Environment Plan

BassGas Offshore Operations

Revision	Date	Reason for issue	Originator	Reviewer/s	Approver
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Annually from date of acceptance	Five-yearly

THE THREE WHATS
What can go wrong?
What could cause it to go wrong?
What can I do to prevent it?

Document Information and History

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A	Apr 2019	Preliminary draft for internal review	T. Flowers, A. Keely	Aventus Consulting	N/A

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Abbreviations

Acronym	Definition
ALARP	As Low As Reasonably Practicable
AMA	Alternative Muster Area
AMOSC	Australian Marine Oil Spill Centre
AMSA	Australian Maritime Safety Authority
AMSA JRCC	Australian Maritime Safety Authority Joint Rescue Coordination Centre
ANZECC	Australian and New Zealand Environment and Conservation Council
APASA	Asia-Pacific Applied Science Associates
APIA	Australian Pipeline Industry Association
APPEA	Australian Petroleum Production and Exploration Association
AQIS	Australian Quarantine Inspection Service
Bar(g)	Gauge pressure
BAT	Best Available Technique/s
BIA	Biologically important areas
BOD	Basis of Design
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CAMBA	China-Australia Migratory Bird Agreement
CCPS	Critical Control Performance Standard
CCR	Central Control Room
CCTV	Closed Circuit Television
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CERI	Collaborative Environmental Research Initiative
CFT	Critical Function Testing
CMMS	Computerised Maintenance Management System
CMR	Commonwealth Marine Reserve
CMT	Crisis Management Team
CO_2	Carbon dioxide
CoEP	Code of Environmental Practice
CP	Cathodic Protection

CRA	Corrosion Resistant Alloy
CRG	Community reference group
Cth	Commonwealth
CVI	Close Visual Inspection
d	Day
DAWE	Department of Agriculture, Water and the Environment (Cth)
DC	Direct current
DCS	Distributed Control System
DJPR	Department of, Jobs, Precincts and Regions (Vic)
DELWP	Department of Environment, Land, Water and Planning (Vic)
DN	Nominal diameter
DNV	Det Norske Veritas
DoEE	Department of the Environment and Energy (Cth) (former)
EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
EIS	Environmental Impact Statement
EMAC	Eastern Maar Aboriginal Corporation
EMBA	Environment that May Be Affected
EMT	Emergency Management Team
EP	Environment Plan
EPA	Environmental Protection Authority (Vic)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
EPIRB	Emergency Position Indicating Radio Beacon
EPO	Environmental Performance Objectives
EPS	Environmental Performance Standard
ERA	Environmental Risk Assessment
ERP	Emergency Response Plan
ESD	Emergency Shutdown
ESDV	Emergency Shutdown Valve
FFG Act	Flora and Fauna Guarantee Act 1988 (Vic)
GVI	General Visual Inspection
HAZID	Hazard Identification
HFL	Hydraulic Flying Lead
HPU	Hydraulic Power Unit
HSE	Health Safety and Environment
HSEMS	Health, Safety and Environment Management System
HVAC	Heating, ventilation and air-conditioning
IAP	Incident Action Plan

IBC	Intermediate Bulk Container
ICS	Integrated Control System
ID	Inside Diameter
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IMO	International Maritime Organisation
ISO	International Standards Organisation
ISPP	International Sewage Pollution Prevention
JAMBA	Japan-Australia Migratory Bird Agreement
JSA	Job Safety Analysis
KEF	Key Ecological Features
KPI	Key Performance Indicator
LLGP	Lang Lang Gas Plant
LoC	Loss of Containment
LoWC	Loss of Well Control
LPG	Liquefied Petroleum Gas
MAOP	Maximum Allowable Operating Pressure
MARPOL	IMO International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)
MEG	Mono-Ethylene Glycol
MMO	Marine Mammal Observer
MMSCFD	Million Standard Cubic Feet per Day
MNES	Matter of National Environmental Significance
MNP	Marine National Park
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
MOV	Manual Operated Valve
MP	Marine Park
MPa	Megapascal(s)
MSDS	Material Safety Data Sheet
NC	No contact
NDT	Non-destructive Testing
NEBA	Net Environmental Benefits Analysis
NNTT	National Native Title Tribunal
NOEC	No Observed Effect Concentration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOPTA	National Offshore Petroleum Titles Administration
NORM	Naturally Occurring Radioactive Materials
NP	National Park
NUI	Normally Unmanned Installation

OCNS	Offshore Chemical Notification Scheme
OEM	Original Equipment Manufacturer
OIW	Oil In Water
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006 (Cth) & 2009 (Vic)
OPGGS(E)	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth)
OPGGS Regulations	Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (Vic)
OSMP	Operational and Scientific Monitoring Plan
OSPAR	Oslo and Paris Commission
OSRA	Oil Spill Response Atlas
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response
PA/GA	Public Address and General Alarm
PCM	Pipeline Corrosion Monitoring
PCS	Process Control System
PFW	Produced Formation Water
PIC	Person In Charge
PL	Pipeline licence
PLONOR	Pose Little or No Risk
PMP	Primary Muster Point
PMS	Planned Maintenance System
PMST	Protected Matters Search Tool
PMV	Production Master Valve
PPE	Personal Protective Equipment
PPL	Petroleum Production Licence
PTS	Permanent Threshold Shift
PTW	Permit To Work
PSV	Pressure Safety Valve
PWV	Production Wing Valve
RBI	Risk Based Inspection
RESDV	Riser Emergency Shutdown Valve
RGP	Raw Gas Pipe
RO	Reverse Osmosis
ROKAMBA	Republic of Korea–Australia Migratory Birds Agreement
ROV	Remote/ly Operated Vehicle
RWP	Relief Well Plan
RWT	Rhodamine WT
SCM	Subsea Control Module

SCSSV	Surface Controlled Subsurface Safety Valve
SDU	Subsea Distribution Unit
SEL	Sound Exposure Level
SEMR	South-East Commonwealth Marine Region
SESSF	Southern and Eastern Scalefish and Shark Fishery
SHK	Species or habitat known to occur in the area
SHM	Species or habitat may occur in the area
SHX	Subsea Heat Exchanger
SITHP	Shut-in Tubing Head Pressure
SIS	Safety Instrumented System
SMC	Subsea Manifold Cooler
SMPEP	Shipboard Marine Pollution Emergency Plan
SOPEP	Shipboard Oil Pollution Emergency Plan
SPCU	Subsea Power and Control Unit
SPL	Sound Pressure Level
SPRAT	Species Profile and Threats (database)
SQG	Sediment Quality Guidelines
SSSV	Sub-Surface Safety Valve
SST	Sea Surface Temperature
SVS	Subsea Valve Skid
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
TOLC	Top of Line Corrosion
TPC	Third Party Contractor
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbons
TTS	Temporary Threshold Shift
TUTU	Topside Umbilical Termination Unit
TRSC-SSSV	Tubing Retrievable Surface Controlled Sub-Surface Safety Valve
UHF	Ultra-High Frequency
UTA	Umbilical Termination Assembly
VBA	Victorian Biodiversity Atlas
VCS	Vertical Connection System
VHF	Very High Frequency
Vic	Victoria
VoO	Vessel/s Of Opportunity
WET	Whole Effluent Toxicity
WIMP	Well Integrity Management Plan
WOMP	Well Operations Management Plan

WRSSV	Wireline Retrievable Subsurface Safety Valve
XT	Christmas Tree

Units of Measurement

Abbreviation	Definition
'	Foot/Feet
"	Inch(es)
°C	Degrees Celsius
bbl	Barrel
cui	Cubic Inches
dB	Decibel(s)
g	Gram/s
ha	Hectare/s
hr	Hour/s
kJ	Kilojoule(s)
km	Kilometre
km/hr	Kilometres per hour
kPa	Kilopascal(s)
kPaG	Kilopascal(s) – guage pressure
L	Litre(s)
m	Metre(s)
m^2	Square metres
m^3	Cubic metres
mL	Millilitre(s)
MM	Million
MMbbl	Million barrels
MMscf	Million Standard Cubic Feet
nm	Nautical Mile(s)
ppb	Parts per billion
ppm	Parts per million
s	Second(s)
scf	Standard Cubic Foot/Feet
t	Tonne(s)
TJ	Terajoule(s)
V	Volt(s)
µg	Microgram(s)

1. Introduction

1.1 Background

Beach Energy (Operations) Ltd (Beach) is the Operator of the BassGas Development. The BassGas Development consists of gas and liquids produced from the Yolla gas field, located 147 km south of Kilcunda (Victoria) in Bass Strait (Figure 1.1), that are transported via a subsea pipeline to the Victorian mainland via a coastal crossing near Kilcunda. Commercial gas production started in June 2006.

1.2 Environment Plan Summary

Table 1.1 provides a summary of this Environment Plan (EP) as required by Regulation 11(4) of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (herein referred to as the OPGGS(E)).

Table 1.1. EP Summary of material requirements

EP Summary requirement	Relevant EP section
The location of the activity	Section 3.2
A description of the receiving environment	Chapter 5
A description of the activity	Chapter 3
Details of the environmental impacts and risks	Chapter 7
The control measures for the activity	Chapter 7
The arrangements for ongoing monitoring of the titleholder's environmental performance	Chapter 8
Response arrangements in the oil pollution emergency plan (OPEP)	Refer to OPEP
Consultation already undertaken and plans for ongoing consultation	Chapter 4
Details of the titleholder's nominated liaison person for the activity	Section 1.4

1.3 Scope

This EP includes a description of:

- The nature of the activity (location, layout, operational details);
- The legislative framework relevant to the activity;
- Stakeholder consultation activities;
- The environment affected by the activity;
- Environmental impacts and risks;
- Mitigation and management measures;
- Environmental performance outcomes, standards and measurement criteria;
- How impacts and risks will be reduced to be an acceptable level and be As Low As Reasonably Practicable (ALARP);

- The implementation strategy to ensure that the environmental impacts and risks are managed in a systematic manner; and
- Reporting arrangements.

1.3.1 Definition of the Activity

In accordance with Regulation 4(1) of the OPGGS(E), this EP applies to a defined 'petroleum activity.' The petroleum activity in Commonwealth waters is defined as:

> *Operation and maintenance activities related to the production and flow of gas and condensate through the Yolla-A platform and wells (in Production Licence T/L1) and subsea pipeline (pipeline licences Vic/PL34 and T/PL2) in Commonwealth waters.*

In accordance with the Victorian Offshore Petroleum and Greenhouse Gas Storage (OPGGS) Regulations 2011 (herein referred to as the OPGGS Regulations) Regulation 6, the petroleum activity is defined as the:

> *Operation and maintenance activities related to the flow of gas and condensate through the pipeline in state waters (licence Vic/PL34(V)).*

More specifically, the activity is defined as the operation and maintenance for the next five years of the:

- Yolla-A manned platform (in Production Licence T/L1);
- Yolla-3, -4, -5 and -6 wells; and
- Offshore Raw Gas Pipeline (RGP) (Pipeline Licences PL34 and PL34(V)).

The onshore components of the project excluded from the scope of this EP include the:

- Onshore RGP;
- Lang Lang Gas Plant (LLGP); and
- Sales Gas Pipeline.

1.3.2 Jurisdictions

Because the activity occurs in both Commonwealth and Victorian waters, this EP has been prepared to satisfy the requirements of Commonwealth and Victorian legislation, namely:

- Part 2 of the OPGGS(E), administered by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA); and
- Part 2.2 of the OPGGS Regulations, administered by the Earth Resources Regulation [ERR] branch of the Victorian Department of Jobs, Precincts and Regions (DJPR).

This single EP has been submitted to both regulators for assessment and acceptance.

The regulatory jurisdictions of the BassGas offshore facilities are detailed further in Section 2.2.

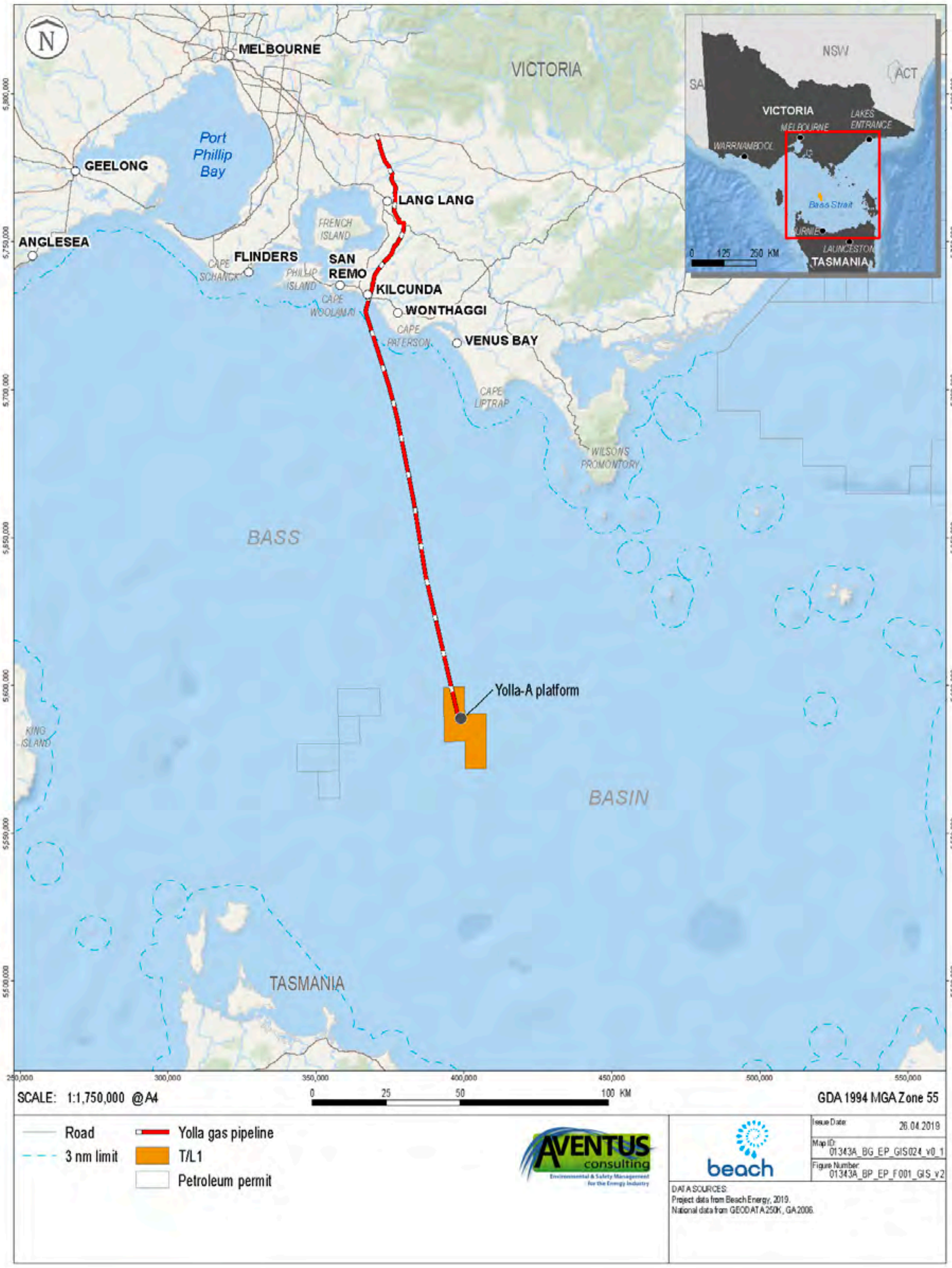


Figure 1.1. BassGas location map

1.3.3 Interfaces with Other Documents

This EP interfaces with several other plans, including the:

- Yolla-A Safety Case (CDN/ID 5214686);
- Lang Lang Gas Plant Safety Case (CDN/ID 5214692);
- BassGas Raw Gas Pipeline - Offshore Pipeline Safety Case (CDN/ID 5214688);
- BassGas Raw Gas Pipeline – PL243 Safety Management Plan (CDN/ID 8201905);
- Yolla-A Platform Well Operations Management Plan (WOMP) (CDN/ID 3972817);
- BassGas Site Emergency Response Plan (SERP) (CDN/ID 3974548);
- Emergency Management Plan (EMP) (CDN/ID 18025990);
- BassGas Operations Oil Pollution Emergency Plan (OPEP) (CDN/ID 3972816); and
- Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908).

These documents describe in detail the facilities, health and safety risks associated with their operation, emergency management arrangements and the systems in place to manage these risks.

1.4 The Titleholder

Beach is the Titleholder and Operator of the development on behalf of several joint venture partners:

- Beach Energy (Operations) Limited (ABN 66 007 845 338) – 37.5% (Operator);
- Beach Energy (Bass Gas) Limited (ABN 40 009 475 325) – 5.0%;
- Beach Energy Limited (ABN 20 007 617 969) – 11.25%;
- AWE Petroleum Pty Ltd (ABN 52 009 440 975) – 22.5%;
- AWE (BassGas) Pty Ltd (ABN 81 124 779 068) – 12.5%; and
- Prize Petroleum International Pte Ltd (ABN 16 601 684 048) – 11.25%.

Beach acquired Lattice Energy Ltd (previously Origin Energy Resources Limited (Origin)) on 31 January 2018. This ownership change follows on from the announcement made by Origin in December 2016 to divest its conventional upstream oil and gas assets in Australia and New Zealand and the subsequent formation of the Lattice group of companies as owner of the conventional upstream assets. Subsequently in January 2020, Beach completed a name change of Lattice Energy to Beach Energy.

Beach was formed in 1961 and is an Australian Stock Exchange-listed oil and gas, exploration and production company headquartered in Adelaide, South Australia. It has operated and non-operated onshore and offshore oil and gas production from five petroleum basins across Australia and New Zealand and is a key supplier to the Australian east coast gas market. Beach's asset portfolio includes ownership interests in strategic oil and gas infrastructure, as well as a suite of high potential exploration prospects. Beach's gas exploration and production portfolio includes acreage in the Otway, Bass, Cooper/Eromanga, Perth, Browse and Bonaparte basins in Australia, as well as the Taranaki and Canterbury basins in New Zealand (Figure 1.2).

Beach is Australia's largest onshore oil producer and a key supplier to the Australian east coast gas market, supplying approximately 15% of the east coast's domestic gas demand.

The Company has approximately 500 employees and is a leading producer of gas in eastern Australia, with two offshore production platforms and two gas plants in Victoria.

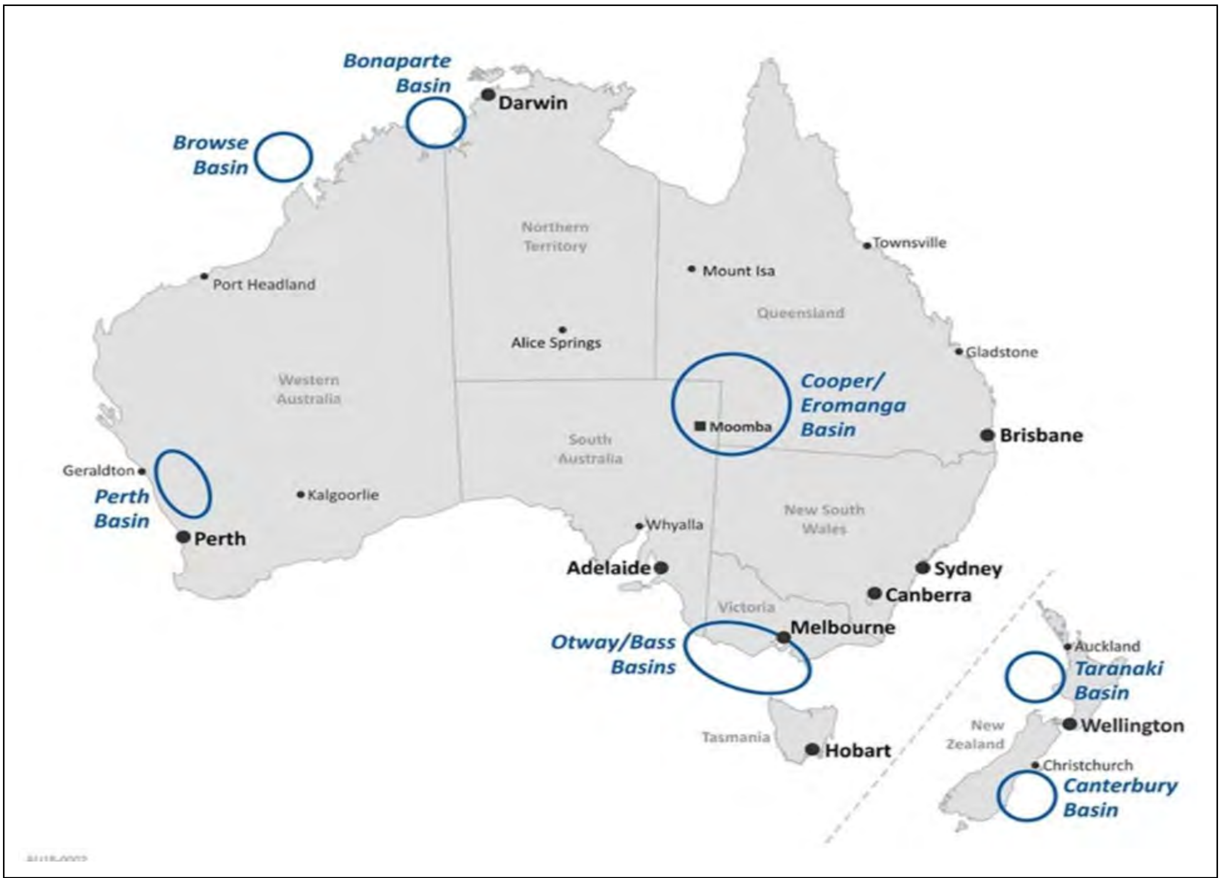


Figure 1.2. Location of Beach's assets

The Titleholder for this activity is:

Beach Energy (Operations) Ltd (ACN 007 845 338)
Level 8, 80 Flinders Street, Adelaide, South Australia, 5000
Phone: 08-8338 2833
Email: info@beachenergy.com.au

The nominated liaison person for this EP is:

Philip Wemyss
Beach Principal Environment Advisor
Level 8, 80 Flinders Street, Adelaide, South Australia, 5000
Phone: 08-8338 2833
Email: info@beachenergy.com.au

Beach will notify NOPSEMA and DJPR (ERR) of any change in titleholder, a change in the titleholder's nominated liaison person, or a change in the contact details for either the titleholder or the liaison person as soon as practicable after such a change takes place.

1.5 Objectives of this EP

As required by Regulation 19(1) of the OPGGS(E) and Regulation 22(1) of the OPGGS Regulations, an EP must be revised and resubmitted every five (5) years. This EP aims to secure acceptance to continue operating the activity for an additional five years by demonstrating that Beach is managing the environmental impacts and risks of the activity to ALARP and to an acceptable level.

Of particular focus with this five-yearly EP update is:

- Updating the Titleholder details (in accordance with Regulation 17(7) of the OPGGS(E) and Regulation 20(4) of the OPGGS Regulations);
- Applying new EP guidance provided by NOPSEMA since the EP's last acceptance in October 2014, including:
  - Expanding on the demonstration of ALARP and Acceptability.
  - Describing the existing environment within an Environment that May Be Affected (EMBA), as determined by oil spill trajectory modelling (OSTM) undertaken using revised hydrocarbon spill scenarios and thresholds.
  - Integration of the description and impact assessment of Matters of National Environmental Significance (MNES) under the EPBC Act resulting from the streamlining process (see Section 2.2.1 for more detail).
- Including assessments of environmental impacts and risks against the management plans of Australian Marine Parks (AMPs), state marine parks and species recovery plans within the EMBA; and
- Distinguishing between issues pertinent to NOPSEMA (Commonwealth waters) and DJPR (Victorian state waters).

2. Environmental Regulatory Framework

In accordance with Regulation 13(4) of the OPGGS(E) and Regulation 15(3)(a) of the OPGGS Regulations, this chapter describes the legislative requirements that apply to the activities described in this EP.

2.1 Beach Environment Policy

In accordance with Regulation 16(a) of the OPGGS(E) and Regulation 19(a) of the OPGGS Regulations, Beach's Environment Policy is provided in Figure 2.1. The policy provides a public statement of the company's commitment to minimise adverse effects on the environment and to improve environmental performance.

Beach operates under Lattice's Health, Safety and Environment (HSE) Management System (HSEMS) for offshore operations to minimise and manage the impacts on employees, contractors, the environment and the communities in which the company operates. The Lattice HSEMS has been developed in accordance with Australian/New Zealand Standard ISO 14001:2004 (Environmental Management Systems) (described further in Chapter 8).

2.2 Legislative Framework

Because the activity occurs in both Commonwealth and Victorian waters, this EP has been prepared in accordance with:

- Part 2 of the OPGGS(E); and
- Part 2.2 of the OPGGS Regulations.

NOPSEMA is the designated regulator for petroleum activities in Commonwealth waters (3 nm to 200 nm from land) and the DJPR is the designated regulator for petroleum activities in Victorian State waters (from the high-water mark to 3 nm from land).

Figure 2.2 provides a simplified representation of the jurisdictions for the BassGas Development, with Table 2.1 outlining the geographic coordinates for the same.

Table 2.1. Geographic coordinates and jurisdiction of assets

Asset	Licence	Section	Regulations
Yolla-A platform	T/L1	Centred on 39° 50′ 38″ S and 145° 49′ 05″ E	OPGGS(E)
RGP	T/PL2	From the Yolla platform to 39° 11′ 55″ S and 145° 36′ 03″ E (Victorian/Tasmanian administrative border)	OPGGS(E)
	Vic/PL34	From the Victorian/Tasmanian administrative border to 38° 37′ 09″ S and 145° 27′ 48″ E (Victorian 3 nm limit)	OPGGS(E)
	Vic/PL34(V)	From the low water mark to 38° 37′ 09″ S and 145° 27′ 48″ E (Victorian 3 nm limit)	OPGGS Regulations

Environment Policy

Objective

Beach is committed to conducting operations in an environmentally responsible and sustainable manner.

Strategy

To achieve this, Beach will:

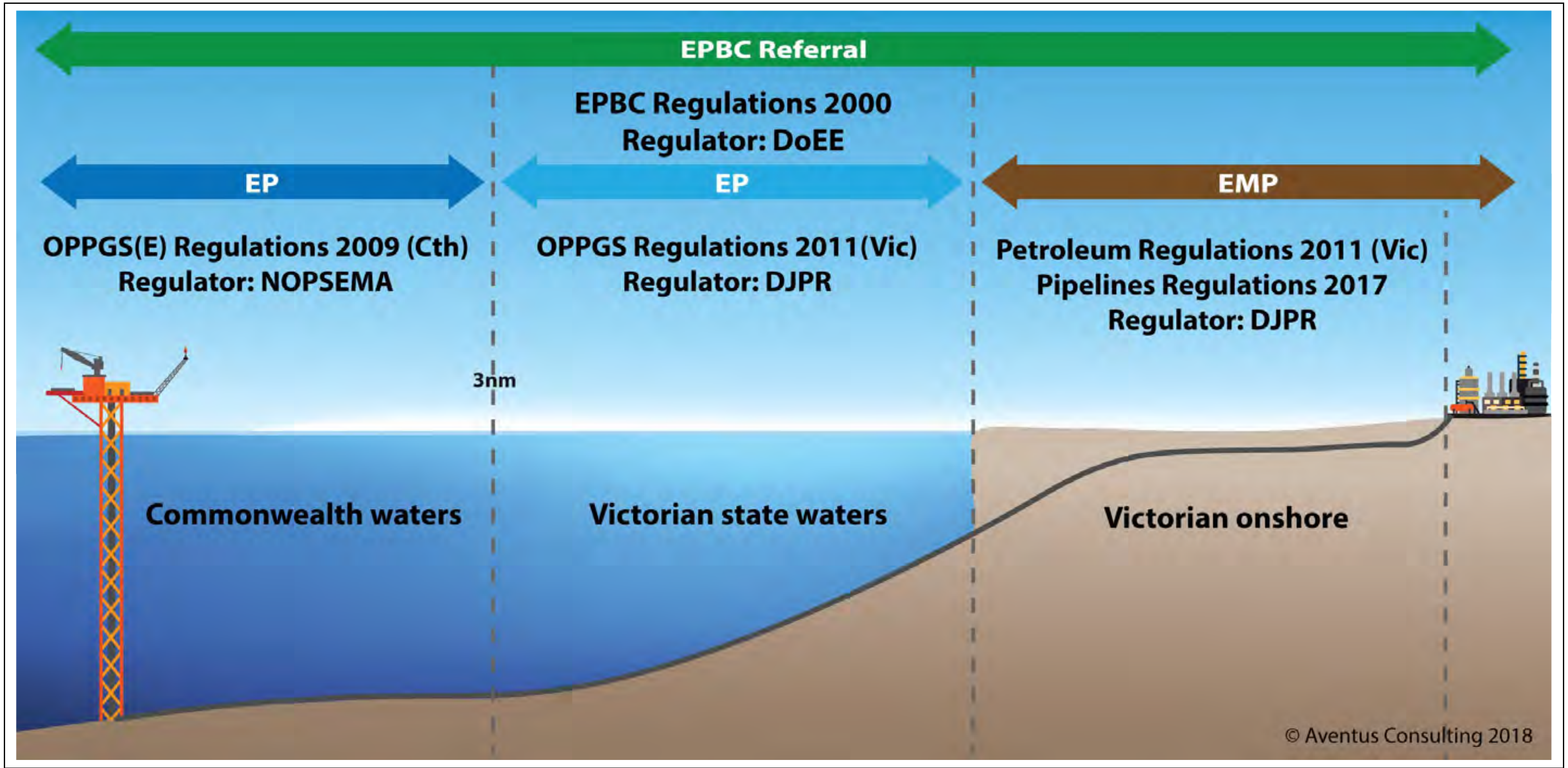
- Comply with relevant environmental laws, regulations, and the Beach Health, Safety and Environment Management System which is the method by which Beach identifies and manages environmental risk.
- Establish environmental objectives and targets, and implement programs to achieve them that will support continuous improvement;
- Identify, assess and control environmental impacts of our operations by proactive management of activities and mitigation of impacts;
- Ensure that incidents, near misses, concerns and complaints are reported, investigated and lessons learnt are implemented;
- Inform all employees and contractors of their environmental responsibilities including consultation and distribution of appropriate environmental management guidelines, regulations and publications for all relevant activities;
- Efficiently use natural resources and energy, and engage with stakeholders on environmental issues; and
- Publicly report on our environmental performance.

Application

This policy applies to all personnel associated with Beach activities.

Matt Kay
Managing Director and CEO
December 2019

Figure 2.1. Beach Environmental Policy



* *Note: The EPBC Referral was relevant to the original development application and does not apply to ongoing operations.*

Figure 2.2. Simplified outline of the regulatory jurisdictions of the BassGas Development

2.2.1 Commonwealth Legislation

Table 2.2 presents a summary of the key Commonwealth legislation and regulations relevant to the environmental management of the activity, with detail to the most pertinent legislation and regulations provided below.

Offshore Petroleum and Greenhouse Gas Storage Regulations 2009

The OPGGS(E) addresses all licensing and environmental issues for offshore petroleum and greenhouse (GHG) activities in Commonwealth waters.

The OPGGS(E) requires the preparation of an EP prior to conducting a petroleum activity for acceptance by NOPSEMA. The EP is an activity-specific document that provides a detailed impact and risk assessment and explains how identified risks will be managed. Upon EP acceptance, the activity may commence (or continue, as is the case for ongoing operations), and an EP Summary is prepared by the proponent for exhibition on the NOPSEMA website.

Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) is the key legislation regulating projects that may have an impact on MNES. The Commonwealth Department of Agriculture, Water and the Environment (DAWE) (formerly the Department of the Environment and Energy (DoEE)) is the Regulator of the EPBC Act.

In February 2014, NOPSEMA became the sole designated assessor of petroleum and GHG activities in Commonwealth waters in accordance with the Minister for the Environment's endorsement of NOPSEMA's environmental authorisation process under Part 10, section 146 of the EPBC Act. Under the streamlined arrangements, impacts on the Commonwealth marine area by petroleum and GHG activities are assessed solely through NOPSEMA. As such, an EPBC Act Referral has not been prepared and submitted to the DoEE for the continuation of BassGas operations.

The development's Environmental Impact Statement (EIS) and resulting EPBC Decision 2001/321 gave Origin approval, with conditions, to construct and operate the production wells in the Yolla gas field, the Yolla offshore production facility, the onshore and offshore pipelines, an onshore gas treatment and compression plant and an onshore pipeline. None of the conditions associated with the development's original EPBC approval relate to ongoing operations and as such the approval is not relevant to this EP.

2.2.2 Victorian Legislation

Table 2.3 presents a summary of the key Victorian legislation and regulations relevant to the environmental management of the activity, with detail to the most pertinent legislation and regulations provided below.

Offshore Petroleum and Greenhouse Gas Storage Regulations 2011

The OPGGS Act 2010 (and associated OPGGS Regulations 2011) is the key legislation regulating petroleum activities in Victorian state waters and mandates that environmental considerations should be integrated into decision-making with regard to the administration of the Act. In this regard, an EP must be prepared and submitted to the Regulator for assessment and acceptance.

This Act and its Regulations (Chapter 2 – Environment) essentially mirror those of the Commonwealth Act and Regulations of the same name, however have not been modified to align with most recent revisions of the Commonwealth Act and regulations (streamlining amendments made in 2014 and transparency amendments made in 2019) and hence variations between jurisdictions exist.

Table 2.2. Summary of key Commonwealth environmental legislation relevant to the activity

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (& Regulations 2000)	Protects MNES, provides for Commonwealth environmental assessment and approval processes and provides an integrated system for biodiversity conservation and management of protected areas. The nine MNES are: 1. World heritage properties; 2. National heritage places; 3. Wetlands of international importance (Ramsar wetlands); 4. Nationally threatened species and ecological communities; 5. Migratory species; 6. Commonwealth marine environment; 7. The Great Barrier Reef Marine Park; 8. Nuclear actions (including uranium mining); and 9. A water resource, in relation to coal seam gas development and large coal mining development. **Relevance to this activity:** This EP includes a description and assessment of the MNES that may be impacted by the activity (principally items 4 and 5 in this list).	• Convention on Biological Diversity and Agenda 21 1992. • Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 (CITES). • Agreement between the Government and Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment 1974 (JAMBA). • Agreement between the Government and Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986 (CAMBA). • Republic of Korea Migratory Birds Agreement 2006 (ROKAMBA). • Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 (RAMSAR). • International Convention for the Regulation of Whaling 1946. • Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.	DAWE (NOPSEMA in the case of this activity)
OPGGS Act 2006 and OPGGS (Environment) Regulations 2009	The Act addresses all licensing and HSE issues for offshore petroleum and GHG activities extending beyond the 3 nm limit. The Regulations (Part 2) specify that an EP must be prepared for any GHG activity and that activities are undertaken in an ecologically sustainable manner. **Relevance to this activity:** The preparation and acceptance of this EP satisfies the key requirements of this legislation.	Not applicable.	NOPSEMA
Environment Protection (Sea Dumping) Act 1981 (& Regulations 1983)	Aims to prevent the deliberate disposal of wastes (loading, dumping, and incineration) at sea from vessels, aircraft, and platforms. **Relevance to this activity:** There will be no dumping at sea within the meaning of the legislation that would require a sea dumping permit to be obtained.	• Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1972 [London Convention] • Protocol on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1996 [London Protocol]	DAWE

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Australian Maritime Safety Authority Act 1990 *(*AMSA Act*)*	Facilitates international cooperation and mutual assistance in preparing and responding to major oil spill incidents and encourages countries to develop and maintain an adequate capability to deal with oil pollution emergencies. Requirements are implemented through AMSA. AMSA is the lead agency for responding to oil spills in the Commonwealth marine environment and is responsible for implementing the Australian National Plan for Maritime Environmental Emergencies (NatPlan). **Relevance to this activity:** In the event of a Level 2 or 3 hydrocarbon spill to sea from the wells, pipeline or vessels in Commonwealth waters, AMSA may take over from Beach as the Combat Agency and implement the NatPlan.	• International Convention on Oil Pollution Preparedness, Response and Cooperation 1990 (OPRC). • Protocol on Preparedness, Response and Cooperation to Pollution Incidents by Hazardous and Noxious Substances 2000. • International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969. • United Nations Convention on the Law of the Sea 1982 (UNCLOS) (articles 198 & 221).	AMSA
Underwater Cultural Heritage Act 2018	Protects the heritage values of shipwrecks, sunken aircraft and relics (older than 75 years) in Australian Territorial waters below the low water mark to the outer edge of the continental shelf (excluding the State's internal waterways. It is an offence to interfere with a shipwreck covered by this Act. **Relevance to this activity:** No historic shipwrecks, sunken aircraft or relics are mapped to occur near the Yolla-A platform, and there is only one in close proximity to the pipeline in Commonwealth waters. In the event of the discovery of, and damage to previously unrecorded wrecks, this legislation may be triggered.	• Agreement between the Netherlands and Australia concerning old Dutch Shipwrecks 1972.	DAWE
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	Regulates the manufacture, importation and use of ozone depleting substances. **Relevance to this activity:** The platform does not have a register of ozone-depleting substances (ODS), but vessels may do.	• Montreal Protocol on Substances that Deplete the Ozone Layer 1987. • United Nations Framework Convention on Climate Change (UNFCCC) 1994.	DAWE
Navigation Act 2012 (& Regulations 2013)	This Act regulates ship-related activities in Commonwealth waters and invokes certain requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) relating to equipment and construction of ships. Several Marine Orders (MO) are enacted under this Act relating to the environmental and social management offshore petroleum activities, including: • MO Part 21: Safety and emergency arrangements. • MO Part 30: Prevention of collisions.	• United Nations Convention on the Law of the Sea 1982 (UNCLOS). • International Convention for the Safety of Life at Sea 1974 (SOLAS). • Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREG). • International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 (MARPOL).	AMSA

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
	• MO Part 50: Special purpose vessels. **Relevance to this activity**: The platform, support and maintenance vessels will adhere to the relevant MOs while operating within Commonwealth waters.	• International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) as amended, 1995.	
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994	Regulates ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, garbage, air pollution etc. Requires that ships >400 gross tonnes to have pollution emergency plans. Several MO are enacted under this Act relating to offshore petroleum activities, including: • MO Part 91: Marine Pollution Prevention – Oil • MO Part 93: Marine Pollution Prevention – Noxious Liquid Substances • MO Part 94: Marine Pollution Prevention – Packaged Harmful Substances • MO Part 95: Marine Pollution Prevention – Garbage • MO Part 96: Marine Pollution Prevention – Sewage • MO Part 97: Marine Pollution Prevention – Air Pollution • MO Part 98: Marine Pollution Prevention – Anti-fouling Systems. **Relevance to this activity:** Supply, support and maintenance vessels >400 gross tonnes will adhere to the relevant MOs by having a SMPEP, Oil Record Book and Garbage Management Plan in place and implemented, along with international pollution prevention certificates verifying compliance with oil, air pollution and sewage measures. See also Table 2.4 for further information.	Various parts of MARPOL.	AMSA
Protection of the Sea (Shipping Levy) Act 1981	Provides that where, at any time during a quarter when a ship with tonnage length of no less than 24 m was in an Australia port, there was on board the ship a quantity of oil in bulk weighing more than 10 tonnes, a levy is imposed in respect of the ship for the quarter. **Relevance to this activity:** Supply, support and maintenance vessels will adhere to the shipping levy, as required.	Not applicable.	AMSA
Protection of the Sea (Civil Liability for Bunker	Sets up a compensation scheme for those who suffer damage caused by spills of oil that is carried as fuel in ships' bunkers.	• International Convention on Civil Liability for Bunker Oil Pollution Damage 2001.	AMSA

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
Oil Pollution Damage) Act 2008	There is an obligation on ships >1,000 gross tonnes to carry insurance certificates when leaving/entering Australian ports or leaving/entering an offshore facility within Australian coastal waters. **Relevance to this activity:** Supply, support and maintenance vessels will hold the necessary insurance certificates, as required.		
Protection of the Sea (Harmful Antifouling Systems) Act 2006	Creates an offence for a person to engage in negligent conduct that results in a harmful anti-fouling compound being applied to a ship. Also provides that Australian ships must hold 'anti-fouling certificates', provided they meet certain criteria. **Relevance to this activity:** Supply, support and maintenance vessels will hold valid anti-fouling certificates, as required.	• International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001.	AMSA
Protection of the Sea (Shipping Levy) Act 1981	Provides that where, at any time during a quarter when a ship with tonnage length of no less than 24 m was in an Australia port, there was on board the ship a quantity of oil in bulk weighing more than 10 tonnes, a levy is imposed in respect of the ship for the quarter. **Relevance to this activity:** Supply, support and maintenance vessels will adhere to the shipping levy, as required.	Not applicable.	AMSA
Native Title Act 1993	Allows for recognition of native title through a claims and mediation process and also sets up regimes for obtaining interests in lands or waters where native title may exist. **Relevance to this activity:** Native Title Determination area does not cover the offshore area in which the activities will be undertaken, and therefore there is no relevance to this activity.	Not applicable.	Department of Families, Housing, Community Services and Indigenous Affairs
National Greenhouse and Energy Reporting Act 2007 (NGER) (& Regulations 2008)	Establishes the legislative framework for the NGER Scheme, which is a national framework for reporting GHG emissions, GHG projects and energy consumption and production by corporations in Australia. **Relevance to this activity:** Beach is a registered reporter under this Act (ABN 200 076 179 69). The development as a whole triggers this legislation because of the volume of emissions from the various assets.	• UNFCCC 1994.	Clean Energy Regulator
Biosecurity Act 2015 (& Regulations 2016)	This Act provides the Commonwealth with powers to take measures of quarantine, and implement related programs as are necessary, to prevent the introduction of any plant, animal, organism or matter that could contain anything that could threaten Australia's native	• International Convention for the Control and Management of Ships Ballast Water & Sediments 2004.	DAWE

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
	flora and fauna or natural environment. The Commonwealth's powers include powers of entry, seizure, detention and disposal. Offshore petroleum installations outside of 12 nm are located outside of Australian territory for the purposes of the Act. While these installations are not subject to biosecurity control, aircraft and vessels (not subject to biosecurity control) that leave Australian territory and are exposed to the installations are subject to biosecurity control when returning to Australian territory. When a vessel or aircraft leaves Australian territory and interacts with an installation or petroleum industry vessel it becomes an 'exposed conveyance' and is subject to biosecurity control when it returns to Australian territory unless exceptions can be met. The person in charge of an exposed conveyance carries the responsibility for pre-arrival reporting under the Act and must arrive at a first point of entry. This Act includes mandatory controls in the use of seawater as ballast in ships and the declaration of sea vessels voyaging into and out of Commonwealth waters. The regulations stipulate that all information regarding the voyage of the vessel and the ballast water is declared correctly to the quarantine officers. **Relevance to this activity:** Supply, support and maintenance vessels sourced from foreign ports will adhere to the DAWE guidelines regarding quarantine clearance to enter Australian waters.	• World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures (SPS agreement). • World Organisation for Animal Health and the International Plant Protection Convention.	
Marine Safety (Domestic Commercial Vessel) National Law Act 2012 (& Regulations 2013)	This Act provides for a national system for Domestic Commercial Vessels (DCV) between states and territories to ensure their safe operation. This system provides for MO and National Standards to be adopted for DCVs of different classes. Current MO include: • MO 501 (Administration – National Law) 2013; • MO 502 (Vessel Identifiers – National Law) 2013; • MO 503 (Certificates of Survey – National Law) 2013; • MO 504 (Certificates of Operation and Operational Requirements – National Law) 2013; • MO 505 (Certificates of Competency – National Law) 2013; and • MO 507 (Load Line Certificates – National Law) 2013. This law does not over-ride state legislation with respect to marine environmental management, dangerous goods management, speed	Not applicable.	AMSA

