management Procedure.
 - The pipeline low-pressure trip is routinely tested.
- *Spill Response Preparedness:*
 - The Iona Gas Plant Emergency Response Team (ERT) is trained to respond to process alarms and to notify Cooper of any spill events.
 - Routine drills test oil spill response arrangements.
 - Approved emergency and oil spill response documentation is readily available to Cooper Energy personnel.
- *Spill Response (Implementation):* In the event of a spill:
 - The approved Emergency Response Plans (including the Cooper OPEP) are implemented
 - For wellhead releases the Cooper Offshore Victoria Source Control Plan is implemented.
 - Operational and scientific monitoring is undertaken in accordance with the Cooper Operational and Scientific Monitoring Program (OSMP) to reduce impacts to the environment.

5.18 RISK: Diesel Spill (Vessel)

5.18.1 Hazard

The following activities have the potential to results in a spill of marine diesel oil (MDO):

- A collision between the support vessel and a third-party vessel that results in diesel tank rupture and MDO loss;
- Vessel grounding of smaller IMR vessels nearshore as a result of loss of power (i.e. drift grounding).

Given the close proximity to ports, it is not planned to undertake refuelling activities on location, so refuelling spills have not been considered or modelled.

There are no emergent features along the CHN assets (rocky near-shore areas had pipeline installed by HDD and therefore have no need to be visited by vessels), so vessel grounding of larger marine support vessels for activities around wellheads as a causal pathway has been ruled out as a credible risk. DNV (2011) identifies that the risk of powered grounding within 4 nm of the shoreline or emergent system is negligible.

DNV (2011) indicates that for the period 1982-2010, there were no spills over 1 tonne (1 m³) for offshore vessels caused by collisions or fuel transfers.

MDO OSTM

A spill volume of 160 m³ of marine diesel oil (MDO) has been modelled for the CHN assets as the largest MDO spill risk. The specifications of the MDO used for the OSTM are presented below. MDO classified as a Group II oil (persistent).

Table 5-35: Boiling Ranges and physical characteristics of MDO used in OSTM

Characteristic	Volatiles (%)	Semi-volatiles (%)	Low volatiles (%)	Residuals (%)	Density (kg/m ³)	Dynamic viscosity (cP)
Boiling point (°C)	<180	180-265	265-380	>380		
MDO	6	34.6	54.5	5	829.1 @ 25°C	4 @ 25 °C
	Non-persistent			Persistent		

It is noted that the smaller IMR vessels, which have a smaller spill risk, may operate in near-shore areas around the HDD location (i.e. approx. 800 m from shore). ADIOS modelling (NOAA, 2017) for a 12m³ oil spill at 15°C water temperature predicts the following:

- At wind speeds of 5 knots after 24 hrs approximately 55% of the spill remains on the sea surface (6.6 m³) with approximately 45% evaporated;
- At wind speeds of 15 knots, 23% of the volume has evaporated after four hours is approximately 23%, 70% of the spill volume has become entrained in the water column and 7% remains at the sea-surface (0.84m³).

Based upon MDO results for larger spills, the spill trajectories are influenced by the north-west/south-east currents in the region and the prevailing wind direction, noting that the average wind speed at Cape Otway is approximately 25 km/hr (13.5 knots) (BOM, 2017). As per Section 3.2.5, if a spill occurred in shallower waters given the predominant south-westerly swell direction, there are minimal longshore currents and water movements are predominantly influenced by the orbital motion waves and localised wave-generated currents. As observed in Section 5.17, condensate releases at the HDD site, the shoreline areas adjacent to the release site were the areas primarily affected by spill impacts. Given the small volumes of MDO utilised in IMR vessels, MDO spill impacts from a nearshore spill would be expected to affect adjacent shoreline areas between the Arch and Port Campbell before being diluted and dissipated.

For spills along the pipeline alignment but at greater distances from shore, the semi-diurnal currents will prevail. Given the small spill volume it is expected that the spill residue may travel 6 hrs in prevailing currents direction before current reversal. Spill residues would be expected to dissipate and disperse below threshold levels after this time. On this basis the maximum excursion, assuming the maximum current speed for the entire 6 hours would be 10.8 km to the north-west and 19.5 km to the south east.

Table 5-36: MDO OSTM summary results

Scenario	Results	
Surface water	Sea surface exposure	Shoreline exposure
1 g/m ² (low exposure)	Travelled a maximum of 36 km, favouring the northwest direction. 0-5% chance of scattered exposure to Twelve Apostles Marine National Park.	A 22% probability of shoreline exposure, taking a minimum of 11.5 hours. A maximum volume of 66 m ³ of MDO stranding ashore.
10-25 g/m ² (moderate exposure)	Travelled a maximum of 18 km, favouring the west-northwest direction. No exposure to marine parks.	0-16% probability of shoreline exposure, from west of Portland to Anglesea, with the majority of contact probability being in the 0-5% range. MDO would travel through the Twelve Apostles Marine National Park.
>25 g/m ² (high exposure)	Travelled a maximum of 11 km, favouring the northwest direction. No exposure to marine parks.	Maximum 13% probability of shoreline exposure.
Dissolved phase		
576-4,800 ppb.hrs (low exposure)	No exposure of any meaningful level.	
4,800-38,400 ppb.hrs (moderate exposure)	No exposure of any meaningful level.	
>38,400 ppb.hrs (high exposure)	No exposure of any meaningful level.	
Entrained phase		
672 ppb.hrs (low exposure)	This zone extends to waters up to 100 km west-northwest and approximately 186 km east	
6,768 ppb.hrs (moderate exposure)	Exposure was scarce and isolated.	
77,088 ppb.hrs (high exposure)	No exposure of any meaningful level.	
Shoreline		
LOW EXPOSURE: 10-100g/m ²	The affected area is predicted to stretch between Cape Bridgewater and Anglesea at very low probabilities of exposure (0-10%). The areas with the highest probability of exposure at these levels are between Port Fairy and Cape Otway.	
MODERATE EXPOSURE: 100-1000g/m ²	This area lies again from Port Fairy to Cape Otway. As per low level exposure the probability of this exposure is very low.	
HIGH EXPOSURE: >1000g/m ²	These isolated areas lie from Peterborough to Warrnambool and at Cape Otway. As per low level exposure the probability of this exposure is very low.	

5.18.2 Known and Potential Impacts

The known and potential impacts of an MDO spill are:

- A temporary and localised reduction in water quality; and
- Injury or death of marine fauna and seabirds exposed to the MDO.

EMBA

The EMBA for an MDO spill is based on OSTM, which indicates that a 160 m³ spill of MDO may on as surface sheen basis travel up to 36 km, favouring the northwest direction. Figure 5-2 provides the EMBA with the entrained phase boundary incorporated upon the surface sheen.

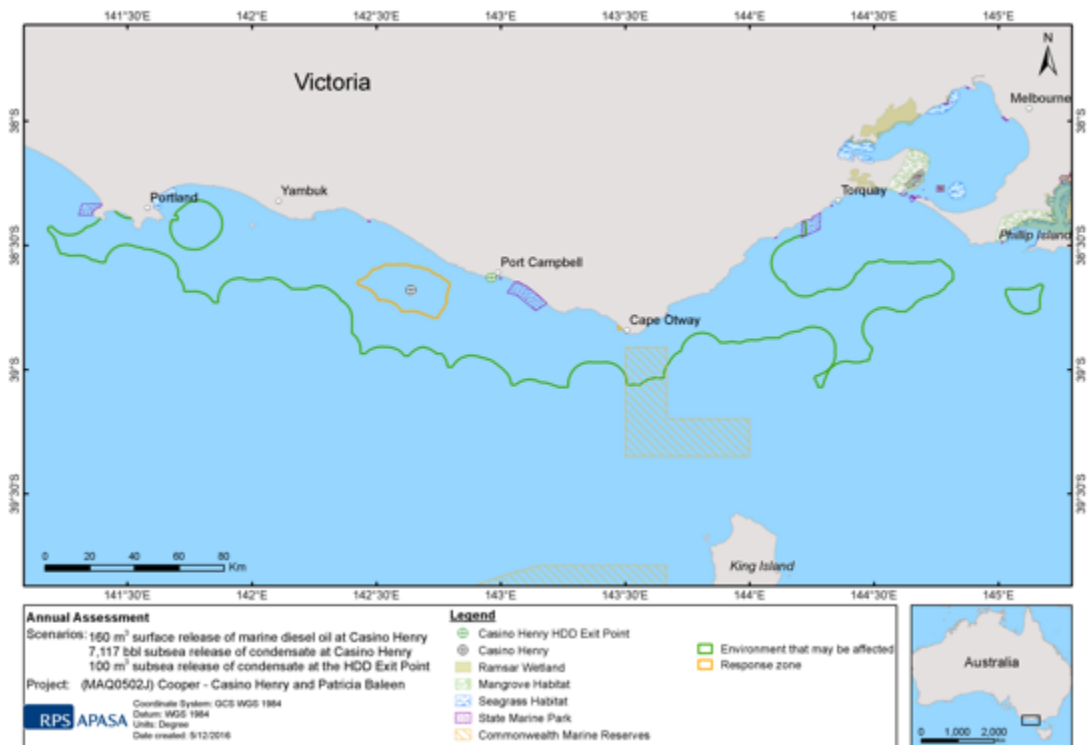


Figure 5-2: Predicted 160 m³ MDO EMBA

Receptors within the EMBA

Receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic and demersal fish;
- Benthic species;
- Marine mammals (cetaceans and pinnipeds);
- Seabirds and shorebirds;
- Commercial fishing
- Tourism.