Legislation/Regulation	Scope	Related International Conventions	Administering Authority
	limits, navigation aids, rules for prevention of collisions, monitoring of marine communications systems, workplace health and safety or emergency management and response. **Relevance to this activity:** Applies to DCV used as supply, support or maintenance vessels at the platform or along the pipeline in Commonwealth waters.		
Fisheries Management Act 1991 *(& Regulations 2009)*	This Act aims to implement efficient and cost-effective fisheries management on behalf of the Commonwealth, ensure that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of Ecologically Sustainable Development (ESD), maximise the net economic returns to the Australian community from the management of Australian fisheries, ensure accountability to the fishing industry and to the Australian community in AFMA's management of fisheries resources, and achieve government targets in relation to the recovery of the costs of AFMA. **Relevance to this activity:** Provides the regulatory and other mechanisms to support any necessary fisheries management decisions in the event of a hydrocarbon spill in Commonwealth waters.	Not applicable.	Australian Fisheries Management Authority (AFMA)

Table 2.3. Summary of key Victorian environmental legislation relevant to the activity

Legislation/Regulation	Scope	Relevance to activity	Administering Authority
Offshore Petroleum and Greenhouse Gas Storage Act 2010 (& Regulations 2011)	Addresses all licensing, health, safety and environmental issues for offshore petroleum and GHG activities in Victorian coastal waters (between the low water mark and the 3 nm limit). This Act and its Regulations (Chapter 2 – Environment) mirror those of the Commonwealth Act and Regulations of the same name in most aspects. Section 61 of the Act (Principles of sustainable development) states that the administration of the Act should take into account the principles of sustainable development. These principles include involving the community in issues that affect them.	The gas pipeline traverses Victorian state waters.	DJPR (ERR)
Emergency Management Act 2013 (& Regulations 2003)	Provides for the establishment of governance arrangements for emergency management in Victoria, including the Office of the Emergency Management Commissioner and an Inspector-General for Emergency Management. Provides for integrated and comprehensive prevention, response and recovery planning, involving preparedness, operational co-ordination and community participation, in relation to all hazards. These arrangements are outlined in the Emergency Management Manual Victoria.	Emergency response structure for managing emergency incidents within Victorian waters. Emergency management structure would be triggered in the event of a Level 2 or 3 MDO spill that extends into Victorian waters.	Department of Justice and Regulation (Inspector General for Emergency Management)
Flora and Fauna Guarantee Act 1988 (FFG Act) (& Regulations 2011)	The purpose of this Act is to protect rare and threatened species and enable and promote the conservation of Victoria's native flora and fauna and to provide for a choice of procedures that can be used for the conservation, management or control of flora and fauna and the management of potentially threatening processes. Where a species has been listed as threatened, an Action statement is prepared setting out the actions that have been or need to be taken to conserve and manage the species and community.	Triggered in the unlikely event of the injury or death of an FFG Act-listed species (e.g., collision with a whale) in State waters.	Department of Environment, Land, Water and Planning (DELWP)
Seafood Safety Act 2003 (& Regulations 2014)	The purpose of this Act is to provide a regulatory system under which all sectors in the seafood supply chain are required to manage food safety risks.	Triggered in the unlikely event that a hydrocarbon spill results in impacts to commercial fisheries or the prevention of sale of seafood caught in waters affected by a spill.	Victorian Fisheries Authority (VFA)
Environment Protection Act 1970 (& various regulations)	This is the key Victorian legislation that controls discharges and emissions (air, water) to the environment within Victoria (including state and territorial waters). It gives the Environment Protection Authority (EPA) powers to control marine discharges and to undertake prosecutions. Provides for the maintenance and, where necessary, restoration of appropriate environmental quality.	Triggered in the unlikely event of a hydrocarbon spill that occurs from or extends to State waters. All support and maintenance vessels working on the pipeline within State waters must abide by the ballast water management	EPA

	The State Environment Protection Policy (Waters of Victoria) designates: • Spill response responsibilities by Victorian Authorities to be undertaken in the event of spills (DJPR) with EPA enforcement consistent with the Environment Protection Act 1970 and the Pollution of Waters by Oil & Noxious Substances Act 1986. • Requires vessels not to discharge to surface waters sewage, oil, garbage, sediment, litter or other wastes which pose an environmental risk to surface water beneficial uses. Since 2017, the EPA no longer regulates domestic ballast water management in Victoria. This has been taken over by the Commonwealth government. This means vessels visiting a Victorian port no longer need to provide ballast water documentation to EPA Victoria, and that ballast water must be managed in accordance with the Commonwealth Biosecurity Act 2015 (see Table 2.2).	requirements (see note regarding Commonwealth jurisdiction of ballast water management).	
Pollution of Waters by Oil and Noxious Substances Act 1986 (POWBONS Act) (& Regulations 2002)	The purpose of the POWBONS Act is to protect the sea and other waters from pollution by oil and noxious substances. This Act implements MARPOL Annex I in State waters. This Act restricts the discharge of treated oily bilge water according to vessel classification, discharge of cargo substances or mixtures, garbage disposal and packaged harmful substances, and sewage. The Act requires mandatory reporting of marine pollution incidents. See also Table 2.4 for further information.	Triggered in the unlikely event of a hydrocarbon spill that originates from or extends to State waters that requires a vessel-based response.	Jointly administered by DEDJTR and EPA
National Parks Act 1975	This Act established a number of different types of reserve areas onshore and offshore, including Marine National Parks and Marine Sanctuaries. A lease, licence or permit under the OPGGS Act 2010 that is either wholly or partly over land in a marine national park or marine sanctuary is subject to the National Parks Act 1975 and activities within these areas require Ministerial consent before activities are carried out. Several marine national parks occur within the amalgamated oil spill EMBA (see Section 5.4).	Triggered in the unlikely event of a hydrocarbon spill that enters Victorian marine parks.	DELWP
Wildlife Act 1975 *Wildlife (Marine Mammals)* Regulations 2009	The purpose of this Act is to promote the protection and conservation of wildlife, prevents wildlife from becoming extinct and prohibit and regulate persons authorised to engage in activities relating to wildlife (including incidents). The regulations prescribe minimum distances to whales and seals/seal colonies, restrictions on feeding/touching and restriction of noise within a caution zone of a marine mammal (dolphins (150m), whales (300m) and seals (50m)).	Triggered if the unlikely event of injury or death of whales, dolphins or seals in Victorian waters (e.g., during response to a MDO spill).	DELWP

Marine (Drug, Alcohol and Pollution Control) Act 1988 (& Regulations 2012)	This Act provides for the prohibition of masters and other persons involved in vessel operations from being under the influence of prescribed drugs or alcohol, defines prohibited discharges (refer to POWBONS), and allocates roles, responsibilities and liabilities to ensure there is a capacity and obligation (i.e., Director – Transport Safety, public statutory body) to respond to marine incidents which have the potential, or do, result in pollution. The Victorian Marine Pollution Contingency Plan (EMV, 2016) is prepared under this Act.	Applies to vessel masters, owners, crew operating vessels in Victorian State waters. Provides the Victorian Government response structure and contingency planning arrangements for marine pollution incidents in Victorian waters that must be implemented for vessel incidents.	Maritime Safety Victoria
Heritage Act 1995 (& Heritage (Historical Shipwrecks) Regulations 2007)	The purpose of the Act is to provide for the protection and conservation of historic places, objects, shipwrecks and archaeological sites in state areas and waters (complementary legislation to Commonwealth legislation). Part 5 of the Act is focused on historic shipwrecks, which are defined as the remains of all ships that have been situated in Victorian waters for 75 years or more. The Act addresses, among other things, the registration of wrecks, establishment of protected zones, and the prohibition of certain activities in relation to historic shipwrecks.	May be triggered in the event of impacts to a known or previously un-recorded shipwreck in Victorian waters (along the pipeline route).	Heritage Victoria (DELWP)

2.2.3 Tasmanian Legislation

The *Petroleum (Submerged Lands) Act* 1982 (Tas) provides for the exploration for petroleum and other resources in areas adjacent to the coast of Tasmania and for the sustainable exploitation of these resources.

None of the BassGas Development occurs within Tasmanian state waters and as such, no environmental approvals for ongoing operations are required from the Tasmanian government. Tasmanian legislation is relevant to BassGas operations in the case of a large hydrocarbon release, as the EMBA intersects areas of Tasmanian waters (around some Bass Strait islands and the northwest coast, see Figure 5.1).

The key Tasmanian legislation relevant to marine pollution in Tasmanian state waters includes:

- *Pollution of Waters by Oil and Noxious Substances Act* 1987 – designed to protect State waters from pollution by oil and other substances and to give effect to certain parts of the MARPOL convention;
- *Environmental Management and Pollution Control Act* 1994 – provides for the management of the environment and the control of pollution;
- *Emergency Management Act* 2006 – provides for the protection of life, property and the environment in a declared State emergency by outlining prevention, preparedness, response and recovery procedures;
- *Tasmanian Ports Corporation Act* 2005 – sets out administrative arrangements for the Tasmanian Ports Corporation Pty Ltd; and
- *Marine and Safety Authority Act* 1997 – sets out powers to ensure the safe operation of vessels in Tasmanian state waters.

2.2.4 New South Wales Legislation

None of the BassGas Development occurs within New South Wales (NSW) state waters and as such, no environmental approvals for ongoing operations are required from the NSW government. New South Wales legislation is relevant to BassGas operations in the case of a large hydrocarbon release, as the EMBA (low threshold for entrained marine diesel oil, MDO) intersects areas of the southern NSW coastline (see Figure 7.20).

The key New South Wales legislation relevant to marine pollution in NSW state waters includes:

- *Marine Pollution Act* 2012 (and Marine Pollution Regulations 2014) – designed to protect State waters from pollution by oil and other substances and to provide the Minister with powers of intervention with regard to detaining or directing commercial and trading vessels;
- *Protection of the Environment Operations Act* 1997 (and Protection of the Environment Operations (General) Regulations 2009) – applies to all navigable waters, with authorised officers have powers to non-pilotage vessels to give clean-up directions and direct a person to take preventative action;
- *Ports and Maritime Administration Act* 1995 – provides for the relevant port authority (in this case, Port Authority of NSW (Eden)) to exercise port safety functions, which involves providing or arranging for the provision of emergency environment protection services for responding to pollution incidents and carrying out investigations into marine incidents;
- *State Emergency and Rescue Management Act* 1989 – provides the emergency response framework for state agencies and specifies the requirement for a State Emergency Management Plan to be in place and implemented in the event of an emergency as defined in the plan.

2.3 Government Guidelines

Although the activity takes place within Victorian state waters and Commonwealth waters, this EP has been developed in accordance with the NOPSEMA Guidance Note for *Environment Plan Content Requirements* (N04750-GN1344, Revision 4, April 2019) in the absence of equivalent Victorian guidelines. This document provides guidance to the petroleum industry on NOPSEMA's interpretation of the OPGGS(E) to assist Titleholders in preparing EPs and ensures that regardless of jurisdiction, the content of this EP is of the standard required at the Commonwealth level.

Other relevant government guidelines that have been incorporated or taken into consideration during the preparation of this EP include:

<u>EPs</u>

- Environment Plan decision making (NOPSEMA Guideline GL1721, Rev 6, November 2019).
- Oil spill modelling (NOPSEMA Bulletin #1, April 2019).
- Decision-making guideline – Criterion – 10A(g) – Consultation requirements (NOPSEMA Guideline N-04750-GL1629, Rev 1, November 2016).

<u>OPEPs</u>

- Oil pollution risk management (NOPSEMA Guidance Note GN1488, Rev 2, February 2018).
- Advisory Note Offshore Petroleum Industry Oil Spill Contingency Planning Consultation (Department of Transport Planning and Local Infrastructure [DTPLI], Version 2.0, August 2013).
- Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA, January 2015).
- Advisory Note for Offshore Petroleum Industry Consultation with Respect of Oil Spill Contingency Plans (AMSA, 2012).

<u>OSMPs</u>

- Operational and scientific monitoring programs (NOPSEMA Information Paper, N-04700-IP1349, March 2016).

<u>EPBC Act</u>

- EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance (DoE, 2013).

2.4 Government Management Plans

The environmental performance standards (EPS) provided throughout Chapter 7 of this EP have taken into account various government management plans, generally under the categories of:

- AMP management plans;
- State coastal park management plans; and
- Recovery Plans, Conservation Plans and Conservation Advice for species threatened at the Commonwealth and/or state levels.

Table 2.4 lists the objectives of the AMP and state marine reserve management plans relevant to BassGas operations. **Appendix 1** provides a complete assessment of BassGas operations against marine reserve objectives.

Table 2.4. AMP and state marine reserves objectives of relevance to BassGas operations

Park Management Plan	Management Objectives	Relevance to Operations
South-east Commonwealth Marine Reserves Network Management Plan 2013-2023	Addresses knowledge and protection of conservation values, approval decision-making, facilitating education, supporting indigenous people, promoting community understanding of the reserve and evaluating the effectiveness of the management plan.	Management objectives for each reserve may only be at risk in the event of a large hydrocarbon release.
Bunurong Marine National Park (MNP)/Marine Park (MP)/Coastal Reserve (CR) and Kilcunda-Harmers Haven Coastal Reserve	Addresses landscape, seascape, geological features, water quality, hydrodynamics, marine habitats and communities, indigenous cultural heritage, public education and recreational park usage (e.g., boating, fishing, camping).	
Marengo Reefs Marine Sanctuary Management Plan	Addresses geomorphology, water quality, hydrodynamics, habitat and communities, seascape, marine pests, indigenous and maritime cultural heritage, education and interpretation and recreational park usage (e.g., snorkelling, swimming, shore-based activities).	
Mushroom Reef Marine Sanctuary Management Plan	Addresses geological, catchment, water quality, hydrodynamics, habitat, communities, seascape, marine pests, indigenous cultural heritage, maritime history and recreational park usage (e.g., snorkelling, diving, dog walking).	
Yaringa, French Island and Churchill Island MNP Management Plan	Addresses geological, catchment, water quality, hydrodynamics, habitat, communities, seascape, landscape, marine pests, indigenous cultural heritage, maritime history, education and recreational park usage (e.g., boating, swimming, tourism).	
Wilsons Promontory MNP, MP and Marine Reserve	Addresses landscape, seascape, geological features, water quality, hydrodynamics, marine habitats and communities, indigenous cultural heritage, public education and recreational park usage (e.g., boating, fishing, camping).	
Cape Howe MNP	Addresses geological features, water quality, hydrodynamics, habitats, seascape, marine pests, indigenous and maritime cultural heritage, education, information, access, recreational activities and tourism services.	
Point Hicks MNP Management Plan	Addresses geological, catchment, hydrodynamics, habitat and communities, seascape, marine pests, indigenous and maritime cultural heritage, education and interpretation and recreational park usage (e.g., snorkelling, swimming, intertidal activities).	

Table 2.5 details the Commonwealth-listed threatened species Conservation Advice and Recovery Plans applicable to BassGas operations. These species are described in Chapter 5. An assessment of BassGas operations against the objectives of these species' management plans is provided in **Appendix 2**.

Table 2.5. Objectives of Commonwealth-listed threatened species management plans of relevance to BassGas operations

Recovery Plan/Advice	Management Objectives	Relevance to Operations
Seabirds		
National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016.	Details research, monitoring and education strategies for albatross species and giant petrels.	Marine pollution: Evaluate risk of oil spill impact to feeding grounds and, if required, implement appropriate mitigation measures (nesting sites not impacted). Marine debris: Evaluate risk of oil spill (including risk of entanglement and/or ingestion) and, if required, implement appropriate mitigation measures.
National Recovery Plan for Gould's Petrel (*Pterodroma leucoptera leucoptera*)	The conservation of Gould's petrel.	None identified.
Approved Conservation Advice for the Blue Petrel (*Halobaena caerulea*)	The conservation of the blue petrel.	None identified.
Approved Conservation Advice for *Pterodroma mollis* (Soft-plumaged Petrel)	Monitoring and threat abatement strategies to ensure the conservation of the soft-plumaged petrel.	None identified.
Approved Conservation Advice for *Pachyptila tutur subantarctica* (Fairy Prion (southern))	Surveying, monitoring and threat abatement strategies to ensure conservation of the fairy prion (southern).	None identified.
Shorebirds		
Approved Conservation Advice for *Sternula nereis nereis* (Fairy tern)	The conservation of the fairy tern.	Marine pollution: Evaluate risk of oil spill impact to nest locations and, if required, implement appropriate mitigation measures.
Approved Conservation Advice for *Calidris canutus* (Red knot)	The conservation of the red knot.	Marine pollution: Evaluate risk of oil spill impact to nest locations and, if required, implement appropriate mitigation measures.
Approved Conservation Advice for *Botaurus poiciloptilus* (Australasian Bittern)	The conservation of the Australasian bittern.	None identified.
National Recovery Plan for the Orange-bellied Parrot (*Neophema chrysogaster*)	Achieve stable wild and captive populations and protect and enhance remaining habitat.	Illuminated boats and structures: Evaluate risk of lighting on vessels and offshore structures.
Approved Conservation Advice for *Lathamus discolor* (Swift Parrot)	Surveying, monitoring, education and threat abatement strategies to ensure conservation of the swift parrot.	None identified.
Wildlife Conservation Plan for Migratory Shorebirds – 2015	Sustain populations of migratory shorebirds across their range and diversity in Australia and throughout the East Asian-Australasian Flyway.	None identified.
Approved Conservation Advice for *Calidris tenuirostris* (Great knot)	The conservation of the fairy tern.	None identified.
Approved Conservation Advice for *Charadrius leschenaultia* (Great sand plover)	The conservation of the greater sand plover.	Illuminated boats and structures: Evaluate risk of lighting on vessels and offshore structures.

Recovery Plan/Advice	Management Objectives	Relevance to Operations
Approved Conservation Advice for *Charadrius mongolus* (Lesser sand plover)	Mitigate against key threats and aims to ensure the conservation of the lesser sand plover.	Marine pollution: Evaluate risk of oil spill impact to nest locations and, if required, implement appropriate mitigation measures.
Approved Conservation Advice for *Numenius madagascariensis* (Eastern Curlew)	Achieve a stable population, maintain important habitat, reduce disturbance and raise awareness for the eastern curlew, ensuring its conservation.	None identified.
Approved Conservation Advice for *Rostratula australis* (Australian painted snipe)	Minimise the impact of anthropogenic threats to conserve the Australian painted snipe.	None identified.
Conservation Advice *Thinornis rubricollis rubricollis*	Identify and mitigate against threats in order to conserve the hooded plover.	None identified.
Cetaceans		
Conservation Management Plan for the Blue Whale, 2015-2025	Minimise anthropogenic threats to allow for their conservation status to improve so they can be removed from the EPBC Act threatened species list.	Noise interference: Evaluate the risk of noise impacts to cetaceans and, if required, implement appropriate mitigation measures. Vessel disturbance: Evaluate risk of vessel strikes and, if required, implement appropriate mitigation measures.
Approved Conservation Advice for *Balaenoptera borealis* (Sei Whale)	Provides threat abatement activities that can be undertaken to ensure the conservation of the sei whale.	
Approved Conservation Advice for *Megaptera novaeangliae* (Humpback Whale)	Provides threat abatement activities that can be undertaken to ensure the conservation of the humpback whale.	
Conservation Management Plan for the Southern Right Whale, 2011-2021	Provides threat abatement activities that can be undertaken to ensure the conservation of the southern right whale.	
Approved Conservation Advice for *Balaenoptera physalus* (Fin Whale)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the southern right whale.	
Marine Reptiles		
Recovery Plan for Marine Turtles in Australia, 2017-2027	Minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so they can be removed from the EPBC Act threatened species list.	Marine pollution Light pollution Vessel disturbance Noise interference Vessel strike
Fish		
Recovery Plan for the White Shark (*Carcharodon carcharias*)	Mitigate key threats to the white shark and to assist the recovery of the white shark throughout its range in Australian waters.	None identified.
National Recovery Plan for the Australian Grayling (*Prototroctes maraena*)	Restore habitat, identify key populations, mitigate anthropogenic threat and increase public awareness to conserve the Australian grayling.	None identified.

Recovery Plan/Advice	Management Objectives	Relevance to Operations
National Recovery Plan for the Dwarf Galaxias (*Galaxiella pusilla*)	Minimise the probability of extinction and ensure long-term survival of the species in the wild and to increase the probability of important populations becoming self-sustaining in the long term.	None identified.
Approved Conservation Advice for *Epinephelus daemelii* (black cod)	Identify and mitigate key threats to the black cod and undertake priority research actions.	None identified.
Recovery Plan for the Grey Nurse Shark (*Carcharias Taurus*)	Improve the population status of the grey nurse shark to remove from threatened species list and ensure anthropogenic activities do not hinder the species recovery in the near future.	None identified.
Threatened Ecological Communities		
Approved Conservation Advice for Giant Kelp Marine Forests of South East Australia	Provides research priorities and actions that can be undertaken to ensure the conservation of the giant kelp marine forest communities.	None identified.
Approved Conservation Advice for the assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Provides research priorities and actions that can be undertaken to ensure the conservation of open-coast salt-wedge estuaries.	None identified.
Conservation Advice for Subtropical and Temperate Coastal Saltmarsh	Provides research priorities and actions that can be undertaken to ensure the conservation of subtropical and temperate coastal saltmarsh.	None identified.

Table 2.6 details the Victorian Action Statements for threatened species relevant to this activity. Additional species information is addressed in Chapter 5.

Table 2.6. Objectives of Victorian-listed threatened species action statements of relevance to BassGas operations

Action Statement	Management Objectives	Relevance to Operations
Seabirds		
Buller's albatross (*Thalassarche bulleri*)*	Supports national approaches to minimising impacts on the listed seabird species and to implement Victorian management arrangement consistent with the national approach.	Marine Pollution: Evaluate risk of oil spill impact to nest locations and, if required, implement appropriate mitigation measures.
Southern Royal Albatross (*Diomedea epomophora*)*		
Sooty Albatross (*Phoebetria fusca*)*		
Wandering Albatross (*Diomedea exulans*)		
Grey-headed Albatross (*Thalassarche chrysostoma*)		
Northern giant petrel (*Macronectes halli*)*		
Southern giant petrel (*Macronectes giganteus*)*		

Action Statement	Management Objectives	Relevance to Operations
White-bellied Sea-eagle (*Haliaeetus leucogaster*)	Identify all breeding populations within Victoria, protect nesting habitat and ultimately increase the population size and genetic viability of the White-bellied Sea-eagle.	Marine Pollution: Evaluate risk of oil spill impact to nest locations and, if required, implement appropriate mitigation measures.
Shorebirds		
Great Egret (*Ardea alba*)	Restore breeding sites, support the restoration of degraded wetlands and monitor egret populations.	None identified.
Hooded Plover (*Charadrius rubricollis*)*	Protect existing Victorian populations by maintaining habitat and ensuring that the hooded plover can breed successfully.	Marine Pollution: Evaluate risk of oil spill impact to shoreline breeding locations and, if required, implement appropriate mitigation measures.
Orange-bellied Parrot (*Neophema chrysogaster*)*	Supports national approaches to minimising anthropogenic impacts and to achieve a stable, viable wild population of birds.	Illuminated boats and structures: Evaluate risk of lighting on vessels and offshore structures.
Swift Parrot (*Lathamus discolour*)*	Maximise protection and retention of wintering habitat throughout Victoria to ensure that habitat availability will cater for a significant population of birds.	None identified.
Cetaceans		
Blue Whale (*Balaenoptera musculus*)* Humpback Whale (*Megaptera novaeangliae*)* Southern Right Whale (*Eubalaena australis*)	Ensure that the species can survive, flourish and retain its potential for evolutionary development in the wild by minimising human impacts and supporting national and international approaches to recovery.	Noise interference: Evaluate the risk of noise impacts to cetaceans and, if required, implement appropriate mitigation measures. Vessel disturbance: Evaluate risk of vessel strikes and, if required, implement appropriate mitigation measures. Marine pollution: Evaluate risk of oil spill impact to nest locations and, if required, implement appropriate mitigation measures.
Marine Reptiles		
Leartherback turtle (*Dermochelys coriacea*)*	Ensure that the species can survive, flourish and retain its potential for evolutionary development in the wild by minimising human impacts and supporting national and international approaches to recovery.	Vessel disturbance/strike: Evaluate risk of vessel strikes and, if required, implement appropriate mitigation measures. Marine pollution: Evaluate risk of oil spill impact to nest locations and, if required, implement appropriate mitigation measures. Illuminated boats and structures: Evaluate risk of lighting on vessels and offshore structures.
Fish		
Australian Grayling (*Prototroctes maraena*)*	Ensure the species can survive, flourish and retain its potential for evolutionary	None identified.

Action Statement	Management Objectives	Relevance to Operations
Dwarf Galaxias (*Galaxiella pusilla*)*	development in the wild. This is achieved through maintaining the extent of existing habitat and increasing community awareness and support.	
White Shark (*Carcharodon carcharias*)*	Implements appropriate Victorian arrangements to support the national approach for minimising impacts on great white sharks.	

* Species also have an EPBC Recovery Plan or Commonwealth Approved Conservation Advice.

2.5 International Industry Codes of Practice and Guidelines

A number of international codes of practice and guidelines are relevant to environmental management of the activity. Those of most relevance are described in this section. The Commonwealth legislation described in Table 2.2 lists the conventions and agreements that are enacted by, or whose principles are embodied in, that legislation.

While none of the codes of practice or guidelines described in this section have legislative force in Australia (with the exception of MARPOL), they are considered to represent best practice environmental management (BPEM). Aspects of each code or guideline relevant to the impacts and risks presented by the activity are outlined throughout Chapter 7.

2.5.1 MARPOL

The key international convention relating to marine environmental matters is the International Convention for the Prevention of Pollution from Ships (MARPOL). This convention was adopted in November 1973 by the International Maritime Organisation (IMO), with ongoing additions and amendments. MARPOL aims to prevent and minimise pollution (routine discharges and accidents) from ships. It contains six annexes and is in force in 156 countries (at January 2018). It is relevant to the vessels attending to the Yolla-A platform. It is also relevant to the Yolla-A platform itself because MARPOL defines 'ship' to include 'fixed or floating platforms.'

In Australian Commonwealth waters, MARPOL is given effect through the *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (via Marine Orders made under the *Navigation Act* 2012) and is administered by AMSA. In Victorian waters, MARPOL is given effect mainly through the POWBONS Act 1986 (Vic) and is administered by the Victorian EPA. Table 2.7 lists the annexes of the Convention and identifies how they are given effect under Commonwealth legislation (with Victorian legislation also included in the event of ingress into State waters being required in an emergency situation).

MARPOL is given effect in Tasmania by the POWBONS Act 1987 (Tas) and in NSW by the *Marine Pollution Act* 1987 (NSW).

2.5.2 Environmental Management in the Upstream Oil and Gas Industry (2020)

These guidelines were released in August 2020 by the International Association of Oil & Gas Producers (IOGP) and the International Petroleum Industry Environmental Conservation Association (IPIECA). They supersede the United Nations Environment Programme Industry and Environment (UNEP IE) Environmental Management in Oil and Gas Exploration and Production guidelines released in 1997 prepared by the International Exploration and Production Forum (E&P Forum), the precursor to the IOGP.

These guidelines provide descriptions of upstream oil and gas activities environmental management practices. Chapter 4 of the guidelines lists the environmental impacts and mitigation measures associated with offshore activities, and provide a useful benchmark for BPEM for this activity.

2.5.3 Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (2019)

The *Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production* (European Commission, 2019) aims to identify best available techniques (BAT) and best risk management approaches for key environmental issues associated with onshore and offshore oil and gas exploration and production activities. The BATs included are not prescriptive nor exhaustive but included as a point of comparison with documents such as this EP to ensure the desired environmental outcomes commensurate with BAT can be achieved for the European context.

2.5.4 World Bank Group EHS Guidelines (2015)

The *Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development* (World Bank Group, 2015) is a technical reference document with general and industry-specific examples of good international industry practice. These guidelines are applied when one or more members of the World Bank Group are involved in a project.

The document contains measures considered to be achievable in new facilities, using existing technology, at reasonable costs. The guidelines are designed to be tailored to the applicable hazards and risks established for a given project.

While the World Bank Group is not involved in financing or assessing this activity, control measures adopted for this activity that adhere to these guidelines can be referenced as examples of BPEM.

2.5.5 IOGP: Best Practice Guidelines

The International Association of Oil & Gas Producers (IOGP) has a membership including companies that produce more than one-third of the world's oil and gas. The IOGP provides a forum where members identify and share knowledge and good practices to achieve improvements in health, safety, environment, security and social responsibility. The IOGP's aim is to work on behalf of oil and gas exploration and production companies to promote safe, responsible and sustainable operations. The IOGP's work is embodied in publications that are made freely available on its website (www.iogp.org).

At November 2020, IOGP's members comprise 82 members, comprising oil and gas exploration and production companies, associations and contractors.

Beach is an IOGP member and the relevant guidelines have been referenced in this EP (and associated OPEP) to support the oil spill response strategies.

2.5.6 IPIECA Best Practice Guidelines

IPIECA is the International Petroleum Industry Environmental Conservation Association, established in 1974 (since 2002, IPIECA stopped using the full title). At November 2020, IPIECA's members comprise 69 members, comprising oil and gas exploration and production companies, associations and contractors.

IPIECA's vision is for an oil and gas industry whose operations and products meet society's environmental and social performance expectations, with a focus on the key areas of climate and energy, environment, social and reporting. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance. IPIECA's work is embodied in publications that are made freely available on its website (www.ipieca.org).

Although Beach is not an IPIECA member, relevant guidelines have been referenced in this EP (and associated OPEP) as relevant, primarily in the areas of atmospheric emissions and oil spill response and preparedness.

Beach has applied IPIECA's recent *Mapping the Oil and Gas Industry to the Sustainable Development Goals: An Atlas* (July 2017) to its BassGas operations. Goal 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development) is the most relevant to the offshore operations of the development, and has been met by fulfilling the following:

- Incorporating environmental assessments into management plans – this EP satisfies this sub-goal; and
- Accident prevention, preparedness and response – the OPEP and OSMP demonstrate that Beach takes prevention, preparedness and response seriously and is well prepared to act in the event of an environmental emergency.

2.5.7 ITOPF Oil Spill Response Technical Information Papers

The International Tanker Owners Pollution Federation Limited (ITOPF) was established in 1968 to promote effective response to marine spills of oil, chemicals and other hazardous substances by providing five core services (spill response, claims analysis and damage assessment, information services, contingency planning and advice and training and education). Membership of ITOPF comprises owners or demise charterers of tankers, defined as any ship (whether or not self-propelled) designed, constructed or adapted for the carriage by water in bulk of crude petroleum, hydrocarbon products or other liquid substances. While this definition excludes MODU and MODU operators becoming members of ITOPF, owners of support vessels servicing MODUs may become members.

More broadly, ITOPF's series of Technical Information Papers relate to marine pollution, including the effects of oil pollution, contingency planning for marine oil spills and responding to oil spills assist the upstream petroleum industry in preparing for and responding to oil spills.

In this EP (and associated OPEP), these ITOPF guidelines have been referenced to support the oil spill response strategies.

Table 2.7. Commonwealth and Victorian legislation enacting the MARPOL Convention

MARPOL Annex (entry into force in Australia)	Commonwealth waters (Protection of the Sea (Prevention of Pollution from Ships) Act 1983 & Navigation Act 2012)	Victorian waters (POWBONS 1986)	General requirements for operating in Commonwealth and Victorian state waters
I Regulations for the Prevention of Pollution by Oil (1988)	AMSA Marine Orders Part 91; Marine pollution prevention – oil.	Part 3, Division 2 – Prevention of pollution from ships Convention (ships carrying or using oil).	Addresses measures for preventing pollution by oil from regulated Australian vessels or foreign vessels, and specifies that: • An International Oil Pollution Prevention (IOPP) certificate is required; • A Shipboard Marine Pollution Emergency Plan (SMPEP) is required; • An oil record book must be carried; • Oil discharge monitoring equipment must be in place; and • Incidents involving oil discharges are reported to AMSA.
II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (1988)	AMSA Marine Orders Part 93; Marine pollution prevention – noxious liquid substances.	Part 3, Division 3 – Prevention of pollution from ships Convention (ships carrying noxious liquid substances in bulk).	Addresses measures for preventing pollution by 250 noxious liquid substances carried in bulk from regulated Australian vessels or foreign vessels, and specifies that: • An International Pollution Prevention (IPP) certificate is required; • A SMPEP is required; • A cargo record book must be carried; • Incidents involving noxious liquid substance discharges are reported to AMSA; • The discharge of residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with; and • No discharge of residues containing noxious substances is permitted within 12 nm of the nearest land.
III Prevention of Pollution by harmful Substances Carried by Sea in Packaged Form (1995)	AMSA Marine Orders Part 94; Marine pollution prevention – packaged harmful substances.	Part 3, Division 4 – Ships carrying harmful substances.	Addresses measures for preventing pollution by packaged harmful substances (as defined in the International Marine Dangerous Goods (IMDG) code, which are dangerous goods with properties adverse to the marine environment, in that they are hazardous to marine life, impair the taste of seafood and/or accumulate pollutants in aquatic organisms) from regulated Australian vessels or foreign vessels, and specifies that: • The packing, marking, labelling and stowage of packaged harmful substances complies with Regulations 2 to 5 of MARPOL Annex III; • A copy of the vessel manifest or stowage plan is provided to the port of loading prior to departure; • Substances are only washed overboard if the Vessel Master has considered the physical, chemical and biological properties of the substance; and • Incidents involving discharges of dangerous goods are reported to AMSA.

MARPOL Annex (entry into force in Australia)	Commonwealth waters (Protection of the Sea (Prevention of Pollution from Ships) Act 1983 & Navigation Act 2012)	Victorian waters (POWBONS 1986)	General requirements for operating in Commonwealth and Victorian state waters
IV Prevention of Pollution by Sewage from Ships (2004)	AMSA Marine Orders Part 96; marine pollution prevention – sewage.	Part 3, Division 5 – Sewage pollution prevention certificates.	Addresses measures for preventing pollution by sewage from regulated Australian vessels or foreign vessels, and specifies that: • An International Sewage Pollution Prevention (ISPP) is required; • The vessel is equipped with a sewage treatment plant (STP), sewage comminuting and disinfecting system and a holding tank approved by AMSA or a recognised organisation; • The discharge of sewage into the sea is prohibited, except when an approved STP is operating or when discharging comminuted and disinfected sewage using an approved system at a distance of more than 3 nm from the nearest land; and • Sewage that is not comminuted or disinfected has to be discharged at a distance of more than 12 nm from the nearest land.
V Prevention of Pollution by Garbage from Ships (1990)	AMSA Marine Orders Part 95; marine pollution prevention – garbage. * Not made under the *Navigation Act* 2012.	Part 2, Division 2A – Prevention of pollution by garbage.	Addresses measures for preventing pollution by garbage from regulated Australian vessels or foreign vessels, and specifies that: • Prescribed substances (as defined in the IMO 2012 Guidelines for the Implementation of MARPOL Annex V) must not be discharged to the sea; • A Garbage Management Plan must be in place; • A Garbage Record Book must be maintained; • Food waste must be comminuted or ground to particle size <25 mm while en route and no closer than 3 nm from the nearest land (or no closer than 12 nm if waste is not comminuted or ground); and • It is prohibited to discharge wastes including plastics, cooking oil, packing materials, glass and metal.
VI Prevention of Air Pollution from Ships (2007)	AMSA Marine Orders Part 97; marine pollution prevention – air.	Indirectly through the State Environment Protection Policy (Air Quality Management) under the *Environment Protection Act* 1970: • Clause 33 (Management of Greenhouse Gases).	Addresses measures for preventing air pollution from regulated Australian vessels or foreign vessels, and specifies that: • An International Air Pollution Prevention (IAPP) certificate is in place; • An Engine International Air Pollution Prevention (EIAPP) certificate is in place for each marine diesel engine installed; • An International Energy Efficiency (IEE) certificate is in place; • Specifies that incineration of waste is permitted only through a MARPOL-compliant incinerator, with no incineration of Annex I, II and III cargo residues, polychlorinated biphenyls (PCBs), garbage containing traces of heavy metals, refined petroleum products and polyvinyl chlorides (PVCs);

MARPOL Annex (entry into force in Australia)	Commonwealth waters (Protection of the Sea (Prevention of Pollution from Ships) Act 1983 & Navigation Act 2012)	Victorian waters (POWBONS 1986)	General requirements for operating in Commonwealth and Victorian state waters
		• Clause 35 (Management of ODS). • Clause 36 (Management of other Mobile Sources).	• Marine incidents are reported to AMSA; • Sulphur content of fuel oil is no greater than 3.5% m/m; • A bunker delivery note must be provided to the vessel on completion of bunkering operations, with a fuel oil sample retained; and • Emissions of ODS must not take place and an ODS logbook must be maintained.

2.6 Australian Industry Codes of Practice and Guidelines

There are few Australian industry codes of practice or guidelines regarding environmental management for offshore petroleum operations. Those that do apply to this activity are briefly discussed in this section.

None of these codes of practice or guidelines have legislative force in Australia, but are considered to represent BPEM. Aspects of each code or guideline relevant to the impacts and risks presented by the activity are described in the 'demonstration of acceptability' throughout Chapter 7.

2.6.1 National Strategy for Ecologically Sustainable Development (1992)

The National Strategy for Ecologically Sustainable Development (ESDSC, 1992) defines the goal of Ecologically Sustainable Development (ESD) as "*development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends*." Section 3A of the EPBC Act defines the principles of ESD as:

- Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations;
- If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation;
- The principle of inter-generational equity – that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations;
- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making; and
- Improved valuation, pricing and incentive mechanisms should be promoted.

The ESD concept has been taken into consideration in the development of the environmental performance standards outlined in this EP.

2.6.2 APPEA Code of Environmental Practice (2008)

In Australia, the petroleum exploration and production industry operates within an industry code of practice developed by the Australian Petroleum Production and Exploration Association (APPEA); the *APPEA Code of Environmental Practice* (CoEP) (2008). This code provides guidelines for activities that are not formally regulated and have evolved from the collective knowledge and experience of the oil and gas industry, both nationally and internationally.

The APPEA CoEP covers general environmental objectives for the industry, including planning and design, assessment of environmental risks, emergency response planning, training and inductions, auditing and consultation, and communication. For the offshore sector specifically, it covers issues relating to geophysical surveys, drilling and development and production.

The APPEA CoEP has been used as a reference for the impact and risk assessment (Section 7 of this EP) to ensure that all necessary environmental issues and controls for petroleum production have been incorporated into the management of this activity.

2.6.3 Australian Ballast Water Management Requirements (2017)

The *Australian Ballast Water Management Requirements* (DAWR, 2017, v7) detail the mandatory ballast water management requirements and provide information on ballast water pump tests, reporting and exchange calculations. The measures outlined in this EP are designed to minimise the risk of introducing harmful aquatic organisms into Australian waters. This guideline is relevant to the supply, support and maintenance vessels attending to Yolla-A and the pipeline.

2.6.4 National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009)

The *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (DAFF, 2009) provides a generic approach to a biofouling risk assessment and practical information on managing biofouling on hulls and niche areas.

The measures outlined in this EP are designed to minimise the risk of introducing harmful aquatic organisms into Commonwealth or Victorian waters from the support and maintenance vessels attending to the Yolla-A platform and pipeline.

2.6.5 Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2018)

The *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZG, 2018) are based on the philosophy of ESD and provide water and sediment quality guidelines designed to protect and manage the environmental values supported by fresh and marine water resources.

The guidelines are designed to help users assess whether the water quality of a water resource is good enough to allow it to be used for environmental values (humans, food production or aquatic ecosystems). If the water quality does not meet the water quality guidelines, the waters may not be safe for those environmental values and management action could be triggered to either more accurately determine whether the water is safe for that use or to remedy the problem.

In marine environments, the guidelines are generally applied to permanent point source discharges such as those from platform discharges (rather than to temporary vessel-based activities). For the BassGas operations, these guidelines are most relevant to produced formation water (PFW) discharges (see Section 7.6).

3. Activity Description

This chapter provides a description of BassGas operations in accordance with Regulation 13(1) of the OPGGS(E) and Regulation 15(1) of the OPGGS Regulations.

In this EP, the following terms are used to describe the BassGas operations depending on the context:

- Assets – refers to particular physical equipment (e.g., platform, pipeline, wells or components thereof);
- Development – the collective of physical assets that allow hydrocarbons to flow from the wells, be processed on the platform and flow through the raw gas pipeline; and
- Operations – the activities involved in operating (and maintaining) the development.

The definition of the petroleum activity is provided in Section 1.3.1.

Additionally, the term 'operational area' is used to describe the area that is or may be subject to operations, and is spatially defined as:

> A 500-m radius around the development, based on the fact that activities occurring within a 500-m radius of Yolla-A come under the control of the Person-in-Charge (PIC) on the platform. For inspection and maintenance activities, this is also taken to apply to the offshore RGP.

3.1 Facilities Outline

The offshore portion of the BassGas development consists of the following:

- Yolla-A Platform - a normally manned platform located in 80 m water depth with wellheads and topside gas and condensate processing facilities. It is located in Production Licence T/L1, approximately 93 km southwest of Wilson's Promontory in Victoria and 109 km northwest of the Tasmanian mainland. The term 'platform' may be used interchangeably with 'Yolla-A' throughout the EP.
- Offshore RGP – a 350 mm diameter pipeline consisting of a 147 km subsea section from the Yolla-A Platform and a 1.4 km underground shore crossing section near Kilcunda. The term 'offshore RGP' may be used interchangeably with the simpler term 'pipeline'.

The onshore parts of the development are listed below and excluded from the scope of this EP:

- Onshore RGP – a 32 km pipeline from the shore crossing at Kilcunda to the LLGP;
- LLGP – a gas processing facility near Lang Lang with a nameplate capacity of 67 TJ/day sales gas; and
- Sales Gas Pipeline - a 35 km 250 mm diameter underground pipeline transferring processed gas from the LLGP to the Victorian Principal Gas Transmission Pipeline near Pakenham.

3.2 Location

Table 2.1 in Section 2.2 provides the geographic coordinates for the Yolla-A platform and the key points of the offshore RGP. Table 3.1 provides the distances from the Yolla-A platform and offshore RGP to nearby features.

Table 3.1. Distances to key features from BassGas

Feature	Distance and direction from Yolla-A to the nearest point of the feature	Distance and direction from the nearest point of the offshore RGP to nearest point of the feature
Towns		
Tidal River (Vic)	99 km northeast	60 km east
Cape Paterson (Vic)	130 km north	9 km west
Narracoopa (Tas – King Island)	144 km west	
Wynyard (Tas)	127 km south	
Kilcunda (Vic)	145 km north	0.63 km west
Cape Woolamai (Vic – Phillip Island)	150 km north-northwest	13 km northwest
Whitemark (Tas – Flinders Island)	191 km southeast	
Natural Features		
Curtis Island (Tas)	82 km northeast	
Wilsons Promontory (Vic)	92 km northeast	61 km west
Tasmanian Mainland	109 km southeast	
Kent Group of Islands (Tas)	131 km west	
King Island (Tas)	143 km west	
Flinders Island (Tas)	166 km east	
Marine Protected Areas		
Commonwealth		
Boags Australian Marine Park (AMP)	66 km southwest	
Beagle AMP	70 km east	
Franklin AMP	142 km southwest	
Victorian - marine		
Wilsons Promontory Marine National Park (MNP)	86 km northeast	51 km east
Wilsons Promontory Marine Park	91 km northeast	53 km east
Cape Liptrap Coastal Park	102 km northeast	28 km east
Bunurong MNP	124 km north	10 km east
Bunurong Marine Park	126 km north	5 km east
Victorian – coastal (onshore)		

Feature	Distance and direction from Yolla-A to the nearest point of the feature	Distance and direction from the nearest point of the offshore RGP to nearest point of the feature
Kilcunda – Harmers Haven Coastal Reserve	132 km north	0.2 km west of HDD section
Kilcunda Coastal Reserve	145 km north	Intersected by HDD section
Punchbowl Coastal Reserve	145 km north	2 km west
Phillip Island Nature Park	146 km north-northwest	2km west
San Remo Coastal Reserve	146 km north-northwest	10 km west
Phillip Island Coastal Reserve	148 km north-northwest	13 km west
Tasmania - marine		
Kent Group Marine Reserve	126 km east	
Petroleum Infrastructure		
Tasmanian Gas Pipeline	104 km east	
Nearest oil or gas producing well (Perch oil field, monotower)	192 km northeast	156 km east
Other Infrastructure		
Subsea telephone cable – Bass Strait 1 (Sandy Point to Boat Harbour)	7 km east	
Subsea telephone cable – Bass Strait 2 (Inverloch to Stanley)	28 km west	Cross over at KP 70.8
Basslink subsea electricity cable	95 km east	
Victorian desalination plant – intake tunnel point	139 km north	3.4 km east
Victorian desalination plant – outlet tunnel exit	139 km north	3.3 km east

3.3 Overview of Major Components of the Offshore BassGas Development

The Yolla-A platform was installed in 2004 and the offshore RGP was constructed and installed in 2003 and 2004. The Yolla field has been in production since 2006, with the exception of a period between December 2011 and September 2012 when the Mid-Life Enhancements (MLE, including accommodation module) were installed on Yolla-A.