Habitat that may occur within this EMBA where these species may be present includes:

- Sandy beaches;
- Rocky shoreline;
- Submerged shelf rocky reefs and hard substrates;
- Macro-algal and seagrass beds;
- Saltmarsh; and
- Open water.

Protected areas or features that occur within the EMBA are:

- The Arches Marine Sanctuary;
- The Twelve Apostles Marine National Parks;

- The Port Campbell National Park;
- The Bay of Islands Coastal Park;
- Merri Marine Sanctuary;
- Marengo Reef Marine Sanctuary;
- Eagle Rock Marine Sanctuary;
- Apollo CMR;
- Sub-tropical and Temperate saltmarsh; and
- Giant Kelp Marine Forests of SE Australia TEC.

5.18.3 Evaluation of Environmental Impacts

The impacts of MDO to habitats and wildlife are similar to those described for gas condensate spills in Section 6.21. This is due to their common lighter-end components which rapidly evaporate and minor heavier end components which have a low viscosity allowing for rapid spreading and permeability into sediments at shorelines. Specific literature separating gas condensate and refined hydrocarbons such as diesel is sparse, with most impacts related to the physical components of the hydrocarbon released. As such, this section does not discuss the general impacts of MDO spills on individual receptors (refer to Table 6-4 for this information). This section assesses the implications of the MDO spill for this activity as outlined in Table 6-7.

Table 5-37: Assessment of a 160m³ MDO spill from the CHN assets

Receptor	Sea surface	In-water	Shoreline
Benthic assemblages	Not applicable.	<p>The OSTM indicates that temporary patches of entrained MDO may be present through the EMBA at 0-20 m water depth.</p> <p>Impact by direct contact of benthic species with hydrocarbon in the deeper areas of the release area is not expected given the surface nature of the spill and the water depths at the spill location. Species closer to shore may be affected although these effects will be localised, low level and temporary, noting that in-water thresholds selected for interpretation are effects levels for 95-99% species protection .</p> <p>Note that inshore MDO spills (~ 12m³) are smaller in nature and will have very localised and temporary impacts.</p> <p>Filter-feeding benthic invertebrates such as sponges, bryozoans, abalone and hydroids may be exposed to sub-lethal impacts however population level impacts are considered unlikely. Tissue taint may occur and remain for several months in some species (e.g., lobster, abalone) however, this will be localised and low level with recovery is expected (negligible consequence).</p>	<p>There is a 22% probability of shoreline exposure along the Port Fairy to Cape Otway coast line from a significant offshore MDO spill. The maximum volume ashore is 65.9 m³ and average is 26.9 m³ of MDO. Nearer to shore activities undertaken with smaller vessels (~ 12m³ spill risk) have a smaller spill risk.</p> <p>Due to the low viscosity of the MDO residue after a spill, studies indicate it is likely to percolate into the voids between sand particles and not present itself as a surface residue.</p> <p>Inshore and intertidal benthic species may be exposed to weathered MDO (minimum time to shore is 11.5 hours from offshore spill) from an offshore spill and smaller volumes but fresher hydrocarbon from near shore spills. Inshore reefs occur along this section of coastline, so it is also likely that those communities would be exposed but to low level entrained hydrocarbons (95% species protection).</p> <p>Resident shoreline fauna such as worms, molluscs and crustaceans may suffer lethal impacts if MDO penetrate into the sediments, especially in highly productive sheltered shorelines where hydrocarbon is more likely to be retained. However this is considered to be unlikely given the limited sheltered shorelines containing sand along the coast. If this occurred, it would be in isolated areas and recolonization by adjacent species would occur in the short to medium term (negligible consequence).</p>

Receptor	Sea surface	In-water	Shoreline
Plankton and Planktonic eggs	<p>Plankton (including planktonic eggs and larvae) found in open waters of the EMBA is expected to be widely represented within waters of the wider Bass Strait region. Plankton in the upper water column is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by entrained hydrocarbons.</p> <p>Entrained phase MDO may intersect the Bonney Upwelling KEF around the Port Fairy to Portland area. While a spill would not affect the upwelling itself, if the spill occurs at the time of an upwelling event (timing changes year-to-year, but generally occurs around February in southwest Victoria), it may result in krill being exposed to low (effects) level entrained phase MDO (99% species protection). Pygmy blue whales feeding on this krill may suffer from reduced prey however these impacts are expected to be extremely localised and temporary. Once background water quality conditions are re-established, plankton populations are expected to recover due to the recruitment of plankton (& planktonic eggs) from surrounding waters.</p> <p>The overall impact of hydrocarbon spills on plankton is not considered to be significant in the long-term (negligible consequence).</p>		Not applicable.

Receptor	Sea surface	In-water	Shoreline
Fish	<p>The majority of adult fish, including sharks, tend to remain in the mid-pelagic zone and are not likely to come into contact with surface hydrocarbons.</p> <p>It is possible that some near-shore species (e.g. some syngnathid species) associated with nearshore rocky reefs and rafts of floating seaweed may come into contact with surface oil if present through entrainment, however given the dynamic nature around near-shore reefs exposure is not considered to be significant.</p> <p>Any impacts from surface oiling on fish are considered to be negligible at a population level.</p>	<p>Ingestion of hydrocarbons in the water column is possible for adults and juveniles in the mid-pelagic zone, however generally these species are highly mobile and as such are not likely to suffer extended exposure. Hook et al (2016) states that high concentrations of dissolved hydrocarbons are required to cause outright fish mortality. MDO rapidly loses its lighter more toxic components (BTEX) when spilt as identified in modelling where there is not an appreciable dissolved phase exposure.</p> <p>In-water entrained concentrations are predicted to be low to moderate (effect level) exposures (the latter with low probability) which are localised and will be rapidly diluted. Fish mortality is not expected through these exposures and associated sub-lethal effects are not expected as fish are highly mobile and unlikely to remain in the entrained phase plume for the days required to exhibit these effects.</p> <p>For benthic or site attached fish within the shallower areas that are exposed to low-moderate effects levels of entrained hydrocarbons, areas affected will be localised and significant impacts at a population level would not be expected.</p> <p>Large scale population level impacts on fish species, abundances or assemblages from an MDO spill at the CHN assets, given the wide geographical distribution of many fish in Bass Strait is unlikely and impacts are considered negligible.</p>	Not applicable.

Receptor	Sea surface	In-water	Shoreline
Cetaceans	<p>The OSTM modelling shows that exposure zones of surface hydrocarbons from a significant offshore MDO spill are very localized and do not overlap the nearby aggregation BIA for southern right whales (though the nearshore migration BIA may be overlapped).</p> <p>A surface slick may overlap the foraging BIA for the pygmy blue whale (if the spill occurs during their main feeding period of November to May). Zooplankton is able to ingest hydrocarbon particles and rapidly process them (Volkman <i>et al.</i>, 1994), so if large quantities of affected prey were ingested, chronic toxicity impacts to pygmy blue whales may occur.</p> <p>Biological consequences of physical contact with very localised areas of low concentration hydrocarbons present at the sea surface for approximately 24 hours are unlikely to lead to any long-term impacts, with temporary skin irritation and very light fouling/matting of baleen plates possible if present (effect is recoverable) (minor consequence). Population level effects on the pygmy blue whale (or any other cetaceans species present) are considered unlikely.</p>	<p>The zones of potential entrained MDO overlaps with the nearshore migration BIA for southern right whales and aggregation areas at Port Fairy and Logan’s Beach. This effect-level exposure (95-99% species protection) is unlikely to affect aggregating whales given they are no normally foraging at this time. Sub-lethal impacts (temporary skin irritation, etc.) might be experienced, however exposures will be short-term and any effects would be expected to be recoverable.</p> <p>Cetaceans migrating through these zones, especially southern right whales during their predicted nearshore migration (mid-May to mid-July and September to mid-November), may ingest contaminated water and plankton. The biological consequences of physical contact with low effect level concentrations of hydrocarbons in the water column over several days may lead to some short-term impacts, with temporary skin irritation being the most likely impact. Population level effects on migrating, feeding or aggregating whales (and other species that may be present) are considered unlikely.</p>	Not applicable.

Receptor	Sea surface	In-water	Shoreline
Pinnipeds	<p>Localised parts of the foraging range for New Zealand fur-seals and Australian fur-seals may be temporarily exposed to low to high concentrations (up to 25 g/m²) of MDO at the sea surface for very short periods (up to 24 hours) at the spill location.</p> <p>Exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. The extent that this results in permanent injury or mortality is unknown, but given the absence of breeding colonies and haul-out sites within the area of this surface oil, population level impacts would not be expected. Individual animals may be exposed to these high surface loadings which may cause injuries and mortality as they transit the area but this is not expected to lead to population level impacts.</p>	<p>Localised parts of the foraging range for New Zealand fur-seals and Australian fur-seals may be temporarily exposed to low concentrations of entrained MDO in the water column (no dissolved phase).</p> <p>Small colonies of New Zealand fur-seals and Australian fur-seals occur at Caped Nelson (low-moderate entrained phase exposure); Lawrence Rocks (low level exposure); Moonlight Head/Cape Volney (low-moderate entrained phase exposure) and Marengo Reef (low level exposures).</p> <p>Exposure to low/moderate effects level hydrocarbons in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds, however given the temporary and localised nature of the spill, their widespread nature, the low level exposure zones and rapid loss of the volatile components of MDO in choppy and windy seas (such as that of the EMBA), impacts at a population level are considered very unlikely.</p>	<p>Predictive modelling indicates no shoreline stranding of hydrocarbons at Julia Percy Island or Lawrence Rocks. Low level of shoreline accumulation (>100g/m²) is possible at Moonlight Head and Cape Volney where colonies are present. Given the rocky nature of haul-out sites, the MDO will rapidly weather through repeated wave action against the rocks. As such, oiling of individuals or group of pinnipeds (and impacts associated with this) is not expected. Impacts to pinnipeds are considered small (negligible impact).</p>
Marine reptiles	<p>As per the observations made for condensate and cetaceans, marine reptiles encountering hydrocarbon may result in skin or other cavity irritation. However, due to the sparse nature of turtles within the Otway Basin, potential impacts to marine reptile populations are considered to be unlikely.</p>	<p>The sparse population of marine reptiles in the EMBA combined with the localised extent of MDO exposure indicates that potential impacts to marine reptile populations from hydrocarbons in the water column are considered to be negligible.</p>	<p>There are no known turtle nesting beaches within the EMBA, so impacts to turtles from shoreline oiling will not occur.</p>

<p>Seabirds and shorebirds</p>	<p>Table 7-43 provides details of the threatened bird species likely to occur in the EMBA (such as albatross and petrels) and their BIAs for foraging which cover a wide geographic area.</p> <p>When first released, the MDO has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. out to 18 km for a significant offshore MDO spill) may suffer impacts however it is unlikely that a large number of birds will be affected. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with localised areas of sheen >10µm and may experience lethal surface thresholds, however the area of contact is localised and temporary (~24hrs). Contact with areas of high hydrocarbon exposure is highly unlikely. As such, acute or chronic toxicity impacts (death or long-term poor health) to small numbers of birds are possible, however this is not considered significant at a population level.</p> <p>The OSTM indicates that surface hydrocarbons are unlikely to enter the Curdies Inlet at Peterborough (which in any case is rarely open to the sea), thus limiting the potential impacts to wetland bird species in the area (i.e. Curdies Inlet is the only recognised estuary for shorebirds in the areas affected by surface oil).</p>	<p>Impacts from hydrocarbons to birds in the water column are unlikely without the bird first being exposed to surface oil. This exposure route is not considered as significant as direct contact with hydrocarbons on the sea surface or at the shoreline.</p> <p>Penguin colonies feeding in the area may be exposed to localised areas of low – medium (effects level) exposures of entrained hydrocarbons (there is no meaningful level of dissolved MDO predicted by the OSTM), which may cause sub-lethal impacts. Entrained phase hydrocarbon exposure in these areas is not expected to impact on their prey stock.</p> <p>Given the species is wide ranging in foraging habitats and their nightly return to burrows at the shore, they are unlikely to remain within plumes of entrained MDO (i.e. very mobile). This is not expected to cause toxicity effects, however preening once onshore may increase sub-lethal exposures.</p>	<p>Small isolated sections of sandy shoreline between Cape Otway and Port Fairy that have a low probability of MDO stranding at concentrations of >100 g/m². Other sections potentially affected such as intertidal platforms/rocky coastlines are not expected to accumulate hydrocarbon due to wave and tidal action.</p> <p>Locations which are identified along the areas which could be affected by shoreline residues in excess of 100 g/m² are:</p> <ul style="list-style-type: none"> • Penguins (Middle Island – Warrnambool; Murmaine Bay- Flaxman Hill coastline; Bay of Islands; London Bridge; The Twelve Apostles); • Hooded Plover (Nurmaine Bay to Flaxman Hill; Crofts Bay; Curdies Inlet; Shelly Beach; Lochard Gorge; Clifton Beach; Johanna Beach; Aire River; Station Beach). <p>Impacts to penguins are likely to be similar to those described for condensate. Any coating of feathers may be preened once onshore, which would increase oil ingestion and may lead to acute or chronic toxicity depending on the amount ingested and the life stage of the bird.</p> <p>If shorebirds have a long duration of exposure to areas of heavy shoreline oiling (or long duration of ingestion of weathered oil), it is possible that lethal impacts may occur. However, this is extremely unlikely given the characteristics of MDO and its residues which, due to their viscosity, percolate into sand and do not usually present as shoreline residues (hence limited potential for direct oiling). For shoreline areas which are inter-tidal platforms/rocky shorelines, accumulation will be temporary given wave and tidal action which remobilises and weathers MDO residues. Populations of most shorebird species within the EMBA (including plovers, penguins, terns and sandpipers) also have a wide geographic range, meaning that impacts to individuals or a population at one location will not necessarily extend to populations at other locations. Population level impacts due to shoreline residue accumulation are considered unlikely.</p>
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Receptor	Sea surface	In-water	Shoreline
			<p>Shorebirds foraging for food in intertidal sand areas may experience secondary impacts due to MDO residues impacting invertebrate prey. Tidal washing within sand environments rapidly degrades MDO residues allowing for rapid recolonization by adjacent invertebrate species. Areas affected will also be isolated in nature. These localised impacts would not be expected to affect shoreline bird species at a population level.</p>

Receptor	Sea surface	In-water	Shoreline
Sandy beaches	Not applicable.	Not applicable.	<p>Small isolated sections of sandy beaches between Cape Otway and Port Fairy are predicted to have a low probability of MDO residue stranding at concentrations of >100 g/m². These include (excluding mixed platform/sand environments) Port Fairy Bay, Logans Beach (Warrnambool), Crofts Bay, Curdies Inlet, Port Campbell, Lochard Gorge, Clifton Beach, Princetown Beach, Johanna Beach, Aire River Beach and Station Beach. Small sections of the coastline between Curdies Inlet and Mepunga have a low probability of shoreline residues >1000g/m².</p> <p>As per shoreline birds section, sandy beach environments are not likely to accumulate MDO residue due to the viscosity of the hydrocarbon. Additionally the constant wave action and tidal movements will naturally wash and degrade MDO residues which remain in the inter-tidal area. Beach environments rapidly rehabilitate and any residual shoreline residues should not create visual aesthetic impacts to visiting tourists.</p> <p>A threshold of 100 g/m² oil thickness is considered to be enough to coat animals living on or in the sand may impact survival and reproductive capacity. Based on this, areas of heavy oiling may result in acute toxicity, and death, of many shoreline invertebrate communities, especially where oil penetrates into sediments through animal burrows. These communities would be expected to rapidly recover (recruitment from unaffected individuals and recruitment from nearby areas) as oil is removed with the tides (sediment reworking).</p> <p>Given the MDO spill is localised, limited in volume and temporary, invertebrate impacts at a population level are not considered to be significant.</p>