Yolla-A is a steel gravity based, self-installed platform that was originally designed for unmanned operations. The key elements of the offshore facilities are described in Table 3.2.

Table 3.2. BassGas offshore facilities specifications

Aspect	Summary of purpose and specification
Wells	
Subsurface	• Four producing wells (Yolla-3, Yolla-4, Yolla-5 and Yolla-6). • Tubing Retrievable Surface Controlled Sub-Surface Safety Valve (TRSC-SSSV) located down hole in each well. • Wireline Retrievable Surface Controlled Sub-Surface Safety Valve (WRSSV) installed in Yolla-6. • Permanent downhole pressure/temperature gauge in each well to allow real time acquisition of pressure and temperature data.
Yolla-A platform (from lowest to highest deck)	
Sea deck	A stairway from the well bay provides access to a small sea deck landing on the east side of the jacket 7.5 m above MSL. A fixed sea escape ladder terminates 5.5 m below the sea deck.
Well bay	The well bay is approximately 20 m x 24 m and is located within the jacket 8.5 m below the main deck level and is accessed by two stairs to the main deck and a stairway to the sea deck. Equipment in the well bay includes: • Jacket leg deck connections. • Eight well slots. • Four wellheads and corresponding choke valves. • Production flowlines and manifold. • Process piping to export raw gas pipeline riser Last Valve Off (LVO). • Well service pump facilities. • Main firewater pump. • Seawater lift pump. • Sewage caisson. • Produced water dump caisson.
Main deck – production equipment	Production facilities for separation and dehydration of gas and liquids: • Production cooler - receives the hot well fluids and cools them from 90 – 100 °C to 45 °C. • Production separator –separates liquids (condensate and water) from gas. • Triethylene glycol (TEG) contactor and regeneration unit. • Condensate dehydration. • Stripping gas dryer. • Two-stage gas driven export compressor. • Two condensate export pumps for pressure boosting prior to dehydration and export.

Aspect	Summary of purpose and specification
Main deck - utilities	• Main power supply is provided by two gas turbine driven generators (1,400 kW each) each capable of supplying 100 % of the electrical power demand. A diesel driven emergency generator (640 kW) provides back-up. Batteries provide emergency 240 V AC uninterruptable power supply (UPS) and 24V DC power supplies for loss of both main and emergency power generation. • Fuel gas skid - provides fuel gas for the main generators, purge gas and pilot gas, stripping gas for TEG regeneration and the dump caisson pump. • Instrument/plant air package – consists of two electrically driven, oil-lubricated compressors, filters, air dryers and an air reservoir vessel. • Fresh water system – pumps seawater via a filter through the reverse osmosis unit and into the treated water tank. • Sewerage system – treats domestic waste from the accommodation module with a macerator and discharges the effluent into the sewerage caisson.
Main deck – other	• Wellhead control panel. • Chemical injection and storage. • Diesel storage and distribution system. • Diesel firewater pumps and tanks. • Mechanical and instrument/electrical workshops. • Pedestal crane – diesel-powered and hydraulically operated. Pedestal is used for diesel storage. • Flare boom structure. • Telemetry facilities - to enable remote collection of process data and allow process control from LLGP. • 22-person totally enclosed mobile propelled survival craft (TEMPSC). • Safety equipment. • Navigational aids.
Accommodation module	The accommodation module is cantilevered off the north face of the platform jacket and has four levels: • Level 1 - instrument equipment room, electrical equipment room, emergency generator, and heating, ventilation and air conditioning (HVAC). • Level 2 - main temporary refuge (TR) muster area with day room, galley, first aid, permit office, dirty change area and electrical switch room. • Level 3 - cabin deck level for 22 persons. • Level 4 - utilities deck.
Helideck	The helideck is located above the accommodation module in the north-west corner of the platform.
Offshore RGP	
Export riser LVO	The raw gas pipeline and riser can be isolated from the platform by the LVO. A fail closed valve is located on its own mounting below the well bay. The LVO is function tested at least every six months and is subject to visual inspection annually. Periodic leak off tests are also performed.
Pig launcher	The pig launcher is located on the main deck.
Pipeline	The 13¾” (350 mm) offshore RGP is 147 km long and exports dehydrated gas and condensate from the Yolla-A platform to the onshore LLGP.

3.4 Wells

There are currently four producing wells: Yolla-3, Yolla-4, Yolla-5 and Yolla-6. The platform can accommodate up to seven production wells in total.

Christmas trees are fitted to each well, including hydraulically controlled fail-safe upper master and wing valves that close on loss of hydraulic pressure. Choke valves are fitted to each well to allow flow control, operated by remote manual setting, with feedback to confirm the setting. An alarm is initiated if the position registered is different to that set. There is a fail-safe TRSSV located down hole for each well that are held open under hydraulic pressure and close when the hydraulic pressure drops, generally due to a surface signal controlled by the Emergency Shutdown System (ESS). A pneumatically operated hydraulic high-pressure (HP) pump is used on each well to operate the TRSC-SSSVs. The pumps operate automatically by pressure control.

In February 2020, the Yolla-6 TRSSSV failed to meet acceptable performance criteria during testing and a WRSSV was installed.

The design total throughput will be unchanged following the introduction of any further wells (future drilling activity will be covered in a separate EP).

Further details are provided in the Yolla-A WOMP (CDN/ID 3972817).

3.4.1 Reservoir Fluids

The reservoir fluid produced to surface (raw gas) by the four Yolla wells consists of hydrocarbon gas and liquids, condensed water vapour and formation water. The Yolla gas field reservoir contains 65-70% methane (C_1), 17-20% carbon dioxide (CO_2), 5-8% ethane (C_2) and smaller quantities of heavier hydrocarbons. Reservoir fluid composition for each well is detailed in Table 3.3.

Yolla condensate is low in viscosity and has a high proportion (98.5%) of non-persistent components. Table 3.4 presents the physical characteristics of the Yolla condensate, verifying its highly volatile nature (i.e., it is quick to weather).

Well fluid contaminants include hydrogen sulphide (H_2S), mercury (Hg), radon (Rn) and CO_2. Maximum H_2S levels in the well fluids are approximately 40 parts per million (ppm) and the range for mercury is 100-1,000 microgram per standard cubic metre (µg/sm^3). Radon levels detected in onshore equipment have been below the threshold limits of 50 millisievert per hour (µSV/h) (Radiation Regulation 2007).

Procedures are in place for the management of these contaminants, which are generally only required during major shutdowns every 4 years. Decontamination facilities are set up as required on the platform and consist of decontamination wash facilities and storage for waste using personal protection equipment (PPE). Decontamination flushing fluid is classed as prescribed industrial waste and is transported to shore and disposed of in accordance with the BassGas Waste Management Plan (CDN/ID 3974553).

3.4.2 Wellheads and Production Manifold

The arrangement for each wellhead is a 20" (508 mm) conductor housing, a 13⅜" (340 mm) integral compact housing for hanging off the 9⅝" (244 mm) casing and production tubing and a 5,000# API production tree. The well fluids flow from the production trees through a master valve, wing valve and a choke valve to allow flow control into the production manifold. The fail-safe master and wing valves are hydraulically controlled by the wellhead hydraulic control panel (WHCP) and close when there is a loss of hydraulic pressure.

The flow lines downstream of the choke valves include a full flow relief valve. Each relief valve is sized for the flowing capacity of a single well at relieving conditions with the relief valve inlet and pilot heat traced. The relief valve is connected to the platform flare system and has a manual bypass. A pneumatically-operated hydraulic medium pressure (MP) pump is used on each well to operate the master and wing valves.

Material selection for the 25-year design life expectancy of the facility considered the high concentration of carbon dioxide in the well fluids with suitable corrosion-resistant materials specified for equipment and lines upstream of the gas and condensate dehydration units.

The production manifold may be readily extended to accommodate up to seven wells and the design total throughput will be unchanged with the introduction of future wells.

Table 3.3. Yolla reservoir fluids composition

Well	**Yolla-3**	**Yolla-4**	**Yolla-5**	**Yolla-6**
Sample date	08/09/2004	02/08/2007	21/07/2015	18/06/2015
Composition (mol%)				
CO_2 (carbon dioxide)	18.86	20.33	20.47	20.34
N_2 (nitrogen)	0.16	0.22	0.19	0.24
C_1 (methane)	67.16	67.27	66.45	66.72
C_2 (ethane)	6.49	6.38	6.79	6.59
C_3 (propane)	2.76	2.59	2.97	2.75
iC_4	0.48	0.42	0.46	0.48
nC_4	0.77	0.67	0.72	0.76
iC_5	0.26	0.20	0.21	0.25
nC_5	0.27	0.20	0.22	0.26
C_6	0.43	0.29	0.24	0.32
C_7	0.70	0.39	0.37	0.44
C_8	0.65	0.25	0.26	0.26
C_9	0.36	0.22	0.24	0.23
C_{10}	0.19	0.12	0.13	0.14
C_{11}	0.10	0.07	0.07	0.07
C_{12}+	0.36	0.38	0.22	0.15
Total	**100**	**100**	**100**	**100**

Analysis conducted by PetroLab. From sand 2755.

Table 3.4. Physical characteristics of Yolla condensate

	Volatiles	Semi-volatiles	Low Volatiles	Residual Oil (%)	Density (kg/m³ at 15°C)	Dynamic viscosity (cP at 25°C)
Boiling Point (°C)	< 180	180-265	265-380	> 380	770.6	0.14
Yolla condensate (%)	80.0	12.0	6.55	1.45		
Persistence	Non-persistent			Persistent		

3.4.3 Well Intervention Operations

The Yolla-A platform does not have drilling facilities and was specifically designed to allow well workovers by a short stroke/snubbing hydraulic unit (SHU) as well as tubing well intervention operations (e.g., coiled tubing or wireline operations). Reservoir management wireline work on the wells is carried out once a year per well in accordance with maintenance procedures. A specialist wireline crew of up to 16 personnel visits the platform to set-up and run the wireline, taking approximately 10-20 days.

The main deck level over the well bay has been specifically designed to support well intervention equipment including a power pack, coiled tubing reel and control cab.

If required, workover operations are undertaken using the accommodation available on the platform.

Further details on well intervention operations are included in the Yolla-A Platform WOMP (CDN/ID 3972817).

3.5 Yolla-A Platform

The Yolla-A platform (Plate 3.1) is four-legged tubular steel jacket, integrated into a gravity base structure that has a footprint of approximately 50 m x 50 m. It has the following pipework:

- 1 x 350 mm production riser;
- 2 x 350 mm riser slots;
- 8 x 500 mm well conductors;
  - Four for Yolla-3, -4, -5 and -6.
  - Two seawater pumps.
  - One sewage disposal.
  - One vacant.
- 1 x 750 mm dump caisson.

The export pipeline riser has been installed within the jacket structure, close to a jacket leg to provide protection from vessel impact.

The deck is a fully enclosed barge-like structure that provides support for the topsides structures and equipment. The deck is in the form of a rectangular box with an inner rectangle cut out to accommodate the well bay. The deck is approximately 8.5 m deep with primary steel located between the upper and lower decks. The upper and lower decks, and the inner and outer perimeter vertical surfaces are all fully steel plated and painted on exterior surfaces.

Inspection and maintenance of the steel surfaces is discussed in Section 3.6.4 and there is an Integrity Management Program (Structural Integrity, Offshore) for inspection of the unpainted interior surfaces (CDN/ID 11395877).

The general layout of Yolla-A is illustrated in Figure 3.1. The following sections provide a detailed description of the platform's components and functions.

3.5.1 Topsides – Overview of Hydrocarbon Processing Equipment

The main deck of Yolla-A is approximately 42 m x 50 m in size (2,100 m^2). The majority of the hydrocarbon containing equipment is located on the south side of the deck with the utilities and accommodation module located on the north side.

The Christmas trees, flowlines and manifolds are located in the well bay.

Hydrocarbon processing is designed to separate the raw gas into three streams; gas, condensate and produced formation water (PFW). The gas and condensate are then comingled and exported to the LLGP. The treated PFW is discharge to sea (see Section 3.5.6 for more information on PFW management).

The following major systems form the basis of the processing:

- Production cooling – to reduce the raw gas temperature from ~ 90 – 100°C to ~ 45°C to allow the gas and liquids to be separated;
- Production separation – separation of the gas, condensate and PFW;
- Gas compression – compression of the separated gas;
- Gas dehydration – removal of residual water from the gas for export;
- Condensate pumping – boost pressure prior to further dehydration of the condensate prior to export;
- PFW treatment – the PFW from the production separator passes through a hydrocyclone (which has been disabled). Degassing is undertaken to remove dissolved gas from the PFW. The treated PFW is then passed through a produced water filter prior to discharge to sea. Gas is flared via the flare header with oily water passing to the flare knockout (FKO) drum.
- Flaring, venting and drainage – there is no routine venting on the platform (there are safety valves that can vent if necessary). The flare is connected to the degasser and the TEG regeneration package. It is also the primary safety system so gas and condensate can be diverted to the flare system in the case of a non-routine or emergency event. The drainage system consists of an open and closed system. The open system discharges brine from the RO system, PW and treated sewage to sea via a discharge caisson. The closed drainage system is contained and not discharged.

The base number of Persons On Board (POB) is usually seven (7). This can be increased to 22 POB for wireline operations and maintenance (with a maximum of 37 POB).

Plate 3.1. The Yolla-A platform

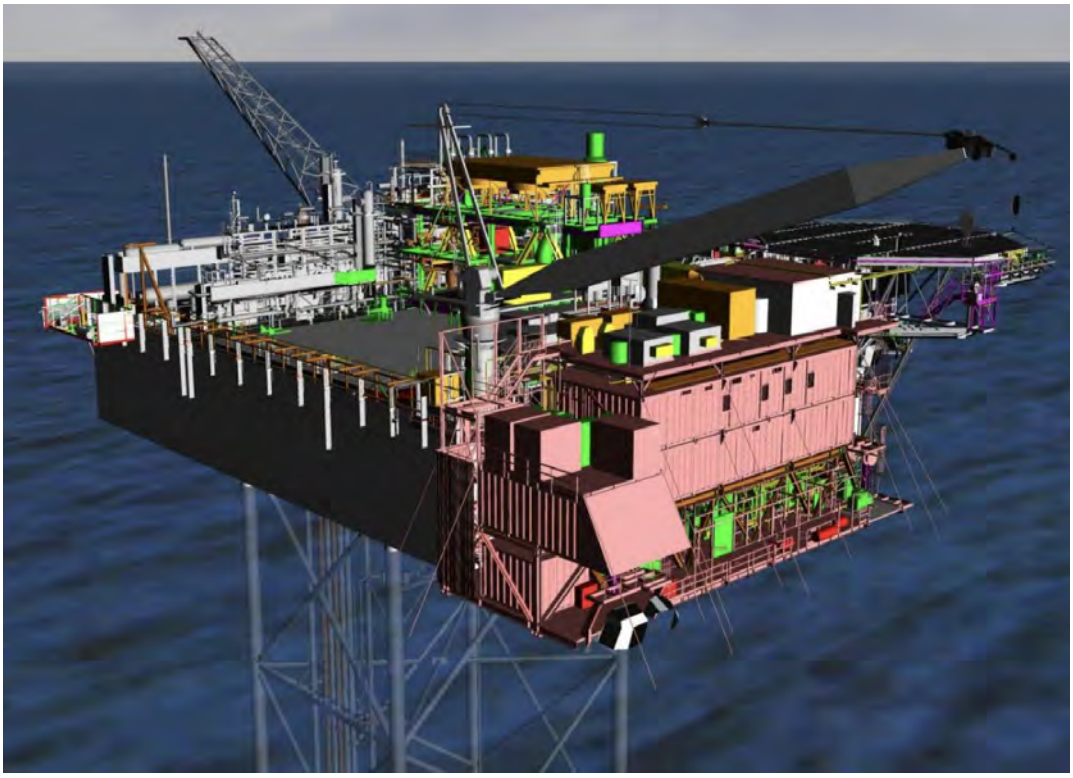


Figure 3.1. The Yolla-A platform general layout

3.5.2 Gas Dehydration

The platform processing plant dehydrates the well fluids for export to the LLGP to prevent internal corrosion of the carbon steel raw gas pipeline. The main process steps for gas and condensate dehydration are:

- Cooling and three-phase separation;
- Dehydration of the total gas stream in the TEG Contactor;
- Dehydration of the total condensate stream by contact with stripping gas (a side stream from the dehydrated gas) in the condensate dewatering column;
- Re-dehydration of the wetted stripping gas in the stripping gas dryer;
- Recombination of the gas and condensate streams for export via raw gas pipeline; and
- TEG regeneration equipment serving both the TEG contactor and the stripping gas dryer.

3.5.3 Process Control System

The process equipment on the platform is controlled by the process control system (PCS) located on the platform that is connected by a satellite link to a companion unit at LLGP. This enables the platform to be controlled and monitored from the LLGP. If satellite communications fail, the PCS can be controlled by the offshore operator via a remote PCS station on the platform. The following remote control functionality is provided:

- Adjustment of well flow rates using stepping actuators;
- Adjustment of chemical injection rates;
- Modulating control, monitoring and recording of process conditions throughout the process system;
- Opening/closing individual wells;
- Monitoring of wellhead pressures and temperatures;
- Start-up and shutdown of gas turbine generators; and
- On/off operation of valves and pumps.

3.5.4 Compression

The compressor is a single train, two-stage tandem dry-sealed centrifugal compressor in compliance with API 616:2011 (*Gas turbines for the petroleum, chemical and gas industry services*) and API 617:2016 (*Axial and centrifugal compressors and expander-compressors*). The two-stage export compressor is driven by a gas turbine and designed to ensure deliverability of gas to the LLGP as the reservoir pressure declines.

The turbine compressor control panel is located on Yolla-A with a data link to the LLGP.

Gas from the production separator is routed to the first-stage compressor suction scrubber and then enters the first stage of the two-stage export compressor where it is compressed and cooled in the intercooler before passing through the second stage compressor suction scrubber. After entering the second stage of the compressor and following compression, it is further cooled in the after-cooler before entering the TEG contactor.

Any water or condensate knocked out from the scrubbers is routed to the FKO drum. Condensate and water diverted to the FKO drum is then re-routed to the inlet separator to go through the process again. The condensate separated in the production separator is directed to two centrifugal export pumps for pressure boosting prior to dehydration and export.

3.5.5 Condensate Pumps

Condensate is separated in the production separator and directed to two 100% vertical type centrifugal condensate export pumps for pressure boosting prior to dehydration and export. The pumps are provided with variable speed drives to allow for turndown. At low flow rates, a minimum flow recycle returns condensate upstream of the production separator. The pumps have tandem seals with an API 610 (*Standard pumps*) flush plan and a separate common seal system skid.

3.5.6 Produced Formation Water Treatment

<u>Design</u>

Production fluids from the wells are passed through the production separator where the gas is separated from the oil and water mixture. PFW discharged from the production separator has suspended condensate/oil droplets that are removed by the hydrocyclone (due to the trace quantity of dispersed hydrocarbons [<5 ppm], the internal elements of the hydrocyclone were removed as part of a de-bottlenecking initiative).

The oil separated from the PFW is recirculated to the raw gas stream before being sent to the LLGP through the RGP.

Dissolved gas and traces of dispersed condensate/oil are then removed in the degasser with the PFW passing through a filter to remove any particulates remaining in the stream.

The PFW is then discharged to the dump caisson through a discharge pipe (Plate 3.2). A schematic of the PFW treatment process is shown in Figure 3.2.

The volume of total PFW discharge was debottlenecked and is now designed to a maximum of 300 m^3 /day. For the 2019 calendar year, the PFW daily flow rate averaged 186.4 m^3 (with a minimum of 29 m^3/day and a maximum of 271 m^3/day).

A side-stream of the discharge pipe is routed to two parallel oil-in-water (OIW) Sigrist analysers that continuously measure the PFW dispersed oil concentration before it is discharged to the caisson.

Plate 3.2. Views of the dump caisson from the 2019 subsea inspection campaign

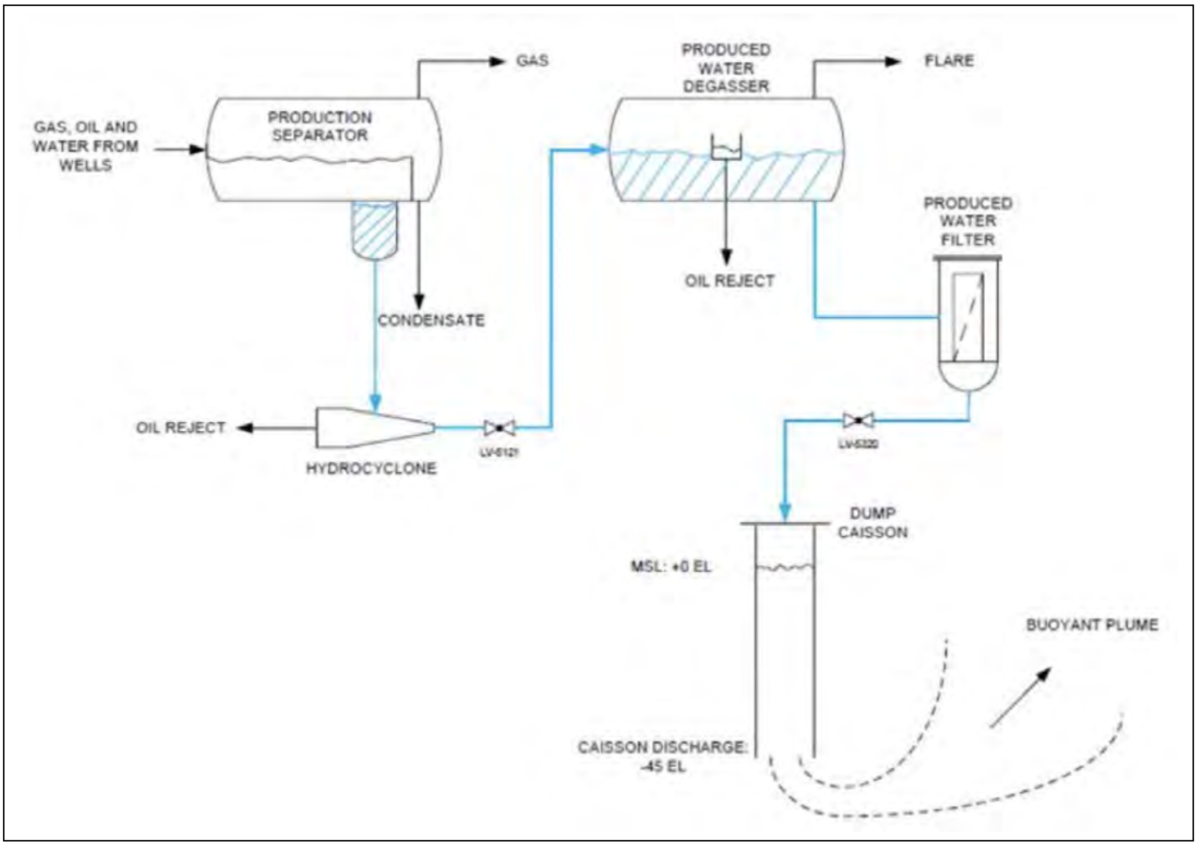


Figure 3.2. The PFW treatment process

PFW is continuously discharged unless the platform is shut in. As such, a vigilant PFW treatment regime is in place to ensure that the PFW discharged remains within the acceptable limits (detailed in Chapter 7).

PFW monitoring regime

Discharge of PFW from the Yolla platform must meet an OIW specification of less than an average of 30 ppm over a 24-hour period, with instantaneous maximums not above 50 ppm at any one time. These limits were derived from an engineering specification used in the Gulf of Mexico in the 1970s and was considered the point at which a visible sheen of oil could be observed on the water's surface.

In early 2014, the OPGGS(E) were modified such that the former prescriptive PFW discharge limit of 30 ppm of OIW averaged over 24 hours (and 50 ppm instantaneous limit) was removed in favour of assessing and managing PFW discharge impacts in the same objectives-based manner as other emissions and discharges. As such, other factors need to be considered, including the PFW discharge regime, chemical composition, toxicity, extent of dispersion and fate. The former regulations regarding PFW discharge did not define 'petroleum', but it was generally interpreted by the industry to refer to dispersed hydrocarbons (not dissolved hydrocarbons).

The current equipment used to remove OIW from the PFW stream is efficient at removing dispersed oil (i.e., droplets) but not dissolved oil (BTEX). As such, more emphasis in recent times has been placed on the management of Total Petroleum Hydrocarbons (TPH, which is the combination of dispersed and dissolved oils) in PFW streams.

In broad terms, hydrocarbons (also termed petroleum hydrocarbon or oil) can be considered to comprise non-dissolved hydrocarbons (in the physical form of films and droplets) and dissolved hydrocarbons. The non-dissolved hydrocarbons are also known as dispersed oil (OIW) and free oil or hydrocarbons.

The dispersed hydrocarbons (OIW) can be measured using techniques such as OSPAR test Method 2005-15. This is reported as OIW or dispersed oil and does not measure all hydrocarbons (e.g., dissolved species such as BTEX, other aromatic and aliphatic species, phenols etc) (aromatic and aliphatic hydrocarbons are defined in Section 7.6).

It is important to note that OIW (or dispersed oil) is not 'total hydrocarbons.'

TPH (also referred to as Total Recoverable Hydrocarbons [TRH] as there is an extraction part of the analytical technique) are analysed through alternate techniques based on extraction and GCMS analyses. The TPH is reported by carbon chain length (e.g., C6-C9, C10-C14, C15-C28, C28-C36; where C6-C9 are carbon species (hydrocarbons) with between 6-9 carbons in the structure). In addition, it is possible to analyse for specific hydrocarbon species (e.g., Benzene, Toluene, Ethyl Benzene and Xylene [BTEX], phenols etc).

In a simplistic sense:

- C6-C9 - are dissolved species including BTEX and aliphatics, some phenols and chlorinated hydrocarbons;
- C10-C14 - are dissolved species including aromatics aliphatics and phenols; and
- C14+ - are mainly non-dissolved hydrocarbons (OIW) with some PAHs.

For Beach, when referring to OIW this is reflective of 'dispersed oil', which has been consistently <5 ppm (well below the industry accepted 30 ppm limit). The dissolved oils are reflective of BTEX. TPH is therefore OIW water plus BTEX (i.e., dispersed oil plus dissolved oils).

The reference test method used to determine compliance with this specification is the OSPAR 2005-15 test method, which uses GC-FID technology to measure a water sample's C7-C40 content, excluding BTEX and any other polar components (i.e., organic/fatty acids). It essentially measures straight chain aliphatic hydrocarbons.

Prior to 2018, Beach used fluorescence-based technology to measure OIW online (Sigrist OIW analysers, AI-5327/AI-5328). This technology measures the aromatic hydrocarbon components only and requires a correlation to the OSPAR 2005-15 reference method. The analysers now analyse OIW (dispersed oil) in line with the OSPAR method. The Sigrist analysers are UV fluorescence meters that measure fluorescent molecules (i.e., those containing an aromatic ring such as BTEX). The FLU readings obtained from the analysers are used to develop calibration curves which are built into the Distributed Control System (DCS). Because this FLU reading is a direct measurement of UV fluorescence components, the actual laboratory analysis is required to develop a calibration curve for BTEX (dissolved hydrocarbon) components, and a separate calibration curve for the OIW (dispersed hydrocarbon) components.

In late 2020, the output readings from the two existing Sigrist analysers were configured to produce a continuous TPH reading in addition to the OIW reading. The weekly laboratory samples measure OIW and BTEX separately and record the FLU reading of the Sigrist analysers at the time of the sampling. With this information, Beach was able to develop two separate correlations for OIW and BTEX that are built into the DCS. This means that two calibrated measurements for the same FLU readings can be obtained from the DCS. The TPH value is the addition of the two values obtained from two separate calibration curves (OIW + BTEX). Both curves have been configured in the DCS and are checked and calibrated against the weekly laboratory test results to ensure the validation of the two readings. The calibration curves can be adjusted if required to ensure the analysers are reading accurately in accordance with laboratory results. A linear curve has been produced for the correlation of BTEX vs FLU. As illustrated in the charts in Figure 3.3, a perfectly linear correlation is difficult to establish due to a number of dynamic process and environmental factors that can influence the concentration of BTEX in PFW. This can include impacts due to high variability in weather conditions, which can affect processing temperatures, as well as process flow rates, which affects associated retention time in process equipment.

Chart A

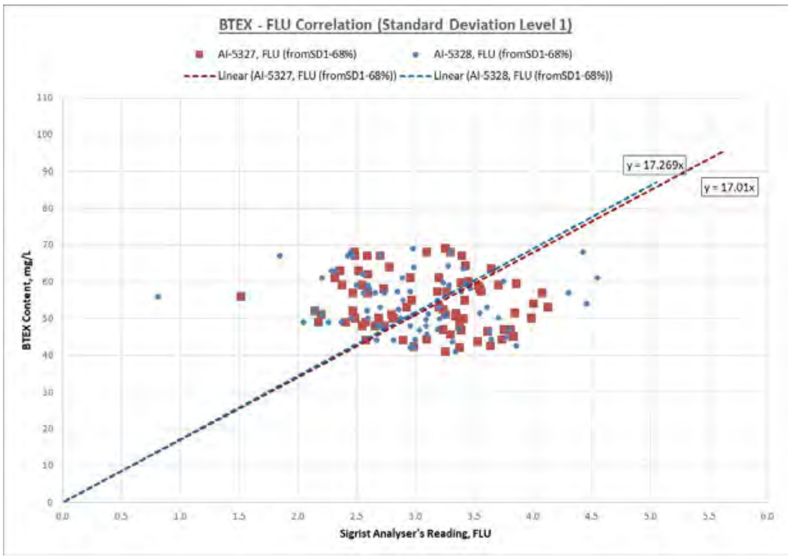


Chart B

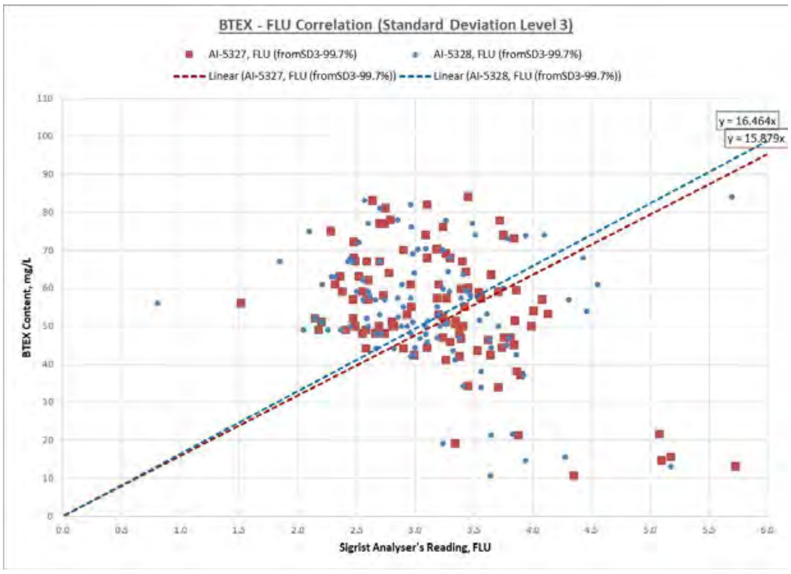


Chart C

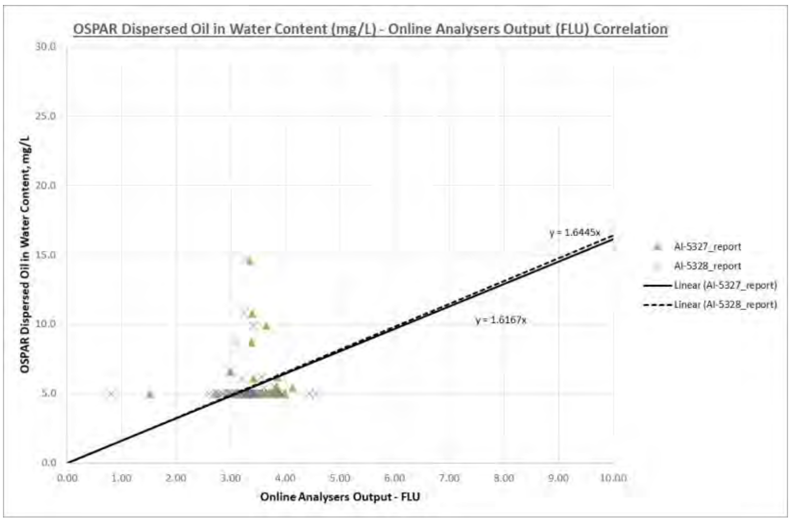


Figure 3.3. Sigrist analsyers' dispersed (OIW) and dissolved (BTEX) correlation curves

The BTEX concentration data has been reviewed and analysed from a standard deviation perspective to enable more representative data capture. Data for BTEX mainly concentrates in the middle of the chart, being the normal operating concentration for BTEX in Yolla's PFW. One standard deviation for the data has been chosen to capture the normal, expected operating range of the BTEX. There is insufficient data below 40 mg/L to establish any relationship with the analyser FLU readings, therefore a linear relationship has been assumed toward zero, which is consistent with the Sigrist vendor's documentation that the FLU-to-oil content relationship is linear below ~150 mg/L (Figure 3.4).

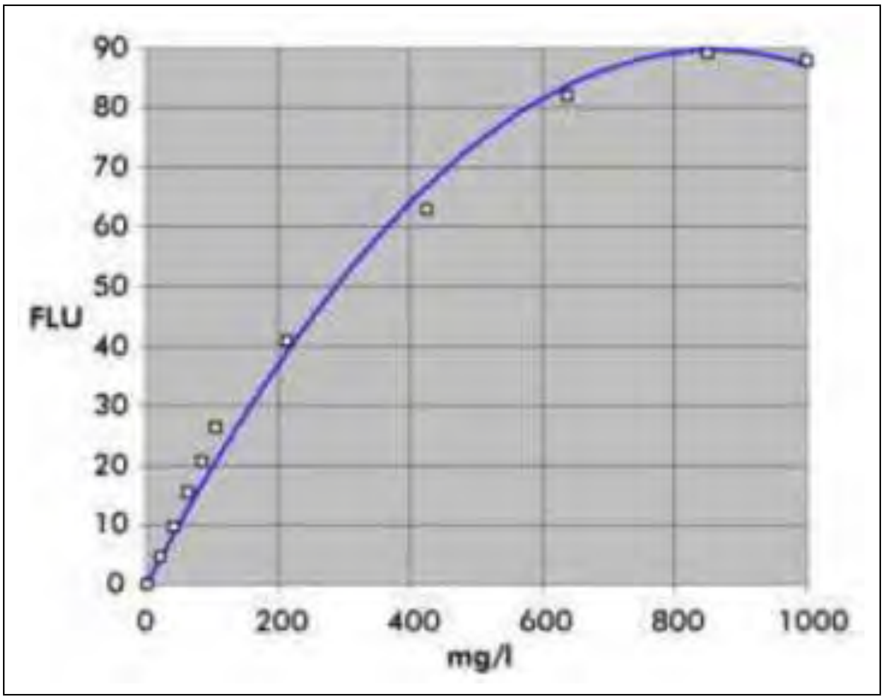


Figure 3.4. Extract from Sigrist documentation showing typical relationship between FLU and crude oil concentration with a linear correlation at less than 150 mg/L

Given the range of interest is 0-127 mg/L, the assumption that the FLU-to-OIW and TPH relationship is linear is considered valid. Additionally, as can be seen in the chart 'B' of Figure 3.3, at three standard deviations (99% of all lab data), a significant amount of outlying data is captured that skews the correlation to produce a lower BTEX reading. It was therefore determined that the use of the correlation of one standard deviation would be more representative of actual operations while also providing a degree of conservatism by generally producing a higher reading. It is expected that Yolla's PFW will continue to operate in this middle band due to current solubility levels in PFW, coming from the same reservoir characteristic.

The analyser readings will continue to be verified via weekly laboratory samples to ensure that the Sigrist analysers are reading with range, and also to verify that PFW samples are complying with the targets established in this EP. With the PFW system continuously measuring OIW and TPH, a TPH trigger level of 90 mg/L has been set to enable a reasonable margin for troubleshooting and initiation of actions to mitigate and control the potential increasing levels of TPH. The TPH level of 90 mg/L has an alarm configured in the DCS that alerts the control room operator of an elevated TPH reading and to respond accordingly. The continuous reading of TPH also enables continuous monitoring of changes in TPH levels, which enhances the ability to act and optimise ahead of any adverse changes in TPH caused by process or environmental conditions.

As additional precautions, the PFW system has also been configured with a number of automated shutdowns that will activate if: 1) the OIW concentration reaches 50 mg/L; 2) the TPH concentration reaches 127 mg/L and the PFW flow rate reaches 300 m^3/day; or the TPH concentration exceeds 127 mg/L for a period of 60 minutes, The correlation in Chart 'C' of Figure 3.3 displays the current (late 2020) dispersed OIW correlation. The data is concentrated at 5 mg/L, being the limit of detection for the OSPAR test method used, where laboratory testing reports are providing results of <5 mg/L and actual concentrations could range from 0 to 5 mg/L. Dispersed oil levels are very low for the Yolla platform, with water samples not visually displaying any signs of sheening (very clear in appearance), evidenced by the low OIW results produced by laboratory testing.

As previously mentioned, the TPH value is the addition of the two values obtained from two separate calibrations curves (OIW + BTEX). Both curves have been implemented in Yolla-A's DCS to produce a continuously instantaneous reading. The curves are reviewed and calibrated against the weekly laboratory test results to ensure the validation of the two readings. The calibration curves can be adjusted if required to ensure the analysers are reading accurately, in accordance with laboratory results. The weekly laboratory tests have been occurring since mid-2018 and will continue to confirm the continuously monitored TPH levels.

Alarms are set at trigger points to alert the platform operations personnel to be able to take preventative action before any limits are breached. The limits have been set by undertaking chemical characterisation of the PFW and applying this to whole-of-effluent-toxicity (WET) testing, which analyses the impact of the PFW on the receiving environment. The OIW and TPH limit have been established based on the Australian & New Zealand Guidelines for Fresh and Marine Water Quality 2018 ('ANZG 2018') and the OSPAR methods for testing whole toxicity limits.

The PFW discharge limits are listed below with continuous monitoring in place to minimise the risk of breaching these limits:

- OIW (Dispersed oil) – does not exceed 30 mg/L 24-hour average or 50 mg/L instantaneous;
- TPH – does not exceed 127 mg/L at any time; and
- Total PFW volume – does not exceed 300 m^3/day.

See Section 7.6 for a definition of the PFW mixing zone. Weekly PFW samples are collected and sent to Melbourne for laboratory analysis to verify that the continuous monitoring results are accurate.

It is important to note that although TPH levels are generally in the range of 50-80 mg/L, the platform's PFW system is operating at about half capacity, and gas production is also at about half capacity. The water cut of the wells will increase to closer to the maximum 300 m^3/day design limit over the coming years as the reservoir depletes. This has the potential to increase the TPH levels due to the reduced residence time of the PFW in the process. The current goal is to maintain TPH at these levels, therefore a lower limit of 90 mg/L has been set. The retention time in the caisson based on the current flow rate is around two hours and this provides additional PFW quality improvement such as flotation of free hydrocarbon with associated skimming and potentially some volatilisation.

Operating conditions such as pumping liquid from the KO flare drum may see TPH spikes or fluctuations; these will be monitored and investigated to ensure the cause of the spike is known and is recorded in the Laboratory Information Management System (LIMS) database. If the causes of TPH spikes are not known and cannot be rectified, then actions will be undertaken as per the Adaptive Management Framework (AMF) (see Section 7.6). As outlined in Section 7.6, the PFW mixing zone and impact assessment are based on the worst-case PFW flow rate of 300 m^3/day and TPH concentrations up to 127 mg/L (based on the concentrations in the PFW samples collected for the WET testing). Therefore, the upper TPH limit is 127 mg/L. Beach is committed to maintaining TPH levels to concentrations as low as possible and will continuously monitor this.

<u>Historical OIW monitoring</u>

Table 3.5 presents the average of the OIW (dispersed oil) test results conducted from the daily continuous monitoring on the PFW discharge confirming that OIW concentrations are routinely below the 30 ppm limit.

Table 3.5. Average of OIW test results from Yolla-A PFW discharges 2013-2019

Year	Sigrist AI-5327 (ppm)*	Sigrist AI-5328 (ppm)*
2013	2.45	5.2
2014	3.87	3.6
2015	3.7	4.8
2016	1.3	1.1
2017	0.9	0.8
2018	11.3	11.0
2019	7.3	7.6
Average	**4.4**	**4.9**

* Sigrist analysers - continuous automatic OIW analysers working in parallel.

3.5.7 Open Drains

The open drain system primarily captures rainwater and washdown water; the system also captures any loss of containment (LOC) that may occur on the platform decks. Drains are classified as either hazardous or non-hazardous based on the area of collection, as outlined in Table 3.6 The hazardous and non-hazardous area drains are segregated to prevent migration of hydrocarbon vapours into safe areas especially in the event of a spill.

Table 3.6 Open drain collection and discharge details

	Hazardous	Non-hazardous
Collection area	Process facilities Wellhead service pump	Deck drains
Open drain header	Two	One
Drains to	Dump caisson below water level	

To maintain the segregation between the drain headers and to prevent any vapour that may accumulate in the dump caisson from migrating back along drains, each of the drain headers terminates in the dump caisson below the water level. Further segregation is provided for each drain header by a 450 mm minimum liquid seal upstream of the dump caisson. A vent is provided between the liquid seal and caisson to allow for the pressure changes caused by wave action. Each vent is fitted with flame arrestors and routed to a safe location.

All areas on the platform where there is potential for hydrocarbon liquid release (e.g., during maintenance draining) have bunds/drip trays for drain collection. Skids have open drains that are collected and routed to the drain system.

3.5.8 Closed Drains

The closed drain system collects liquids from process vessels and routes the liquid through headers back to the FKO drum. These drains are used when pressure in the process vessels has been reduced to 1,000 kPag or lower and pressure drive can transfer fluid into headers, some of which are elevated. The main header transfers slope downwards to drain to the FKO drum.

3.5.9 Dump Caisson

The dump caisson was constructed as part of the platform jacket and provides for recovery of hydrocarbon liquid that may be present in PFW, in the stream from the open drains system, or from a spill. Hydrocarbon liquid is captured by gravity separation and accumulates at the top of the caisson and can be pumped to the flare knockout drum or into containers for transport onshore. Water flows from the bottom of the dump caisson at a depth of 45 m below sea level (see Plate 3.2).

The open drain and PFW feeds to the caisson are discharged below the minimum sea level so vapours can be controlled and released to a safe location through designated atmospheric vents. The caisson is also fitted with a vent to a safe location in the well bay that has a flame arrestor.

The dump caisson has a pneumatically-operated pump to recover oil and condensate. Level indication alarms (set at 10 m) assist with the operation of the dump caisson pump and provide indication of the liquid hydrocarbon level within the caisson. The pump has flexible connections and can deliver a nominal flow rate of 1 m^3/h from the surface of the water within the dump caisson and pump the fluid into the flare knockout drum for reprocessing. The pump is operated by fuel gas and can be controlled remotely from the LLGP.