Receptor	Sea surface	In-water	Shoreline
Rocky shores	Not applicable.	Not applicable.	<p>Much of the coastline predicted to be contacted by an MDO spill comprises steep rocky cliffs.</p> <p>Impacts to the rocky shores of the EMBA should not vary significantly from those described for the condensate spill scenarios.</p> <p>The action of reflected waves off rocky shores means it is unlikely that toxicity or smothering effects to exposed invertebrates will occur on this type of shoreline. The oil is likely to be continually washed off the substrate and into the water, leading to further weathering. Given the MDO spill is localised and temporary, impacts to these areas are not considered to be significant.</p>
Macro-algal communities	Not applicable.	<p>The Giant Kelp TEC is not known to be present in the entrained phase EMBA except at the Merri Marine Sanctuary which may be exposed to low-moderate effects level entrained hydrocarbons. It is possible that other areas of Giant Kelp Forests TEC may occur within the EMBA for entrained MDO, however surveys undertaken in The Arches MS and Twelve Apostles NP have not identified any stands. Kelp dominated reefs to occur in the region. Kelp-dominated reefs are noted as occurring around the Portland area with seagrass meadows also mapped as occurring along the Portland and Warrnambool coasts. These areas may be exposed to low concentrations of (effects level) entrained MDO, which are unlikely to result in significant impacts.</p> <p>Impacts to this community are likely to be similar to those described for condensate, noting that the rough seas of the nearshore environment will result in rapid weathering of the MDO residue.</p>	
Saltmarsh	<p>Surface sheens from MDO spills may extend from isolated areas around the Twelve Apostles National Park to Mepunga along the Otway coastline. Within that coastline segment, there are no areas of saltmarsh except a small area in Port Campbell Creek which is at elevations of 6masl and is not considered to be at threat from surface sheens.</p>	<p>In-water concentrations of low level effects-level entrained hydrocarbons (no aromatics) extend from Portland to Point Addis. Within that coastline there are a number of estuaries with saltmarsh lying within normal tidal ranges which may be exposed to these effects level concentrations. Invertebrates and fish nursery areas present in the salt marsh areas and exposed to these hydrocarbons may experience sub-lethal impacts, however impacts would be limited given the exposure from the hydrocarbons would be at a time when estuary mouths were open to tidal influence and there would be constant tidal flushing of these areas during the spill incident. Impacts are not expected to be significant to the saltmarsh plant or the species it protects.</p>	<p>Shoreline residues which exceed 1000g/m², and therefore may present a significant impact to saltmarsh growth rates are predicted between Curdies Inlet and Mepunga – a section of coastline which does not have areas of saltmarsh.</p> <p>Other estuaries between Port Fairy and Cape Otway may encounter residues of 100 g/m² however impacts would be sub-lethal and not expected to affect saltmarsh growth rates.</p>

Receptor	Sea surface	In-water	Shoreline
Commercial fishing	<p>Direct impact to finfish fisheries (snapper, wrasse) is not considered to be significant due to the large spatial extent of the fisheries and the localised zone of exposure to MDO at the sea surface.</p> <p>Given the commercial fishing equipment which is used in the EMBA, impacts associated with its contamination is assessed as a negligible consequence (<\$5M) should it come into contact with surface oil (considered unlikely).</p>	<p>Direct impact to the finfish fisheries is not considered to be significant due to the large spatial extent of the fisheries and the localised zone of low exposure to entrained hydrocarbons.</p> <p>Fisheries closures imposed at the time of a spill would limit fishing activity and may result in tainted fish (which are unsaleable).</p> <p>While tainting is considered possible from the MDO spill, entrained phase hydrocarbon levels in the environment is localised and at low levels and not considered sufficiently high to cause significant levels of tainting (~ 250 ppb has been recorded as an MDO threshold) to fish stock, particularly for mobile pelagic species. The exception to this is abalone and rock lobster found in inshore reef areas where isolated areas of moderate effects-level exposure of entrained phase MDO may occur. Exposures are localised and not considered sufficient to cause injury to the stock, but may cause tainting in these isolated areas.</p> <p>The value of the Victorian Abalone fishery in 2013 was \$20M (DSEWPC, 2013) and approximately 40% of the catch is taken from the Central region. Possible economic impact is assessed at \$5-10M (moderate consequence).</p>	<p>Vessels used in local fisheries use local ports. However, hydrocarbon coating of vessel hulls and jetty or port infrastructure is highly unlikely.</p>

Receptor	Sea surface	In-water	Shoreline
Tourism	<p>The OSTM predicts low level sheens (1-10 µm) may occur between The Twelve Apostles NP and Port Fairy, however these are mostly offshore. Shoreline sheens would be expected between the western side of the Twelve Apostles NP and Mepunga. This may be visible as a rainbow sheen on the sea surface during calm conditions.</p> <p>Such levels of hydrocarbon exposure, while not predicted to affect the ecological integrity of the receiving environment, may trigger a localised stakeholder response to potential contamination of isolated pristine environments and potential beach closures. Sheens close to the coast may be visible to tourists from coastal cliff lookouts, with offshore sheens visible to tourists undertaking helicopter joy flights. This may affect their visitor experience of the region although the reason for visitation is the shipwreck coastline aesthetics and scenery which is unlikely to be significantly affected by temporary surface sheens. Minor impacts to tourist operators (such as helicopter and charter vessel operators) may result of this and attract state level media attention (moderate consequence based upon business reputation).</p> <p>Impacts to other tourist areas outside the sheen (Logan's Beach, Dinosaur Cove) are not expected.</p>	<p>Entrained phase MDO is not expected to be visible. Recreational divers may notice isolated areas of entrained MDO if it is coincident with dive sites such as shipwrecks.</p>	<p>Beached MDO does not tend to accumulate on sandy beaches and percolates into the sand due to its low viscosity. Visual amenity impacts, even if concentrations exceed 100 g/m² are predicted to be temporary and localised. Most of the tourist coastal viewing platforms are along coastal cliffs, where shoreline oiling is not likely to be visually evident. As such, tourists should not suffer a reduced visitor experience (negligible impact).</p>

Impacts to Matters of NES

An MDO spill is not likely to have a ‘significant’ impact to any of the matters of NES applicable to this project.

Impacts to other areas of Conservation Significance

There are no other areas of conservation significance within the EMBA by accidental disposal of hazardous and non-hazardous materials and waste to the ocean. This discharge will not have any impacts to other areas of conservation significance, as outlined in the box below.

KEFs (Bonney Upwelling / Shelf Rocky Reef and Hard Substrates)	Nationally Important Wetlands	State Marine Parks	Coastal protected areas
✓ / ✓	X	Possible	X
<p>The KEF is within the EMBA for entrained MDO (top 10 m of water column). Upwelling is not affected by the spill. However, blue whales feeding on krill during an upwelling (see Section 3.4.5) may ingest contaminated prey and water. As per the discussion in the evaluation of impacts, impacts to cetaceans are unlikely to be significant.</p> <p>The shelf rocky reef and hard substrate KEF may lie in the EMBA of MDO spills which occur in the deeper areas of the CHN assets (i.e. water depth > 60 m)</p>	Residue is unlikely to enter nationally important wetlands along the coast.	<p>The Arches Marine Sanctuary may be within the EMBA for visible sheens (2.8 km east of pipeline).</p> <p>The following marine sanctuaries may be affected by low levels entrained phase hydrocarbon:</p> <ul style="list-style-type: none"> • The Twelve Apostles Marine National Parks; • The Port Campbell National Park; • The Bay of Islands Coastal Park; • Merri Marine Sanctuary; • Marengo Reef Marine Sanctuary; • Eagle Rock Marine Sanctuary <p>Reserve values will not be impacted by the temporary and low level hydrocarbon exposures predicted (refer to Appendix 4 for assessment).</p>	Coastal protected areas are outside the EMBA.

5.18.4 Risk Assessment

Table 5-38 presents the risk assessment for a spill of MDO.

Table 5-38: ERA for MDO spill

Aspect:	Vessel MDO Loss of Containment (Fuel Tank)
Impact summary	Pollution of surface waters and/or shoreline. Injury or death of marine fauna and seabirds through ingestion or contact.
Extent of impact	Extends from Cape Bridgewater in the west to Anglesea in the east (based upon entrained phase concentration at 7ppb for 96hrs).
Duration of impact	Short-term and recoverable

Level of certainty of impact	<p>HIGH.</p> <p>All parameters provided for spill modelling have been conservatively estimated to provide the largest credible spill footprint. Conservative thresholds have also been utilised to define this footprint.</p> <p>Modelling parameters are also conservative on the following basis:</p> <ul style="list-style-type: none"> • Models used are best practice and industry standard conforming to quality standards (ASTM Standard F267-07); • Modelled tides and currents have been validated against actual tides and currents; • Weathering characteristics of MDO have been based upon scientific studies and the degree of confidence is high; • Sample size has been studied by RPS-APASA and shown that variation can occur between 50 and 100 simulation runs however the variation between 100 and 200 simulations results in minimal variation.
Impact decision framework context	<p>B. The activity is a standard operation and well understood, it is not new to the area and good practice is well defined. <i>ALARP demonstrated through use of probabilistic modelling has been performed to assess potential impacts.</i></p>

Control measures for this hazard should be read in conjunction with the prevention of displacement of third party vessels (refer Section 6.16).

Additional control measures to be implemented to eliminate or mitigate spills to the environment include:

- *Fuel Selection:* Fuel use on-board is marine diesel.
- *Refuelling:* No refuelling will be undertaken at sea (this will be done in port).
- *Vessel Selection:* The vessel selected for IMR activities will meet:
 - Class certification requirements under the Navigation Act 2012;
 - Relevant crew shall hold valid STCW certificates (or equivalent to class);
 - Marine Inspection for Small Workboats IMCA audit shows vessel safety and integrity requirements are met.
- *SMPEP Implementation:* Vessels have a current approved SMPEP (or equivalent appropriate to class) that is implemented in a spill event.
- *SMPEP Crew Induction:* Vessel crew members are inducted and trained into vessel spill response procedures.
- *Vessel SMPEP Exercises/Drills:* Vessel implements routine emergency exercises (including spills) as part of its drills matrix.
- *OPEP Exercise:* Prior to IMR activities an oil spill response exercise will be conducted to test interfaces between the SMPEP, OPEP, the National Plan for Maritime
- Environmental Emergencies (NATPLAN) and Victorian Maritime Emergency (Non search and Rescue) Plan.
- *Spill Reporting:* Cooper will report the spill to regulatory authorities within 2 hours of becomes aware of the spill.
- *OPEP Implementation:* The Cooper Offshore Victoria OPEP is implemented in response to a spill during IMR activities;
- *Operational and Scientific Monitoring Plan (OSMP) Implementation:* Cooper will undertake operational and scientific monitoring in accordance with the Offshore Victorian OSMP.

6 Environmental Performance Monitoring

6.5 Implementation

Cooper manages the environmental impacts and risks associated with the CHN operational activity to ALARP and acceptable levels through the implementation of the Cooper Health, Safety, Environment and Community (HSEC) Management System (MS). The HSEC MS is a formal and consistent framework for all activities performed by Cooper and contracted resources.

This EP details a number of Environmental Performance Outcomes (EPOs) and Environmental Performance Standards (EPSs) for the activity. To achieve these performance outcomes, the EP's implementation strategy incorporates the following key HSEC MS processes:

- Position definition (roles and responsibilities);
- Training and awareness (Inductions, competency and training requirements);
- Emergency response (planning, testing, training and competency);
- Communications (workforce participation, communication forums);
- Contractor and supplier management (pre-qualification assessment, ongoing performance management, campaign-specific requirements);
- Impact and risk management (campaign-specific risk assessments, job hazard assessments);
- Operational Controls (permit-to-work, management of change, chemical selection and use);
- Performance Reporting (operational reports, annual reports, incident reporting, emissions monitoring);
- Audit and inspection; and
- Management of non-conformance.

Key roles within the Cooper organisation structure are allocated the responsibility for the implementation or compliance monitoring of EP commitments. All Cooper positions have position descriptions outlining their HSEC role, responsibilities, accountabilities and authorities and where relevant the specific competency requirements.

Lochard Energy, Cooper Energy's contract operator, operate the CHN pipeline facilities and wells on behalf of Cooper Energy from the Iona Gas Plant control room. The Iona Gas Plant is continuously manned—Production Technicians work a 12-hour shift on a two week on/off roster. Each shift comprises an Operations Shift Leader, a Responsible Officer and two additional operations personnel.

All contractors engaged on CHN operational activities undergo prequalification prior to contract award to ensure they have equivalent resource management systems to ensure personnel competencies and training and their procedures meet the requirements of this EP.

A key implementation activity is the induction of offshore personnel in a campaign-specific induction prior to activity commencement to ensure personnel understand the environmental requirements of the activity EP and their specific responsibilities in the EP.

6.6 Ongoing Monitoring of Environmental Performance

Environmental performance is monitored via a range of management system processes as detailed below.

6.6.1 Contractor Management

Cooper has a contractor management system that provides a systematic approach for the selection and management of contractors to ensure any third party has the appropriate management system and structures in place to achieve HSEC performance in accordance with Cooper's expectations. These requirements are contained within the Cooper Contractor and Supplier Management Standard Instruction.

The procedure applies to sub-contractors, Third Party Contractors (TPCs) and suppliers, attending, conducting work at Cooper sites or providing services for Cooper and its operations. It addresses operational HSEC performance of all contractors.

Implementation and monitoring contractor performance:

As part of any work scope, Cooper reviews and approves contractor procedures to be utilised in asset activities. These procedures will be included in the work plan for the asset and monitored by the Cooper Offshore representative.

Cooper ensures that all works undertaken by contractors are aligned to Cooper's HSEC requirements which include adhering to environmental compliance items. Ongoing contractor performance against these requirements is monitored by both the contractor and Cooper.

Vessels:

Cooper, as part of contractor pre-qualification and selection, assess vessel compliance with the requirements of this Environment Plan. This covers aspects including, but not limited to:

- Vessel pollution control equipment;
- Assessment of IMS risk;
- Navigational safety (vessel lighting and navigation equipment);
- Crew competencies and training; and
- Emergency/spill response.

6.6.2 Management of Change

The Cooper Management of Change (MOC) process describes the requirements for dealing with change and requires all changes to engineering activities, safety critical procedures, operations, facilities, processes, equipment, plant, materials and/or controlled management system documentation changes to be assessed and managed.

An impact/risk assessment will accompany any MOC with identified environmental impacts or risks in accordance with the Cooper Risk Management Standard. The impact or risk assessment will consider the impact of the proposed change on the environmental impacts/risks and adopted control measures. It will also consider impacts and risks to stakeholders and seek their feedback on proposed changes if their interests are affected by the change.

In the event that the proposed change introduces a significant new environmental impact or risk, results in a significant increase to an existing risk, or through a cumulative effect of series of changes there is a significant increase in environmental risk, this EP will be revised for re-submission to DEDJTR.

6.6.3 Performance Reporting

Cooper undertake various forms of reporting, both internally and externally to track performance including:

- Routine internal reporting of HSE matters
- Quantitative record of emissions and discharges
- Annual Environmental Performance report to be submitted to DEDJTR

6.6.4 Incident Recording and Reporting

All environmental incidents are recorded and investigated in accordance with Coopers Incident Management process. Recording and close out of corrective actions are tracked to closure in the Cooper's incident action tracking system. Incident investigations are initiated and closed out in some timely manner and learnings associated with incidents and near misses are communicated across the organisation.

6.6.5 Audits and Inspections

Cooper will undertake audits and inspections on assets and vessels undertaking IMR activities to ensure environmental performance is being achieved, potential non-compliances and opportunities for continuous improvement are identified; and all environmental monitoring requirements are being met.

Any non-compliance with the environmental performance standards outlined in this EP will be subject to investigation and follow-up action as per 'management of non-conformance' requirements.

The findings and recommendations of inspections and audits will be documented and opportunities for improvement or non-compliances noted will be communicated to all relevant personnel at the time of the audit to ensure adequate time to implement corrective actions. Results from the environmental inspections and audits will be summarised in the annual EP performance report submitted to the DEDJTR.

6.6.6 Management of non-conformance

In response to any EP non-compliances, corrective actions will be issued which specify the remedial action required to fix the breach and prevent its reoccurrence. The corrective action is closed out only when the remedial action has been verified by the appropriate manager and signed off. The status of the corrective action is monitored through the Cooper corrective action tracking system.

6.7 Oil Pollution Emergency Plan

6.7.1 Emergency (Oil Spill) Response Strategies

The Offshore Victoria Oil Pollution Emergency Plan (OPEP) is Cooper's response strategy in the event of a hydrocarbon spill during CHN operational activities. The OPEP has been accepted by NOPSEMA and DEDJTR as compliant with the Commonwealth OPGGSR and Victorian Offshore Petroleum and Greenhouse Gas Storage Regulations 2011(OPGGSR).

Cooper has reviewed the oil spill risks, hydrocarbon types and spill impact results which may occur as part of the CHN operational activities. Oil spill response options have been assessed for their suitability and effectiveness in reducing oil spill impacts to ALARP.

Cooper have utilised a Net Environmental Benefit Assessment (NEBA) methodology to identify the appropriate response strategies for hydrocarbon spill scenarios possible during CHN operational activities. A planning NEBA was conducted to determine the spill response strategies considered viable and expected to offer net benefit to sensitivities within the EMBA.