3.5.10 Flare System

The platform has a cantilevered flare boom. Extraction processes such as fuel gas, process pressure control valves, closed drain system and TEG regeneration package on the platform generate hazardous hydrocarbon gas emissions that are flared. The flaring rate is continuously monitored and minimised as far as possible. The flare system capacity is approximately 171,000 kg/h of flow and comprises:

- A flare header network feeding into the FKO drum.
- A 50 m-long flare boom located in the south west corner of the platform.
- A sonic type flare tip for abnormal operation (major flaring incidents) designed to minimise smoke.
- Continuous flare tip pilots, flare electronic ignition package and flame detectors. The flare electronic ignition package will re-ignite a pilot flame when a loss of flame is detected.
- Ultrasonic flow meter.

The FKO drum receives vapours and liquids from pressure safety valves (PSVs), blowdown valves, TEG flash gas, closed drains and liquid return headers. There is continuous liquid flow to the FKO drum from the PFW degasser and the contactor columns. The FKO drum is fitted with an electric immersion heater to maintain the temperature of the liquid phase above 5ºC. During normal operations, the liquids are pumped into the production separator for reprocessing. During periods of shutdown and/or restart, the liquids can be pumped directly into the raw gas pipeline. Gases within the flare system are directed through the FKO drum and are combusted at the flare tip. The gas volumes directed through the FKO drum since the 2014 EP update are:

- 2019-20 – 6,231,236 kg;
- 2018-19 – 4,740,068 kg;
- 2017-18 – 4,811,020 kg;
- 2016-17 – 3,521,199 kg;
- 2015-16 – 3,824,835 kg (the higher volume of flaring this year was due to multiple shutdowns, resulting from power failure, production cooler failure, and pigging activities);
- 2014-15 – 3,458,039 kg; and
- 2013-14 – 3,285,503 kg.

A continuous flow of fuel gas normally provides flare purge and pilot gas; propane and nitrogen cylinders provide for ignition and purge purposes respectively when there is loss of fuel gas supply (e.g., when the platform is de-pressured normally). Propane and nitrogen cylinders are stored on the main deck west of the well bay.

Products of hydrocarbon combustion from flaring that are emitted to atmosphere include water vapour and carbon dioxide together with traces of carbon monoxide and nitrogen oxides. For the last three reporting years, there was:

- 2019-20 - 17,291 t CO_2-e of flared emissions from Yolla-A (with 1,914 t CO_2-e from the LLGP);
- 2018-19 - 13,152 t CO_2-e of flared emissions from Yolla-A (with 3,493 t CO_2-e from the LLGP); and
- 2017-18 - 13,350 t CO_2-e of flared emissions from Yolla-A (with 6,530 t CO_2-e from the LLGP).

There are fugitive emissions of hydrocarbons including BTEX (benzene, ethyl benzene, toluene and xylenes) and particulate matter from various process equipment on the platform. Using National Pollution Inventory (NPI) data for the last three reporting years for Yolla-A:

- Fugitive emissions released to atmosphere - 3,278 tonnes of BTEX were processed, resulting in 10.3 kg (in both 2017-18 and 2018-19) and 2,854 tonnes of BTEX were processed, resulting in 8.4 kg (2019-20);
- Particulate matter (10 µm) released to atmosphere - 1,260 kg (2017-18), 1,260 kg (2018-19) and 1,720 kg (2019-20); and
- Particulate matter (2.5 µm) released to atmosphere - 1,260 kg (2017-18), 1,260 kg (2018-19) and 1,720 kg (2019-20).

3.5.11 Diesel Storage and Distribution

Diesel is supplied by supply vessel and stored in the diesel storage tank built into the crane pedestal that has a total working capacity of 8.4 m^3. The diesel is transported to the platform by supply vessel in a 4 m^3 ISO container, which is then decanted into the crane pedestal tank. Bunkering diesel directly by hose can also be conducted.

The tank operates at atmospheric pressure and ambient temperature and is equipped with two level instruments: one for diesel level indication with a high- and low-level alarm, the other for shutdown on low-low level. An audible alarm at high-level assists with preventing tank overfill during bunkering of diesel. During bunkering, it is a requirement that the tank level is constantly monitored by operations personnel on the platform. An overflow line is directed to the non-hazardous area open drain, and the tank vents to atmosphere, with a flame arrestor in the vent line.

Using pumps, diesel is distributed from the diesel storage tank to platform equipment including the crane diesel day tank, survival craft refuelling stations, well head service pump, fire water pumps and the emergency diesel generator package. With the exception of the wellhead service pump, diesel is filtered. Under normal conditions, the pressure drop across the filter is around 10 kPag and when the pressure drop is greater than 50 kPag the filter fouled element is replaced. A full flow bypass around the filter allows the element to be changed out without interrupting the flow of diesel to equipment.

3.5.12 Corrosion Inhibitor

Well hydrocarbon fluids are dehydrated for transfer to the raw gas pipeline to prevent the elevated CO_2 levels present in the hydrocarbon fluids combining with water to form a steel corrosive acid. There remains a risk of residual water being present in the gas, therefore corrosion inhibitor is continuously injected into the pipeline. The inhibitor is pumped from a transportable tote tank that uses a dry break coupling between the tote tank and the single skid-mounted injection package to prevent spills.

3.5.13 Demulsifier and Reverse Demulsifier

Demulsifier can be injected upstream of the production separator. The demulsifier breaks emulsions, thereby enabling water separation from hydrocarbon fluids.

Reverse demulsifier can be injected into the PFW stream from the production separator upstream of the hydrocyclone to aid separation of residual oil from the PFW. There is also provision for a future injection point upstream of the produced water degasser.

Neither demulsifier nor reverse demulsifier have been required to date on Yolla-A. Both systems are isolated but can be reinstated if required.

3.5.14 Chemical Injection

The main chemicals used on the platform are corrosion inhibitor, demulsifier, reverse demulsifier (currently decommissioned but with the option for reinstatement) and hydrate inhibitor. The chemical injection packages are located on the west side of the well bay. These and other hazardous materials are used on demand and are described in Table 3.7. All of the chemicals are used in closed systems, thereby reducing the risk of accidental spills and discharge. The chemicals are all stored in bunded areas with drainage to the open drain system. From the main deck of the platform, methanol is injected into the process (well stream, production coolers and raw gas pipeline) and corrosion inhibitor is injected into the raw gas pipeline.

Table 3.7. Hazardous substances stored on the Yolla-A platform

Substance	Storage volume	Location
Corrosion Inhibitor	2 m^3	Stored in a 1 m^3 tote tank as part of the self-contained and bunded Corrosion Inhibitor Package, which can be drained into the open drain system if required. Located on the west side of the main deck, with a further 1 m^3 in storage on the southern infill laydown area.
Demulsifier	1 m^3	Stored in a 1 m^3 tote tank as part of the demulsifier injection package on the west side of the main deck.
Reverse demulsifier	1 m^3	Stored in a 1 m^3 tote tank as part of the reverse demulsifier injection package on the west side of the main deck.
Methanol	4 m^3	Stored in 1 m^3 tote tanks on a raised platform above the self-contained and bunded methanol injection package that is connected to the open drain system. Two 1 m^3 tote tanks are stored on southern infill laydown area.
Diesel	8.4 m^3	Stored in an 8.4 m^3 tank within the crane pedestal.
Diesel	5 m^3	5 m^3 emergency generator day tank. 100 L diesel day tanks for fire pumps.
TEG	24 m^3	Throughout the TEG system and 4 m^3 of storage.
Propane gas	A rack of nine cylinders	Cylinders stored on the main deck west of the well bay. Used for flare purge when fuel gas is unavailable.
Nitrogen gas	Two racks of 15 cylinders	Cylinders stored on the main deck, west of the well bay.

3.5.15 Hydrate Inhibitor

Hydrates are crystals that form when the gas/condensate cools or rapidly reduces in pressure. These crystals can form blockages in the process. Hydrate inhibitors are, therefore, injected at the wellhead to prevent hydrate formation.

The main hydrate inhibitor on the platform is tri-ethylene glycol (TEG). This is injected into the raw gas and then recovered in the TEG Regeneration Unit during start-up and shutdown. Hydrate inhibitor (in the form of methanol) is injected into the flowlines immediately downstream of the wellheads and upstream of the chokes during start-up and shut down by remote manual operation from the LLGP (to start the methanol pump and open the appropriate actuated valve). Methanol injection is typically undertaken 5-10 times each year. Methanol is a low toxicity chemical (ranked as 'Gold' under the CHARM model).

Provision is also included for injection upstream of the production cooler to prevent potential hydrate blockages as a result of over-cooling. Methanol can be injected into the raw gas pipeline when hydrate formation occurs in the pipeline if the pipeline contents cool to seabed temperature. Injection of methanol into the pipeline only occurs during a planned shutdown, as continuous methanol injection into the pipeline during production potentially causes onshore processing difficulties.

3.5.16 Hazardous Substances

The main hazardous substances and typical inventories that may be stored on the platform are shown in Table 3.8. Other hazardous substances may be present on the platform in smaller quantities (e.g., cleaning/ maintenance chemicals, lubricant/gear oils, etc.) and these are stored either on deck or in the flammable liquids cupboard. Safety Data Sheets (SDS) for all hazardous substances are available on board the platform in the permit to work hut and electronically via 'ChemAlert'.

Chemicals including methanol, TEG, corrosion inhibitor, demulsifier and reverse demulsifier are transported to the platform in sealed containers. Hazardous substances and chemicals are shipped to the platform in accordance with International Maritime Organisation (IMO) codes and requirements, and then added to the hazardous materials register. Management of hazardous materials is guided through the Hazardous Material and Secondary Containment Directive (CDN 14176239).

In addition to the hazardous substances usually on board the platform, the substances that may be stored on board during well intervention operations are listed in Table 3.9. Other activities that require chemicals or volumes beyond what is available on the platform will be brought to the platform after a risk assessment is conducted in line with the Hazardous Material and Secondary Containment Directive (CDN 14176239) and added to the hazardous materials register.

Table 3.8. Hazardous substances that may be present during well intervention operations

Substance	Typical inventory	Description
Diesel	20 m^3 for workover. 10 m^3 for project work (e.g., temporary generators/air compressors).	IBCs (intermediate bulky container) stored on main deck.
Radioactive materials	As required.	A purpose designed container will be used for storage if radioactive materials are utilised.
Explosive materials	As required.	A purpose designed container will be used for storage if explosive materials are utilised.

3.5.17 Waste Disposal

There are two liquid waste discharge points from the platform to the ocean, these being:

- PFW and deck drainage discharged via the dump caisson.
- Black and grey water from the accommodation module combines with brine from the desalination plant and surplus water from the sea water lift and fire pump header and is discharged from the sewage caisson 7 m below sea level. The sewage treatment system is connected to a storage 1,000 L tank, with a solids macerator located upstream of this tank.

All other liquid and solid wastes are transported from the Yolla-A platform to shore using the supply vessel. From the port, the waste is transported to the LLGP, where Cleanaway (the waste contractor for operations) then transport waste to licensed facilities for reuse or disposal. Waste generated during project activities is collected by Veolia for transport to licensed facilities, with Cleanaway transporting flammable goods.

Solid wastes generated on the platform include paper and cardboard, wooden pallets, scrap steel, metal, aluminium, cans, bottles, glass, plastics and rope. Waste is managed in accordance with MARPOL Annex V (Garbage Pollution Prevention), which requires:

- Placards on the platform identifying the waste disposal requirements.
- A Garbage Management Plan to be in place.

Waste is managed in accordance with the BassGas Waste Management Plan (CDN/ID 3974553). This plan describes the waste management hierarchy, waste characterisation and classifications, storage, labelling, collection and transport, recording and reporting and training requirements.

All solid wastes produced are segregated and stored on the platform while awaiting transport to the Beach supply base onshore and then to an EPA Victoria-approved disposal facility. Chemicals are stored in purpose-built bunded areas on the main deck, while temporary self-contained bunds (tied or weighted down to prevent loss overboard) are used to store chemicals used during shut-down or maintenance activities.

All waste generated on Yolla-A is listed in a waste manifest before it is sent ashore and combined with that from LLGP.

3.5.18 Accommodation Facilities

Originally designed for unmanned operations (and operated as such), the Yolla MLE project converted the platform to a manned facility in 2012 with the installation of permanent accommodation modules and an upgrade of the safety system.

Yolla-A manning level scenarios are:

- Normal manned operation with typically seven POB for basic operations and routine maintenance activities.
- Normal fully manned operation with up to 22 POB for wireline and planned maintenance activities.
- Exceptional circumstance maximum manning 44 POB (up to 38 sleeping on board plus day visitors). This scenario is for major campaigns such as well workover and construction works.

The accommodation block contains the following:

- Ten bedrooms (9 x 4 berth, 1 x 2 berth);
- First aid room;
- Galley and mess area;

- Frozen, cold and dry storage for the galley;
- External laydown for the galley;
- Laundry facilities and linen store;
- TR (temporary refuge) muster area;
- TV lounge, quiet room and gymnasium;
- Toilet and wash facilities;
- Dirty change area;
- Supervisor's office and permit to work (PTW) area; and
- Electrical switch room.

3.5.19 Communications

Communications integrity is ensured round the clock, with control and surveillance of the platform and two-way voice communication with personnel on-board, by the provision of the following communications equipment:

- Primary satellite link for voice, fax, production data transmission and office network facilities.
- Back-up satellite system that is able to exchange a limited range of critical data in the event of a main satellite communication link failure. The back-up satellite is energised upon shutdown of the main satellite antenna and sends a selected list of PCS, Safety Instrumented System (SIS) and fire and gas (F&G) information to LLGP to allow continued remote monitoring.
- Private Automated Branch Exchange (PABX) telephone system onshore with external links channelled through the satellite network.
- Analogue handsets and two copier/scanning machines with ability to email files/copies.
- Ultra-high frequency (UHF) radio system consisting of intrinsically safe handheld radios and a base station. Allowing communication between personnel throughout the facility and with onshore personnel via the primary satellite link telephone interconnect.
- Aeronautical very high frequency (VHF) radio system allows communication with approaching helicopters or other aircraft in the vicinity of the platform.
- Portable satellite phones are available for emergency communications.
- Marine very high frequency (VHF) radio system allows communication with vessels providing services to the platform (e.g., the supply vessel and standby vessel) or other marine vessels in the vicinity of the platform. Marine VHF also allows communication to general marine traffic in the vicinity of the platform during an emergency situation.
- Public address and general alarm (PA/GA) system.
- UHF and VHF marine radio units in the crane cabin.
- Emergency Position Indicating Radio Beacons (EPIRB) for use during an emergency are located within the TEMPSC, and in each of the life rafts located at the TEMPSC embarkation area and at the alternative muster area (AMA).

Communications at the AMA include a hand-held satellite phone and hand-held radios for communications with the TR muster area, LLGP control room and aircraft and vessels in the vicinity of the platform. A telephone with PA/GA access port has been provided at the AMA as a means to access the PA/GA system.

When the LLGP central control room (CCR) has the remote console selected to monitor the platform operations channel, the attendant onshore operators are able to hear the platform local radio traffic and are able to transmit if required.

The TR muster area is equipped with a communications panel, fire and gas and ESD (emergency shut down) mimic panel, hand-held satellite phone, PA/GA access panel, and closed-circuit television (CCTV) coverage.

3.5.20 Navigational Aids

The platform has a fully automatic navigational aid system comprising:

- RACON Radar Beacon – Phalcon 2000 RACON that detects radar signals from passing ships and returns a coded response.
- Four navigational lights provide cover in all directions, with battery back-up that will supply power for 96 hours (4 days).
- A foghorn with battery back-up that will supply power for 96 hours (4 days). The fog horn can be manually activated from either the LLGP CCR or the platform.
- An automatic identification system (AIS) sounds an alarm should any vessels with an AIS unit enter the gazetted 3 km-radius cautionary zone (restricted navigation) around the platform. The prohibition of Entry into a Safety Zone (with a 500 m-radius) was gazetted under the former *Petroleum (Submerged Lands) Act 1967* (Cth) (Section 119) by Mineral Resources Tasmania on the 31st of August 2005. To date, there have been no breaches of the Safety Zone, but entry into the cautionary zone has been noted. Anchoring, navigation or fishing in the cautionary zone is not permitted without prior approval from the platform OIM.

3.5.21 Lighting

Under normal operations, personnel activities on the platform are undertaken during day shift conditions, with only essential work undertaken during hours of darkness. After the MLE upgrade to the platform, lighting was upgraded to cater for the new operating conditions and new equipment and escape routes.

The Yolla MLE Project Basis of Design identified the required areas of illumination throughout the deck (lux levels and maintenance factors), with an 'as-built' assessment of lighting conditions conducted in August 2011 by Worley Parsons. As a result of this assessment, the navigation aid lantern was relocated to the corner of the accommodation module. Lighting on the platform is deemed suitable for a manned facility.

3.6 Offshore Raw Gas Pipeline

The 350 mm offshore RGP that exports dehydrated gas and condensate from the Yolla-A platform to LLGP has three sections:

1. An offshore export riser and subsea section that runs approximately 147 km along the seabed in a direct route to landfall near the township of Kilcunda on the Victorian coastline.
2. A shore crossing consisting of a horizontal directionally drilled (HDD) buried pipeline approximately 1.4 km in length that passes under the surf zone, beach and coastal dunes.
3. The buried onshore pipeline, which is 32.4 km in length and terminates at the LLGP (outside the scope of this EP).

The offshore RGP rests on the seabed (i.e., it is not trenched) and is stabilised by concrete weight coating along its entire length (Plate 3.3).

The riser, submerged RGP and shore crossing have a protective coating. The riser has a fusion-bonded epoxy (FBE) coating, the subsea pipeline has a 5 mm thick asphalt enamel under 30-60 mm concrete weight coating, and the shore crossing section has a 1 mm NAPROCK coating over 0.4 mm FBE.

Aluminium/zinc bracelet type sacrificial anodes are installed along the length of the pipeline on the seabed and on the riser to provide external corrosion protection in case of coating damage. Intervals vary along the pipeline, but are generally every 5 to 12 pipe joints. Approximately 1,500 anodes are installed.

The shore crossing section of pipeline is protected by an impressed current cathodic protection system. Internal pipeline corrosion is controlled by separation and dehydration of the well fluids and the continuous injection of corrosion inhibitor into the pipeline from the platform.

The pipeline has a single main line valve (MLV) station situated onshore near the shore crossing at Kilcunda. The valve station is located north of the Bass Highway and is a buried installation within a small unobtrusive compound located on private property. The 350 mm nominal bore MLV ball valve is locked open under normal operation with the valve hand-wheel stored at the gas plant.

The offshore pipeline and riser can be isolated from the platform topsides facilities by the LVO. The LVO is located above the water level on the riser just below the platform cellar deck and is controlled by the platform ESD system. The pipeline approach to the west of the platform just north of the south-western jacket leg was selected to avoid the possibility of damage from a mobile offshore drilling unit (MODU) or crane operations. The riser is located within the Yolla-A platform jacket substructure to provides protection against vessel impact.

The offshore pipeline maximum allowable operating pressure (MAOP) is 14,100 kPag @ 80°C. The operational limits of the offshore RGP during normal operation are:

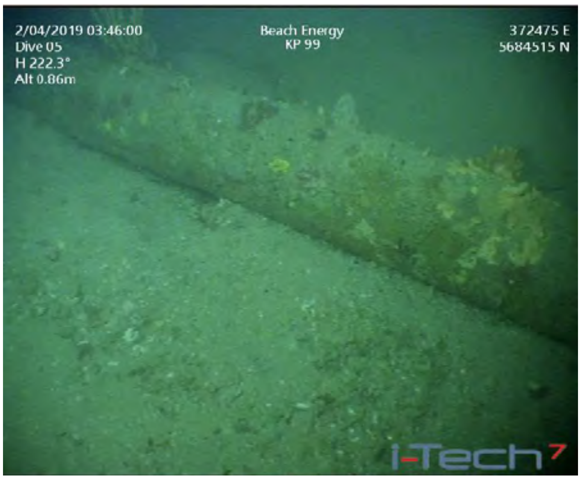
- Flow rate of raw fluids into the pipeline in the range of 20–67 TJ/day sales gas equivalent.
- Normal operating pressure at the onshore slug catcher is 6,000 – 7,000 kPag. The pipeline can be operated at pressures between 5,500 – 13,000 kPaG by design where the line pack is considered to be operating at pressures above 7,000 kPaG at the gas plant inlet. The offshore pipeline typically operates between 9,300 – 12,800 kPaG at 45°C.

In the event of a pipeline leak, a drop in pressure will be identified at either the LLGP via the inlet PZT (which will trip the plant at 4,000 kPa) or at the Yolla-A platform if two out of three independent pressure transmitters on the export line register a pressure of 4,000 kPa, these transmitters also have a low alarm at 5, 000 kPa. A small (i.e., pin hole) leak would possibly not be picked up if the Control Room Operator (CRO) does not see a loss of pressure on the instrumentation, but there is a possibility that if the ground was disturbed onshore that a famer may notice it or when maintenance inspections are completed. Intelligent pigging of the pipeline is completed every 5 years and would detect abnormalities that could result in a leak (see Section 3.6.1, following).

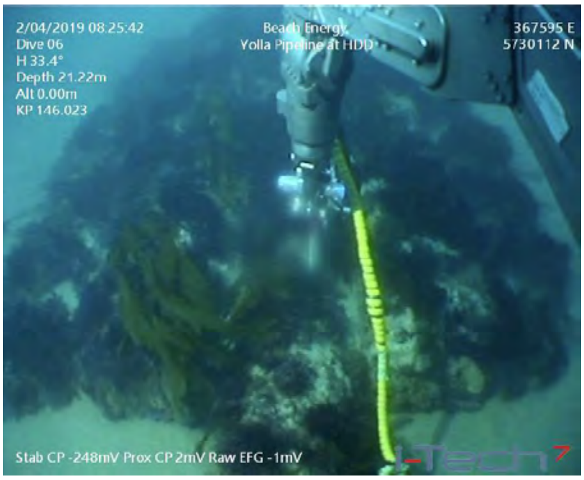
The design life of the RGP is 25 years. The life expectancy of the pipeline remains at 25 years from original construction date (2006), meaning end of pipeline design life is 2031.

Kilometre point 87, view from the east

Kilometre point 87, view from the west



Kilometre point 99, view from east



Shore crossing point where the pipeline enters the stabilisation mattress, view from the south

Plate 3.3 Images of various sections of the offshore RGP from the 2019 subsea inspection campaign

3.6.1 Pigging Facilities

The export riser and the offshore RGP are cleaned and pigged (using an intelligent pig) from the pig launcher installed on the main deck of the platform. The pig launcher design conditions are consistent with the offshore pipeline. This is conducted every 5 years in line with the Pig Launcher Operation: BassGas Raw Gas Pipeline Procedure (CDN/ID 3976964). The last two intelligent pipeline pigging surveys were conducted in December 2010 and March 2016, with no appreciable defects detected. The next pigging survey is due to take place in 2021.

The pigging facilities are fitted with mechanical interlocks to minimise any safety risk arising from improper operation. A quick opening closure is provided for easy loading of a pig into the major barrel with pressurisation lines and vent to atmosphere provided for pressuring/depressuring operations. The depressurisation line to atmosphere is stainless steel, which allows for the localised cold temperatures experienced during depressurisation operations. To minimise the risk of a release to atmosphere, valve safety interlocks have been installed on the main operating valves used during the pigging operations. They are fitted on the pig trap valve, blowdown valve, kicker valve, drain valve and pig trap enclosure.

A short duration of flaring is required to depressurise the pig launcher prior to opening and inserting the pig, typically lasting about 5 minutes.

3.7 Integrity Maintenance

Inspection and maintenance of BassGas facilities and equipment is coordinated through the Computerised Maintenance Management System (CMMS). Maintenance plans and procedures are outlined in the Monitoring of Compliance with Risk Controls (CDN/ID 3976775) and Management of Integrity of Pressure Vessels and Piping (CDN/ID 3976802) documents.

These plans aim to:

- Ensure a consistent, cost-effective and efficient system of maintenance management; and
- Provide optimum levels of inspection and maintenance to ensure that equipment and the facilities remain fit for purpose over the life of the operation.

Condition monitoring of critical equipment is input into the maintenance plan and management system and an equipment specific risk-based inspection (RBI) program determines maintenance and inspection frequencies.

For example, a Level 3 Inspection was completed on Yolla-A in March 2014, with the next inspection planned for the summer of 2019/20. This involved inspection of selected high fatigue nodes in the platform jacket topsides structure. Several anomalies were reported during the course of the survey and none of the anomalies were deemed to require immediate action. A detailed evaluation of all the anomalies was conducted by platform structural engineers and an action plan was developed to address the recommendations.

3.7.1 ROV Inspections

Subsea remotely operated vehicles (ROV) are used to inspect the Yolla-A platform, the offshore pipeline, and plugged and suspended exploration wells to detect features, damage or signs of damage and deterioration that could present structural integrity risks. These inspections are undertaken in accordance with ROV contractor procedures, supplemented by project-specific procedures, as required.

ROV surveys are regularly planned but may also occur on an ad-hoc basis based on the findings of previous inspections or based on operational or weather events. Table 3.9 summarises the results of the ROV surveys undertaken since BassGas became operational in 2006.

Table 3.9. Summary of ROV inspections

Year	Inspection target
2019	Spud can depression crater and suspended well surveys, pipeline span survey
2017	Platform, pipeline, suspended well and spud can depression surveys, pipeline span rectification
2015	Spud can depression crater survey
2014	Spud can depression crater survey
2013	Pipeline span rectification
2011	Platform, riser and pipeline surveys
2007	Pipeline survey

ROV inspections normally use a dynamically positioned Inspection Support Vessel (ISV), or the Platform Supply Vessel (PSV) routinely used for cargo operations. Specialist ROV contractors are used, with the pipeline survey typically taking 5-7 days to complete. The pipeline HDD exit is inspected for cathodic protection and stability of matts.

ROV deployments will be completed as part of the integrity inspection program (Pipeline Integrity Management Plan, TAS-5185-E55-PLN-17278891) including:

- Cathodic protection (CP) surveys – involves direct contact measurement and/or continuous field gradient measurement when traversing the length of the offshore pipeline. Pipeline protection is measured (in millivolts) at selected locations where a probe is used to pass through the marine growth layer onto the metal surface to ensure the anodes attached are providing corrosion protection. The field gradient is measured by proximity as the ROV traverses the pipeline while completing a general visual inspection.
- General visual inspections (GVI) – undertaken in close proximity (within 1 m) of the pipeline, pipeline spools, risers and associated clamps, and platform jacket members. GVI locate spans along the pipeline that may exceed allowable span lengths (this varies, but is generally between 11 m and 29 m) as spans lengthen and shorten due to prevailing environmental factors if soft sediments are present at the extremities of the span.
- Pipeline span remediation projects – undertaken when excessive pipeline spans require placement of support mattresses. Polypropylene bags of varied size are used for placement under the pipeline and once in position are inflated by grout. Grout is prepared on the support vessel back deck in a mixing bowl and delivered to the mattress by hose. Minimal amounts of excess grout exit vents from the mattress once it is fully inflated.

3.7.2 Diving Activities

Diving is a routine activity undertaken from a diving support vessel or from the Yolla-A launch and recovery system (LARS). Diving procedures are prepared for each campaign, specific to the contractor and vessel performing these services. A diving contractor is selected for each campaign based on a competitive tender process.

The diving related work carried out from the Yolla-A platform typically includes the following:

- General inspection of subsea areas of the platform and pipeline;
- Marine growth removal (to facilitate weld inspections) using mechanical grit blasting or high-pressure water jetting;
- Visual inspection (GVI and close visual inspection (CVI)) and non-destructive testing (NDT) of welds and areas of interest for selected high fatigue platform jacket nodes;
- Debris removal;
- General platform and pipeline repair works; and
- Use of magnetic particle inspection, alternating current field measurement or A-scan ultrasonics.

There have been no diving campaigns since the 2014 acceptance of the EP. Level 3 diving-based inspections are planned for 2020, with scoping work underway.

3.7.3 Fabric Maintenance

Fabric maintenance involves ongoing steel surface preparation and painting across the entire platform for selected areas of structural and process equipment. Fabric maintenance requires sand/grit/wet blasting to remove surface paint and corrosion coating followed by painting.

Enviropeel/Stopaq is applied at various times during the year (depending on the outcomes from integrity inspections, but generally undertaken in summer) between flanges to prevent contact with air and avoid corrosion. These activities are undertaken within a bottom-lined humpy to contain removed surface coatings.

3.7.4 Pressure Vessel Inspection

Internal/external inspection of Yolla-A pressure vessels require purging and venting of nitrogen and the use of Hydex® (a chemical compound) for hydrocarbon cleaning. Hydex® waste is contained within a circulated system and brought onshore for disposal to a licensed facility. Mecure 99 is used for mercury decontamination of the pressure vessels and similarly the Mecure 99 waste stream is contained and brought onshore for disposal to a licensed facility. This activity is undertaken once every 2-3 years, usually coinciding with planned platform shutdowns.

Pressure vessel inspection also involves the removal and re-testing of PSVs, which are tested onshore.

3.7.5 Pipeline Geophysical Surveys

Geophysical surveys along the offshore RGP are required infrequently to determine its precise location, especially as large sections of the pipeline have become buried by seabed sediments over time. This allows pipeline engineers to determine any integrity issues. Such surveys involve using a small vessel (typically a fishing vessel) and generally only take up to a few days (depending on sea state conditions). One or all of the following geophysical techniques described below may be used (generally in combination), and a simple pictorial representation of these techniques is presented in Figure 3.5.

Single-beam echo sounder

A single-beam echo sounder (SBES) may be used, primarily for confirming water depths at site locations. The SBES transmits sound energy and analyses the return signal (echo) from the seabed or other objects. The sound waves will be transmitted from a vessel hull-mounted transducer to produce single line coverage of the seabed.

Multi-beam echo sounder

A multi-beam echo sounder (MBES) is similar to SBES except that coverage on the seabed is wider than a single beam and typically in the order of 3-12 times the water depth. The backscatter data from the MBES is used to characterise the seabed and to assist in seabed classification. The beams record seabed reflectivity (termed 'backscatter'), which can be used in making seabed facies (or substrate maps). Muds generally give a weak or 'soft' reflection, sands are medium energy or 'harder' and cemented materials (limestones, or exposed rock) give the hardest reflection.

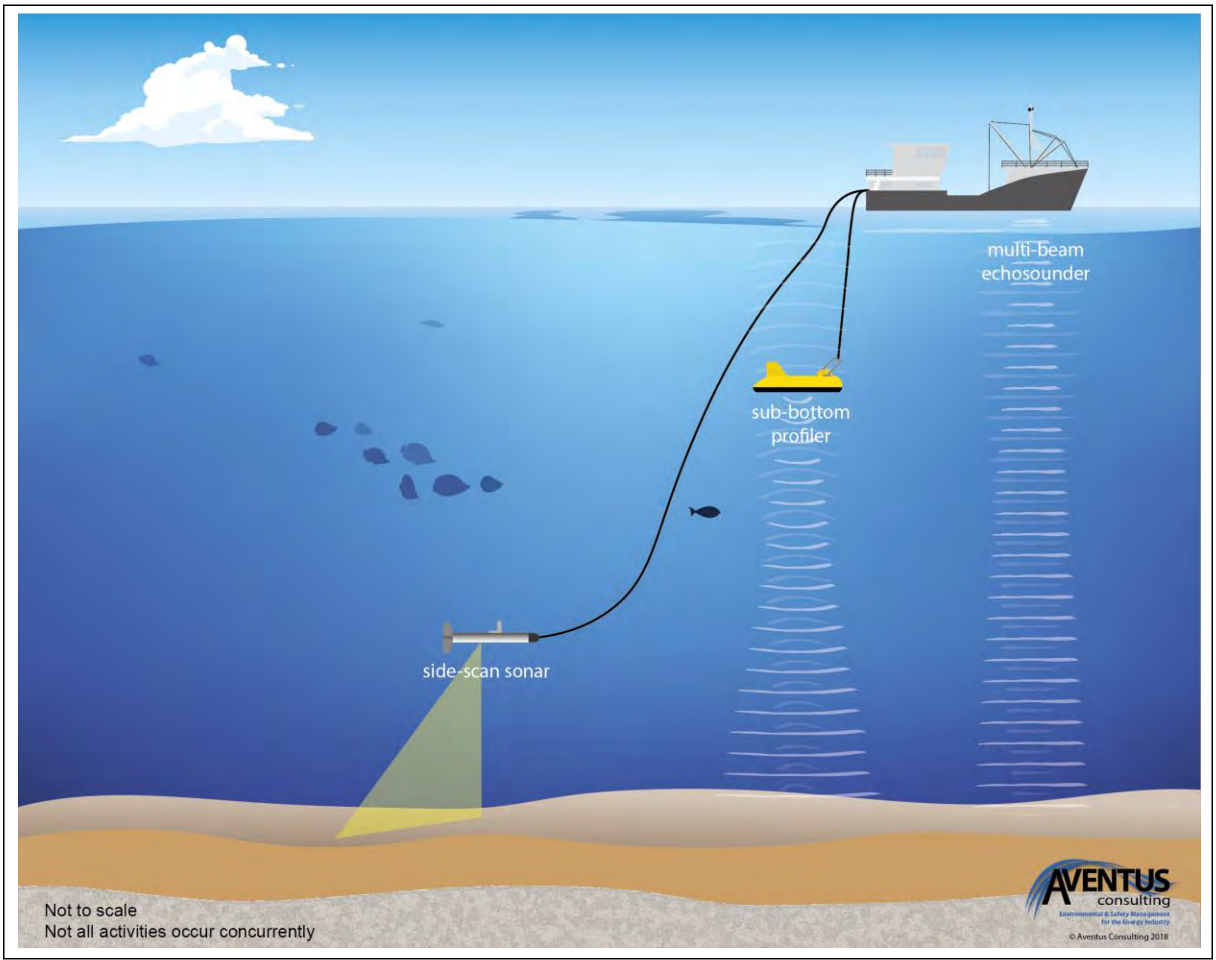


Figure 3.5. Simplified representation of pipeline geophysical survey techniques

Bathymetric data is acquired using an MBES from a transducer mounted to the base of a pole attached to the side of the vessel. An MBES acquires a wide swath (strip) of bathymetry data perpendicular to the vessel track and provides total seabed coverage with no gaps between vessel tracks. The number of beams may be up to 250 with a maximum sounding rate of 40 Hz. The MBES equipment is generally operated at tow speeds of 3-4 knots (5.5–7.4 km/hr).

Side scan sonar

Side scan sonar (SSS) is a hydro-acoustic technique used to detect hazards such as pipelines, lost shipping containers, boulders, debris, unmarked wrecks, reefs and craters.

An SSS survey is undertaken by towing a sonar tow-fish over the pipeline. The towfish is equipped with a liner array of transducers that emit and later receive an acoustic energy pulse in a specific frequency range. Typically, a dual-channel, dual-frequency SSS is used. The acoustic energy received by the SSS (backscatter) is continuously recorded creating a 'picture' of the seabed that can be used to give an indication of the texture of the seabed. The resultant SSS image is created by assembling each swath of data into a georeferenced composite that represents the acoustic character of the seabed.

All data is digitally recorded and allows for a geo-referenced mosaic of the data so that a digital model of the seabed can be created. Interpretation of these data allow mapping of seabed features to take place, with particular emphasis on the pipeline (though surface geology, geomorphology, and other natural and man-made obstructions and debris can also be detected).

The SSS towfish is typically towed at a speed of 3-4 knots (5.5–7.4 km/hr), approximately 10–15 m above the seabed (depending on water depth and the exact frequency) at a distance of about 150- 200 m behind the vessel. The SSS is towed and operated at the same time as the MBES.

Sub-bottom profiler

Sub-bottom Profilers (SBPs) are devices for converting electrical energy into acoustic energy. They produce an acoustic profile which extends from the seabed down to the limit of penetration. SBPs are used to survey the shallow geology of an area, and as such have a lower output of acoustic energy compared to other geological survey techniques such as seismic surveys using airgun arrays. Acoustic emissions from SBPs are typically in the frequency range of 0.05 to 12 kHz, with peak sound pressure level (SPL) of up to 220 dB re 1µPa @ 1 m. There are three different types of SBP, which exhibit a trade-off of in resolution versus depth of penetration based on the frequency of the acoustic signal:

1. Very high frequency systems including pingers, parametric echo sounding and Compressed High-Intensity Radar Pulse (CHIRP) – produce a swept-frequency signal. CHIRP systems usually employ various types of transducers as the source. The transducer that emits the acoustic energy also receives the reflected signal. The beam width is usually between 15° and 55°. CHIRP system transducers are usually circular and point downwards. A CHIRP is normally hull-mounted when used for shallow water operations, but may also be towed in a similar fashion to the SSS. This system uses an FM signal across a full range of frequencies, typically either 2-16 kHz or 4-24 kHz (low to high frequency). This SBP method is most likely to be used for pipeline surveys because CHIRP signals typically penetrate only about 5-10 m into the seabed and provide the best resolution.

2. High-frequency boomers – consist of a circular piston moved by electro-magnetic force (comprising an insulated electrical coil adjacent to a metal plate). The high voltage energy that excites the boomer plate is stored in a capacitor bank. A shipboard power supply generates an electrical pulse that is discharged to the electrical coil causing a magnetic field to repel a metal plate. This energetic motion generates a broadband, high amplitude impulsive acoustic signal in the water column that is directed vertically downward. Boomer sources show some directionality, which increases with frequency. Although they can be considered omnidirectional for frequencies below 2 kHz, they are quite directional in the vertical. Boomers are mostly surface towed, but may also be towed below the surface to avoid sea surface wave noise and movement. A boomer system is unlikely to be used for pipeline surveys as they penetrate far deeper into the seabed (up to 100 m below the seabed) than is required.

3. Medium-frequency sparkers – are seismic sources that create an electric arc between electrodes with a high voltage energy pulse. The arc momentarily vaporises water in a localised volume and the vapour expands, generating a pressure wave. Sparkers can use the same capacitor bank as boomers. Sparkers provide low-resolution data to a much greater penetration depth below the seabed (~100 m). Sparkers are surface towed. A sparker system is unlikely to be used for pipeline surveys as they penetrate deeper into the seabed (>30 m below the seabed) than is required.

The receiver for the sparker or boomer system is usually a solid-state hydrophone or hydrophone array consisting of a string of individual hydrophone elements located within a neutrally buoyant synthetic hydrocarbon filled tubing. They typically contain 8 to 12 hydrophone elements evenly spaced in a tube that is 2.5 to 4.5 m in length and 25 mm in diameter.

The SBP system can be towed and operated at the same time as the MBES and SSS.

3.8 Logistics

This section provides an overview on the logistics of providing transport for the supply of personnel, equipment and supplies to the Yolla-A platform.

3.8.1 Helicopters

The platform has a cantilevered helideck. Helicopters are the primary form of transport for crew changes and transfer of day visitors to and from Yolla-A platform as well as the preferred means of evacuation. The current service provider is Bristow, using a Sikorsky AW139. There are no helicopter refuelling facilities on the platform; helicopters carry enough fuel to travel to the platform and return.

The approximate flight time (one way) between the helicopter base at Tooradin and the Yolla-A platform is 45 minutes. During normally manned operations there are approximately three return helicopter flights per week to the platform.

A weather station on the platform transmits weather data to LLGP control room. This allows the helicopter pilots to obtain real-time weather information before departing base. The platform has helicopter radio communication links and a non-directional beacon (NDB) for helicopter navigation purposes.

3.8.2 Platform Supply Vessels

A PSV (currently the *Tek-Ocean Spirit*) visits the Yolla-A platform approximately once per month during normal manning to deliver:

- Food;
- Diesel and production chemicals; and
- Maintenance equipment and materials.

PSV contractors (currently Tek-Ocean Energy Services) must demonstrate they have a rigorous HSE Management System onboard in accordance with Beach's Contractor Management Directive (LAT-HSE-DVE-001), Level 1 High Risk HSE Pre-qualification assessment (CDN/ID 17866434), Level 3 third-party assurance audit and compliance with the Field Support Vessel Operations Procedure (CDN/ID 3974221). Vessel contractors are subject to change.

The PSV returns domestic and industrial waste generated on Yolla-A platform to shore, operating out of Port Anthony (Barry Beach) in Corner Inlet (about 159 km/86 nm travel from Yolla-A, taking 10-16 hours sailing time). The Port of Hastings (Western Port Bay) and Corio Quay (Geelong) are used (rarely) as back up ports.

Beach ensures that PSVs owners are members of the International Association of Classification Societies (IACS).

3.8.3 Bunkering Facilities

The Yolla-A bunkering station is located near the pedestal crane on the east face of the main deck. Hoses are provided for the bunkering of diesel (as outlined in Section 3.5.12, diesel is currently transferred to the platform using ISBs) and fresh water from supply vessels as detailed in the Bunkering Operations Procedure (CDN/ID 3973929).

3.8.4 Vessel-related Emissions and Discharges

Routine emissions and discharges associated with supply vessels (and vessels used for maintenance activities) are relevant only when the vessel is within the 500-m PSZ of Yolla-A (or working along the pipeline for maintenance activities), and include:

- Atmospheric emissions – fuel consumption.
- Liquid discharges – cooling and brine water, treated sewage and grey water, bilge water and deck drainage.
- Solid waste discharges – putrescible waste.

The environmental risks associated with any vessel used to support BassGas operations and maintenance include:

- Accidental overboard release of waste;
- Introduction of invasive marine species;
- Interference with third-party vessels;
- Vessel strike with megafauna; and
- Diesel spill.

3.8.5 Other Vessels

Certain operational activities will require the presence of additional offshore vessels:

- Standby vessels – for higher risk activities, such as work over water, heavy lifts, and well intervention.
- ROV support vessels – for routine asset integrity inspections of the platform and pipeline.
- Diving support vessels – for asset integrity inspections that cannot be completed with an ROV.

The Field Support Vessel Operations Procedure describes the requirements for all vessels operating within the facility PSZ and Cautionary Zone. It includes procedures for vessel approach, cargo operations, communications and emergency response. It applies to all registered vessels capable of supporting BassGas operations.

Beach requires vessels used as part of its operations to hold valid Australian Quarantine Inspection Service (AQIS) certification for vessels entering from outside Commonwealth waters. Smaller, locally based vessels are not required to hold this certification.

3.9 Non-routine Operations

The Offshore Yolla risk register identifies loss of containment (LoC) from the PSVs, wells, platform and pipeline as the key risks during operations.

3.9.1 Loss of Containment – RGP

The LoC of gas or gas condensate from the offshore RGP is highly unlikely to occur, taking the following factors taken into account:

- A catastrophic failure event is remote and the most likely scenario would be pin hole leaks due to corrosion;
- Failure at the HDD exit point is possible, however it would need to be a result of free span type issues. Surveys for pipeline free spans are regularly conducted and promptly rectified (the most recent rectification works taking place in 2017, see Section 3.7.1); and
- If in a main shipping lane, it is possible that the anchor drag would result in rupture.

The most credible release location has been determined as the pipeline intersection with the shipping lane, approximately 24 km (13 nm) from the shore (at the pipeline's shore crossing point) (see Figure 5.44 in Chapter 5).

3.9.2 Loss of Containment - Wells

An uncontrolled release of hydrocarbons from Yolla-A may occur from a loss of well control (LoWC) caused by damage to well head equipment, a failure of process equipment or, in an extreme case, the collapse of the platform from a collision or a catastrophic storm event (in the unlikely event of a SCSSSV failure to isolate reservoir fluids).

In such an event, access to the platform may not be possible due to fire, the presence of a gas cloud or extensive structural damage to the platform.

To respond to a LoWC, Beach has considered the use of a well capping stack, but it has been discounted because in order to install a subsea well cap, the platform will need to be removed from location to gain access at the seabed to cut the conductor, surface casing and expose the 9⅝" production casing to enable installation of a subsea cap. Subsea well capping is not an option if existing platform production wells are live (i.e., shut in at the TRSSSV). Under certain circumstances, this may be an option if the platform has been destroyed, or collapsed and wells are flowing uncontrollably. However, drilling a relief well is the most expeditious response to a hydrocarbon release at Yolla-A.

In the interest of ensuring personnel safety, drilling a relief well is the most feasible and safest response option to a hydrocarbon release scenario at Yolla-A. The environmental impacts associated with the drilling of the relief well are comparable to those of drilling a production well and are insignificant when compared to the impacts of a loss of well control.

A Relief Well Plan (RWP) (Otway and Bass) (T-5100-35-MP-005) is in place and will be implemented if required. The Relief Well Plan is briefly summarised here. A relief well decision tree is presented in Figure 3.6.

The RWP has been developed in line with the Oil and Gas UK (OGUK) Guidelines on Relief Well Planning (Issue 2, March 2013). This plan ensures that Beach has considered its response requirements in order to reduce the time required to initiate relief well drilling operations in the event of a blowout and to allow the relief well to be completed in the shortest time practicable.

The RWP estimates that it would take about 86 days to source a suitable drill rig, mobilise it to site, drill the relief well and kill and abandon the well. Two possible relief well locations have been identified based on seabed survey details and an analysis of prevalent wind directions (from the southwest) and surface current directions (towards the east).

The relief well drilling team will be sourced and mobilised as outlined in Section 4.5 of the RWP. This team will consist of Beach drilling engineers and external experts (including well control specialists, site surveyors, rig broker and spill control organisations) as required.

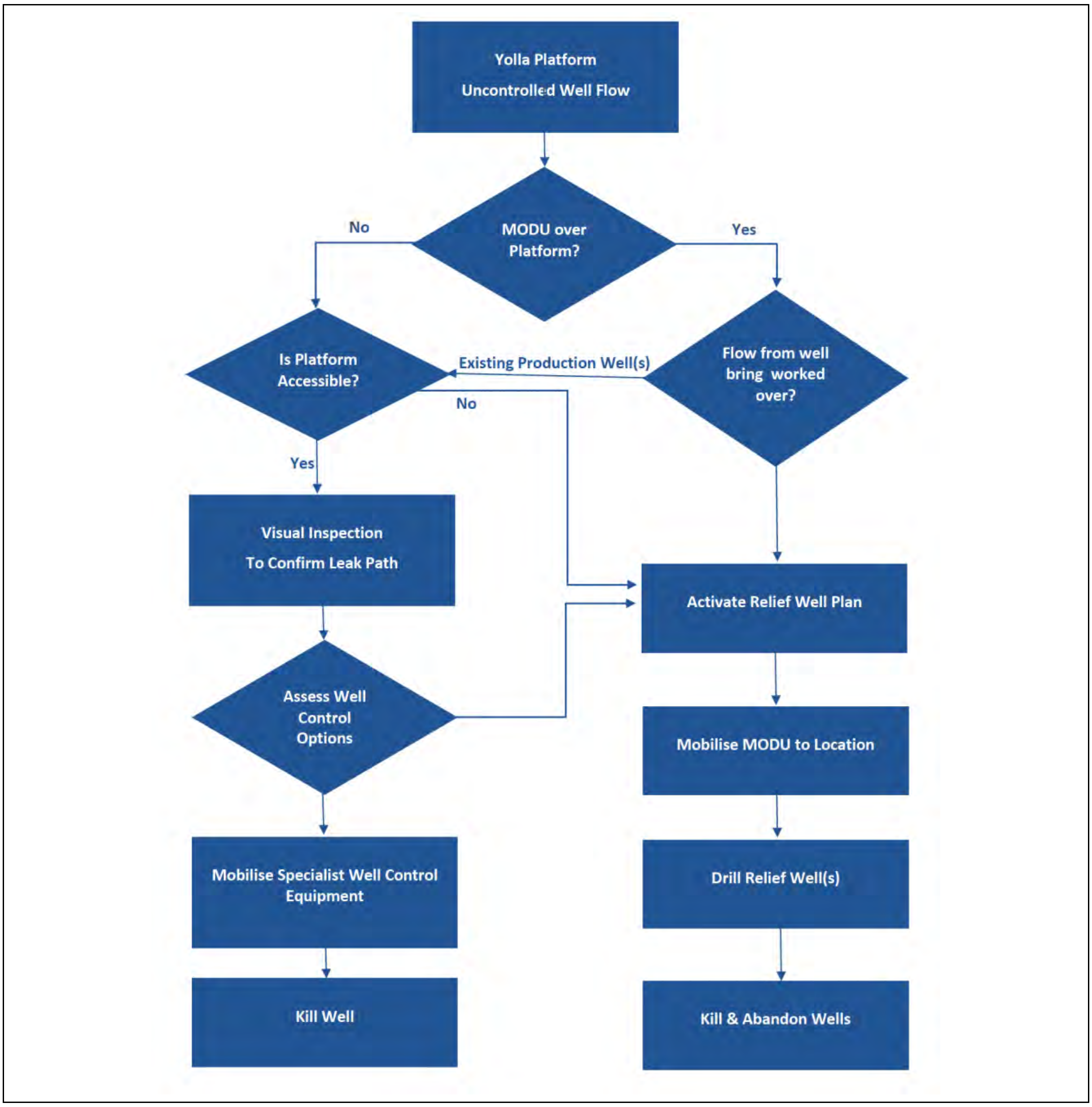


Figure 3.6. Yolla relief well decision tree

3.10 Cessation of Production and Decommissioning

The end of field life for Yolla is anticipated to be the end of 2025 based on current production (i.e., assuming no infill drilling in the Yolla field or connection of other wells).

Beach is currently planning on developing the Trefoil gas field in T/RL2 to the immediate west of Yolla-A. While the development concept is still in the planning phase, the plan involves drilling one or more wells in the Trefoil gas field (located 30 km west of Yolla-A) and tying the well/s in with Yolla-A via a pipeline. This would extend the life of the BassGas Development until 2037 and therefore delay decommissioning of the BassGas infrastructure. Activities related to the Trefoil development will be addressed in future EPs.

Notwithstanding this, the following describes the process likely to be followed for the Yolla decommissioning phase.

3.10.1 Cessation of Production

During the decommissioning planning stage, Beach will prepare plans for cessation of production (CoP) of the Yolla field and associated infrastructure under production licence requirements. An EP for CoP will be prepared and submitted to NOPSEMA prior to CoP, which will be followed by a decommissioning EP. The CoP EP will include any proposed alternative arrangements to complete removal of property at the CoP.

3.10.2 Decommissioning

At this stage of field production, Beach has not developed plans for decommissioning the BassGas infrastructure. The EPBC Act environmental approval decision for the BassGas Development (2001/321) states that decommissioning must not commence unless an EP for decommissioning is in place. Section 572(3) of the OPGGS Act imposes an obligation on the duty holder to remove all structures, equipment and property within the title area that will not be used for the purposes of petroleum production, and there may be requirements under the *Environmental Protection (Sea Dumping) Act 1981* (Cth) that apply to some decommissioning activities.

Beach fully acknowledges that the default position through Section 572 of the OPGGS and NOPSEMA Policy *Section 572 Maintenance and Removal of Property* (N-00500-PL1903, A720369, November 2020) is for removal of all property when it is no longer in use and that any deviations from this position will need to be evaluated and approved by NOPSEMA. Beach will incorporate the requirements of this policy into the BassGas decommissioning concept study.

Decommissioning Planning Process

Decommissioning is covered by Beach's HSEMS. The suspension of assets is divided into:

1. Temporary suspension;
2. Mothballing;
3. Preliminary abandonment; and
4. Final abandonment and removal.

The requirement to initiate preliminary or final abandonment for assets of the scale of the BassGas Development is managed through a dedicated capital project and the decommissioning process requires a multi-disciplinary team. Final approval to undertake the work must be granted by the regional General Manager Operations and General Manager Development. Consideration for the environmental approvals process is part of the decommissioning standard.

Beach applies its 'gate process' to decommissioning projects, as illustrated in Figure 3.7.

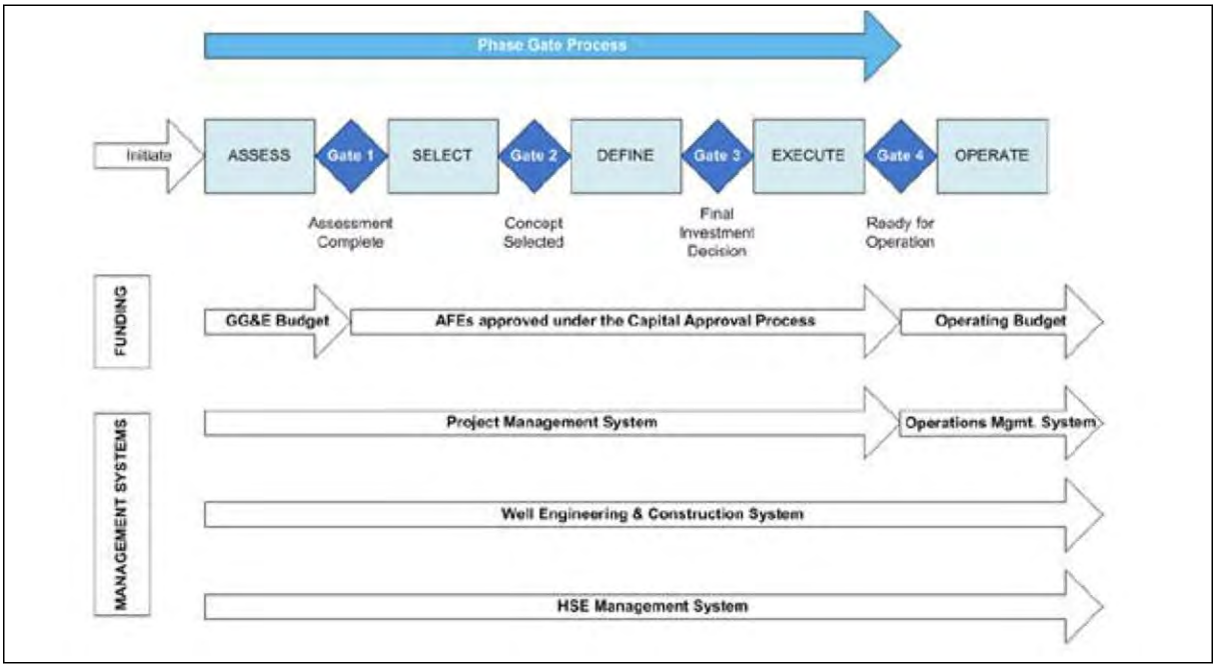


Figure 3.7. Beach's gate process

Until a decommissioning process commences, no timeframe can be allocated to this process, though this would be expected to take several years from the 'assess' phase through to the 'execute' phase for BassGas. Below are notional timeframes for decommissioning with and without development of the Trefoil gas field.

Without Trefoil development (production scheduled to end in 2025):

- 'Assess' decommissioning options – CoP minus 3 years (2022).
- 'Select' decommissioning option – CoP minus 2 years (2023).
- Commence CoP regulatory approvals process – CoP minus 2 years (2023).
- Obtain CoP regulatory approvals – CoP minus 6 months (2024).
- Cease production – 2025.
- Commence decommissioning regulatory approvals process – CoP plus 6 months (2025).
- 'Define' decommissioning plans – 2025.
- Obtain decommissioning regulatory approvals – CoP plus 18 months (2026).
- 'Execute' decommissioning activities – 2026-27.

With Trefoil development:

- 'Assess' development options – Yolla CoP minus 2 years (2023).
- 'Select' development option – Yolla CoP minus 1 year (2024).
- Commence development regulatory approvals process – Yolla CoP minus 1 year (2024).
- 'Define' development plans - 2025.
- Obtain development regulatory approvals – Yolla CoP plus 18 months (2026).
- 'Execute' development – install new pipeline, platform upgrades, etc (2027).
- 'Operate' (production) phase – 2027-2039.
- 'Assess' decommissioning options – Trefoil CoP minus 3 years (2036).
- 'Select' decommissioning option – Trefoil CoP minus 2 years (2037).
- Commence cessation of operations regulatory approvals process – Trefoil CoP minus 2 years (2037).
- Obtain CoP regulatory approvals – Trefoil CoP minus 6 months (2038).

- 'Define' decommissioning plans – 2039.
- Cease Trefoil production – 2039.
- Commence decommissioning regulatory approvals process –Trefoil CoP plus 6 months (2040).
- Obtain decommissioning regulatory approvals – CoP plus 18 months (2040).
- 'Execute' decommissioning activities – 2041.

Decommissioning Environmental Approvals

The former Commonwealth Department of Industry, Innovation and Science (DIIS) (now the Department of Industry, Science, Energy and Resources, DISER) released an Offshore Petroleum Decommissioning Guideline (January 2018). This, and future revisions of the guideline, will be taken into account during the decommissioning planning process.

Issues likely to be explored in the decommissioning EP (and addressed through the stakeholder consultation process) include:

- Decommissioning options (leave platform and pipeline in situ vs complete removal vs partial removal);
- If equipment is left in situ:
    - Ongoing monitoring requirements;
    - Impacts to commercial fisheries of remaining infrastructure;
    - Clearance below sea level for commercial fishers (current regulatory requirements in Commonwealth waters for decommissioned platforms are to provide a 30 m clearance from the sea surface in the water column); and
- Re-purposing of decommissioned infrastructure to create marine habitat for recreational fishers and divers, either in situ or moved to more accessible location/s.

The timeframe allocated to planning for decommissioning allows for the preparation of a CoP EP and/or decommissioning EP and to have each assessed by NOPSEMA sufficiently in advance of activities commencing to ensure each EP is accepted prior to activities commencing.

Future Plans for the BassGas Development

Beach envisions that the following options will be considered for the decommissioning phase of the BassGas Development, noting that these are concepts only that are not subject to current planning:

- Yolla-A – platform will be removed on a derrick barge. An assessment will be made closer to the time as to whether to remove the topsides and top sections of the jacket while leaving the lower parts of the jacket in place. Doing so allows the jacket to continue providing marine habitat while minimising the risk of vessel collision. Footage gathered from in-water inspections of the platform jacket will inform whether the habitat value of the jacket justifies consideration for retaining parts of it.
- Wells – will be plugged and abandoned (P&A) using a MODU or construction vessel in line with industry standards. The wells will be cut several metres below the mudline and cement plugs installed downhole to prevent the release of gas. The severed steel and other equipment will be recovered to the deck of the MODU or vessel and sent ashore to be scrapped.

- Offshore RGP – an assessment will be made closer to the time as to whether to remove the pipeline or to leave it in place and purge it of gas and fill with an inert substance (such as nitrogen). Leaving it in place minimises the environmental impacts and risks associated with its removal and provides continued seabed habitat (for example, see Plate 3.3). Footage gathered from in-water inspections of the RGP (during inspection and maintenance activities) will inform the decision on whether the habitat value of the pipeline justifies retaining it (in whole or part).

Maintaining Inventory

All property owned by Beach, including its condition, is listed in an assets register that is retained within the CMMS and maintained by the Technical Services Team. If any equipment is retained in the title areas after the decommissioning process is complete, the assets register will be updated to reflect this.

All equipment associated with the BassGas Development is being inspected, monitored and maintained in accordance with the CMMS to ensure that it is in good condition and can be safely decommissioned when required.

3.11 Summary of Emissions and Discharges

This chapter provides a detailed description of the Yolla-A platform and pipeline operations and maintenance activities. Table 3.10 summarises the hazards associated with planned activities (e.g., routine emissions and discharges) and unplanned activities (e.g., emergency events) resulting from operations and maintenance activities and where these are addressed in the environmental impact assessment (EIA) and environmental risk assessment (ERA) in Chapter 7 of this EP.

Table 3.10. Environmental hazards associated with the operation and maintenance of the offshore BassGas facilities

Hazard	Described in EP Section	Assessed in EP Section
Planned activities		
Platform only		
Physical presence	3.2, 3.3	7.1
PFW disposal	3.5.7	7.6
Air emissions	3.5.11, 3.5.12	7.4
Chemical injection	3.5.13	N/A – closed loop
Navigational and deck lighting	3.5.22	7.3
Platform and vessels		
Deck drainage	3.5.9, 3.5.10	7.10
Sewage and grey water disposal	3.5.14	7.8
Waste disposal	3.5.14, 3.7.1, 3.7.3	7.11
Sound and vibration	N/A	7.5
Pipeline only		
Physical presence	3.5	7.1
Sound (maintenance activities)	3.7.5	7.5
Vessels only		

Hazard	Described in EP Section	Assessed in EP Section
Cooling and brine water discharges	3.7	7.9
Helicopters only		
Air emissions	3.8.1	7.4
Sound and vibration	3.8.1	7.5
Unplanned activities		
Platform only		
LoC – production chemicals	3.5.13	7.14
LoC – diesel	3.5.12	7.15
LoWC	3.9	7.17
Platform and vessels		
Discharge of contaminated deck drainage	3.5.9, 3.5.10, 3.7	7.10
Accidental waste overboard	3.5.14	7.11, 7.14
Pipeline only		
LoC – pipeline rupture	3.9	7.16
Vessels only		
Sound and vibration	N/A	7.5
Vessel collision with megafauna	3.8.2	7.12
Introduction of invasive marine species	N/A	7.13
Diesel spill	3.8.2	7.15
Oil spill response activities		
Relief well drilling, ocean-based and shoreline oil spill response activities	3.9, 7.18, 7.19	7.18, 7.19

The environmental aspects associated with the BassGas operations are presented in Table 3.11 over page.

Table 3.11. Environmental aspects associated with BassGas operations

ACTIVITIES	Planned Events										Unplanned Events						
	Physical presence of infrastructure	Infrastructure inspection and maintenance	Routine emissions - light	Routine emissions - atmospheric	Routine emissions - noise & vibratic	Routine discharges - PFW	Routine discharges - putrescible was	Routine discharges - sewage & grey water	Routine discharges - cooling & brine water	Routine discharges - Bilge water & deck drainage	Accidental discharge of waste to the ocean	Vessel collision with megafauna	Introduction and establishment of invasive marine species	LoC of bulk chemicals and hydrocarbons	Loss of well control	Loss of control from pipeline ruptur	MDO release
Production wells																	
Yolla-3, -4, -5, -6	✓	✓			✓									✓	✓		
Yolla-A Platform																	
Physical presence	✓	✓	✓		✓							✓					
Process operations	✓	✓	✓	✓	✓	✓			✓	✓	✓			✓	✓		
Waste management							✓	✓			✓						
Accommodation							✓	✓			✓						
Inspection and maintenance		✓	✓		✓									✓	✓		
Raw gas pipeline																	
Operations	✓	✓			✓									✓		✓	
Inspection and maintenance		✓	✓		✓							✓				✓	

ACTIVITIES	Planned Events										Unplanned Events						
	Physical presence of infrastructure	Infrastructure inspection and maintenance	Routine emissions - light	Routine emissions - atmospheric	Routine emissions - noise & vibratic	Routine discharges - PFW	Routine discharges - putrescible was	Routine discharges - sewage & grey water	Routine discharges - cooling & brine water	Routine discharges - Bilge water & deck drainage	Accidental discharge of waste to the ocean	Vessel collision with megafauna	Introduction and establishment of invasive marine species	LoC of bulk chemicals and hydrocarbons	Loss of well control	Loss of control from pipeline ruptur	MDO release
Logistics																	
Vessel operations	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓			✓
Helicopter operations		✓	✓	✓	✓												
Oil spill response strategies																	
Source control	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			
Monitor and evaluate		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓			✓
Assisted natural dispersion		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓			✓
Oiled Wildlife Response																	

4. Stakeholder Consultation

In keeping with Beach's Community and Stakeholder Engagement Policy (Figure 4.1) and APPEA's Principles of Conduct, Beach is committed to open, ongoing and effective engagement with the communities in which it operates and providing information that is clear, relevant and easily understandable. Beach welcomes feedback and is continuously endeavouring to learn from experience in order to manage its environmental and social impacts and risks.

4.1 Stakeholder consultation objectives

The objectives of Beach's stakeholder consultation in preparation of the revised EP are to:

- Engage with stakeholders in an open, transparent, timely and responsive manner, building on existing relationships;
- Minimise community and stakeholder concerns where practicable;
- Build and maintain trust with stakeholders; and
- Demonstrate to regulatory agencies that stakeholders have been appropriately consulted.

The objectives are achieved by:

- Identifying and confirming 'relevant persons' (stakeholders whose functions, interests or activities may be affected by the BassGas operations) for the activity;
- Ensuring stakeholders are informed about the EP revision and the potential environmental and social impacts and risks;
- Proactively providing informative, accurate and timely information;
- Ensuring affected stakeholders are informed about the process for consultation and that their feedback is considered in the revision of the EP; and
- Ensuring that issues raised by affected stakeholders are adequately assessed, and where requested or relevant, responses to feedback are communicated back to them.

4.2 Regulatory requirements

Stakeholder consultation is required under both the OPGGS(E) and the OPGGS Regulations. This section summarises these regulatory requirements.

4.2.1 Commonwealth Requirements

Section 280 of the OPGGS Act states that a person carrying out activities in an offshore permit area should not interfere with other users of the offshore area to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.

Community and Stakeholder Engagement Policy

1. Policy Introduction

This policy outlines Beach's commitment to engage with its stakeholders to ensure that it develops positive relationships with communities within which it operates. This policy applies in all joint venture operations where Beach is the operator. This policy should be read together with other policies including the Aboriginal Engagement Policy and the Environmental Policy.

2. Scope

This policy applies to all Beach's directors, officers and employees.

3. Position statement

Beach is committed to open and transparent communication with its stakeholders and recognises that its business success is contingent upon building respectful and mutually beneficial relationships while effectively managing its operations. Beach will take the time to listen, understand, give due consideration and respond to the interests and concerns of its stakeholder groups. Beach's aim is to be seen as the operator of choice for its stakeholders, and that its presence in the community is welcomed as a positive experience.

Stakeholders include, but are not limited to, landholders, Aboriginal communities, communities in which Beach operates, interest groups and government.

4. Policy commitment

Beach is committed to:

- Acknowledging that local communities are stakeholders in all operations, that there will be access to reliable and timely information about exploration and development activities and transparent, sincere and respectful consultation with them prior to, during and after operations.
- Clearly communicating the goals and parameters for stakeholder engagement.
- Understanding the social, environmental and economic effects of Beach's activities while delivering business outcomes.
- Seeking to understand stakeholder values, interests and concerns with relevant business operations and in a timely manner address these and deliver on any agreed support or commitments.
- Ensuring its employees and contractors are aware of their obligations toward the protection of local community culture and relationships and the environment.
- Contributing to the community by local employment and engagement of local contractors and suppliers where appropriate and possible.
- Participating in community events where appropriate; and
- Communicating frequently and effectively through a number of means including public meetings, stakeholder forums, its website, annual report, road shows and one-on-one meetings.

Figure 4.1. Beach's Community and Stakeholder Engagement Policy

In relation to the content of an EP, more specific requirements are defined in the OPGGS(E) Regulation 11(A). This regulation requires that the Titleholder consult with 'relevant persons' in the preparation of an EP. A 'relevant person' is defined in Regulation 11A as:

1. Each Department or agency of the Commonwealth to which the activities to be carried out under the EP, or the revision of the EP, may be relevant;
2. Each Department or agency of a State or the Northern Territory to which the activities to be carried out under the EP, or the revision of the EP, may be relevant;
3. The Department of the responsible State Minister, or the responsible Northern Territory Minister;
4. A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP, or the revision of the EP; and
5. Any other person or organisation that the titleholder considers relevant.

Further guidance regarding the definition of functions, interests or activities is provided in NOPSEMA's Assessment of Environment Plans: Deciding on Consultation Requirements Guidelines (N-04750-GL1629, Rev 0, April 2016), as follows:

- Functions – a person or organisation's power, duty, authority or responsibilities;
- Activities – a thing or things that a person or group does or has done; and
- Interests – a person or organisation's rights, advantages, duties and liabilities; or a group or organisation having a common concern.

Regulation 14(9) of the OPGGS(E) also defines a requirement for ongoing consultation to be incorporated into the Implementation Strategy defined in the EP. In addition, Regulation 16(b) of the OPGGS(E) requires that the EP contain a summary and full text of this consultation.

Amendments to the OPGGS(E) that took effect on the 25th of April 2019 also specify (in Regulation 9AB) that the complete EP will be published on the NOPSEMA website within five days of submission to NOPSEMA (subject to the EP satisfying a completeness check).

4.2.2 Victorian Requirements

Section 61(2)(j) of the OPGGS Act 2010 specifies that "decisions and actions should provide for community involvement in issues that affect them."

The OPGGS Regulations also specify that certain activities in relation to stakeholder consultation must occur, as listed below:

- Regulation 13(1)(f) – a Minister can only accept an EP if it demonstrates that there has been an appropriate level of consultation with authorities, interested persons and organisations;
- Regulation 16(8) – the implementation strategy must provide for appropriate ongoing consultation with relevant authorities of the Commonwealth or the State and other relevant interested persons or organisations; and
- Regulation 19(b) – a report on all consultations between the operator and relevant authorities, interested persons and organisations in the course of developing the EP.

4.3 Stakeholder Engagement Plan

The key stakeholders and methods of consultation that have been employed are guided by and documented in the BassGas Stakeholder Engagement Plan (SEP) for the revision of the BassGas EP. Given the remote location of the offshore assets and the ongoing nature of the operations, the stakeholder engagement program implemented is simple and informal for ongoing operations.

4.4 Stakeholder Identification and Classification

Beach (and its predecessor Origin) has been undertaking regular stakeholder consultation prior to, during and since the initial construction of the offshore assets commenced in 2004.

For the purpose of stakeholder consultation to support this revision of the EP, Beach has identified and consulted with relevant persons whose functions, interests or activities may be affected by the activities carried out under the EP, as well as those who Beach deems necessary to keep up to date with the activities in Bass Strait. Table 4.1 identifies these relevant persons.

To determine the type of information to provide to a stakeholder, an information category was developed and is detailed in Table 4.2.

Table 4.1. Stakeholders consulted for the BassGas operations EP revision

Category 1 – Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant	
Australian Maritime Safety Authority (AMSA)	Department of Defence (DoD)
Civil Aviation Safety Authority (CASA)	Australian Fisheries Management Authority (AFMA)
Department of Industry, Innovation and Science (DIIS)	Australian Hydrographic Service (AHS)
Department of Agriculture, Water and the Environment (DAWE)	Australian Communications Management Authority (ACMA)
National Native Title Tribunal (NNTT)	Department of Agriculture and Water Resources (DAWR)
Australian Energy Market Operator (AEMO)	Director of National Parks
Category 2 – Each Department or agency of a State to which the activities to be carried out under the EP may be relevant	
Victoria	
Department of Jobs, Precincts and Regions (DJPR): - Emergency Management Branch (EMB) - Earth Resources Regulation (ERR) - Victorian Gas Program (VGP)	Department of Environment, Water, Land and Planning (DEWLP): - Marine Heritage Branch - Planning Approvals
Victorian Fisheries Association (VFA)	Environment Protection Authority (EPA) Victoria
Aboriginal Victoria (AV)	Transport Safety Victoria (TSV) (Maritime Safety)
Tourism Victoria	Parks Victoria
Energy and Water Ombudsman Victoria	Essential Services Commission Victoria
Tasmania	
Tasmanian Parks and Wildlife Service (TPWS)	Department of Primary Industries, Parks, Water and Environment (DPIPWE)
New South Wales	

Port Authority of NSW	Transport for NSW
Category 3 – The Department of the responsible State Minister	
Office of the Victorian Premier	Office of the Minister for Agriculture, Regional Development
Office of the Minister for Resources	Office of the Minister for Energy, Environment and Climate Change
Category 4 – A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP	
Fisheries - Commonwealth	
AFMA - Bass Strait Central Zone Scallop Fishery Manager	AFMA - Southern Jig Squid Fishery Manager
AFMA - Eastern Tuna and Billfish Fishery	AFMA - Small Pelagic Fishery Manager
Southern Shark Industry Alliance	Southern Bluefin Tuna Industry Association
Sustainable Shark Fishing Inc	South Australian Rock Lobster Advisory Council (SARLAC) & South Eastern Professional Fisherman Association (SEPFA)
South-east Trawl Fishing Industry Association (SETFIA)	Commonwealth Fisheries Association (CFA)
Fishwell Consulting	National Seafood Industry Alliance
Fisheries - Victorian	
Seafood Industry Victoria (SIV)	Victorian Rock Lobster Association (VRLA)
Victorian Scallop Association	Abalone Victoria Central Zone
Total Marine Gippsland	VR Fish
Corporate Alliance Enterprises T/A Total Marine Gippsland	Portland Professional Fisherman's Association
Fisheries – Tasmanian	
Tasmanian Association for Recreational Fishing	Tasmanian Rock Lobster Fisherman's Association
Tasmanian Commercial Divers Association	Tasmanian Seafood Industry Council (TSIC)
Tasmanian Abalone Council Limited	Southern Rock Lobster Limited (SRL) (SA, VIC, TAS).
Infrastructure asset owners	
Alcatel Submarine Networks UK LTD	Watersure (Victorian Desalination Plant)
Nearby titleholders	
Cooper Energy Ltd	CarbonNet Project
Esso Australia Resources Pty Ltd	
Native title and cultural heritage significance	
Gunaikurnai Land and Waters Aboriginal Corporation	Bunurong Land Council Aboriginal Corporation
Flinders Island Aboriginal Association	First Nations Legal & Research Services Ltd
Conservation groups	
Institute for Marine and Antarctic Studies (IMAS)	Bass Coast Landcare Network
Three Creeks Landcare	Cape Woolamai Coast Action

Phillip Island Conservation Society	Victorian National Parks Association (VNPA)
Blue Whale Study Inc	South Gippsland Conservation Society
International Fund for Animal Welfare (Australia)	Deakin University
Other organisations	
Destination Phillip Island Regional Tourism Board	SCUBA Divers Federation of Victoria
Phillip Island Business & Tourism Association	Australian Petroleum Production and Exploration Association (APPEA)
Ocean Racing Club of Victoria	
Category 5 – Any other person or organisation that the Titleholder considered relevant	
Flinders Council (Tas)	Mornington Peninsula Shire Council (Vic)
Bass Coast Shire Council (Vic)	South Gippsland Shire Council (Vic)
Near neighbour (pipeline shore crossing)	Member for Bass (Vic)
Mineral Resources Tasmania	EPA Tasmania
Office of the Minister for Energy and Environment (Cth)	

Table 4.2. Information category to determine information provided to stakeholder.

Information Category	Description	Information Type	Follow up
1	Organisations or individuals whose functions, interests or activities <u>may be</u> impacted by the activity. Representative body for fishers who provide information to their members.	Information Sheet and/or provision of information as per organisations consultation guidance. Provision of further information where required. Meeting or phone call where required.	In the event there is no response to initial email/s, follow up is required because routine and non-routine activities <u>may</u> impact on the functions, interests or activities of this stakeholder.
2	Organisations or individuals who functions, interests or activities <u>will not</u> be impacted by the activity but are kept up to date with Beach's activities in Bass Strait.		In the event there is no response to initial email/s, follow up is not required because routine and non-routine activities will <u>not</u> impact on the functions, interests or activities of this stakeholder.

Note that consultation with contractors to Beach who will assist with the execution of activities associated with asset operation is not addressed in this section of the EP.

This also includes organisations that Beach has a contract or agreement with for assistance in the event of oil spill response or operational and scientific monitoring. Discussions held with these organisations that are not directly linked to the day-to-day operations of the BassGas Development are not included in the summary of stakeholder consultation in Section 4.5.

Where discussions with these organisations have assisted in the development or refinement of oil spill response strategies described in the OPEP, then these have been incorporated. The 'functions, interests or activities' of these organisations are only triggered in an emergency response. Consultation with these contractors and organisations is undertaken in accordance with Regulation 14(5) of the OPGGS(E) and Regulation 16(5) of the OPGGS Regulations, which requires measures to ensure that each employee or contractor working on, or in connection with the activity, is aware of his or her responsibilities in relation to this EP and has the appropriate competencies and training. This is detailed in Section 8.6.2 of the EP.

Beach recognises that the relevance of stakeholders identified in this EP may change in the event of a non-routine event or emergency. Every effort has been made to identify stakeholders that may be impacted by a non-routine event or emergency, the largest of which is considered a Level 2 or 3 marine diesel oil (MDO) spill from support vessels or a well blowout or pipeline release (see Sections 7.15, 7.16 and 7.17).

Beach acknowledges that other stakeholders not identified in this EP may be affected, and that these may only become known to Beach in such an event.

4.5 Engagement Approach

Consultation has been broadly undertaken in line with the International Association for Public Participation (IAP2) spectrum, which is considered best practice for stakeholder engagement. In order of increasing level of public impact, the elements of the spectrum and their goals are:

- Inform – to provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.
- Consult – to obtain public feedback on analysis, alternatives and/or decisions.
- Involve – to work directly with stakeholders throughout the process to ensure that public concerns and aspirations are consistently understood and considered.
- Collaborate – to partner with the public in each aspect of the decisions, including the development of alternatives and the identification of the preferred solution.
- Empower – to place final decision-making in the hands of the stakeholders.

The manner in which Beach has informed, consulted and involved stakeholders with the ongoing operations of the BassGas Development are outlined through this section.

Under the regulatory regime for the approval of EPs, the decision maker is the regulator (or regulators in the case of this activity). This being the case, the final step in the IAP2 spectrum, 'Empower', has not been adopted.

Beach has a strategic and systematic approach to stakeholder engagement, which aims to foster an environment where two-way communication and ongoing, open dialogue is encouraged to build positive relationships. Key principles that guide Beach in its stakeholder engagement are outlined in its Community and Stakeholder Engagement Policy (see Figure 4.1).

Beach has a good record of engaging with key its stakeholders including regulators, local communities, local councils, community groups and fishing industry associations.

4.6 Engagement Methodology

The tools and methods that have been and will continue to be used for stakeholder engagement are:

- **Project Information Sheet** – this was issued to most stakeholders in late October 2018 and provided an introduction to Beach as the new owner of the BassGas Development, an overview of the BassGas operations, and a description of the EP revision process (**Appendix 3**). The information sheet also included questions and answers (Q&As) and contact details to provide the opportunity to provide feedback.
- **One-on-one briefings** – where stakeholders have expressed concerns, one-on-one meetings with Beach's Community Manager, who is supported by project-specific personnel (such as the Environment Advisor, Cultural Heritage Advisor and Emergency Response Coordinator) to discuss their concerns and to provide clarifying and targeted information on the activity. The purpose of these briefings is for Beach to provide activity information and updates, listen to issues and concerns, gain feedback on the project and to identify further opportunities for engagement. Information is tailored to accommodate the different levels of stakeholder understanding.

- **The BassGas Environmental Liaison Group (ELG)** – The ELG meetings are held on a six-monthly basis and are open to the neighbours of the LLGP. Where appropriate, this forum is used as a conduit to distribute project information and seek feedback on the offshore operations, but is primarily concerns with onshore activities associated with the operation of the gas plant and gas pipeline. The BassGas ELG was informed of this EP revision process during the meetings held in November 2018 and May 2019. To date, no issues about the EP revision have been raised in these meetings.
- **Project hotline and dedicated project email** – A freecall telephone number (1800 797 011) and email address (community@beachenergy.com.au) was provided in the project information sheet and is included in all project information. The phone number and email address are monitored by the Community Manager.
- **Company website** – the project information flyer has been made available on the Beach website (https://www.beachenergy.com.au/bass-basin/) for ease of access. The BassGas web page also provides key facts and figures about the asset.

4.7 Summary of Stakeholder Consultation

There are no key themes and outcomes resulting from stakeholder consultation. Given that consultation relates to the ongoing operation of an existing asset that has been operating for over 12 years, government agencies, fisheries representatives and conservation groups have not expressed any concerns about the overlap between their functions, activities or interests and the continued operation of the BassGas Development.

A summary of key stakeholder consultation undertaken to date, together with Beach's responses and assessment of merit is included in Table 4.3.

A complete copy of original communications to and from all stakeholders is provided in **Appendix 4**.

4.8 Ongoing Consultation

Beach will continue consulting with relevant persons regarding the BassGas offshore operations at appropriate times, taking into consideration Beach's desire to minimise 'consultation fatigue' that many stakeholders have expressed.

It is envisaged that the only issue that would warrant stakeholder engagement prior to the next 5-yearly EP revision (other than the regular BassGas ELG meetings, which focus largely on onshore issues) would be in the event of a large-scale hydrocarbon release (from the well/s, pipeline or vessels), major changes to operations or infill drilling campaigns.

Table 4.3. Summary of stakeholder consultation undertaken

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
Category 1. Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant					
AMSA	AMSA is a statutory authority established under the *Australian Maritime Safety Authority Act* 1990, with one its key functions being to promote maritime safety and protect the ocean.	2	23/10/2018	Beach emailed the project information sheet and invited return comments.	No information is required from AMSA. Shipping traffic is described in EP Section 5.7.8.
			24/10/2018	Stakeholder returned email and raised no concerns.	
CASA	Aviation regulator.	2	23/10/2018	Beach emailed the project information sheet and invited return comments.	Beach agrees with the premise that CASA should have no concern with ongoing helicopter operations to and from Yolla-A.
			23/10/2018	Automated response from stakeholder acknowledging Beach's email.	
			29/10/2018	Stakeholder returned email and raised no concerns.	
DIIS	Has administrative and regulatory functions to drive growth and job creation by facilitating economic transformation.	2	23/10/2018	Beach emailed the project information sheet and invited return comments. There has been no response to date.	As per Table 4.2.
DAWE	Commonwealth department responsible for administration of the EPBC Act, Australian Marine Parks (AMPs) and MNES.	1	29/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	Beach does not believe that follow up is required as MNES issues are addressed throughout this EP.
NNTT	The NNTT is an independent agency established by the *Native Title Act* 1993 (Cth) to make decisions, conduct inquiries, reviews and mediations, and assist various parties with native title applications, and Indigenous Land Use Agreements (ILUAs).	2	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			23/10/2018	Automated response from stakeholder acknowledging Beach's email. There has been no response to date.	
AEMO	Responsible for operating Australia's largest gas and electricity markets and power systems.	2	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			23/10/2018	Automated response from stakeholder acknowledging Beach's email. There has been no response to date.	

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
DoD	Manage all Australian defence activities. DoD has operations in Sale, Gippsland.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
AHS	Responsible for the publication and distribution of nautical charts and other information required for safe shipping navigation in Australian waters.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
DAWR (biosecurity)	Biosecurity requirements for vessels entering Australian waters and ports.	1	23/10/2018	Beach emailed the project information sheet and invited return comment.	N/A
			31/10/2018	Phone call from stakeholder asking whether the Yolla platform and service vessels are domestic or international (in relation to quarantine requirements).	N/A
			8/11/2018	Stakeholder called again about the supply vessel's 'Coastal Status' or if the Yolla platform has a 'Low Risk Exemption'.	Beach is not familiar with these requirements and will be seeking clarifications from the Operations Team and DAWR.
			26/11/2018	After a phone call with the Senior Biosecurity Inspector, the stakeholder emailed requesting confirmation only domestic vessels interact with Yolla and that Yolla is on Low Risk Status from Biosecurity.	N/A
			27/11/2018	The Beach Environment Advisor called the stakeholder to discuss this issue, but was only able to leave a voicemail message.	N/A
			02/12/2018	Stakeholder emailed beach to ask for copies of forms related to 'low risk exemption' for Yolla platform.	Beach does not have copies of these certifications.
			04/12/2018	The Beach Environment Advisor called the stakeholder again to discuss this issue, but was only able to leave a voicemail message. This was followed	N/A

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
				up with an email asking for clarifications about the 'low risk exemption'.	
			18/12/2018	The Beach Environment Advisor emailed the stakeholder to follow up this issue. To date, there has been no response.	Beach does not believe that follow up is required as BassGas operations comply with all biosecurity requirements.
AFMA	Manager of fisheries in Commonwealth waters.	1	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2. The extent of Commonwealth fisheries overlap with BassGas operations is well understood (see EP Section 5.7.7).
ACMA	Administrator of submarine cable protection zones.	2	18/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2. The location of subsea communications cables in relation to the BassGas Development is well understood (see EP Section 5.7.5).
			18/01/2019	Automated response from stakeholder acknowledging Beach's email. There has been no response to date.	
DNP	Manages the Australian Marine Park network in Commonwealth waters	1	12/02/2020	Beach emailed the project information sheet and invited return comment.	N/A
			05/03/2020	A Senior Marine Parks Officer from the DAWE responded via email, stating that because the activity does not overlap any AMPs, there are no authorisation requirements from the DNP. Beach was referred to the NOPSEMA guidance note Petroleum Activities and AMPs (Rev 0, July 2018). The Senior Marine Parks Officer stated that no further notification of progress with the activity is required unless there is a pollution incident.	Beach has taken the NOPSEMA guidance note into consideration. An assessment of the routine and non-routine activities associated with BassGas operations against the AMPs is presented in Appendix 1.
Category 2. Each Department or agency of a State to which the activities to be carried out under the EP may be relevant					
Victoria					

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
DJPR – EMB	Control agency for marine pollution emergencies in Victorian waters.	1	29/11/2018	Beach emailed DJPR detailing information on the EP revision and invited return comment.	Beach remains in contact with the DJPR – EMB so that the hydrocarbon spill response strategies outlined in the OPEP can be reviewed. Beach will issue a copy of the OPEP for EMB's files.
			08/01/2019	Stakeholder emailed Beach and asked for information about Beach's schedule for EP revision.	
			15/01/2019	Beach met with DJPR. The EMB asked when the OPEP would be available for review. Beach agreed to send it to them for review when it is ready. Stakeholder was comfortable with this.	
DJPR – ERR	Regulator of oil and gas activities in Victorian waters.	1	24/10/2018	Beach emailed the project information sheet and invited return comment.	DJPR (ERR) is the regulator for the Victorian state waters component of the BassGas Development. No communications are required until the EP is submitted.
			24/10/2018	Stakeholder called Beach and advised that they will assess the EP when it is formally submitted for assessment.	
DJPR – VGP	The VGP aims to deliver a comprehensive program of geoscience and environmental research and related activities from 2017-2020.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
VFA	Manager of fisheries in Victorian waters.	1	23/10/2018	Beach emailed the project information sheet and invited return comment.	Beach does not believe that follow up is required, as consultation with individual fisheries representatives has taken place.
			23/10/2019	The VFA replied asking about plans to undertake consultation with SIV and VR Fish. Beach responded that this would be taking place in the coming weeks.	
DELWP – Planning Approvals	Responsible for management of coastal and marine parks and oiled wildlife response in the event of a hydrocarbon spill in state waters.	2	23/10/2018	Beach emailed DELWP detailing information on the EP revision and invited return comment.	As per Table 4.2.
			23/10/2018	Automated response advising stakeholder contact was on leave until 07/11/2018.	
			07/11/2018	Original email re-issued. No response to date.	

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
DELWP – Planning Approvals	Protection of Victoria's native landscapes.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
DELWP – Marine heritage branch	Responsible for the protection of maritime heritage and shipwrecks.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2. The location of recorded shipwrecks is known (see EP Section 5.6.2).
DELWP – Wildlife	Responsible for protecting and managing native wildlife.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Tourism Victoria	Victorian tourism promotion agency.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Energy and Water Ombudsman Victoria	A not-for-profit, independent and impartial dispute resolution service that handles complaints about energy and water issues, providing Victorian customers with free, accessible, informal and fast dispute resolution.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Essential Services Commission Victoria	The commission is an independent regulator that promotes the long-term interests of Victorian consumers with respect to the price, quality and reliability of essential services (energy, water and transport sectors).	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
EPA Victoria	Victorian environmental regulator.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Parks Victoria	Manager of several coastal and marine parks in the EMBA.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
TSV (Maritime Safety)	Victorian government agency responsible for maritime safety.	2	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
				There has been no response to date.	
AV	The AV works on Aboriginal policy reform, with a focus on self-determination and treaty, community strengthening and engagement, and cultural heritage management and protection. It is responsible for implementing the *Aboriginal Heritage Act* 2006 and the *Aboriginal Lands Act* 1970.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Tasmania					
DPIPWE	Tasmania's leading natural resources agency, responsible for the sustainable management of natural and cultural heritage.	2	24/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
TPWS	Government agency responsible for managing protected areas on Tasmanian public land.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			24/10/2018	Stakeholder emailed Beach to provide additional contact details for Parks and Wildlife Service.	
			24/10/2018	Additional stakeholders provided with consultation information.	
New South Wales					
Port Authority of NSW	The Port Authority acts as harbourmaster at the State's six commercial seaports, managing shipping movements, safety, security and emergency response.	1	09/07/2020	Beach spoke with the Manager of Marine Operations (Port Botany) about	Beach remains in contact with the Port Authority of NSW and updated the notification details in the OPEP.
			10/07/2020	Beach emailed the project information sheet to the Manager of Marine Operations (Port Botany) and asked for the notification details to include in the OPEP to inform the Port Authority in the case of a large MDO spill.	
			13/07/2020	Stakeholder replied to email and supplied their contact details, and those for Transport of NSW, for inclusion in the OPEP.	