Given the rapid evaporation/volatilisation of hydrocarbons when released, the rapid spreading rate of MDO and condensate, and the potential for shoreline residue impacts associated with MDO spills, the response strategy would include the following according to the specific scenario:

- Initiate **source control**:
 - For vessels, this includes the implementation of SMPEP actions to reduce the leak;
 - For pipelines this includes operator response and ESD systems;

For CHN well releases this may include:

- Vessel-based intervention via a work-class ROV; or
- Well capping and/or relief well installation;
- **Monitor and evaluate** the spill via aerial and/or marine surveillance and oil spill trajectory modelling (all spill types) and via oil spill tracking buoys (for IMR vessel MDO spills);
- Initiate **protection and deflection** booming within estuaries which may be at risk (for nearshore IMR vessel MDO spills);
- Initiate **shoreline assessment and clean-up** (MDO and condensate spills) (where access is possible); and
- Initiate **oiled wildlife response** where oiled wildlife are observed (MDO and condensate spills).

In the event of a spill, an operational NEBA will be undertaken to review and verify the response option and assess for additional factors which may affect the implementation of these options.

6.8 Oil Spill Response Arrangements

Cooper has the following oil spill response arrangements in place:

- Associate membership (standing agreement and service contract) with the Australian Marine Oil Spill Centre (AMOSOC) for the supply of experienced personnel, equipment and oil spill trajectory modelling services;
- Memorandum of Understanding with the Australian Maritime Safety Authority (AMSA) as managers of the National Plan for Maritime Environmental Emergencies, will support and supply Cooper with response equipment from national stockpiles and trained personnel;
- A service agreement to provide specialist resources for scientific monitoring, analytical services, scientific monitoring vessels and sampling equipment;
- Contract pre-qualification with an aviation supplier for provision of surveillance aircraft and pilots; and
- Contract with a vessel contractor for marine vessel support during an oil spill.

Source control arrangements for well incidents include an agreement with well control specialists (including capping stack capability), well engineering company, casing material suppliers and the APPEA Mutual Assistance Agreement for rig provision.

6.9 Preparedness

6.9.1 Emergency Response

For CHN infrastructure emergencies, first response to an emergency is by Lochard Energy personnel as per the Iona Gas Plant Emergency Response Plan (ERP) who notifies Cooper of emergency incidents. Cooper Energy operates under the Victorian Emergency Management Plan (VEMP) to ensure timely response and effective management of any emergency. This includes environmental incidents and any incidents arising as a result of a hydrocarbon spill. For hydrocarbon spills, the response is managed by the Cooper Offshore Victoria OPEP.

During IMR activities, general vessel emergencies are handled under the contract vessel's Emergency Response Procedures which are supported by the contractor vessel's Shore-side Emergency Management System. The Cooper Emergency Management Team (CEMT) provides shore-side support to the contract vessel as necessary in the event of an emergency. This information is detailed in the project-specific interface documentation for IMR activities.

Vessel activities will also operate under the vessel's SMPEP (as appropriate) or approved spill clean-up procedures/equipment by qualified personnel to ensure timely response and effective management of any vessel-sourced oil spills. The SMPEP (or equivalent appropriate to class) is routinely tested with exercise drills are conducted regularly. The SMPEP is designed to ensure a rapid and appropriate response to any oil spill and provides guidance on practical information that is required to undertake an effective response; and reporting procedures in the event of a spill.

6.9.2 Training

Key Cooper and vessel positions to initiate and manage spill response are identified within the Cooper Offshore Victoria OPEP. Cooper position descriptions identify responsibilities for maintaining oil spill response capability and preparedness. Persons fulfilling Cooper's operational/emergency roles outline the necessary qualifications required to undertake the role.

All contractors engaged on CHN asset activities have equivalent resource management systems to ensure equivalent levels of personnel competency and training as required. All IMR vessel personnel have full inductions into the CHN operations EP and OPEP requirements prior to the commencement of vessel activities.

6.9.3 Testing of Response Arrangements

To ensure readiness, oil spill response exercises are conducted in accordance with the exercise schedule contained in the CHN Environment Plan. Testing is undertaken when arrangements are first introduced, prior to the commencement of an IMR campaign, when the oil spill response arrangements are significantly altered or at least, on an annual basis.

7 Stakeholder Consultation

Cooper has consulted with stakeholders in the preparation of the CHN Environment Plan. Cooper has contacted stakeholders known through reviewing the previous titleholder's consultation records, review of Commonwealth and State fishing information and other identified contacts to establish working relationships with stakeholders that have functions, interest or activities in the CHN asset areas.

Stakeholders identified for the CHN assets are listed in Table 7-1.

Table 7-1: Stakeholders for the CHN assets

Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant	
Department of the Environment (DoE) - Parks Australia	Australian Fisheries Management Authority (AFMA)
National Offshore Petroleum Titles Administrator (NOPTA)	Department of Innovation, Industry and Science (DIIS)
Australian Maritime Safety Authority (AMSA)	Department of Defence (DoD)
Maritime Border Command (MBC)	Australian Hydrological Service (AHS)
Department of Agriculture and Water Resources (DAWR)	

Each Department or agency of a State or the Northern Territory to which the activities to be carried out under the EP may be relevant	
DEDJTR – Earth Resources Regulation (ERR)	DEDJTR – Fisheries Victoria
Transport Safety Victoria (Maritime Safety)	

The Department of the responsible State Minister, or the responsible Northern Territory Minister	
DEDJTR – Earth Resources Regulation (ERR)	

A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP	
<i>Fisheries:</i>	
Commonwealth Fisheries Authority	Apollo Bay Fisherman's Cooperative
Seafood Industry Victoria (SIV)	Port Campbell Professional Fisherman's Association
Warrnambool Professional Fisherman's Association	Victorian Recreational Fishers Association (VRFish)
Victorian Rock Lobster Association (VRLA)	Portland Professional Fisherman's Association
Victorian Abalone Divers Association (VADA)	Western Abalone Divers Association (WADA)
Central Zone Abalone Association (AVCZ)	South-east Fishing Trawl Industry Association (SETFIA)
Southern Shark Industry Alliance	Sustainable Shark Fishing Inc. (SSF)
<i>Oil spill preparedness and response agencies:</i>	
Australian Marine Oil Spill Centre (AMOSOC)	DEDJTR – Marine Pollution Branch
Parks Victoria – Port Campbell	Department of Environment, Land, Water and Planning (DELWP)
Lochard Energy Incorporated	
<i>Nearby Petroleum Titleholders:</i>	
Origin Energy Resources Ltd	BHP Billiton Petroleum (Victoria) Pty Ltd
WHL Limited	3D Oil T49P Pty Ltd
<i>Local Government Associations:</i>	

A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP

Corangamite Shire Council	
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Any other person or organisation that the Titleholder considers relevant

<i>Community interests:</i>	
Parks Victoria (Port Campbell office)	Port Campbell Tourism and Information Centre
Port Campbell Boat Charters	Scuba Divers Federation of Victoria (SDFV)
<i>Conservation interests:</i>	
Bay of Islands Coastal Park	

7.1 Consultation (Environment Plan Collation)

Stakeholders identified above were engaged during the collation of this Environment Plan. Stakeholders were contacted directly by phone as an introductory activity to confirm stakeholder relevance to the asset, activities and interests in relation to CHN activities; to identify further opportunities for engagement; and confirm contact details were correct for the delivery of future correspondence. A letter formally introducing Cooper, the acquisition of the CHN assets, a brief description of the assets and Cooper contact details was sent by email in December 2016.

No concerns or objections have been raised with regard to the continued operation of the CHN assets. Cooper believes that the low rate of feedback (i.e., replies to initial and follow up emails and return phone calls) and the low level of concern from stakeholders expressed to date is due to the fact that the assets have been operating for over 10 years without any major incidents.

For those stakeholders which responded, the key theme emerging was that Cooper maintains ongoing engagement and conversation on future activities (Fishing Associations) and ensuring that Cooper has an awareness of the abalone fishery when undertaking activities (abalone associations).

A stakeholder consultation summary undertaken to date, together with Cooper’s responses and assessment of merits and feedback is included in Table 7-2. This table focuses on stakeholders who have been identified as ‘relevant persons’ whose functions, interests or activities may be affected by the assets’ operations. It also includes key stakeholders with whom engagement has taken place to enable Cooper to determine whether they are ‘relevant persons’ for the CHN activity.