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
Transport for NSW	NSW leading transport and roads authority	1	13/07/2020	Following the recommendations in the communications with the Port Authority of NSW for Beach to contact Transport for NSW, Beach emailed Transport for NSW (Manager Marine Pollution & Emergency Response) to ask for advice on the response options they envisaged for low concentrations of MDO in the water column adjacent to the NSW coastline.	Beach will continue to consult with Transport for NSW to determine a mututally agreeable response option for low threshold MDO in the water column adjacent to the NSW coastline. Because Beach has nominated a monitoring response (as opposed to an on-water response) as the only suitable response, it is not necessary to close out this conversation prior to EP submission.
			14/07/2020	Transport for NSW Marine Pollution & Emergency Manager requested a phone call with Beach in order to discuss OPEP arrangements for NSW.	
			22/07/2020	Beach responded to the email noted above asking if there was an opportunity to discuss the matter on 24 July.	
			29/07/2020	Beach followed up with a phone call and left a message asking for a return call. No response to date.	
Category 3. The Department of the responsible State Minister					
Office of the Victorian Premier	Constituents may have an interest or be affected by the project.	2	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			23/10/2018	Stakeholder advised via email on leave for the remainder of term of government. There has been no response to date.	
Victorian Office of the Minister for Agriculture, Regional Development	Oversight of the agriculture and regional development portfolios.	2	24/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			24/10/2018	Automatic email response received. There has been no response to date.	
Victorian Office of the Victorian Minister for	Oversight of the Energy, Environment and Climate Change portfolios.	2	29/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
Energy, Environment and Climate Change					
Victorian Office of the Minister for Resources	Oversight of the resources portfolio.	2	24/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Category 4. A person or organisation who functions, interests or activities may be affected by the activities to be carried out under the EP					
Commonwealth fisheries					
AFMA - Bass Strait Central Zone Scallop Fishery Manager	The Bass Strait Central Scallop Fishery operates in the central area of Bass Strait between the Victorian and Tasmanian scallop fisheries. Fishing is concentrated on beds east of King Island.	1	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2. The extent of Commonwealth fisheries overlap with BassGas operations is well understood (see EP Section 5.7.7).
AFMA - Eastern Tuna and Billfish Fishery Manager	The Eastern Tuna and Billfish Fishery operates in the Exclusive Economic Zone from Cape York to the Victoria/South Australia border including water around Tasmania and the high seas of the Pacific Ocean.	1	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As above.
AFMA - Southern Jig Squid Fishery Manager	The Southern Squid Jig Fishery is located off New South Wales, Victoria, Tasmania and South Australia and targets Gould's squid (*Nototodarus gouldi*).	1	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As above.
AFMA - Small Pelagic Fishery Manager	Commonwealth fishery that extends from southern Queensland to south Western Australia and targets Australian sardine, blue mackerel, jack mackerel and redbait.	1	23/10/2019	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As above.
SETFIA	Peak representative body for trawl fishing in south-east Australia.	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	N/A
			29/01/2019	Beach called the stakeholder and left a voicemail message.	N/A

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
			01/02/2019	Stakeholder returned Beach's call and expressed concern over whether the position of Yolla-A and the safety zone is known to fishers. Beach confirmed the platform has been in place for a decade and breaches of the safety zone are very rare.	Details of the safety zone are included in EP Section 3.5.21.
			07/02/2019	Stakeholder called Beach and left a voicemail asking Beach to call.	Beach called the following day but there was no answer.
			11/02/2019	Beach called the stakeholder again and left a voicemail message. There has been no response to date.	As per Table 4.2. The extent of Commonwealth fisheries overlap with BassGas operations is well understood (see EP Section 5.7.7).
National Seafood Industry Alliance	Peak seafood industry representative body providing national representation to the Australian federal government.	1	17/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2. The extent of Commonwealth fisheries overlap with BassGas operations is well understood (see EP Section 5.7.7).
			15/02/2019	Beach sent a follow up email offering consultation.	
			14/03/2019	Beach sent another follow up email offering further consultation. There has been no response to date.	
Southern Bluefin Tuna Industry Association	Peak body representing the Southern Bluefin Tuna Fishery.	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As above.
			17/01/2019	Beach called to follow-up and offer further consultation. Reception advised that if no return contact was made then there shouldn't be any concerns.	
			14/03/2019	Beach emailed a further follow up and offered consultation. There has been no response to date.	
CFA		1	17/01/2019	Beach emailed the project information sheet and invited return comment.	As above.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
	Peak body representing the collective rights, responsibilities and interests of a range of Commonwealth fisheries.		15/02/2019	Beach sent follow up email offering further consultation. Email used due to no phone number.	
			14/03/2019	Beach sent follow up email offering further consultation.	
Southern Shark Industry Alliance	Supports its members whom rely on the sustainable harvesting of the Southern Shark Fishery	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As above.
			17/01/2019	Beach sent follow up email to offer consultation (no phone number available to call).	
			14/03/2019	Beach sent further follow up email to offer consultation.	
Sustainable Shark Fishing Inc	Peak industry body for shark gillnetters.	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2. The extent of Commonwealth fisheries overlap with BassGas operations is well understood (see EP Section 5.7.7).
			17/01/2019	Beach sent follow up email to offer consultation (no phone number available to call).	
			14/03/2019	Beach sent further follow up email to offer consultation.	
Fishwell Consulting	Specialised research and consulting services to encourage and promote sustainable fishing practices to the commercial fishing industry within Australia.	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	N/A
			17/01/2019	Beach sent follow up email offering further consultation.	N/A
			03/08/2019	Beach called and left a voicemail message offering further consultation.	N/A
			14/03/2019	Beach sent a follow up email offering further consultation. Stakeholder responded by email requesting information about all incidents that have occurred over the last five years.	N/A

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
			15/03/2019	Beach called stakeholder and advised him that all incidents are reported to NOPSEMA and that such information is not released publicly. Beach also noted its adherence to the activity's in-force EP and addressed the stakeholder's concerns via a follow-up email.	Beach considers that this stakeholder's concerns have been addressed.
SARLAC & SEPFA	Commercial fisheries representing the views and interests of its members. SARLAC promotes the interests of the SA rock lobster fishing industry.	1	17/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			15/02/2019	Beach left a voicemail message offering further consultation.	
			08/03/2019	Beach called and left another voicemail message.	
			14/03/2019	Beach sent a follow up email offering further consultation. There has been no response to date.	
Victorian fisheries					
Seafood Industry Victoria (SIV)	Peak industry body for Victorian Fisheries	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	N/A
			17/01/2019	Beach called SIV and left a voicemail message offering further consultation.	N/A
			17/01/2019	Stakeholder returned message and noted they were not planning on engaging individual fishers as there is no change to operation of the assets.	N/A
			06/02/2019	Follow up email from Beach encouraging questions from SIV regarding the BassGas Operations EP revision.	N/A
			19/02/2019	Beach met with SIV's Executive Director, where a number of Beach activities were discussed. SIV did not raise any specific questions about BassGas	Beach agreed to this request.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
				operations. SIV asked Beach to provide a one-page article in the next edition of 'ProFish'.	
			28/02/2019	Follow up email and confirmation of one-page article on the revision of the BassGas Operations EP to appear in March edition of 'ProFish'.	N/A
			04/03/2019	Beach provided its new logo to be used in the 'ProFish' article which was published in May 2019, featuring BassGas EP Revision information on page 12.	N/A
Total Marine Gippsland	Specialised vessel management for the fishing industry and broader commercial marine industry	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			17/01/2019	Beach sent a follow up email offering further consultation.	
			08/03/2019	Beach called stakeholder and offered consultation and explained the EP review process. Re-issued the project information sheet.	
			14/03/2019	Beach sent follow up email offering further consultation. There has been no response to date.	
Victorian Scallop Association	Scallop fisheries representative. Members are entitled to operate in the Bass Strait Central Zone Scallop Fishery (Cth) and the Victorian and Tasmanian scallop fisheries.	1	05/02/2019	Beach emailed the project information sheet and invited return comment.	No further consultation required.
			08/03/2019	Beach called to obtain the most suitable email address and re-issued the project information sheet.	
			14/03/2019	Beach sent a follow up email offering consultation.	
			21/03/2019	Beach called the stakeholder, who said the association has no issues or concerns.	
VRLA	Peak industry body for rock lobster fisheries.	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
			17/01/2019	Beach called and left a voicemail message offering consultation.	The extent of Victorian fisheries overlap with BassGas operations is well understood (see EP Section 5.7.7).
			29/01/2019	Beach called and left a voicemail offering further consultation. There has been no response to date.	
VR Fish	Peak body representing recreational fishers in Victoria.	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As above.
			17/01/2019	Beach called VR Fish to offer further consultation. The receptionist advised she would pass the message on.	
			15/02/2019	Beach sent a follow up email to offer consultation.	
			14/03/2019	Beach sent another follow up email with offer of further consultation. There has been no response to date.	
Abalone Victoria Central Zone	Part of broader Victorian Abalone Fishery	1	18/02/2019	Beach emailed the project information sheet and invited return comment.	As above.
			08/03/2019	Beach sent follow up email offering further consultation.	
			14/03/2019	Beach sent follow up email offering further consultation. There has been no response to date.	
Tasmanian fisheries					
Tasmanian Association for Recreational Fishing	Peak body representing recreational marine fishers in Tasmania.	2	07/01/2019	Beach emailed the project information sheet and invited return comment.	No further consultation required.
			17/01/2019	Beach called stakeholder offering consultation. Stakeholder said they would contact Beach with any questions or concerns they may have.	

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
			14/03/2019	Beach called to follow up with stakeholder, who advised that the association has no issues, but wishes to remain informed about the activity.	
Tasmanian Commercial Divers Association	Peak body representing commercial divers in Tasmania.	2	17/01/2019	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Tasmanian Abalone Council Limited	Voice of the fishery representing divers, non-diving quota holders, processors and exporters.	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			17/01/2019	Beach left a voicemail message offering consultation.	
			15/02/2019	Beach left another voicemail message and sent another email offering consultation.	
			08/03/2019	Beach left another voicemail message.	
			14/03/2019	Beach sent another email offering consultation. There has been no response to date.	
Tasmanian Rock Lobster Fisherman's Association	Association of Tasmanian Rock Lobster Fishermen	1	07/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			17/01/2019	Beach left a voicemail message offering consultation.	
			15/02/2019	Beach left another voicemail message and sent another email offering consultation. The stakeholder advised to call back on 18/02/2019.	
			25/02/2019	Beach left a voicemail message offering consultation.	
			14/03/2019	Beach sent a follow up email to offer further consultation.	
			21/03/2019	Beach left a voicemail offering consultation. There has been no response to date.	
Southern Rock Lobster Ltd	Peak body representing rock lobster fishermen in Tasmania.	1	17/01/2019	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
			05/02/2019	Beach left another voicemail message and sent another email offering consultation.	
			08/03/2019	Beach called stakeholder to offer further consultation. The stakeholder advised that he'd need to read the SIV stakeholder engagement plan before responding and he'd then get in contact with Beach.	
			21/03/2019	Beach called stakeholder to offer further consultation. The stakeholder advised that he sources his information from the VRLA, and that Beach should check with VRLA regarding what their plans with regards to providing comments. There has been no additional correspondence. See VRLA entries (who have not engaged with Beach).	
TSIC	Peak body representing the interests of wild capture fishers, marine farmers and seafood processors in Tasmania.	1	17/01/2019	Beach emailed the project information sheet and invited return comment. Beach called stakeholder who advised their contact is on leave until the end of the month. Stakeholder advised the email has been forwarded to the relevant contact.	As per Table 4.2.
			05/02/2019	Beach called stakeholder who advised the contact is out of the office, but a message will be passed to him.	
			14/03/2019	Beach called stakeholder to ask if TSIC needs any information from Beach to pass to its members. TSIC did not think so. Beach forwarded original information sheet again.	
			21/03/2019	Beach contacted TSIC asking if TSIC had any concerns. TSIC reception stated that the original email was forwarded to the relevant contact and he would contact Beach directly if there were any concerns.	
Infrastructure asset owners					

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
Alcatel Submarine Networks UK LTD	Operator of the two subsea communications cables linking Victoria and Tasmania.	2	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2. The location of subsea communications cables in relation to the BassGas Development is well understood (see EP Section 5.7.5).
Watersure	Operator of the Victorian water desalinisation facility on the coast near Wonthaggi.	1	19/10/2018	Beach emailed the project information sheet and invited return comment.	N/A
			25/06/2019	Beach called stakeholder and left a voicemail message and sent another email offering to meet to discuss Watersure's processes in the event of a hydrocarbon release from BassGas offshore assets.	N/A
			27/06/2019	Beach left another voicemail message offering to meet. Stakeholder's community advisor responded stating that they are seeking the correct contact person at the organisation.	N/A
			11/07/2019	Stakeholder replied by email, stating that concerns regarding oil pollution are the: • Potential of hydrocarbons to impact integrity of the plant's assets and quality of drinking water. • Risk assessment requires the relevant incident information in order for Watersure to determine the appropriate action. • Main concern is incident with Bass Gas pipeline. The stakeholder provided emergency contact details.	Stakeholder requires more detailed information. Stakeholder agreed to meet with Beach to discuss oil spill risks.
			26/07/2019 – 20/08/2019	Multiple emails between Beach and Watersure regarding arranging a suitable meeting time.	Meeting date agreed for 30 August 2019.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
			30/08/2019	The Beach Environmental Advisor and Community Advisor presented to Watersure at their Wonthaggi facility. Watersure stated their main concern is the impact of pipeline rupture and diesel spill. Two main concerns of hydrocarbon pollution are: • Damage to assets - hydrocarbons would damage the water filtering membranes. • Damage to customers (drinking water quality). Watersure stated that the water filtering membranes are very sensitive with regard to contaminants. In response to questions from Watersure, Beach discussed the inspection and maintenance regime for the raw gas pipeline. Beach's Environmental Advisor explained that NOPSEMA use a risk-based approach for undertaking inspections, based on analysis of reportable and recordable incidents. Both parties discussed their respective incident management processes and agreed to provide emergency contact details. Beach's Environmental Advisor explained that the physical properties of condensate means that the most suitable response measure in the event of a spill is to let it weather naturally.	The main outcome of the meeting was to ensure that both parties confirmed the emergency contact details with each other and were aware of their marine inspection and maintenance activities. Beach agreed to add Watersure to their routine offshore notifications database.
			04/09/2019	Beach emailed a copy of the meeting notes to Watersure, together with a copy of the presentation.	N/A.
			10/09/2019	Watersure responded to the email by providing geographic coordinates of their marine inlets and outlets and confirming the emergency response contact details.	The emergency response details are included in the BassGas contact directory.
Nearby titleholders					

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
CarbonNet Project	Currently investigating commercial-scale carbon capture and storage network in offshore Gippsland greenhouse gas permits to the east of Yolla-A.	2	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			31/11/2018	Email from stakeholder asking to add their generic email address to Beach's stakeholder list. There has been no other response to date.	
Esso Australia Resources Pty Ltd	Operates oil and gas facilities in Bass Strait to the east of Yolla-A.	2	28/11/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Cooper Energy Ltd	Operates oil and gas facilities in Bass Strait to the east of Yolla-A.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Native Title and cultural heritage interests					
Gunaikurnai Land and Waters Aboriginal Corporation	Peak body representing Traditional Owners from the Brataualung Brayakaulung, Brabralung, Krauatungalung and Tatungalung family clans.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Bunurong Land Council Aboriginal Corporation (BLCAC)	Incorporated association representing the Bunurong community.	1	19/10/2018	Beach emailed the project information sheet and invited return comment.	Beach believes that all issues and concerns this stakeholder has have been addressed to their satisfaction. Additional consultation is only required in the event of potential or actual damage to cultural heritage.
			26/10/2018	The BLCAC emailed Beach asking to meet.	
			21/11/2018	Meeting was held between BLCAC and Beach at the BLCAC office. Beach discussed the update of the BassGas EP and OPEP and the stakeholder engagement process. BLCAC expressed concerns regarding incidents that would damage shoreline, ocean and the impacts on country and affected biodiversity, and expressed their appreciation for meeting with them.	
			22/11/2018	Beach emailed BLCAC to thank them for meeting, provided a link to the in-force BassGas Operations	

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
				EP Summary and a copy of the current BassGas ILUA. Beach also asked for any concerns to be provided in a return email.	
			23/01/2019	BLCAC emailed Beach reiterating that their concerns extend to any damage to cultural heritage. BLCAC also confirmed that the party that is a signatory to the BassGas ILUA no longer exists and that BLCAC is now the peak body for the Bunurong people.	
			23/01/2019	Beach response email assuring BLCAC that it is not undertaking new activities thus no new ground disturbance is being considered. Beach affirmed it would seek to engage with BLCAC should matters of cultural heritage be identified in the future.	
Flinders Island Aboriginal Association	Aboriginal community organisation established in 1971.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2. The EMBA does not extend to Flinders Island.
First Nations Legal & Research Services Ltd	Native Title service provider for Victorian traditional owners.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Conservation groups					
Bass Coast Landcare Network	Landcare network across Bass Coast region. The EMBA makes contact with the shoreline in their area of interest.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	Beach believes that all issues and concerns have been addressed to the stakeholder's satisfaction.
			12/11/2018	Beach sent a follow up email including the same information.	
			12/11/2018	Stakeholder responded, stating they have no immediate concerns and will contact Beach if they have questions.	
Three Creeks Landcare	Landcare network that operates in the Kilcunda area.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
	The EMBA makes contact with the shoreline in their area of interest.			Email bounced back.	This stakeholder's area of interest is located inland of the shoreline.
Cape Woolamai Coast Action	Cape Woolamai coast environment group. The EMBA makes contact with the shoreline in their area of interest.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			31/05/2019	Beach made follow-up phone call. No answer or option for voicemail. Beach sent follow-up email shortly after phone call. There has been no response to date.	
Phillip Island Conservation Society	Non-profit community organisation promoting environmental protection and conservation of Phillip Island. The EMBA makes contact with the shoreline in their area of interest.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
			31/05/2019	Beach made follow-up phone call and left voicemail. Beach also sent follow-up email shortly after phone call. There has been no response to date.	
South Gippsland Conservation Society	Not-for-profit organisation aimed at preserving South Gippsland's natural resources. The EMBA makes contact with the shoreline in their area of interest.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			31/05/2019	Beach made follow-up phone call and obtained updated contact details. Beach re-issued the information sheet and invited return comment.	
			03/06/2019	Beach received a response stating that the society was not monitoring the email address that the original email was issued to. They will review the project information sheet and let Beach know if they have any concerns.	
Blue Whale Study Inc	Organisation concerned with conservation outcomes for blue whales.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
				There has been no response to date.	The effects of routine and non-routine activities will be negligible for blue whales.
International Fund for Animal Welfare (Australia)	Organisation concerned with improving the welfare of animals.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
VNPA	Environment group concerned with diverse and healthy protected environments.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			22/10/2018	Email from stakeholder requesting to add additional contacts to stakeholder list. No concerns were raised.	
Deakin University	Conservation research.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	Continue discussions with stakeholder regarding opportunities for a long-term marine environmental monitoring program for fur-seal behaviour around platforms and pipelines.
			21/10/2018	Email from stakeholder requesting consultation.	
			26/10/2018	Stakeholder spoke with Beach's Environmental Advisor wishing to discuss opportunities for a long-term marine environmental monitoring program for fur-seal behaviour around platforms and pipelines. The Environmental Advisor passed on details of this request to Beach.	
			19/06/2019 – 21/06/2019	Beach emailed stakeholder with introductions and to arrange a meeting.	
			26/06/2019	Phone call with stakeholder to discuss the potential opportunities for further research in the Bass Basin. Stakeholder stated interest in scholarship opportunities. Stakeholder stated concerns that seismic surveys may impact on the foraging of penguins in the area. The BassGas offshore infrastructure may provide habitats for marine fauna and flora leading to potential increased foraging areas for species.	

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
				Beach requested indicative costs to assist in scholarships.	
			9/07/2019	Stakeholder emailed Beach with recap of general concepts discussed in previous phone call and provided a secondary contact at the university.	
			10/07/2019	The secondary contact emailed Beach to introduce himself as the leader for the recently established Victorian Integrated Marine Observing System (IMOS) node.	
			2/08/2019	Beach emailed the stakeholder acknowledging the information provided and provided an update on Beach's position. Both parties will get in contact soon to discuss the benefits of the proposed studies.	
IMAS	Cooperative teaching and research institute between various marine and Antarctic agencies.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Other organisations					
APPEA	Peak representative body for the oil and gas industry.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	Beach does not require a response from APPEA, as they represent Beach's interests.
Ocean Racing Club of Victoria	Conducts ocean/offshore and bay yacht races and events in Victoria.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
SCUBA Divers Federation of Victoria	Peak body representing the interest of over 2,500 SCUBA divers in Victoria, including 25 amateur dive clubs.	2	19/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Phillip Island Business &	Association supporting business and tourism in Phillip Island.	2	19/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
Tourism Association				There has been no response to date.	
Destination Phillip Island Regional Tourism Board	Peak industry body for tourism in the Phillip Island region.	2	19/10/2018	Beach emailed stakeholder detailing information on the EP revision and invited return comment.	As per Table 4.2.
			19/10/2018	An auto-reply was generated, directing Beach to a different email address. There has been no response to date.	
Category 5. Any other person or organisation that the Titleholder considers relevant					
Local Government Authorities					
Flinders Council	Includes the communities within the Furneaux Group and the islands of eastern Bass Strait up to the Victorian border, including the Hogan Island Group and the Deal Island Group. The EMBA makes contact with small sections of shoreline within their council boundary.	2	18/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Bass Coast Shire Council	Victorian shire council in closest proximity to the activity area. The EMBA makes contact with the shoreline within their council boundary, from Venus Bay to Phillip Island.	2	18/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.
			18/10/2018	An auto-reply was generated, stating the relevant department would respond.	
			31/05/2019	Beach made follow-up phone call. The stakeholder stated that they would get in contact with Beach in early June.	
			04/06/2019	The Shire Council responded to the email stating that there was a change of CEO in October 2018 and it was best for Beach to send the project information sheet again to another contact. Beach did so on the same day. There has been no additional response to date.	

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
Mornington Peninsula Shire Council	Victorian shire council near the activity area. The EMBA does not make contact with the shoreline within this council's boundary.	2	12/04/2019	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
South Gippsland Shire Council	Victorian shire council near the activity area. The EMBA makes contact with the shoreline within their council boundary, from Venus Bay to Wilsons Promontory.	2	18/10/2018	Beach emailed the project information sheet to various people within the shire and invited return comment.	As per Table 4.2.
			31/05/2019	Beach sent follow-up email to various people with the organisation and invited return comment. Beach also followed up with a voicemail. There has been no response to date.	
Local landholders					
Near neighbour	Landholder adjacent to the pipeline shore crossing at Kilcunda.	2	01/11/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
State Members of Parliament					
Member for Bass	Constituents may have an interest in or be affected by the activity.	2	24/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2.
Government agencies					
Office of the Minister for Energy and Environment	This office supports the Commonwealth Minister responsible for the energy and environment portfolios.	2	23/10/2018	Beach emailed the project information sheet and invited return comment. There has been no response to date.	As per Table 4.2. DoEE staff will be advised of any non-routine events and associated response activities.
MRT	The MRT gives effect to government policy in relation to minerals and petroleum resources.	1	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2.

Stakeholder	Function, interests and/or activities	Information type	Date	Consultation conducted and stakeholder concerns	Beach's assessment of merit
	They are responsible for the administration of the offshore petroleum sector.			There has been no response to date.	
EPA	The EPA regulates developments and activities that may impact on environmental quality and promote best practice and sustainable environmental management.	2	23/10/2018	Beach emailed the project information sheet and invited return comment.	As per Table 4.2. The oil spill risk to Tasmanian waters is negligible with no active spill response likely to be required.
			24/10/2018	Stakeholder requested further information.	
			Dec 2018	Beach called several times but was not able to reach anyone.	

5. Existing Environment

In accordance with OPGGS(E) Regulation 13(2) and the OPGGS Regulation 15(2), the 'environment that may be affected' (EMBA) by the activity is described in this section, together with its values and sensitivities. While each hazard associated with the development has its own unique EMBA, the largest one has been chosen (the 'hydrocarbon spill EMBA') for this chapter so as to describe all possible values and sensitivities, which is a combination of a marine diesel oil (MDO) spill and a loss of containment of gas condensate.

The hydrocarbon spill EMBA ('spill EMBA' for simplicity) (Figure 5.1) is therefore defined as:

> *The amalgamation of the extent of low level hydrocarbon exposure to the sea surface (1 g/m^2), entrained in the water column (10 ppb), dissolved in the water column (10 ppb), and contact to shorelines (10 g/m^2) as a result of a 204,250 bbl subsea release of gas condensate at the Yolla-A location (over 86 days), loss of 3,145 bbl of gas condensate from a subsea pipeline rupture (over 1 hour) and the release of 300 m^3 of MDO (over 6 hours) from a supply vessel during annualised metocean conditions.*

This spill EMBA has been established through hydrocarbon spill modelling (see Sections 7.15, 7.16 and 7.17 for spill scenarios and modelling results). The EMBA is generated from stochastic modelling and therefore does not represent the possible outcome from a single spill scenario. The EMBA represents the compilation of possible outcomes and encompasses the area predicted to be affected from 100 simulations for each spill scenario under annualised weather conditions. Because of this, the EMBA is large, covering areas that may not be affected by any single spill event. Since the EMBA is generated with predictive tools including numerical models and research findings that may not have been verified under field conditions (e.g., toxicity testing to derive effects thresholds), it carries a degree of uncertainty. The EMBAs presented in this chapter illustrate low level exposure for all three scenarios combined for:

- Sea surface hydrocarbons;
- Entrained;
- Dissolved; and
- Shoreline.

Where appropriate, descriptions of the Bass Strait environment (beyond the spill EMBA) are provided for context. The 'environment' is defined in both sets of regulations as:

- Ecosystems and their constituent parts, including people and communities;
- Natural and physical resources;
- The qualities and characteristics of locations, places and areas;
- The heritage value of places; and
- The social, economic and cultural features of these matters.

The operational area (a 500-m radius around the development) is described where this information exists.

The key sources of information used in developing this chapter include the:

- EPBC Act Protected Matters Search Tool (PMST) database (DAWE, 2020a), conducted on 12th September 2018 and again on 18th February 2020 (**Appendix 5**);
- Species Profile and Threats (SPRAT) Database (DAWE, 2020b);
- Victorian Biodiversity Atlas (VBA) (DELWP, 2020), conducted on 12 March 2019 and again on 18 February 2020. (**Appendix 6**);

- South-east Marine Region Profile (DoE, 2015a);
- Marine Natural Areas Values Study Vol 2: Marine Protected Areas of the Flinders and Twofold Shelf Bioregions (Barton *et al*., 2012);
- National Conservation Values Atlas (DAWE, 2020c); and
- Victorian Oil Spill Response Atlas (OSRA) (DEDJTR, 2017) (**Appendix 7**).

The relevant values and sensitivities considered in this section are inclusive of but not limited to the matters protected under Part 3 of the EPBC Act.

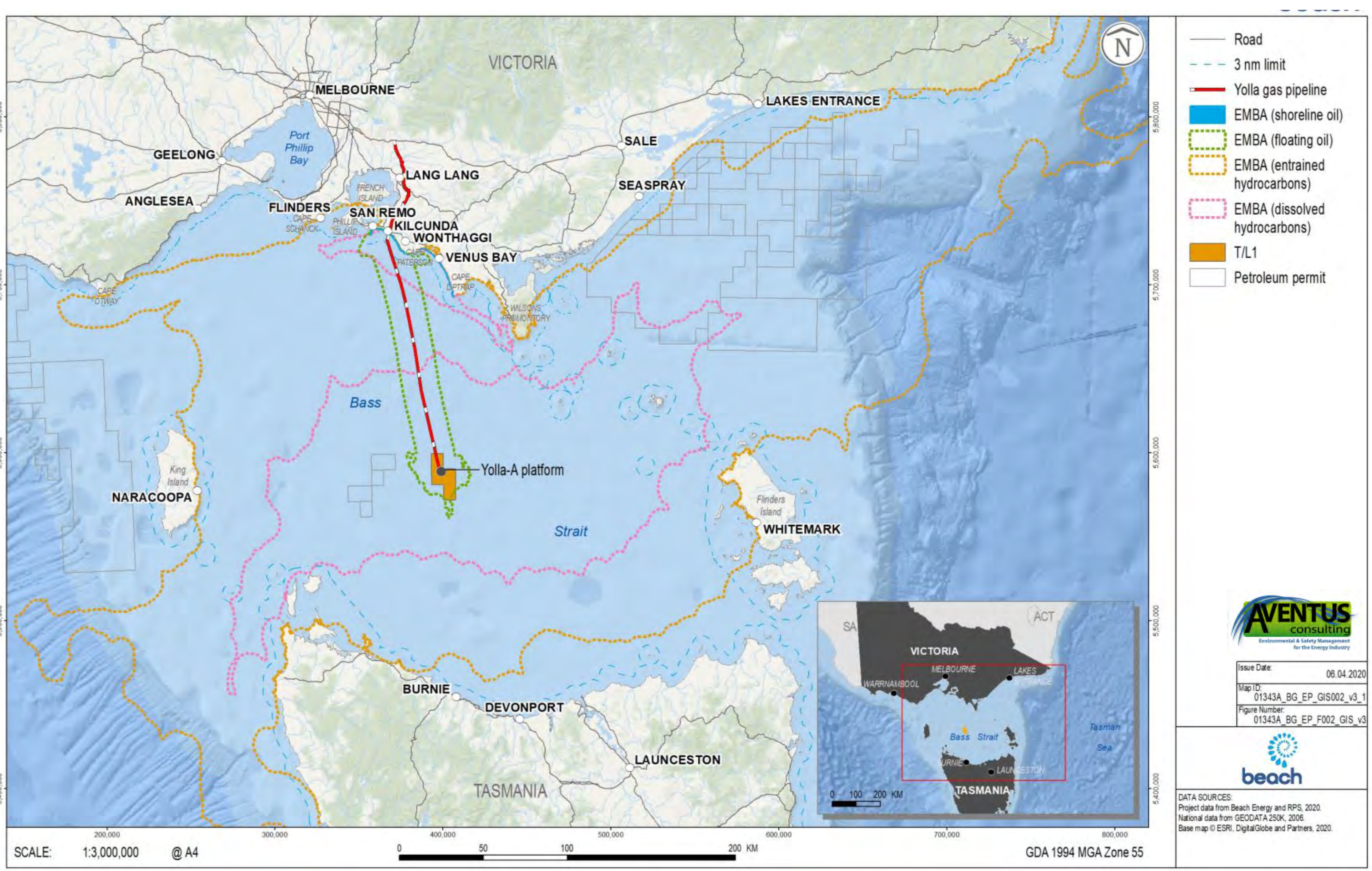


Figure 5.1. The BassGas development EMBA

Table 5.1 summarises the presence or absence of receptors and sensitivities within the proposed operational area (split between Commonwealth waters, Victorian State waters and the EMBA).

Table 5.1. Presence of receptors within Commonwealth and State waters of the operational area and the EMBA

Receptor	**Jurisdiction of operational area**		**EMBA**
	Commonwealth	**Victoria**	
Physical			
Mud			
Sand			
Rocky reef			
Sponge gardens			
Seagrass communities			
Conservation Values			
Australian Marine Parks (AMPs)			
World Heritage-listed properties			
National Heritage-listed properties			
Threatened Ecological Communities (TECs)			
Key Ecological Features (KEFs)			
Nationally important wetlands			
Victorian marine protected areas			
Onshore protected areas			
Biological environment			
Plankton			
Benthic species:			
Abalone	Unlikely	Unlikely	
Scallops	Unlikely	Unlikely	
Rock lobsters	Unlikely	Unlikely	
Fish:			
BIA, great white shark	Distribution		
Cetaceans:			
BIA, pygmy blue whale	Foraging		
BIA, southern right whale		Migration	Migration
BIA, humpback whale			
Pinnipeds			
Reptiles (turtles)			
Seabirds	Foraging, flyovers, BIA for many species		
Shorebirds	Islands		
Marine pests	Possible		

Receptor	Jurisdiction of operational area		EMBA
	Commonwealth	Victoria	
Cultural heritage values			
Shipwrecks	[red]	[green]	[green]
Indigenous heritage	[red]	[green]	[green]
Socio-economic environment			
Native title	[red]	[green]	[green]
Tourism	[red]	[green]	[green]
Recreational fishing	[green]	[green]	[green]
Commercial fishing	[green]	[green]	[green]

** Operational area constitutes a 500-m radius around the development.*

Green cells = presence of receptor, red cells = absence of receptor.

5.1 Regional Environmental Setting

Bass Strait separates Tasmania from the southern Australian mainland by approximately 230 km at its narrowest point and contains a number of islands, with the largest being King Island and Flinders Island (see Figure 5.1).

The Yolla gas field is located within the Bass Strait Provincial Bioregion using the Interim Marine and Coastal Regionalisation for Australia (IMCRA) classification (Figure 5.2) (DEH, 2006). At the mesoscale level, the development is located in the Central Bass Strait (CBS) bioregion, which is approximately 60,000 km^2 in size with water depths between 50 m at the margins and 80 m at the centre and is on the continental shelf (DEH, 2006). The substrate in the central area of the CBS is predominantly mud (DEH, 2006).

The following IMCRA mesoscale zones are intersected by the EMBA:

- Twofold Shelf;
- Flinders;
- Boags;
- Central Bass Strait;
- Otway;
- Central Victoria; and
- Victorian Embayments.

5.2 Physical Environment

5.2.1 Climate and Meteorology

Bass Strait is located on the northern-most zone of an area known as the 'Roaring Forties' with its climate determined chiefly by the presence of sub-tropical high-pressure ridges and migratory low-pressure systems (extra-tropical cyclones). Migrating low pressure systems typically bring a westerly wind regime to Bass Strait and are likely to affect the area every three to five days on average during the winter months.

5.2.2 Temperature and Rainfall

Average air temperatures recorded at King Island airport (165 km west of the Yolla platform, but the closest point for a Bureau of Meteorology [BoM] weather station) for 1995-2019 range from a minimum of 10.0°C to a maximum of 17°C (BoM, 2019).

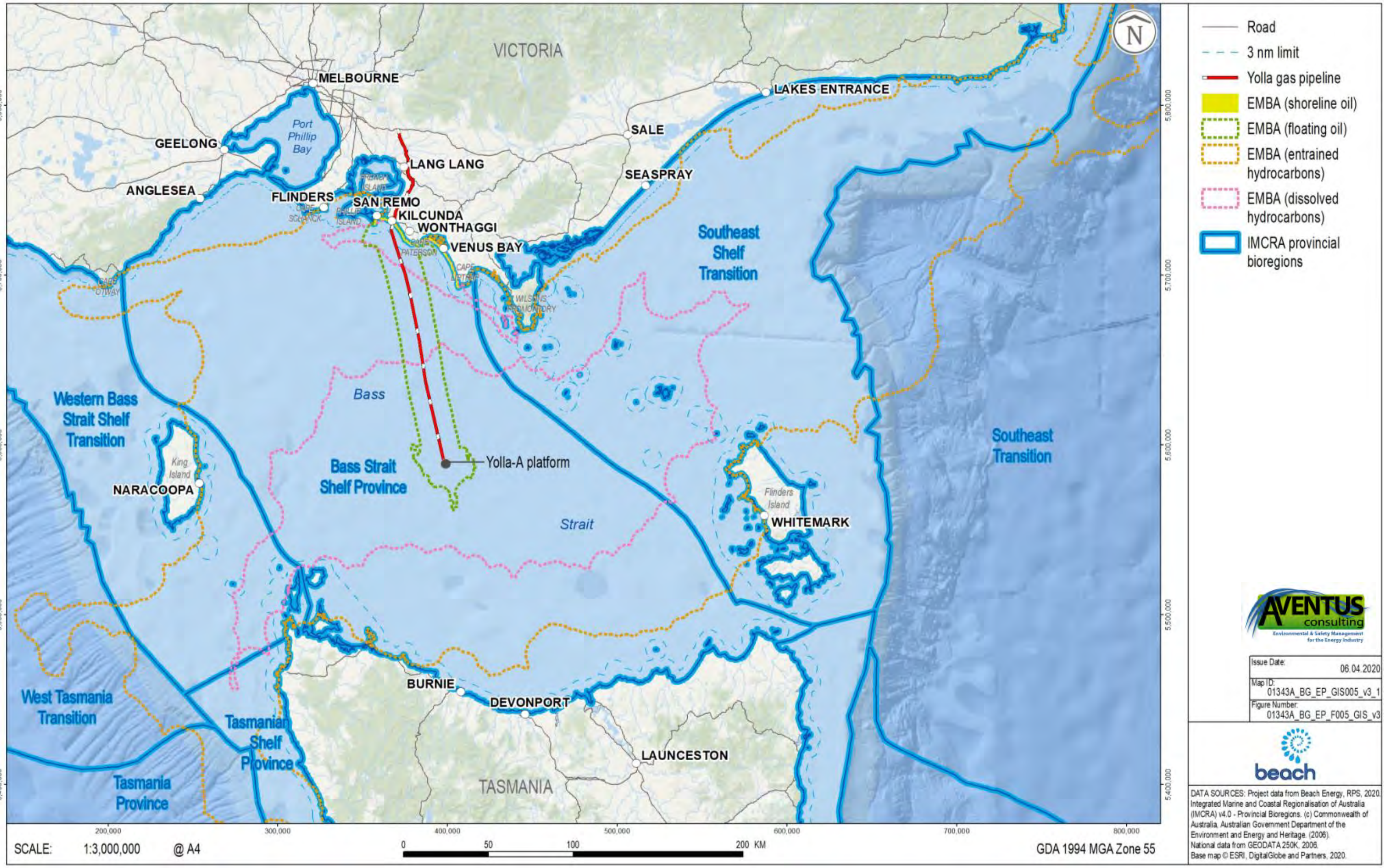


Figure 5.2. IMCRA provincial bioregions

Mean annual rainfall for the period 1974-2019 is 857 mm, with the highest rainfall totals falling in June, July and August (with an average minimum of 30 mm in February and an average maximum of 117 mm in July) (BoM, 2019).

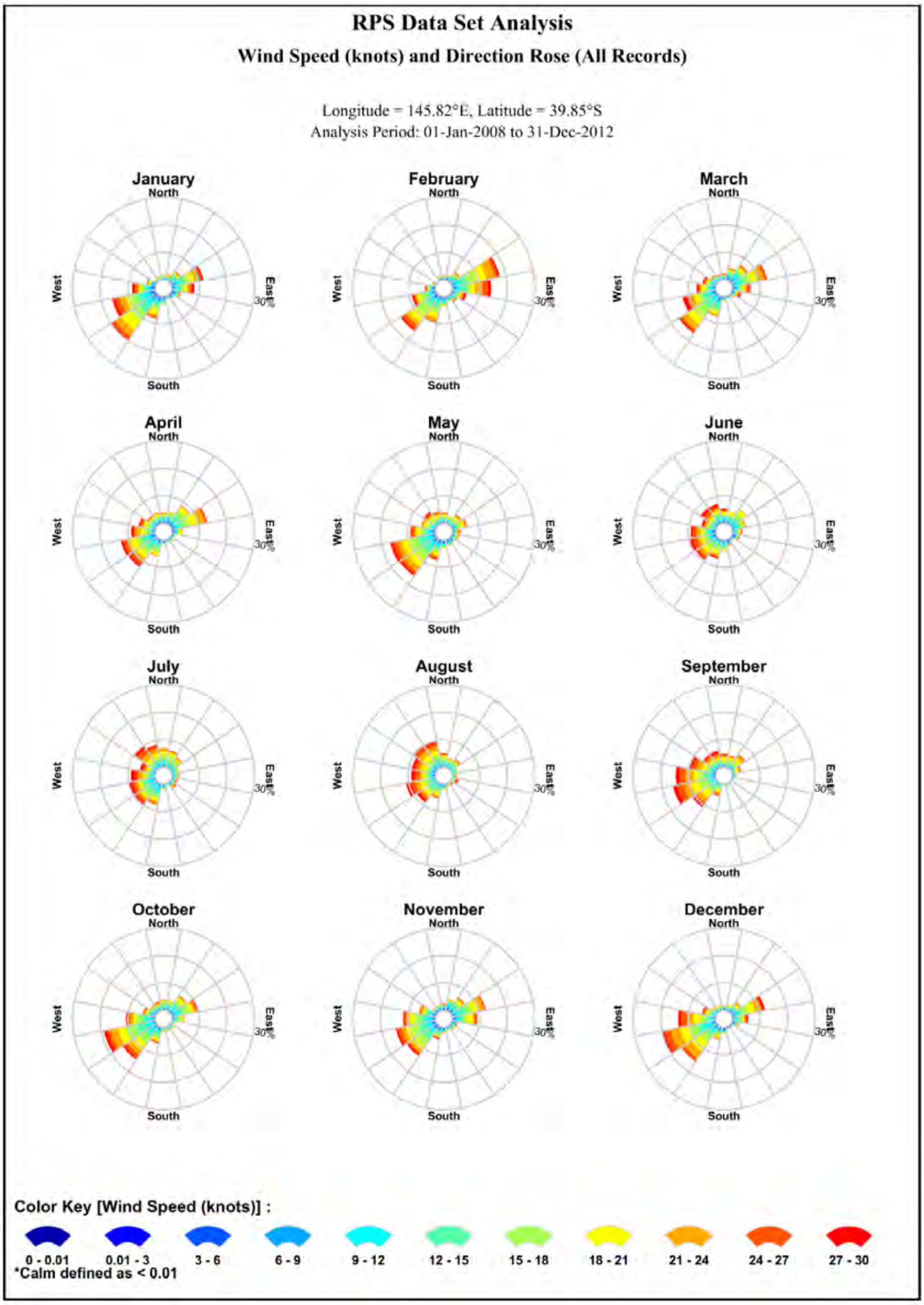
5.2.3 Winds

RPS (2020) acquired high-resolution wind data from 2008 to 2012 (inclusive) across their modelling domain from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR). Table 5.2 lists the monthly average and maximum winds derived from the CFSR station located nearest to the Yolla platform. Figure 5.3 illustrates the monthly wind rose distributions from 2008 to 2012 (inclusive), with Figure 5.4 illustrating the modelled total wind distributions from 2008-2012 (inclusive), which clearly indicates that winds from the southwest dominate this region.

Table 5.2. Predicted average and maximum wind speeds for the representative wind station near Yolla-A

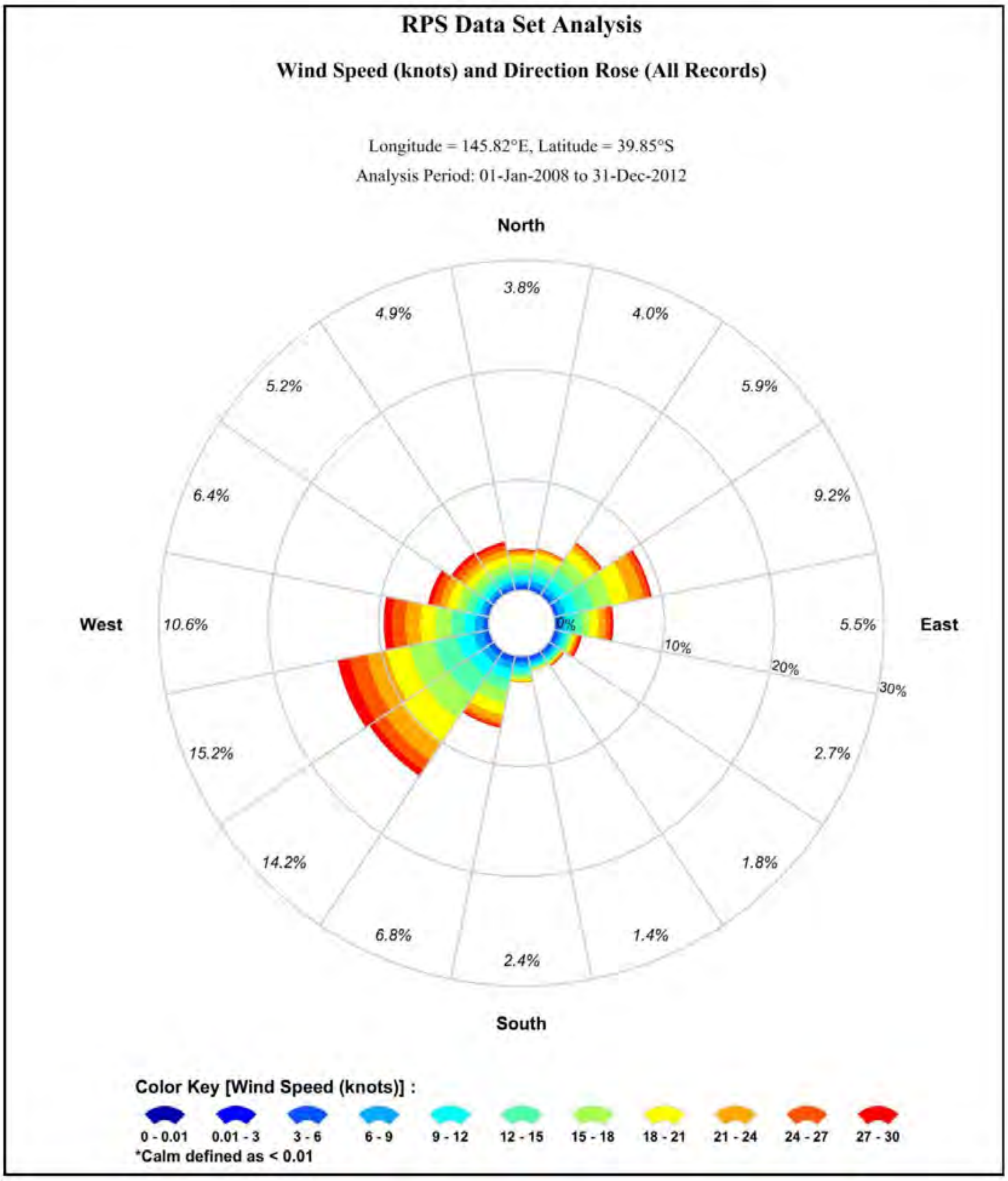
Month	Average wind speed (knots)	Maximum wind speed (knots)	General direction (from)
January	15.7	37.2	Southwest
February	16.4	42.3	East-northeast
March	16.4	44.6	Southwest
April	16.3	46.2	Southwest
May	16.3	40.7	Southwest
June	17.5	45.5	Variable
July	18.0	48.8	Variable
August	19.3	45.8	Variable
September	19.2	46.0	West-southwest
October	15.7	36.9	West-southwest
November	15.0	42.2	West-southwest
December	16.7	40.3	West-southwest
Minimum	**15.0**	**36.9**	
Maximum	**19.3**	**48.8**	

Source: RPS (2020).



Source: RPS (2020). The convention for defining wind direction is the direction the wind blows from.

Figure 5.3. Modelled monthly wind rose distributions from 2008-2012 (inclusive) for the representative wind station closest to the Yolla platform



Source: RPS (2020). The convention for defining wind direction is the direction the wind blows from.

Figure 5.4. Modelled annual wind rose distributions from 2008-2012 (inclusive) for the representative wind station closest to Yolla-A

5.3 Oceanography

5.3.1 Tides and Currents

Bass Strait is a relatively shallow area on the continental shelf, connecting the southeast Indian Ocean with the Tasman Sea. The strait has a reputation for strong tidal currents, which are primarily driven by tides, winds and density-driven flows. The tides of central Bass Strait are semi-diurnal with the dominant large-scale water movements due to the astronomical tide (Jones, 1980).

The tidal waves enter Bass Strait from the east and west almost simultaneously and as a result in the centre of the strait there is an area with small tidal currents where the two waves meet. The magnitude of the tidal currents then increases as the distance from the central strait increases with relatively strong tidal currents at either end. The times and magnitudes of the tide within Bass Strait are relatively uniform and predictable. However, the effects of meteorological phenomena may be significant, causing variations in level and also changing the phasing or timing of the tide (Sandery and Kampf, 2005).

In winter and spring, waters within the strait are well mixed with no obvious stratification while during summer the central regions of the strait become stratified (Baines and Fandry, 1983; Middleton and Black, 1994).

The region is oceanographically complex, with sub-tropical influences from the north and sub-polar influences from the south (DoE, 2015a). There is a slow easterly flow of waters in Bass Strait and a large anti-clockwise circulation (DoE, 2015a). Three key water currents influence Bass Strait:

1. The **Leeuwin Current** transports warm, sub-tropical water southward along the Western Australian (WA) coast and then eastward into the Great Australian Bight (GAB), where it mixes with the cool waters from the Zeehan Current running along Tasmania's west coast (DoE, 2015a). The Leeuwin and Zeehan currents are stronger in winter than in summer, with the latter flowing into Bass Strait during winter.
2. The **East Australian Current** (EAC) is up to 500 m deep and 100 km wide, flows southwards adjacent to the coast of NSW and eastern Victoria, and carries with it warm equatorial waters (DoE, 2015a). The EAC is strongest in summer when it can flow at a speed of up to 5 knots, but flows more slowly (2-3 knots) in winter where it remains at higher latitudes.
3. The **Bass Strait Cascade** occurs during winter along the shelf break, which brings nutrient-rich waters to the surface as a result of the eastward flushing of the shallow waters of the strait over the continental shelf mixing with cooler, deeper nutrient-rich water (DoE, 2015a).

Table 5.3 provides the average and maximum net current speeds from combined HYCOM and tidal currents near the Yolla platform.

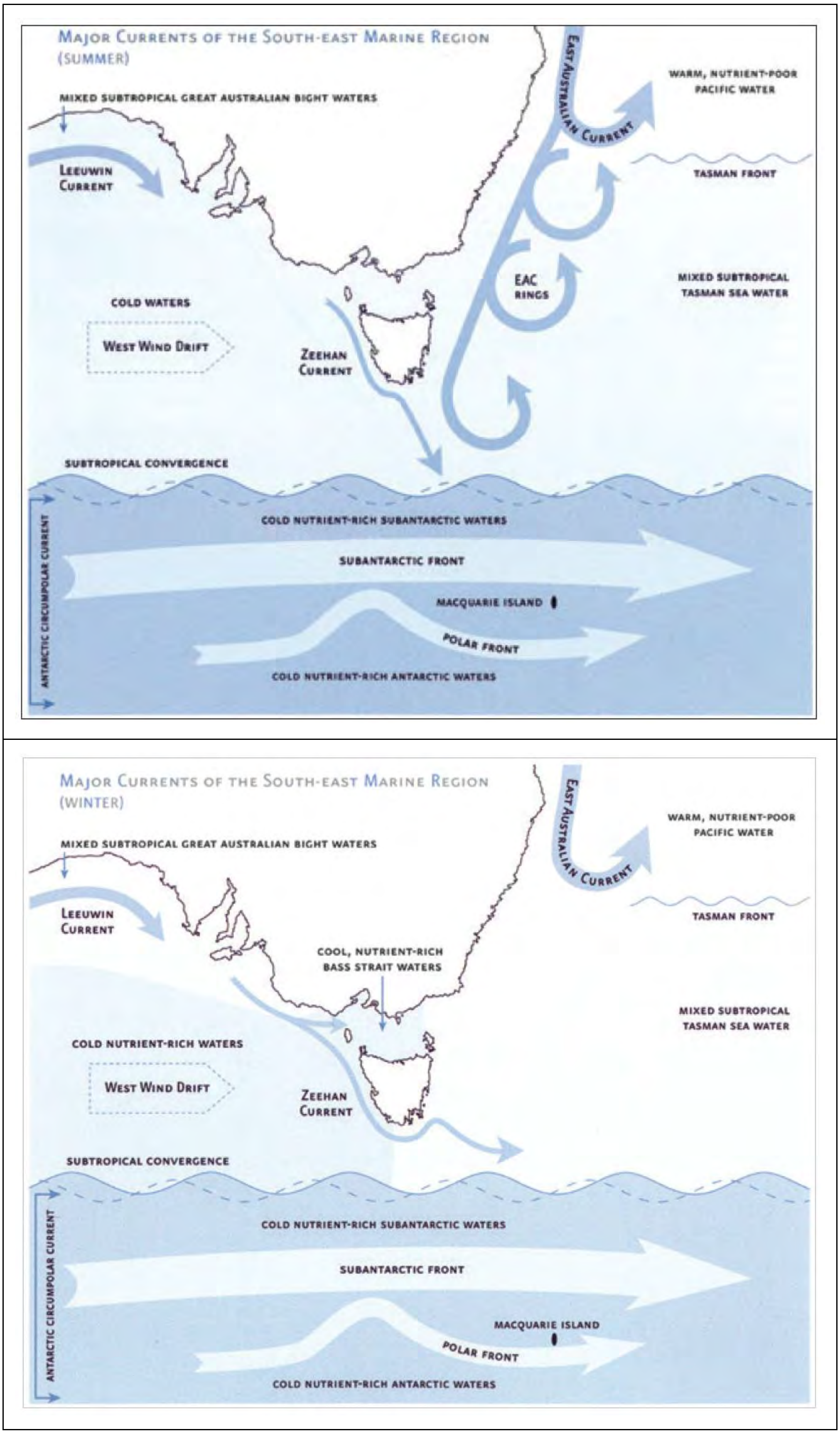
Figure 5.5 illustrates the major ocean currents in south-eastern Australian waters during summer and winter. Figure 5.6 illustrates the monthly surface current rose distributions from the combination of HYCOM ocean current data and HYDROMAP tidal data near the Yolla platform for the five years from 2008 to 2012 (inclusive) and Figure 5.7 shows the total surface current rose distributions for the same time period. This data indicates that surface currents flow predominantly eastwards.

Semi-diurnal astronomical tides provide the major water level variations in the region with four current reversals each day and a relatively small tidal range of about 1.3 m. The tidal range at the Yolla platform location is estimated to be about 2.3 m at spring tides and 1.7 m at neap tides and the combined sea and tidal currents vary in intensity with the time of year, typically reaching speeds of up to 1.0 m/s. The lowest and highest astronomical tides at the platform are -1.47 m and +1.33 m, respectively. Tidal currents at the platform move in an ellipse and tend to flood and ebb to the southeast and northwest respectively.

Table 5.3. Predicted monthly average and maximum surface current speeds near Yolla-A

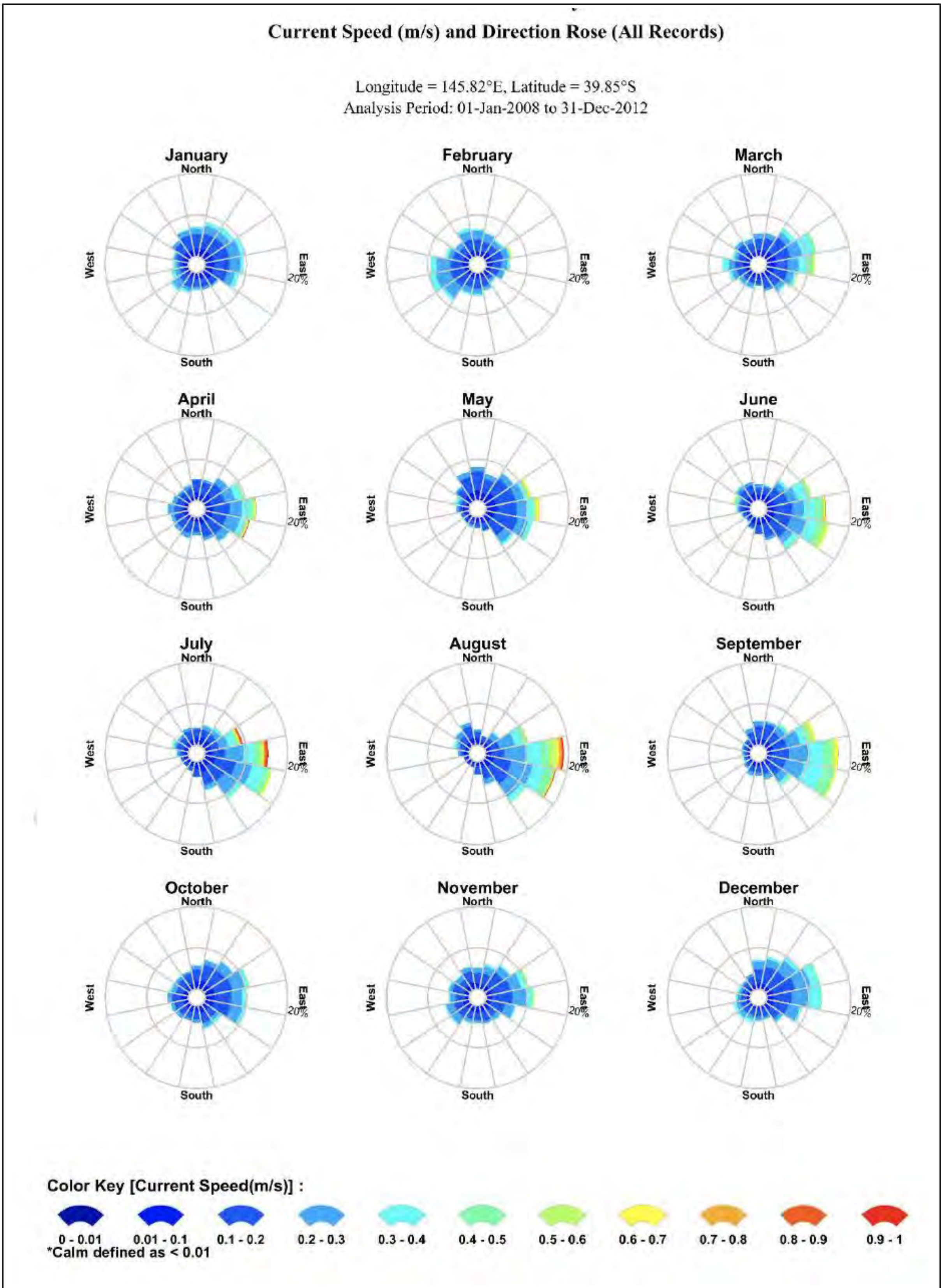
Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction (from)
January	0.16	0.48	Variable
February	0.18	0.66	Variable
March	0.18	0.68	East-northeast
April	0.17	0.98	East
May	0.16	0.73	East
June	0.19	0.85	East-southeast
July	0.20	1.02	East-southeast
August	0.22	0.99	East-southeast
September	0.21	0.73	East-southeast
October	0.16	0.54	East-southeast
November	0.17	0.61	East
December	0.18	0.48	East
Minimum	**0.16**	**0.48**	
Maximum	**0.22**	**1.02**	

Source: RPS (2020).



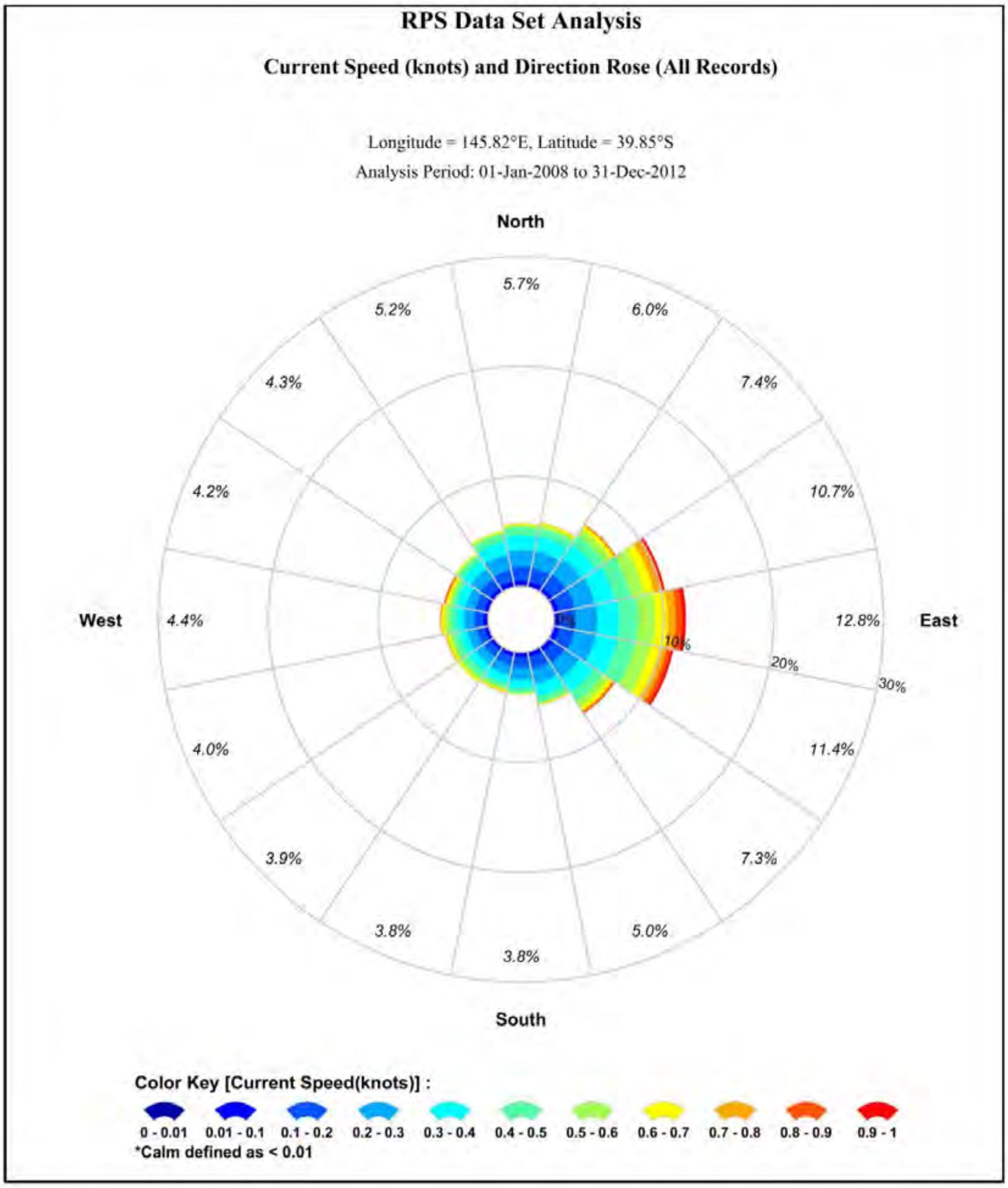
Source: DoE (2015a).

Figure 5.5. Major ocean currents in south-eastern Australian waters during summer (top) and winter (bottom)



Source: RPS (2020). The convention for defining water current direction is the direction the current flows ***towards****.*

Figure 5.6. Monthly surface water current rose plots from 2008-2012 (inclusive) near Yolla-A



Source: RPS (2020). The convention for defining current direction is the direction the current flows towards.

Figure 5.7. Annual surface water current plots from 2008-2012 (inclusive) near Yolla-A

5.3.2 Waves

In Bass Strait, the interaction between sea and swell and the resultant wave motion is complicated by the islands and Australian mainland coastline embayments, peninsulas and headlands. This restricts the access of swell from the Southern Ocean into Bass Strait. Some swell is blocked completely and some refracted by the seabed and modified as it passes into shallower waters of Bass Strait. There are also waves generated by wind within Bass Strait and the conditions at any location will be the result of these two wave-energy bands (Falconer and Lindforth, 1972).

The local wave climate is derived principally from locally-generated wind waves mostly from the west and southwest. Wave heights range from 1.5 m to 2 m with periods of 8 s to 13 s, although heights of 5 m to 7 m can occur during storm events.

The 100-year ARI for waves near the Yolla platform has a maximum significant wave height of 8.3 m and a period of 12 s from the west to west-northwest. Maximum significant wave heights for 1-year and 10-year ARIs are 6.7 m and 7.4 m respectively. Smaller 100-year ARI maximum significant wave heights (4.4 m to 7.4 m) and periods (7.6 s to 10.2s) have been estimated for non-critical directions. The maximum is likely to be about twice the significant wave height.

5.3.3 Water Temperature

The shallowness of Bass Strait means that its waters more rapidly warm in summer and cool in winter than waters of nearby regions (DoE, 2015a). The sea surface temperatures in the area reflect the influence of warmer waters brought into Bass Strait by the EAC (IMCRA, 1998; Barton *et al*., 2012).

Waters of eastern Bass Strait are generally well-mixed, but surface warming sometimes causes weak stratification in calm summer conditions. During these times, mixing and interaction between varying water masses leads to variations in horizontal water temperature and a thermocline (temperature profile) develops. The thermocline acts as a low-friction layer separating the wind-driven motions of the upper well-mixed layer of Bass Strait from the bottom well-mixed layer.

RPS (2020) reports that sea surface temperature in the region (based on the World Ocean Atlas) varies from an average minimum of 12.7°C in winter to a maximum of 18.1°C in late summer. In the shallower waters of the EMBA such as the Bunurong Marine National Park (MNP) and Bunurong Marine Park, Parks Victoria (2006a) notes that surface water temperatures range from 13°C in the warmer months to 17.5°C in the cooler months.

5.3.4 Water Quality

The nutrient concentrations in Central Bass Strait are low compared to that of what is seen at its extremities (Gibbs *et al*.,1986; Gibbs, 1992). It is hypothesised that this could be due to the biological demands of the Bass Strait waters consuming much of the nutrients before moving into Central Bass Strait (Gibbs, 1992). In the nearshore areas of the EMBA, water quality may be negatively affected through the discharge of polluted waters from rivers, which drain catchments dominated by stock grazing and small coastal settlements (Parks Victoria, 2006a).

5.3.5 Salinity

RPS (2020) reports that the average monthly salinity consistently remains in the range of 34.9 to 35.5 practical salinity units (based on the World Ocean Atlas database).

5.3.6 Seabed

<u>Bass Strait</u>

The bathymetry of Bass Strait shown in Figure 5.8 illustrates that the seafloor is gently sloping with water depths increasing gradually from the shore to reach a maximum of about 80 m at the Yolla-A platform.

Mainland Tasmania and the Bass Strait islands belong to the same continental landmass as mainland Australia. The continental shelf is narrow along the east coast of Tasmania but broadens in the northwest, underlying Bass Strait and the Otway and Gippsland basins. The central part of Bass Strait contains a depression that exchanges water with the ocean to the north of King Island. The Basinal Plain is the main seafloor feature of Bass Strait; a ridge along the western edge of this plain extends from King Island to northwest Tasmania.

Sedimentation in Bass Strait is generally low due to the low supply from rivers and the relatively low productivity of carbonate.

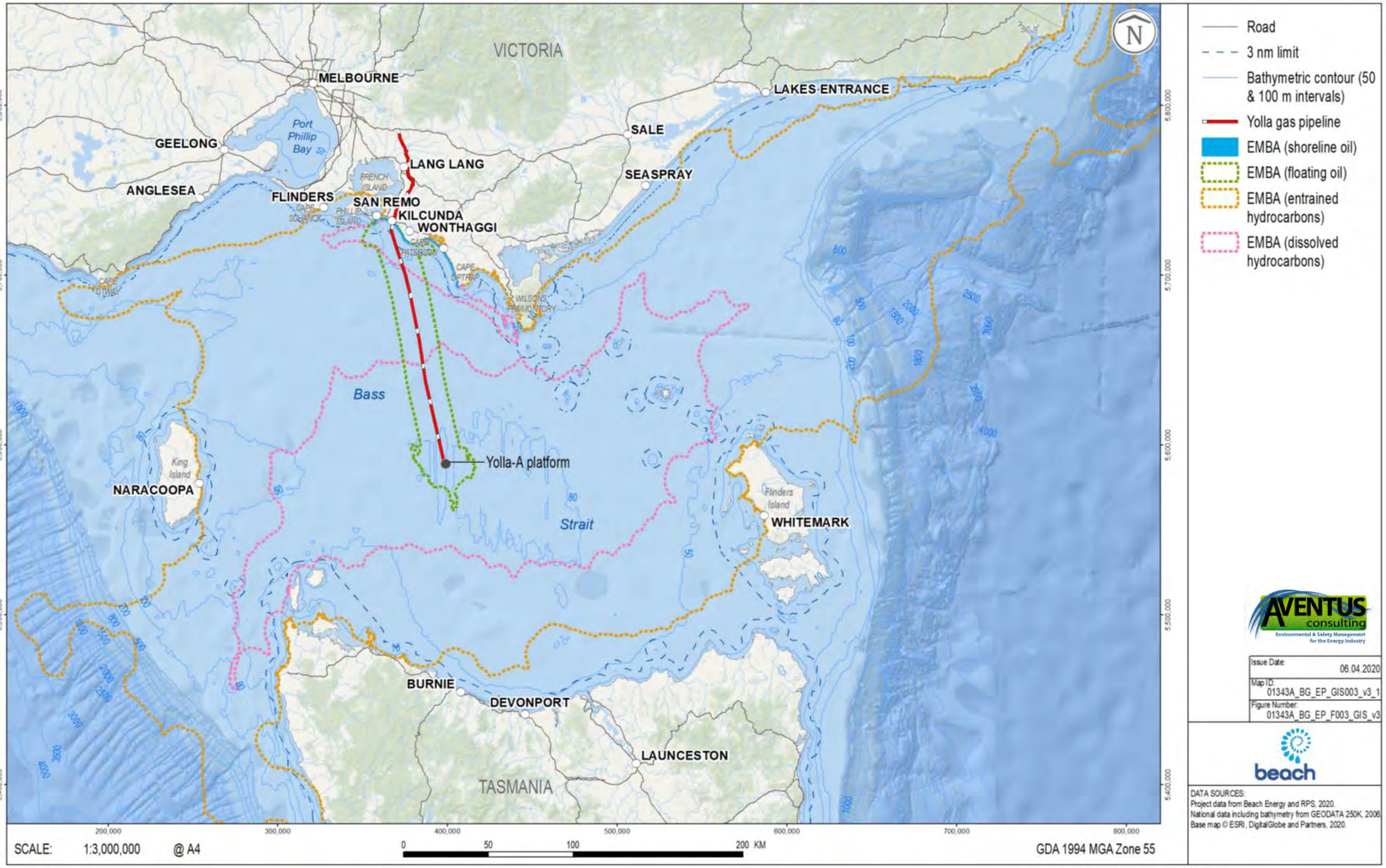


Figure 5.8. Bathymetry of Bass Strait and the EMBA

Yolla Location

Origin Energy, as the previous operator of the BassGas development, undertook several geotechnical surveys in and around Yolla-A (Thales GeoSolutions, 2001; Benthic, 2001; Fugro, 2002; Benthic, 2009; Benthic, 2013). These surveys indicate that there are no obstructions or wrecks in the area. The seabed is flat and featureless, with surveys prior to construction indicating the seabed has very soft to soft alternating layers of silty carbonate clay and silty sands containing fragile white shell fragments (Thales GeoSolutions, 2001; 2003).

Three depressions are located on the east side of Yolla-A, formed from the spud cans of the jack-up drill rigs that drilled the Yolla wells. These depressions are shown in Figure 5.9 and the approximate dimensions are 5 m below mean seabed level and approximately 36 m in diameter. Their shape and depth is preserved in a clay seabed base and the total spud can volume has not substantially changed over the course of three surveys conducted between 2007 and 2015 (Fugro, 2007; Neptune, 2014; 2015).

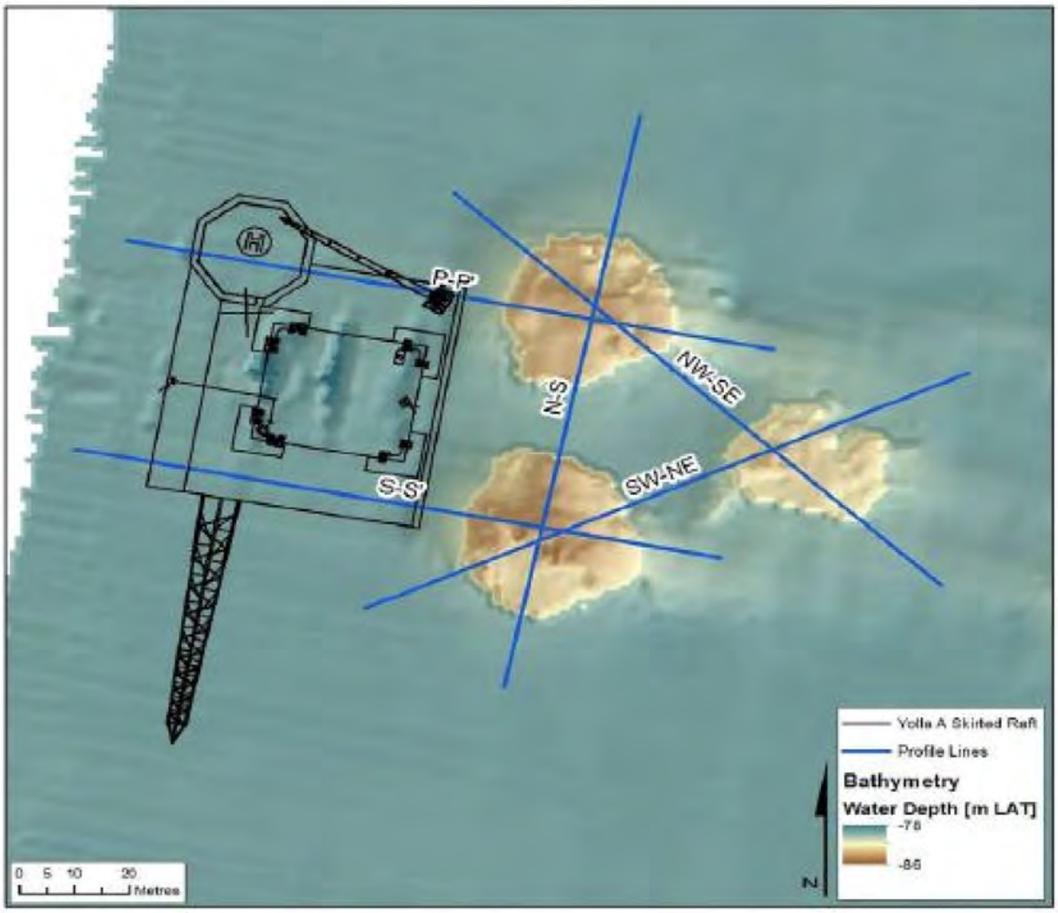


Figure 5.9. Existing drill rig spud can depressions on the east side of the Yolla platform

Pipeline

Surveys along the raw gas pipeline route in Commonwealth waters indicate that the seabed consists predominantly of medium to loose sand with localised pockets of clay and gravel. Table 5.4 summarises the seabed sediment types encountered at various depths along the pipeline route.

The shore crossing for the pipeline within State waters is generally through sedimentary rock (sandstone, mudstone) with sand and clay layers at the surface at both ends. There are numerous small reefs nearby on either side of the exit hole within state waters.

Table 5.4. Seabed types along the raw gas pipeline route

Pipeline segment (kilometre point, KP)	Maximum water depth	Seabed type
KP0 to KP19 (Yolla)	81.3	Clay
KP19 to KP53	79.2	Sand
KP53 to KP75	77.0	Sand
KP75 to KP90	77.0	Sand
KP90 to KP112	77.0	Sand
KP112 to KP118	74.5	Sand
KP118 to KP122	65.0	Sand
KP122 to KP143	51.6	Sand
KP143 to KP144	40.2	Sand
KP144 to KP146.4 (shore)	36.0 (minimum 18.5 m)	Sand

Spill EMBA

The seabed in the nearshore parts of the spill EMBA is mapped only at a coarse scale for the Oil Spill Response Atlas (OSRA, see **Appendix 7**) using LiDAR data. This section describes the seabed in the areas intersected by the spill EMBA, broken down into OSRA mapping sections (moving from the western parts of the spill EMBA to the eastern areas).

Victoria

- Apollo Bay (OSRA Map 07) – Immediately south of Cape Otway is an extensive area of reefs interspersed with sandy substrate extending 1 km offshore. Moving east along the coast towards Apollo Bay, there is a stretch of nearshore reef with sandy substrate dominant further out to sea. East of the township of Marengo are the Marengo reefs that disrupt the otherwise consistent sandy sediments in the area.
- Mornington Peninsula South (OSRA Map 14) – The nearshore seabed of the Mornington Peninsula South coast is dominated by subtidal rocky reef between the townships of Cape Schanck and Flinders. The seabed at the western entrance to Western Port Bay is predominantly reef before transitioning to subtidal sandy sediments and seagrass communities further into the bay.
- Phillip Island (OSRA Map 15) – the southern nearshore seabed of Phillip Island is dominated by subtidal rocky reef with intermittent patches of sandy substrate. On the western coast, sandy sediments are dominant with patches of subtidal reef. The northern and eastern coast nearshore seabed is dominated by sandy substrate, intertidal mud-sand flats and seagrass communities. Some of the marine areas on the northeast coast of Phillip Island are under special management areas or designated MNP. The spill EMBA also intersects the Bass River delta, which is under a special management arrangement and comprises intertidal mud-sand flat, sandy sediments and seagrass communities.
- Kilcunda (OSRA Map 17) – starting immediately south of Venus Bay, the seabed continues to be dominated by sandy substrates. West of Anderson Inlet, there are extensive areas of subtidal rocky reef (up to 1 km wide in some areas) and other areas of reef and reef/sediment. A 2-km wide section of the seabed occurs within the Bunurong MNP. The seabed becomes sandier closer to San Remo.
- Cape Liptrap (OSRA Map 18) – the EMBA intersects Waratah Bay (which comprises mostly sandy seabed and some reef offshore Walkerville), as well as making contact with the western part of Cape Liptrap. The seabed in this area is a mixture of sandy sediment, reef/sediment and subtidal rocky reef, with sandy being more dominant in the more northern parts of the shoreline.

- Wilsons Promontory West (OSRA Map 19) – the western parts of Wilsons Promontory intersected by the EMBA are dominated by sandy sediments, with small and isolated areas of reef.
- Wilsons Promontory East (OSRA Map 20) – the eastern parts of Wilsons Promontory intersected by the EMBA are dominated by sandy sediments, with small and isolated areas of reef.
- Ninety Mile Beach East (OSRA Map 24) – the area of Ninety Mile Beach East intersected by the EMBA is dominated by subtidal sandy substrate.
- Point Hicks (OSRA Map 28) – the nearshore seabed intersected by the EMBA is dominated by sediment, with patches of subtidal reef.
- Mallacoota (OSRA Map 29) – the areas of nearshore seabed intersected by the EMBA south of Mallacoota are dominated by subtidal rocky reef with intermittent areas of sandy sediments. East of Mallacoota is dominated by sandy sediments with areas of reef concentrated around the offshore islands of Gabo Island and Tullaberga Island. Mallacoota inlet and its seagrass community are not intersected by the EMBA.

Tasmania

Seamap Australia (2017) presents benthic spatial data and has been used in place of OSRA mapping to describe the seabed within the Tasmanian section of the EMBA. The nearshore seabed of the northwest coast of Tasmania that is intersected by the EMBA is mapped as predominantly sandy, with the only considerable area of reef present off the north coast of Stanley. Seagrasses are mapped in the strait between Robins Island and mainland Tasmania as well as on the west coast of the Stanley peninsula. Seabed mapping of Kind Island, Flinders Island and the west coast of Tasmania is not included in the Seamap database.

The following information provides a description of the key seabed types listed above.

Subtidal rocky reef

Rocky reefs provide a stable seabed for a wide range of plants and animals including kelps and other seaweeds, encrusting invertebrates such as sea squirts, sponges and bryozoans. In turn fixed biota provide habitat and food for mobile animals including molluscs such as abalone and octopus, crustaceans such as lobster and crabs, and a wide range of fish species including wrasse and leatherjackets.

There have been a wide range of studies of nearshore reef biota in Victoria including work for the Environment Conservation Council's marine coastal and estuarine investigation (Ferns and Hough, 2000). The nearshore reefs along Victoria's open coastline are characterised by an abundance of brown kelps, with a diverse understorey of red, green and brown seaweeds, sea squirts, sponges, bryozoans, crustaceans and molluscs. There is a degree of variation in the composition of biota on the reefs along the coast but in general most species are represented widely along the Victorian coast. Parks Victoria (2006a) notes that the Bunurong MNP and Bunurong Marine Park have the highest diversity of intertidal and shallow subtidal invertebrate fauna recorded in Victoria on sandstone.

Sandy substrate

The shifting sands of unsheltered nearshore seabed are often too mobile for the development of marine floral communities and lack the necessary hard substrate required for anchoring. Nevertheless, a rich abundance of faunal communities may be present among the sands including species of molluscs, bivalves, annelids, crustaceans, and echinoderms.

Seagrass communities

Seagrasses, such as those found in Western Port Bay, are often called nursery habitats because the leafy underwater canopy they create provides shelter for small invertebrates (like crabs, shrimp and other types of crustaceans), small fish and juveniles of larger fish species. Seagrass leaves absorb nutrients and slow the flow of water, capturing sand, dirt and silt particles, which, along with their roots trap and stabilise the sediment, which helps improve water clarity and quality and reduces erosion of coastlines. Seagrass beds are an important component of unique food webs whereby the seagrass may be consumed directly by large gazers (e.g., dugongs and turtles), provide substrate for epiphytic organisms to colonise and eventually nutrients for detritivores (Parks Victoria, 2007).

Yolla Seabed Surveys

A side scan sonar survey conducted by Origin (the then BassGas operator) along the proposed RGP route in September 2000 (Thales GeoSolutions, 2001) indicated that the nearshore seabed comprises a range of soft sediments and patchy reefs.

A video reconnaissance survey undertaken to determine the nature of fixed epibiota in the nearshore area also revealed that the seabed comprises fine sands with distinct sand waves and areas of reef. The survey findings indicated that the nearshore sediments appear to be too mobile for the establishment of fixed biota such as seagrass communities. Diver inspection and video images from the reef areas revealed that the shallow reefs are characterised by kelps (predominantly *Phylospora commosa* and *Ecklonia radiata*), various smaller seaweed species, sea squirts (predominantly the solitary ascidian *Herdmani amomus*) and sponges. Blacklip abalone are common in the fissures and under the crevices on the rocky reefs.

Few fish were observed during the initial survey of the pipeline route however it is known from previous inspections in the area and from discussions with fishers that a wide range of reef fish occur on the reefs in the area (CEE Consultants Pty Ltd, 2001). These include wrasse, box fish, leatherjackets, barber perch, magpie perch and hula fish.

5.3.7 Shorelines

This section describes the shoreline in the areas intersected by the spill EMBA.

In October 2019 Bass Coast was declared a Distinctive Area and Landscape under the Planning and Environment Act 1987 by the Victorian Government as part of the Distinctive Areas and Landscapes Program. The Bass Coast contains distinctive rural and coastal landscapes, productive agricultural land, and sensitive environments of significant biodiversity value. The area attracts lifestyle residents, as well as holiday makers and includes the popular tourist destination of Phillip Island.

The declaration made in October 2019 triggers the requirement for DELWP to prepare a Statement of Planning Policy, which will include a 50-year vision and land use strategy. Currently in Phase 2 Engagement, DELWP is working in collaboration with the Bass Coast Shire Council, and Traditional Owners, the Bunurong People in preparing a draft Statement of Planning Policy, with input from local communities and other key stakeholders.

OSRA maps have been used to characterise the shoreline intersected by the spill EMBA (moving from the western parts of the spill EMBA to the eastern areas). Where OSRA mapping is unavailable, Google Earth imagery has been used. Note that the shorelines predicted to be exposed to hydrocarbons in the event of spill (and not entrained and/or dissolved phase only) are described first.

Modelled exposure to shoreline hydrocarbons

- Wilsons Promontory West (OSRA map 19) – the western parts of Wilsons Promontory intersected by the EMBA are dominated by intertidal shore platforms and interspersed by sandy beaches, particularly in the bays (e.g., Oberon Bay, Norman Beach (Tidal River) and Darby Beach. The offshore islands in this sector (Kanowna, Cleft, Anser Group, Wattle, McHugh, Glennie Group and Norman islands) are all dominated by intertidal shore platforms and provide important breeding habitat for little penguins (see Section 5.5.4), Australian fur-seals and New Zealand fur-seals (see Section 5.5.6). Of all the islands are protected within the Wilsons Promontory Marine National Park (MNP) and Wilsons Promontory Marine Park.
- Cape Liptrap (OSRA map 18) – the EMBA does not intersect most of Waratah Bay (which comprises mostly sandy beaches and intertidal shore platforms), only making contact with the western part of Cape Liptrap. The

following description is based on the EMBA intersecting Grinder Point and areas west of this. The shoreline around Cape Liptrap is dominated by mixed sand beach/shore platform in the southern area, shifting to mixed cobble/shingle beach/shore platform on the western side of the cape. North of this point, the shoreline is dominated by sandy beaches with small sections of mixed sand beach/shore platform in the more southerly reaches. These sandy beaches are noted to have large numbers of hooded plovers and are backed by the Cape Liptrap Coastal Park.

- Kilcunda (OSRA map 17) – starting near Venus Bay, the west-facing beaches continue to be dominated by sandy beaches (Plate 5.1). West of Anderson Inlet, the shoreline is dominated by mixed sand beach/shore platform and intertidal shore platform (see Plate 5.1). North of Harmers Haven, the shoreline is again dominated by sandy beaches, interspersed by mixed sand beach/shore platform through to San Remo. Only the Cape Woolamai section of Phillip Island is intersected by the EMBA, and mapping of the shoreline around the cape indicates it is dominated by mixed sand beach/shore platform on the cape itself (with an isolated area of mixed cobble/shingle beach/shore platform), with sandy shorelines on the eastern and western facing isthmus (see Plate 5.1).

Sandy beach at Venus Bay (view north), with the Cape Liptrap Coastal Park in the foreground

Plate 5.1. Examples of the shorelines present in the Kilcunda section of the EMBA

Intertidal shore platform in the Bunurong MNP (view west)

Mixed sand beach/shore platform at Cape Woolamai (western side, view north)

Plate 5.1 (cont'd). Examples of the shorelines present in the Kilcunda section of the EMBA

Modelled exposure to dissolved and/or entrained phase hydrocarbons (no shoreline loading)

Victoria

- Apollo Bay (OSRA Map 07) – the southern and eastern coast of Cape Otway is dominated by intertidal shore platform with sandy beaches present only in areas of sheltered cove or bay (such as at Apollo Bay). The Park River estuary (intermittently open) disrupts the near continuous intertidal shore platform just east of Cape Otway.
- Mornington Peninsula South (OSRA Map 14) – the area of coastline intersected by the EMBA between Cape Schanck and Flinders is a combination of intertidal shore platform, mixed cobble/shingle beach/shore platform and mixed sand beach/shore platform. East of Flinders the shoreline is mixed sand beach/shore platform.
- Phillip Island (OSRA Map 15) – starting near Summerland on the western edge of Phillip Island and moving along the southern coastline, intertidal shore platform is the dominant shoreline type with intermittent areas of sandy beach and mixed cobble/shingle beach/shore platform. The Cape Woolamai coast at the eastern edge of the island is dominated by sandy beach and sand dunes with some isolated areas of cobble/shingle beach. The north eastern coast is dominated by saltmarsh and isolated patches of cobble/shingle beach, intertidal shore platform, mangrove and mixed cobble/shingle beach/shore platform. The northern coast is primarily sandy beach with mixed sand beach/shore platform dominant on the northwest coast.
- Wilsons Promontory East (OSRA Map 20) – the shoreline of Wilsons Promontory East is dominated by intertidal shore platform in areas exposed directly to the sea. Sheltered bays, such as Waterloo Bay and Sealers Cove, are dominated by sandy beach and mixed sand beach/shore platform. At these locations, Freshwater Creek estuary and Sealers Creek estuary meet Bass Strait.
- Ninety Mile Beach East (OSRA Map 24) – the shoreline intersected by the EMBA is exclusively sandy beach.
- Point Hicks (OSRA Map 28) – the shoreline intersected by the EMBA is primarily sandy beach with isolated areas of intertidal shore platform and mixed sand beach/shore platform. The Thurra River estuary and Mueller River estuary (both intermittently open) are present east of Point Hicks. The Wingman Inlet estuary (continuously open), is located adjacent the Skerries and is noted as Hooded Plover habitat.
- Mallacoota (OSRA Map 29) – the shoreline intersected by the EMBA is dominated by mixed sand beach/shore platform with some continuous areas of sand beach present at Secret Beach and Quarry Beach. Four intermittently open estuaries are located along this stretch of coast. The EMBA does not intersect Mallacoota Inlet. The shoreline east of Mallacoota is dominated by sand beach with mixed sand beach/shore platform present at Cape Howe on the Victoria/NSW border.