Table 7-2: Casino Henry Netherby Environmental Plan - Stakeholder Consultation Log

Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Australian Fisheries Management Authority	Management of Commonwealth Commercial Fisheries from 3nm to 200nm (EEZ) Interests: New Facilities/expanded footprint which may impact commercial fishery access to seabed areas	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2017.01.16	Not Applicable	Not Applicable
Commonwealth Fisheries Association	Peak Group for Commonwealth Fisheries Interests: Increased footprint of activities Activity notifications	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2017.01.16	Not Applicable	Not Applicable
Seafood Industry Victoria	Peak Industry Body for Victorian seafood and fisheries Interests: Increased footprint of activities Activity notifications	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2016.12.28	Not Applicable	Not Applicable
Victorian Rock Lobster Association	Rock Lobster Interests: Sound impacts to Lobsters Interference with fishing equipment deployed.	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	Not Applicable	Not Applicable
Sustainable Shark Fishing Inc.	Peak Group for Victorian Seafood - Shark fishing Interests: Increased footprint of activities Activity notifications	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	Not Applicable	Not Applicable

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Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Australian Hydrographic Office	Commonwealth Agency responsible for Hydrographic Services such as Notice to Mariners Details of infrastructure placed on Navigation Charts Charting and Information Management	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2017.01.16	No objection to advice obtained.	AHO have previously advised an updated email address, this information is incorporated into the including stakeholder engagement register and OPEP addendum Contacts directory (VIC-ER-EMP-0020).
Apollo Bay Fishermen's Cooperative	Industry cooperative for Victorian fishery within offshore Otway region	2016.12.23 Phone call – contact details check, Russell Frost stakeholder provided an updated email address. 2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	No objection to advice obtained.	Not Applicable
Marine Border Command	Integrated defence/customs organisation which provides security for offshore marine areas	2017.03.08 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2017.03.08	No objection to advice obtained.	Not Applicable
Port Campbell Professional Fishermen's Association	Industry association for Victorian fishery within offshore Otway region	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	No objection to advice obtained.	Not Applicable
South-East Trawl Fishing Industry Association	Peak Industry Group for Trawl Fishermen in the SE Region Interests: Activity Notifications Change in Operation New activities or increased footprint Fishing Damages	Cooper Energy has been liaising with SETFIA since mid-2012 with respect to Stakeholder Engagement mechanisms established for the BMG field asset, ongoing initiatives have developed between Cooper Energy and SETFIA since.			
		2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	2017.01.02 Email - SETFIA acknowledgement of information provided. 2017.02.07 Email - J Hinks seeking phone conversation to organise quarterly BMG Fishery risk review and discussion to include other offshore assets.	No objection to request or advice obtained.	Not Applicable

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Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
			<p>2017.02.08 Email calendar invite for phone conversation between SETFIA (S Boag) and Cooper Energy (J Hinks)</p> <p>2017.02.08 Phone conversation between SETFIA (S Boag) and Cooper Energy (J Hinks) included;</p> <ul style="list-style-type: none"> • Agenda items for upcoming formal meeting • 2018 Fishing Industry Survey (FIS) – SETFIA to provide map of survey sites, schedule and duration impacts on any scheduled activities. 	No objection to request or advice obtained.	Not Applicable
			<p>2017.02.22 Email calendar invite for formal meeting to be held on 2017.03.01 between Cooper Energy, Upstream P.S and SETFIA representatives.</p> <p>2017.03.01 Cancelled scheduled meeting by S Boag due to availability of all attendees. Meeting to be reschedule, mid-March 2017.</p>	<p>No objection to invitation request.</p> <p>Await reschedule of Meeting – March 2017</p>	No action required.
Warmnambool professional Fishermen's Association	Industry association for Victorian fishery within offshore Otway region	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28	No objection to details provided.	No objection to details provided.
Portland Professional Fishermen's Association	Industry association for Victorian fishery within offshore Otway region	<p>2016.12.23 Phone call – contact details check, Andrew Levings stakeholder provided an updated email address and mailing details for Cooper Energy. Andrew advised his experience as a fishery liaison in the area.</p> <p>2016.12.28 Email – Letter to Andrew Levings and Posted Letter to David McCarthy Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback</p>	<p>2016.12.23 Email from A Levings advising title and address for D McCarthy details.</p> <p>2016.12.24 Email from A Levings provided his resume as an Oil and Gas Fishery Liaison.</p>	No objection to details provided.	Currency of Stakeholder engagement register updated.

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Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Western Abalone Divers Association (WADA)	Area of Marine use Warrnambool to SA Border Will pass on information to other marine users	<p>2016.12.20 Phone Call – Harry Peeters supplied contact details.</p> <p>2016.12.21 phone Call and Email to Geoff Ellis for contact details of the Western and Central Abalone association contacts.</p> <p>2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback</p>	No Response to email dated 2016.12.28	No objection to details provided.	Currency of Stakeholder engagement register updated.
Suba Divers Federation of Victoria		2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2016.12.28		
Parks Victoria - Port Campbell	Marine Park	2017.01.16 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No Response to email dated 2017.01.16	No objection to advice obtained.	Not Applicable
Central Zone Abalone Industry Association (AVCZ)	<p>Central Zone - largest zone in Victoria (Lake Entrance to Hopkins Rr (Warrnambool))</p> <p>Harvesting is inshore along the coastline and extends no further than 8kms off the coastline.</p>	<p>2016.12.22 Email - to AVCZ to obtain contact phone number and contact details, for information on the AVCZ.</p> <p>2016.12.30 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback</p>	<p>2016.12.23 Phone call from Malcom Petrie, provided contact details and a summary of AVCZ activities;</p> <ul style="list-style-type: none"> Central Zone being largest zone, spanning from Lakes Entrance to Hopkins Rr (Warrnambool) Approx. 20 active divers at any one time. The season is continuous. Abalone Harvesting is inshore along the coastline and extends no further than 8kms. 	No further response received. Not Applicable.	Not Applicable
Southern Shark Industry Alliance	Peak Group for Gummy Shark fishing southern Australia	2016.12.29 Email to contact page to obtain contact details for purpose of stakeholder engagement	No Response to email dated 2016.12.29	Not Applicable	Not Applicable

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Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Victorian Recreational Fishers Association (VRFish)	Peak industry body for Victorian seafood and fisheries	2016.12.28 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.	No Response to email dated 2016.12.28	Not Applicable	Not Applicable
Australian Maritime Safety Authority	<p>Safety Regulator for Marine Safety and Vessel-based Oil Spill Response in Commonwealth Waters</p> <p>Impacts on Shipping Routes & Navigation Warnings</p> <p>Marine Pollution Controller in Commonwealth Waters for Vessels</p>	<p>2016.12.23 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback.</p> <p>Also Cooper Energy sort feedback associated with the potential for encounter of third party vessels during survey activities and advice on the precautions which Cooper Energy needs to undertake to prevent third party vessel interference and to preserve safety.</p> <p>2017.01.16 Follow-up email sent to AMSA seeking feedback to email of 2017.12.23</p>	2017.01.16 Phone call and email correspondence from Nathan Johnson AMSA, Border Force Control (JRCC)	No objection to advice obtained	Cooper Energy to ensure feedback is incorporated into CHN EP (Sections 7 Environmental Impact and Risk Assessment)
		2017.01.25 Email – Cooper Energy sought an MOU with AMSA for specific spill response arrangements relating to the CHN asset.	2017.02.07 Email correspondence from David Imhoff, AMSA with agreement to sign.	No objection to advice obtained 2017.02.22 Cooper Energy signed the MOU agreement with AMSA	Not Applicable
Bairnsdale Air Charter	Aviation support	Cooper will undertake pre-qualification of Bairnsdale Air Charter to allow for charter during any oil spill response operational monitoring activities. Bairnsdale Air Charter has 3 x Cessna 337 aircraft to be utilised for this activity.	2017.02.23 Email - Confirmation Bairnsdale Air Charter can support Cooper Energy, in the event of an oil/condensate spill offshore Gippsland or Otway.	No response received Cooper Energy to follow-up a response	
Comchart Marine Pty Ltd (Bass Trek & Bass Explorer & Bass Rover)	Vessel Services	<p>Cooper Energy is seeking to formalise a Marine Charter Agreement directly with Comchart Marine going forward with respect to Oil Spill Response.</p> <p>2017.02.22 Email – Arrangements to utilise the Bass Trek based upon a Supplytime 89 arrangement.</p>	2017.02.22 Email - Confirmation Comchart is willing to support Cooper Energy, by way of a Marine Charter Agreement similar to that in place with Santos	No Issues with comments provided.	Cooper Energy to progress a Supplytime 89 Agreement with Comchart Marine Pty Ltd

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Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
AMOSC	Oil Spill Response Organisation Review and comment on Cooper Energy Offshore Victorian Oil Pollution Emergency Plan (OPEP) reviewer	Cooper Energy has been liaising with AMOSC since mid-2012 with respect to Oil Spill Response. Cooper Energy maintains an Associate Membership with AMOSC			
		2017.02.08 Email – Review of the Cooper Energy Offshore Victorian OPEP for the CHN EP.	2017.02.16 Email AMOSC provided minor feedback on Offshore Victorian OPEP. Cooper Energy updated this OPEP in accordance with the feedback to allow for final review.	Comments received from AMOSC deemed valid and applicable to the CHN field	2017.03.01 All comments incorporated into the OPEP, for finalisation before submission to NOPSEMA
		2017.03.01 Email - Final revision of the Offshore Victorian OPEP sent to AMOSC with comments of 16/2/2017 recognised.	2017.03.07 Email - AMOSC response indicating AMOSC role responsibilities are accurately reflected within the OPEP	No Issues with comments provided.	Not Applicable
GHD	Scientific Monitoring Support during oil spill Cooper Energy - Offshore Victoria Operational & Scientific Monitoring Plan (OSMP) (VIC-ER-EMP-0002) and OSMP Addendum – Implementation Strategy (VIC-ER-EMP-0003)	The overarching operational & scientific monitoring plan (OSMP) has been updated to include CHN activity. <ul style="list-style-type: none"> Individual study implementation plans - GHD has provided updated drawings which accommodate CHN activities GHD provided correct details for the OSMP Addendum – Implementation Strategy 			
		2017.02.24 Email - Cooper Energy confirm with GHD to act as Principal Investigator for OSMP modules and provide necessary staff and resources to implement the modules for the Cooper Energy Offshore Victoria Operational & Scientific Monitoring Program.	2017.02.24 Email – Confirmation GHD is willing to support Cooper Energy Limited's Offshore Victoria OSMP modules for operations in western Bass Strait and offshore from Gippsland. In the event that the program requires implementation GHD will provide the necessary staff and resources to implement the modules.	No Issues with comments provided.	2017.02.27 Cooper Energy ensures GHD as PI is incorporated into CHN EP, Offshore Victoria OPEP & OSMP and subsidiary documents.

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Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
DEDJTR Earth Resources Regulation (ERR)	Department of Economic Development, Jobs, Transport and Resources (Victorian Joint Authority for Offshore Victorian Developments) Regulator offshore to 3mn Victorian coastal Waters	2016.11.22 Meeting – Cooper Energy requested a meeting with DEDJTR representatives by way of introduction of the offshore asset acquisition, changes in titleholder and guidance for approval of Operator and Titleholder acceptance.	Acceptable attendance at meeting	No Issues with comments provided.	Not Applicable
DEDJTR Emergency Management Division (EMD)	Department of Economic Development, Jobs, Transport and Resources (Control Agency for Level 2/3 spills in Victorian waters) Regulator offshore to 3mn Victorian coastal Waters	2017.02.08 Email – to Environment & Scientific Coordinator, Marine Pollution Emergency Management Division for review of the Cooper Energy Offshore Victorian OPEP for the CHN EP.	2017.02.22 Email - EMD provided minor feedback on Offshore Victorian OPEP. Cooper Energy updated this OPEP in accordance with the feedback to allow for final review. Note DEDJTR EMD will also review oil spill response arrangements as part of the Victorian regulator review of the CHN EP (for Victorian waters section).	Comments received from EMD deemed valid and applicable to the CHN field	2017.03.01 All comments incorporated into the OPEP. Thanked DEDJTR for the current information. Final revision of the Offshore Victorian OPEP sent to AMOSC with comments for finalisation before submission to NOPSEMA
		2017.02.13 Cooper Energy Email request to seeking clarification of DELWP contact for oiled Wildlife response 2017.02.15 DEDJTR EMD response to queries.	DELWP contact is Rodney Vile. Interested in viewing the OSMP (sent to DEDJTR EMD).	All information utilised in oil spill planning and within OPEP. No adverse claims or objections made.	Not applicable.
Department of Environment, Land Water and Planning (DELWP)	Pipeline Regulation, Regulation and Approvals Energy, Environment and Climate Change Group,	2016.11.22 Meeting – Cooper Energy requested a meeting with DELWP representatives by way of introduction of the offshore asset acquisition, changes in titleholder and guidance for approval of Operator and Titleholder acceptance.	Acceptable attendance at meeting	No Issues with comments provided, no forward actions for Cooper Energy	
	State Agency supporting AMSA with oiled wildlife response.	2016.11.30 – Email - Cooper Energy requesting current information on oiled wildlife response in Victoria. 2017.02.19 – DELWP provided relevant information which supports oiled wildlife response arrangements to be included within the OPEP.	DELWP provides the following details: <ul style="list-style-type: none">• Agency arrangements for oiled wildlife response;• DELWP responses available;• Response arrangements during oil spill;• Notification pathways; Relevant actions to be taken.	No objections made to the information provided. Included in the OPEP (Oiled Wildlife Response) Section.	Thanked DELWP for the current information.

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Stakeholder	Relevance to Activity	Information provided (Date, Method, Record, Number)	Summary of Response	Assessment of Merits to Adverse Claim / Objection	Operators Response to each Claim / Objection
Origin Energy Resources Ltd	Nearby Titleholder	2017.03.07 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	2017.03.07 Automated response	Not applicable	Not Applicable
WHL Limited	Nearby Titleholder	2017.03.07 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No feedback to date.	Not applicable	Not Applicable
3D Oil Limited	Nearby Titleholder	2017.03.07 Email – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No feedback to date.	Not applicable	Not Applicable
BHP Billiton Petroleum (Victoria) Pty Ltd	Nearby Titleholder	2017.03.07 Mailed – Letter Cooper Energy provided information associated with the CHN Environment Plan, changes in titleholder and requested feedback	No feedback to date.	Not applicable	Not applicable
Coates Hire	Control Agency for Level 1 marine oil spills -heavy equipment hire	2017.03.15: Telephone conversation with Heather Parsons (Coates Hire) regarding heavy equipment availability and deployment to port Campbell location. 2017.03.15 Email sent to Coates Hire confirming content of conversation	2017.03.16 Heather confirmed equipment availability and deployment time to a Port Campbell location about 5 hours, a call out service is available 24/7.	No adverse claims or objections made.	Not Applicable

7.2 Ongoing Consultation

Cooper Energy elected not to define a 'reasonable period' (as specified in the OPGGS(E)R Regulation 11(3)) in the information letter for stakeholders to provide comments. This is because consultation for this activity relates to a change of Titleholder and the ongoing operation of the CHN assets, so Cooper Energy believes stakeholders are unlikely to see any urgency in engaging (as demonstrated in Appendix 5).

The long-standing and well established industry practice is to allow 30 days as the 'reasonable period' for stakeholders to respond to consultation material, after which time the EP can be submitted to the regulators. In this instance, there have been two months between the dissemination of the information letter and the initial submission of the EP.

Stakeholder consultation will be ongoing during the operation of the CHN assets. Key milestones that will trigger further consultation include:

- EP acceptance and the availability of the EP Summary on the NOPSEMA and DEDJTR websites;
- Inspection, maintenance repair activity (IMRs);
- Any significant incidents (e.g., large hydrocarbon spill);
- Changes to the CHN operational activity and its associate impacts or risks or to the way in which Cooper in managing the impacts and risks;
- Future optimisation activities (e.g., drilling of additional production wells or bringing assets back into production);
- When a decision is made to decommission the assets.

IMR Activity Consultation

At least four weeks prior to the IMR activity, Cooper will provide to all relevant stakeholders (Fishing Industry Bodies, AHS, TSV) information relating to the following:

- The expected timing, duration and location of the survey;
- Vessel name and call sign (if known);
- A description of the activities which are being undertaken;
- Expected impacts associated with the activity;
- A request to provide feedback on the activities; and
- The Cooper Representative for feedback of issues and concerns.

Ongoing Feedback and Response:

Should stakeholder feedback identify issues or concerns prior to or during IMR activities, or during the CHN operational phase in general, that were not previously identified in the preparation of this EP, the impacts and risks will be assessed and if a significant new or increased impact or risk is identified, the EP will be reviewed and, as necessary, revised and resubmitted to NOPSEMA and DEDJTR for assessment. If the feedback, after assessment, results in a change to operations or procedures but is not considered to result in a significant new or increased impact or risk, a Cooper Management of Change process will be undertaken in accordance with the Cooper MoC process.

In the event that a change to the CHN operational activity is planned which alters the impacts and risks or alters the way those impacts and risks are managed, Cooper shall consult with stakeholders, request and obtain feedback from stakeholders to ensure that impacts and risks to stakeholders are managed to levels which are acceptable and ALARP.

8 References

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