Tasmania

Modelled exposure to dissolved and/or entrained phase hydrocarbons

Flinders Island and Cape Barren Islands – The west coast of Flinders Island is primarily composed of wave cut platforms and sandy and gravel beaches. Shorebird and other threatened bird species nesting sites are present on the shoreline intersected by the EMBA as well as seal haul-out sites.

King Island – The east coast of King Island is dominated by long stretches of sand beach from Naracoopa to Wickham. A mix of sandy beaches and rocky cliffs characterises the shoreline south of Naracoopa.

Tasmanian north and west coast – The Tasmanian coastline from the township of Stanley to Woolnorth to the west is characterised by sand beaches, river estuaries and extensive tidal mud-sand flats. South of Woolnorth to the southernmost extent of the EMBA (close to the township of Strahan) is characterised by a mix of rocky shores/cliff face, sand beaches in sheltered coves/bays and occasional river mouths (including the Arthur and Pieman Rivers).

Parks Victoria (2006a) notes that the following values of the shoreline types described for the spill EMBA (noting these are focussed on the Bunurong MNP and Bunrong Marine Park areas):

- Sandy beaches – provide important habitat for invertebrates such as amphidpods, isopods, molluscs, polychaetes and crustaceans, while the beach-washed material (wrack) provides food sources for birds and detritus for invertebrates such as bivalves.
- Intertidal reef platforms and rocky shores – upper areas of the rock platforms support green, red and blue-green algae while the extensive mid-intertidal communities are dominated by Neptune's necklace (*Hormosira banksii*) and the green algae sea lettuce (*Ulva spp*.), which grow in small rock pools and cracks. Lower intertidal platforms that are subject to regular submergence are dominated by brown algae and branching and encrusting coralline red algae. The intertidal reef platforms are feeding and roosting areas for many shorebird species.
- Subtidal reefs – provide habitat for fish, sessile invertebrates and sponges, as well as colonial organisms. These communities have a high diversity of red and green algae but are dominated by two species of green algae. Epifauna present in algae and turf reveal that isopod crustaceans are present, including two families (*Pseudidotheidae, Plakarthriidae*) that had not been previously recorded from Australia.

5.4 Conservation Values and Sensitivities

The conservation values and sensitivities in and around the BassGas operational area and within the spill EMBA are described in this section, with Table 5.5 providing an outline of the conservation categories included.

Table 5.5. Conservation values in the EMBA

Category	Conservation classification	EP Section
MNES	Commonwealth marine areas (principally AMPs)	5.4.1
	World Heritage-listed properties	5.4.2
	National Heritage-listed places	5.4.3
	Wetlands of International Importance	5.4.4
	Nationally threatened species and threatened ecological communities	Throughout Sections 5.5 and 5.4.6.
	Migratory species	Throughout Section 5.5
	Commonwealth marine areas	5.4.1
	Great Barrier Reef Marine Park	Not applicable
	Nuclear actions	Not applicable
	A water resource, in relation to coal seam gas development and large coal mining development	Not applicable
Other areas of national importance	Commonwealth heritage-listed places	5.4.5
	Key Ecological Features (KEFs)	5.4.7
	Nationally important wetlands	5.4.8
Victorian protected areas	MNPs, marine parks and sanctuaries	5.4.9
	Coastal (onshore) conservation reserves	5.4.9
Tasmanian protected areas	MNPs, marine parks and sanctuaries	5.4.10
	Coastal (onshore) conservation reserves	5.4.10
New South Wales Protected Areas	MNPs, marine parks and sanctuaries	Not applicable
	Coastal (onshore) conservation reserves	5.4.11

5.4.1 Australian Marine Parks

The South-east Commonwealth Marine Reserves Network was designed to include examples of each of the provincial bioregions and the different seafloor features in the region (DNP, 2013). Provincial bioregions are large areas of the ocean where the fish species and ocean conditions are broadly similar. There are 14 AMPs in the South-east Commonwealth Marine Reserves Network – none of these are intersected by the operational area, though the spill EMBA intersects the following AMPs, which are described in this section:

- Boags;
- Beagle;
- Franklin;
- East Gippsland; and
- Apollo.

The BassGas development does not overlap any AMPs. Figure 5.10 illustrates the locations of the AMPs.

Appendix 1 presents the strategic objectives of the South-east Commonwealth Marine Reserves Network Management Plan 2013-2023 (DNP, 2013) against the routine and non-routine impacts of BassGas operations.

Boags AMP

The Boags AMP is located 65 km southwest of the Yolla-A platform, covering an area of 537 km^2 in water depths ranging from 40 m to 80 m. It has ecosystems, habitats and communities associated with the IMCRA Bass Strait Shelf Province including the sea floor plateau and tidal sandwave/sandbank. The area is an important foraging location for shy albatross, Australasian gannet, short-tailed shearwater, fairy prion, black-faced cormorant, common diving petrel and little penguins, with bird colonies present on the islands to the south of the AMP (Parks Australia, 2019).

Beagle AMP

The Beagle CMR is located 71 km east of Yolla-A, and is a shallow water (50-70 m deep) reserve covering an area of 2,928 km^2 that surrounds the Hogan and Kent Group of islands. The deep rocky reefs support a rich array of sea life, including sponge gardens and Port Jackson sharks. The area provides homes and feeding grounds for seabirds, little penguins and Australian fur seals (DNP, 2013). The reserve is located near the Hunter group of islands which is an important breeding area for the fairy prion, shy albatross, silver gull, short tailed shearwater, black faced cormorant, Australian gannet, common diving petrel and little penguins.

Franklin AMP

The Franklin AMP is located 142 km southwest from Yolla-A and 25 km off the north-west coast of Tasmania in waters ranging from 40 m to 150 m deep over a total area of 671 km^2. The reserve represents an area of shallow continental shelf ecosystems and incorporates the major bioregions of western Bass Strait and the Tasmanian shelf (DNP, 2013). The ocean reserve provides feeding grounds for seabirds including species of albatross, petrel, shearwater and cormorant that have breeding colonies on the nearby Hunter group of islands. Great white sharks are also known to forage in the reserve (DNP, 2013).

East Gippsland AMP

The East Gippsland AMP contains an extensive network of canyons, continental slope and escarpment at water depths from 600 m to more than 4,000 m. The mix of both warm and temperate waters in the reserve create habitat for free-floating aquatic plants or phytoplankton. The East Australian Current combined with complex seasonality in oceanographic patterns creates large eddies of warm water with cooler, nutrient rich waters around the outside of the eddies (DNP, 2013). The mixing of these patterns creates conditions for highly productive phytoplankton growth, which support a rich abundance of marine life. Oceanic birds including albatrosses, petrels and shearwaters are known to forage in these waters. Humpback whales pass by the reserve during their migrations north and south (DNP, 2013).

Apollo AMP

The Apollo AMP is located off Apollo Bay on Victoria's west coast in waters 80 m to 120 m deep on the continental shelf, 164 km northwest of Yolla-A. The reserve covers 1,184 km^2 of Commonwealth ocean territory (DNP, 2013). The reserve encompasses the continental shelf ecosystem of the major biological zone that extends from South Australia to the west of Tasmania. The area includes the Otway Depression, an undersea valley that joins the Bass Basin to the open ocean. Apollo AMP is a relatively shallow reserve with big waves and strong tidal flows; the rough seas provide habitats for fur seals and school sharks (DNP, 2013).

The major conservation values of the Apollo AMP are:

- Ecosystems, habitats and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features: deep/hole/valley and shelf.
- Important migration area for blue, fin, sei and humpback whales.
- Important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and rested tern.
- Cultural and heritage site - wreck of the *MV City of Rayville* (DNP, 2013).

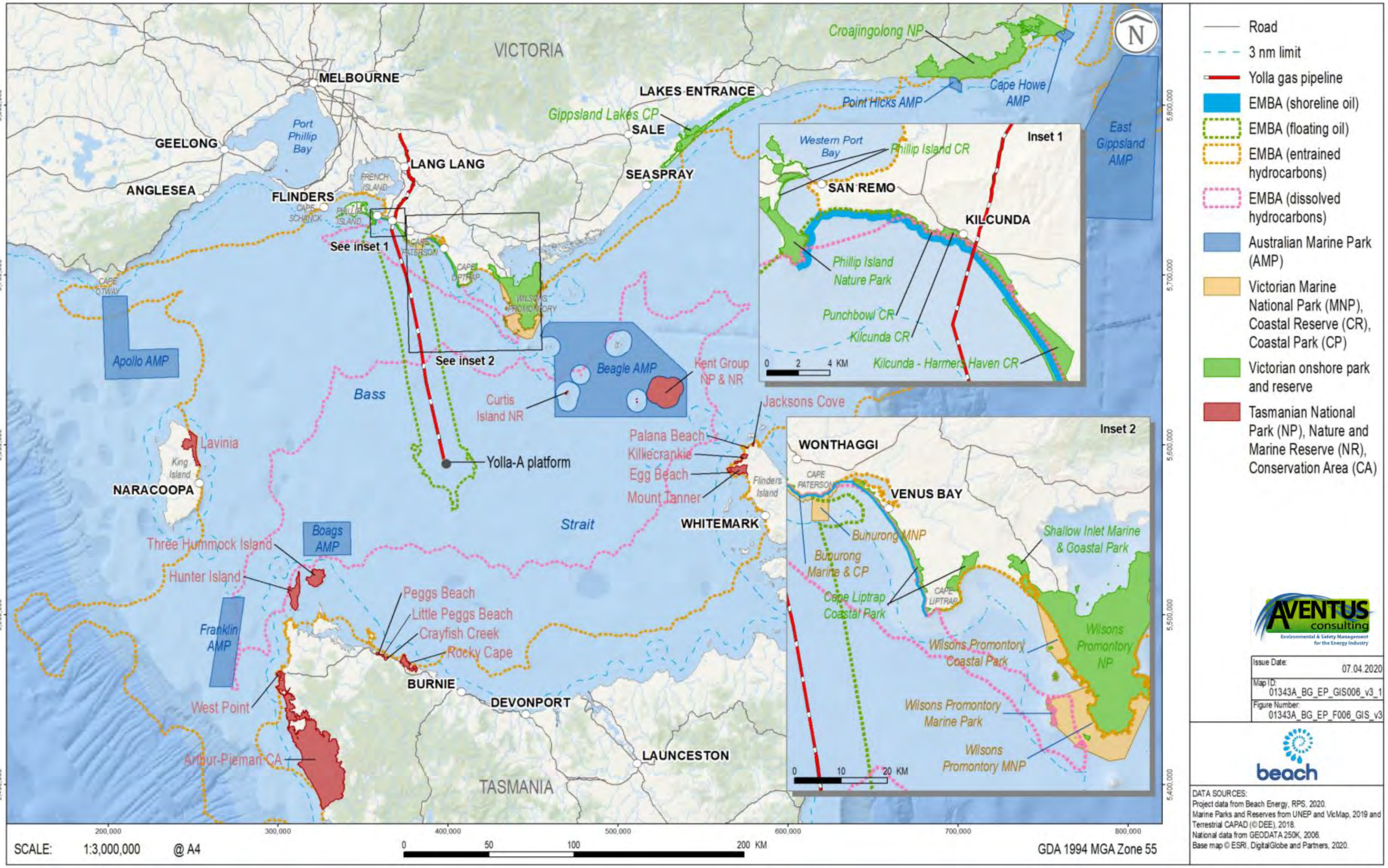


Figure 5.10. Protected areas in the EMBA

5.4.2 World Heritage-listed Properties

World Heritage Listed-properties are examples of sites that represent the best examples of the world's cultural and heritage values, of which Australia has 19 properties (DAWE, 2020d). In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

No properties on the World Heritage List occur within the operational area or spill EMBA. The nearest site is the Royal Exhibition Building and Carlton Gardens in Melbourne, an onshore property located 128 km north-northwest of Yolla-A.

5.4.3 National Heritage-listed Places

The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation (DAWE, 2020e). These places are protected under Chapter 5, Part 15 of the EPBC Act. No National Heritage listed places occur within the operational area. The PMST Report states that the Western Tasmania Aboriginal Cultural Landscape is intersected by the spill EMBA. This national heritage-listed place is described below.

<u>The Western Tasmania Aboriginal Cultural Landscape</u>

This cultural landscape stretches along much of the west coast of Tasmania (in an approximately 3-km wide strip of land that includes the shoreline, from near Marrawah in the north to Duck Creek, north of Granville Harbour, in the south). It is intersected by the low threshold for entrained hydrocarbons for an MDO spill.

During the late Holocene Aboriginal people on the west coast of Tasmania developed a specialised and more sedentary way of life based on a dependence on seals, shellfish and land mammals. This way of life is represented by shell middens that lack the remains of bony fish, but contain 'hut depressions' which sometimes formed semi-sedentary villages (DAWE, 2020e). Nearby some of these villages are circular pits in cobble beaches which the Aboriginal community believes are seal hunting hides. The remains of the shell middens in the Western Tasmania Aboriginal Cultural Landscape and its accompanying hut depressions provide evidence of an unusual, specialized and more sedentary Aboriginal way of life that began almost 2,000 years ago and continued until the 1830s. Archaeological studies of the area found evidence of early villages built near an elephant seal colony. Based on the large number of seal bones in the middens, it is believed the elephant seals where a major source of Aboriginal people's diet in the area (DAWE, 2020e). The Western Tasmania Aboriginal Cultural Landscape also contains other stone artefact scatters, stone arrangements, rock engravings and shelters and human burials that provide further insight into this unique way of life.

5.4.4 Wetlands of International Importance

Australia has 66 wetlands of international importance ('Ramsar wetlands') that cover more than 8.3 million hectares (as of March 2020) (DAWE, 2020c). Ramsar wetlands are those that are representative, rare or unique wetlands, or are important for conserving biological diversity, and are included on the List of Wetlands of International Importance developed under the Ramsar Convention. These wetlands are protected under Chapter 5, Part 15 of the EPBC Act.

No wetlands of international importance are intersected by the operational area. The 'Western Port', 'Lavinia', 'Corner Inlet' and 'Gippsland Lakes' Ramsar sites are intersected by the entrained hydrocarbons EMBA and are described here.

<u>Western Port</u>

Western Port is located approximately 60 km south-east of Melbourne, Victoria and in 1982 a large portion was specified of international importance especially as waterfowl habitat. The area consists of large shallow intertidal areas divided by deeper channels with adjacent narrow strips of coastal land (DELWP, 2017).

Westernport Bay is valued for its terrestrial and marine flora and fauna, cultural heritage, recreational opportunities and scientific value. The area has substantial intertidal areas supported by mangroves, saltmarsh, seagrass communities and unvegetated mudflats, which are significant as shorebird habitat. Additionally, the saltmarsh and mangroves filter pollutants, trap and process nutrients, stabilise sediments and protect the shoreline from erosion (DELWP, 2017). The intertidal mudflats provide a significant food source for migratory waders, making it one for the most significant areas in south-east Australia for these birds. The interaction between critical processes and components provide habitat for many waterbirds. The mangrove and saltmarsh vegetation are of regional, national and international significance because of the role in stabilising the coastal system, nutrient cycling in the bay and providing wildlife habitat (Ross, 2000). There are three marine parks within the Ramsar site (Yaringa, French Island and Churchill Island MNPs). There are numerous community and government projects that help monitor, protect, raise awareness and educate the community about the Ramsar site wetland (Brown and Root, 2010).

Western Port is protected under the Western Port Ramsar Site Management Plan (DELWP, 2017), which describes the values as:

- Supports a diversity and abundance of fish and recreational fishing;
- The soft sediment and reef habitats support a diversity and abundance of marine invertebrates;
- Supports bird species, including 115 waterbird species, of which 12 are migratory waders of international significance;
- Provides important breeding habitat for waterbirds, including listed threatened species;
- Provides habitat to six species of bird and one fish species that are listed as threatened under the EPBC Act;
- Rocky reefs comprise a small area within the Ramsar site, but includes the intertidal and subtidal reefs at San Remo, which support a high diversity, threatened community and Crawfish Rock, which supports 600 species (Shapiro, 1975);
- The Western Port Ramsar Site has three MNPs, one National Park and has been designated as a Biosphere Reserve under the UNESCO's Man and the Biosphere program;
- The Ramsar site is within the traditional lands of the Boonwurrung, who maintain strong connections to the land and waters; and
- The site contains the commercial Port of Hastings that services around 75 ships per year and contributes around $67 million annually to the region's economy.

Lavinia

The Lavinia Ramsar site is located on the north-east coast of King Island, Tasmania. The boundary of the site forms the Lavinia State Reserve, with major wetlands in the reserve including the Sea Elephant River estuary area, Lake Martha Lavinia, Penny's Lagoon, and the Nook Swamps.

The shifting sands of the Sea Elephant River's mouth have caused a large back-up of brackish water in the Ramsar site, creating the saltmarsh which extends up to 5 km inland. The present landscape is the result of several distinct periods of dune formation. The extensive Nook Swamps, which run roughly parallel to the coast, occupy a flat depression between the newer parallel dunes to the east of the site and the older dunes further inland. Water flows into the wetlands from the catchment through surface channels and groundwater and leaves mainly from the bar at the mouth of the Sea Elephant River and seepage through the young dune systems emerging as beach springs.

The Lavinia State Reserve is one of the few largely unaltered areas of the island and contains much of the remaining native vegetation on King Island. The vegetation communities include Succulent Saline Herbland, Coastal Grass and Herbfield, Coastal Scrub and King Island *Eucalyptus globulus* Woodland. The freshwater areas of the Nook Swamps are dominated by swamp forest. Nook Swamps and the surrounding wetlands contain extensive peatlands.

The site is an important refuge for a collection of regional and nationally threatened species, including the nationally endangered orange-bellied parrot. This parrot is heavily dependent upon the samphire plant, which occurs in the saltmarsh, for food during migration. They also roost at night in the trees and scrub surrounding the Sea Elephant River estuary.

Several species of birds that use the reserve are rarely observed on the Tasmanian mainland, including the dusky moorhen, nankeen kestrel, rufous night heron and the golden-headed cisticola.

The site is currently used for conservation and recreation, including boating, fishing, camping and off-road driving. There are artefacts of Indigenous Australian occupation on King Island that date back to the last ice age when the island was connected to Tasmania and mainland Australia via the Bassian Plain.

There are ten critical components and processes identified in the Ramsar site, these being:

- Wetland vegetation communities;
- Regional and national rare plant species;
- Regionally rare bird species;
- Kind Island scrubtit;
- Orange-bellied parrot;
- Water and sea birds;
- Migratory birds;
- Striped marsh frog; and
- Green and gold frog.

Elements essential to the site are the marine west coast climate, mild temperatures along with wind direction and speed. Sandy deposits dominant the site, inland sand sheets cover majority of the western area of the site (PWS, 2000). Between these sand sheets and the eastern coast there are several sand dunes that are an important geoconservation feature. The dunes impede drainage from inland, resulting in the creation of extensive swamps and lakes. Wetland vegetation in the Ramsar site includes swamp forest and forested peatlands that are rare and vulnerable in the region. Along with other types of vegetation, the wetland provides habitat for rare flora and fauna. Six wetland-associated species have been recorded within the site. Rare bird and frog species are dependent on the wetland habitat along with ten migratory birds and other seabirds. Benefits provided by the Lavinia Ramsar site include aquaculture (oyster farming), tourism, education and scientific value (PWS, 2000).

<u>Corner Inlet</u>

The Corner Inlet Ramsar Site is located approximately 250 km south-east of Melbourne and includes Corner Inlet and Nooramunga Marine and Coastal Parks, and the Corner Inlet MNP. It covers 67,192 ha and represents the most southerly marine embayment and intertidal system of mainland Australia (Parks Victoria, 2005a).

The major features of Corner Inlet that form its ecological character are its large geographical area, the wetland types present (particularly the extensive subtidal seagrass beds), diversity of aquatic and semi-aquatic habitats and abundant flora and fauna, including significant proportions of the total global population of a number of waterbird species (BMT WBM, 2011). The description below provides the values and baseline ecological character of the Corner Inlet Ramsar Site.

The Corner Inlet Ramsar Site Management Plan (WGCMA, 2014) identifies the key values of the site as:

- A substantially unmodified wetland that supports a range of estuarine habitats (seagrass, mud and sand flats, mangroves, saltmarsh and permanent marine shallow water);
- Presence of nationally threatened species including orange-bellied parrot, Australian grayling, fairy tern and growling grass frog;
- Non-breeding habitats for migratory shorebird species and breeding habitat for variety of waterbirds including several threatened species;
- Important habitats, feeding areas, dispersal and migratory pathways and spawning sites for numerous fish species of direct or indirect fisheries significance;
- Over 390 species of indigenous flora (15 listed species) and 160 species of indigenous terrestrial fauna (22 threatened species) and over 390 species of marine invertebrates;
- A wide variety of cetaceans and pinnipeds including bottlenose dolphins and Australian fur-seals, as well as occasional records of common dolphins, New Zealand fur-seals, leopard seals and southern right whales;
- Significant areas of mangrove and saltmarsh that are listed nationally as vulnerable ecological communities and provide foraging, nesting and nursery habitat for many species;
- Sand and mudflats, when exposed at low tide, that provide important feeding grounds for migratory and resident birds and at high tide provide food for aquatic organisms including commercial fish species (CSIRO, 2005);
- Ports and harbours – the four main ports (Port Albert, Port Franklin, Port Welshpool and Barry's Beach) service the commercial fishing industry, minor coastal trade, offshore oil and gas production and boating visitors;
- Fishing – the area supports the third largest commercial bay and inlet fishery in Victoria, including 18 licensed commercial fishermen, within an economic value of between $5 and $8 million annually;
- Recreation and tourism – Corner Inlet provides important terrestrial and aquatic environments for tourism and recreational activities such as fishing, boating, sightseeing, horse riding, scuba diving, bird watching and bushwalking;
- Cultural significance to the Gunaikurnai people, with the Corner Inlet and Nooramunga area located on the traditional lands of the Brataualung people who form part of the Gunaikurnai Nation. The area has a large number of cultural heritage sites that provide significant information for the Gunaikurnai people of today about their history. The Bunurong and the Boon Wurrung peoples also have areas of cultural significance in this region;
- Thirty-one shipwrecks are present in the site; and
- Research and education – the wildlife, marine ecosystems, geomorphological processes and various assemblages of aquatic and terrestrial vegetation within the Corner Inlet Ramsar Site provide a range of opportunities for education and interpretation.

<u>Gippsland Lakes</u>

The Gippsland Lakes Ramsar site is a system of lakes and wetlands extending eastward from Sale to Lake Tyers, in some areas extending to the high-water mark of the ocean, and covers an area of 58,824 ha (EGCMA, 2015). The site is about 70 km long and 10 km wide (at its widest point) and was designated in 1982. These lakes and wetlands occur landwards of the coastal dunes adjacent to the spill EMBA. The spill EMBA does not intersect where the Lakes meet the sea at Lakes Entrance. Nevertheless, the site of international importance is described here.

Most of the Ramsar site (64%) is reserved under the *Crown Land (Reserves) Act* 1978 (Vic) as Nature Conservation Reserve, Natural Features Reserve and Public Purpose Reserve. Approximately one-third of the Gippsland Lakes Ramsar site is located within the Lakes National Park (2,390 ha) and Gippsland Lakes Coastal Park (17,584 ha), which are proclaimed under the *National Parks Act* 1975 (Vic).

The Gippsland Lakes are separated from the sea by sand dunes and fringed on the seaward side by the Ninety Mile Beach. The Gippsland Lakes form the largest navigable inland waterway in Australia. These features create a distinctive regional landscape of wetlands and flat coastal plains that is of considerable environmental significance in terms of its landforms, vegetation and fauna (EGCMA, 2015). The lakes are linked to the sea by an artificial entrance at its eastern end, being Lakes Entrance.

The Gippsland Lakes Ramsar site contains three main habitat types; permanent saline/brackish pools, coastal brackish/saline lagoons and permanent freshwater marshes (EGCMA, 2015). Threatened, endangered, vulnerable or rare native fish communities, and mammal, amphibian and plant species exist within these habitats.

The permanence of the main lakes and the relatively regular flooding of the adjacent wetlands mean that this wetland system is an important drought refuge for many waterfowl. The lakes and their associated swamps and morasses regularly support an estimated 40,000 to 50,000 ducks, swans, coots and other waterfowl. Lake Reeve (at the western end of the lake system) is a site of international zoological significance, attracting up to 12,000 migratory waders and is one of the five most important areas for waders in Victoria. The total concentration of waders at the south-western end of Lake Reeve fluctuates in response to local conditions of salinity, water depth and probably human disturbance (EGCMA, 2015). The lake has supported the largest concentration (5,000) of red knot (*Calidris canutus*) recorded in Victoria, as well as up to 3,000 sharp-tailed sandpiper (*Calidris acuminata*) and up to 1,800 curlew sandpiper (*Calidris ferruginea*). Twenty-four (24) bird species listed under JAMBA and 26 species listed under CAMBA have been recorded at the lakes.

Most of the wetlands of the Gippsland Lakes are bordered by emergent reed beds dominated by common reed (*Phragmites australis*) or saltmarsh communities, with characteristic saltmarsh species including beaded glasswort (*Sarcocornia quinqueflora*) and sea rush (*Juncus kraussii*) (EGCMA, 2015).

There is a high concentration of archaeological sites in the Gippsland Lakes area including artefact scatters, shell middens, scarred trees, occupation sites, burials and axe-grinding grooves.

Parts of the Lakes system are heavily used for commercial and recreational fisheries and for other water-based recreation, while the immediate hinterland has been developed for agricultural uses and limited residential and tourism purposes.

5.4.5 Commonwealth Heritage-listed Places

Commonwealth Heritage-listed places are natural, indigenous and historic heritage places owned or controlled by the Commonwealth. In Australia, these properties are protected under Chapter 5, Part 15 of the EPBC Act.

No properties on the Commonwealth Heritage List occur within the operational area or spill EMBA. Though the PMST Report lists the Gabo Island Lighthouse, Goose Island Lighthouse, Cape Lighthouse and Wilsons Promontory Lighthouse, each of these are located high above the high-water mark and the lighthouses themselves are not considered part of the EMBA. The nearest place is the Wilsons Promontory Lighthouse (95 km northeast of Yolla-A), which occurs on a prominent rocky headland.

5.4.6 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 PMST Report identifies the following TECs as occurring in the EMBA:

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria;

- Giant Kelp Marine Forests of South East Australia;
- Littoral Rainforest and Coastal Vine Thickets of Eastern Australia;
- Lowland Native Grasslands of Tasmania;
- Natural Damp Grasslands of the Victorian Coastal Plains
- Subtropical and Temperate Coastal Saltmarsh; and
- Tasmanian Forests and Woodland dominated by black gum or Brookers gum (*Eucalyptus ovata/E. brookeriana*).

Only assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria, Giant Kelp Marine Forests of South East Australia and Subtropical and Temperate Coastal Saltmarsh TECs are described here as the remaining TECs are terrestrial and not present in the spill EMBA. There are no TECs in the operational area. TECs mapped in relation to the EMBA are presented in Figure 5.11.

Giant Kelp Marine Forests of South East Australia

The *Giant Kelp Marine Forests of South East Australia* TEC is mapped as occurring within small coastal parts of the EMBA including the southern coastline of Phillip Island, among islands of the Furneaux Group, the northwest and west coast of Tasmania, around Erith, Dover and Deal Islands in the Beagle AMP, and small areas southwest and east of Mallacoota. TECs are protected as MNES under Part 13, Section 181 of the EPBC Act.

According to the Approved Conservation Advice for Giant Kelp Marine Forests of South East Australia (DSEWPC, 2012a), giant kelp (*Macrocystis pyrifera*) is a large brown algae that grows on rocky reefs from the sea floor 8 m below sea level and deeper. Its fronds grow vertically toward the water surface, in cold temperate waters off southeast Australia. It is the foundation species of this TEC in shallow coastal marine ecological communities. The kelp species itself is not protected, rather, it is communities of closed or semi-closed giant kelp canopy at or below the sea surface that are protected (DSEWPC, 2012a).

Giant kelp is the largest and fastest growing marine plant. Its presence on a rocky reef adds vertical structure to the marine environment that creates significant habitat for marine fauna, increasing local marine biodiversity. Species known to shelter within the kelp forests include weedy sea dragons (*Phyllopteryx taeniolatus*), six-spined leather jacket (*Mesuchenia freycineti*), brittle star (*Ophiuroid sp*), urchins, sponges, blacklip abalone (*Tosia spp*) and southern rock lobster (*Jasus edwardsii*).

The large biomass and productivity of the giant kelp plants also provides a range of ecosystem services to the coastal environment. Giant kelp is a cold-water species and as sea surface temperatures have risen on the east coast of Australia over the last 40 years, it has been progressively lost from its historical range (DSEWPC, 2012a).

Giant kelp requires clear, shallow water no deeper than approximately 35 m below sea level (DSEWPC, 2012a). They are photoautotrophic organisms that depend on photosynthetic capacity to supply the necessary organic materials and energy for growth. O'Hara (in Andrew, 1999) reported that giant kelp communities in Tasmanian coastal waters occur at depths of 5 to 25 m. The largest extent of the ecological community is in Tasmanian coastal waters (outside of the spill EMBA).

Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community

According to the Approved Conservation Advice for the assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria, this ecological community is the assemblage of native plants, animals and micro-organisms associated with the dynamic salt-wedge estuary systems that occur within the temperate climate, microtidal regime (< 2 m), high wave energy coastline of western and central Victoria (TSSC, 2018). The ecological community currently encompasses 25 estuaries in the region defined by the border between South Australia and Victoria and the most southerly point of Wilsons Promontory (TSSC, 2018).

Salt-wedge estuaries are usually highly stratified, with saline bottom waters forming a 'salt-wedge' below the inflowing freshwater layer of riverine waters. The dynamic nature of salt-wedge estuaries has important implications for their inherent physical and chemical parameters, and ultimately for their biological structure and ecological functioning. Some assemblages of biota are dependent on the dynamics of these salt-wedge estuaries for their existence, refuge, increased productivity and reproductive success. The ecological community is characterised by a core component of obligate estuarine taxa, with associated components of coastal, estuarine, brackish and freshwater taxa that may reside in the estuary for periods of time and/or utilise the estuary for specific purposes (e.g., reproduction, feeding, refuge, migration) (TSSC, 2018).

Subtropical and temperate coastal saltmarsh

According to the Conservation Advice for Subtropical and Temperate Coastal Saltmarsh, this TEC occurs in a relatively narrow strip along the Australian coast, within the boundary along 23°37' latitude along the east coast and south from Shark Bay on the west coast of Western Australia (TSSC, 2013). The community is found in coastal areas which have an intermittent or regular tidal influence.

The coastal saltmarsh community consists mainly of salt-tolerant vegetation including grasses, herbs, sedges, rushes and shrubs. Succulent herbs, shrubs and grasses generally dominate and vegetation is generally less than 0.5 m in height (Adam, 1990). In Australia, the vascular saltmarsh flora may include many species, but is dominated by relatively few families, with a high level of endism at the species level.

The saltmarsh community is inhabited by a wide range of infaunal and epifaunal invertebrates and low and high tide visitors such as fish, birds and prawns (Adam, 1990). It is often important nursery habitat for fish and prawn species. Insects are also abundance and an important food source for other fauna. The dominant marine residents are benthic invertebrates, including molluscs and crabs (Ross et al., 2009).

The coastal saltmarsh community provides extensive ecosystem services such as the filtering of surface water, coastal productivity and the provision of food and nutrients for a wide range of adjacent marine and estuarine communities and stabilising the coastline and providing a buffer from waves and storms. Most importantly, the saltmarshes are one of the most efficient ecosystems globally in sequestering carbon, due to the biogeochemical conditions in the tidal wetlands being conducive to long-term carbon retention. A concern with the loss of saltmarsh habitat is that it could release the huge pool of stored carbon to the atmosphere.

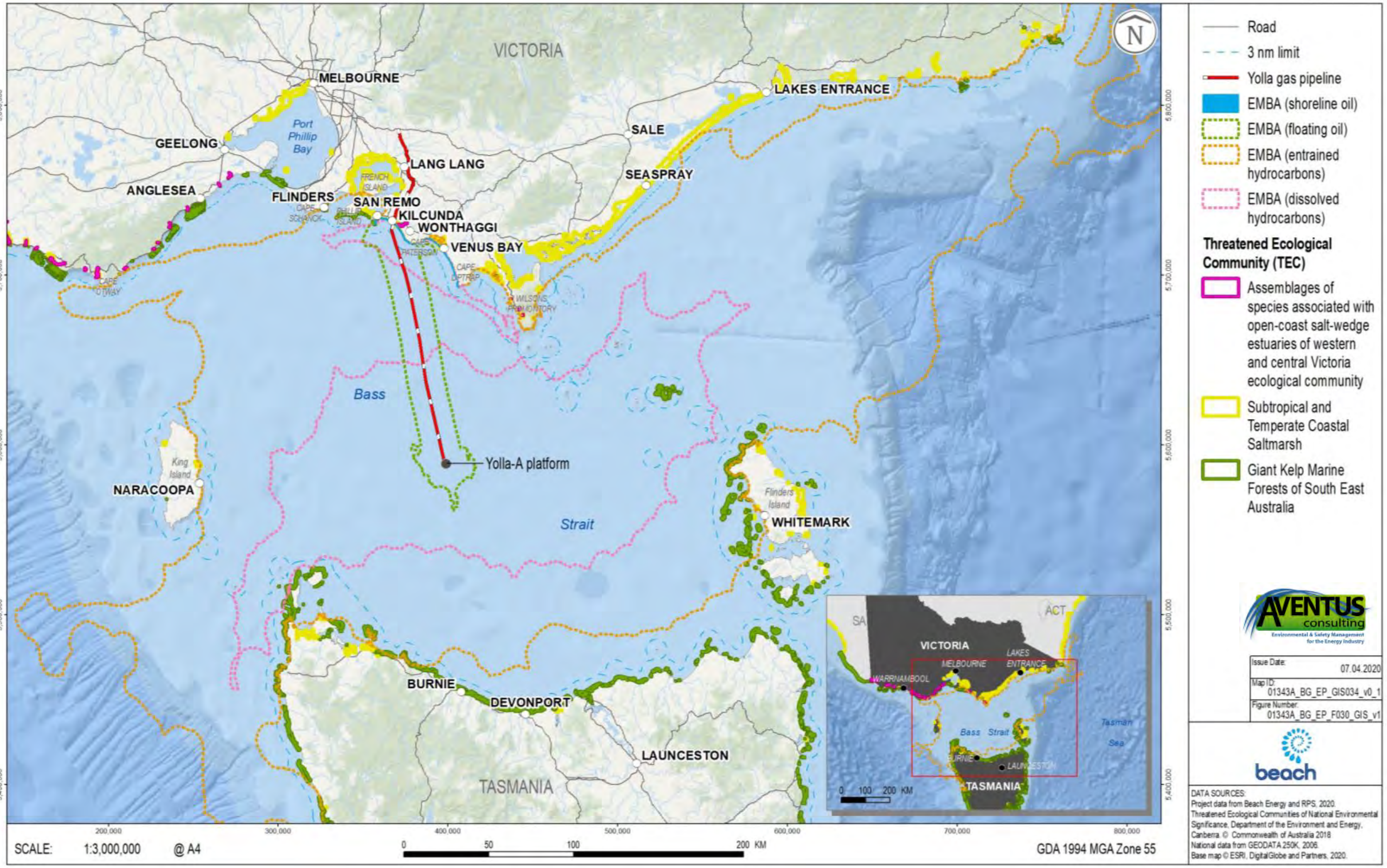


Figure 5.11. TECs in the EMBA

5.4.7 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. KEFs have no legal status in decision-making under the EPBC Act but may be considered as part of the Commonwealth marine area.

The operational area does not intersect any KEFs. The spill EMBA intersects four KEFS (Figure 5.12), these being the West Tasmanian Canyons (214 km to the west of Yolla-A), the Upwelling East of Eden, (271 km to the east), Big Horseshoe Canyon (350 km to the northeast) and Canyons of the Eastern Continental Slope (550 km north east). Each KEF is described below.

Upwelling East of Eden

Dynamic eddies of the EAC cause episodic productivity events when they interact with the continental shelf and headlands. The episodic mixing and nutrient enrichment events drive phytoplankton blooms that are the basis of productive food chains including zooplankton, copepods, krill and small pelagic fish (DoE, 2015a). The key value of the KEF is its high productivity and aggregations of marine life.

The upwelling supports regionally high primary productivity that supports fisheries and biodiversity, including top order predators, marine mammals and seabirds. This area is one of two feeding areas for blue whales and humpback whales, known to arrive when significant krill aggregations form. The area is also important for other cetaceans, seals, sharks and seabirds (DoE, 2015a).

West Tasmania Canyons

The West Tasmania Canyons are located on the relatively narrow and steep continental slope west of Tasmania. This location has the greatest density of canyons within Australian waters where 72 submarine canyons have incised a 500 km-long section of slope (Heap & Harris 2008). The canyons in the Zeehan AMP (outside the EMBA) are relatively small on a regional basis, each less than 2.5 km wide and with an average area of 34 km^2 shallower than 1,500 m. The Zeehan canyons are typically gently sloping and mud-filled with less exposed rocky bottoms compared with other canyons in the south-east marine region (e.g., Big Horseshoe Canyon).

Submarine canyons modify local circulation patterns by interrupting, accelerating, or redirecting current flows that are generally parallel with depth contours. Their size, complexity and configuration of features determine the degree to which the currents are modified and therefore their influences on local nutrients, prey, dispersal of eggs, larvae and juveniles and benthic diversity with subsequent effects which extend up the food chain.

Eight submarine canyons surveyed in Tasmania displayed depth-related patterns with regard to benthic fauna, in which the percentage occurrence of faunal coverage visible in underwater video peaked at 200-300 m water depth, with averages of over 40% faunal coverage. Coverage was reduced to less than 10% below 400 m depth. Species present consisted of low-relief bryozoan thicket and diverse sponge communities containing rare but small species in water depths of 150 m to 300 m.

Sponges are concentrated near the canyon heads, with the greatest diversity between 200 m and 350 m water depths. Sponges are associated with abundance of fishes and the canyons support a diversity of sponges comparable to that of seamounts. Based upon this enhanced productivity, the West Tasmanian canyon system includes fish nurseries (blue warehou and ocean perch), foraging seabirds (albatross and petrels), white shark and foraging blue and humpback whales (TSSC, 2015d).

Big Horseshoe Canyon

The Big Horseshoe Canyon lies south of the coast of eastern Victoria and is the easternmost arm of the Bass Canyon system. The steep, rocky slopes provide hard substrate habitat for attached large megafauna. Canyons have a marked influence on diversity and abundance of species through their combined effects of topography, geology and localised currents, all of which act to funnel nutrients and sediments into the canyon. Sponges and other habitat forming species provide structural refuges for benthic fish, including the commercially important pink ling (*Genypterus blacodes*) It is the only known temperate location of the stalked crinoid (*Metacrinus cyaneu*), which occurs in water depths between 200 m and 300 m (DoE, 2015a).

Canyons of the eastern continental slope

The canyons of the eastern continental slope are defined as a KEF as they provide a unique seafloor feature with enhanced ecological functioning, integrity and biodiversity, which apply to both its benthic and pelagic habitats. These canyons affect the water column by interrupting the flow of water across the seafloor and creating turbulent conditions in the water column. This turbulence transports bottom waters to the surface, creating localised upwellings of cold, nutrient-rich waters, which result in regions of enhanced biological productivity relative to the surrounding waters (DAWE, 2020b).

5.4.8 Nationally Important Wetlands

Nationally important wetlands (NIW) 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 nay native plant or animal taxa or for its outstanding historical or cultural significance (DAWE, 2020f).

Ten NIWs occur along the coast that are intersected by the spill EMBA (Figure 5.13). Many of these NIW would only be intersected by the spill EMBA if they are open to the sea at the time of a spill. The NIWs intersected by the EMBA are described below based on DAWE (2020f):

- Anderson Inlet (VIC062) – Anderson Inlet is one of the largest estuaries on the Victorian coast (2,230 ha) and is significant for the 23 waterbird species recorded here, including many threatened species such as the hooded plover, fairy tern, eastern curlew and orange-bellied parrot. The site is popular for recreational line-fishing, sailing, powerboating, bait collection and duck hunting.
- Boullanger Bay – Robbins Passage (TAS089) – This wetland is an extensive area of tidal channels and intertidal mud and sand flats lying between the northwest channel coastline of Tasmania, and three offshore islands (Perkins, Robbins and Penguin Islands). The site attracts the largest numbers of waders in Tasmania and represents significant habitat for non-migratory species. Extensive anecdotal evidence suggests the area was used by Tasmanian Aboriginals for various purposes including hunting and food gathering.
- Lavinia Nature Reserve (TAS075) – the eastern part of this NIW intersects the EMBA. Lavinia is also a wetland of international significance and is described in Section 5.4.4. The site is a refuge for regional and nationally threatened species (including the orange-bellied parrot) and provides recreational experiences including boating, fishing, camping and off-road driving.
- Powlett River Mouth (VIC078) - The Powlett River Mouth provides valuable habitat for the endangered orange-bellied parrot by supporting saltmarsh vegetation.
- Rocky Cape Marine Area (TAS080) – This marine area extends off the Rocky Cape National Park where the marine intertidal, tidal and deep waters, together with a range of wave exposures found in the area, result in particularly high biotic diversity. Extensive fish fauna contains many warm and cool temperate species including cave dwelling species. The area is commonly used for recreational activities such as scuba diving, snorkelling, fishing and boating.
- Unnamed Wetland (TAS081) – This wetland is located on the northwest coast of Tasmania 6 km northwest of the Arthur River township and covers 3 ha. The site is an important representative wetland for the region and supports communities which are poorly reserved in Tasmania such as *Hdrocotyle muscosa* herbfields.
- Western Port (VIC083) – Western Port is also a wetland of international significance and is described in Section 5.4.4. The site is significant for its ecological, recreational, tourism, scientific, educational, cultural and

scenic values. It contains over 50% of Victoria's mangroves and large areas of highly productive seagrass beds and mudflats.

- Tamboon Inlet (VIC135) – This wetland is located in east Gippsland and hosts a variety of wetland types that are affected by fresh and saline water, which supports a diversity of flora and fauna in estuarine habitat. 96 plant taxa (including 38 introduced) have been recorded in the Tamboon Inlet area. The inlet is fringed by multiple vegetation classes including riparian scrub complex and coastal saltmarsh. The south of the inlet is separated from Bass Strait behind a dune and barrier system that forms part of Ninety Mile Beach. The inlet may flow to Bass Strait during times of high flow, though generally remains closed.
- Thurra River (VIC155) – The reach corridor of Thurra River has an area of 2,920 ha and flows through State forest and Croajingolong National Park. There are 29 threatened flora species and 37 threatened fauna species within the wetland. Ninety Mile Beach and the associated dunes create a barrier to Bass Strait, which may be open during times of high flow, though generally remains closed.
- Benedore River (VIC154) – This wetland occurs in east Gippsland in the Croajingolong National Park. The Benedore River has no introduced fish species and a natural assemblage of native species, which indicates pristine conditions. There are 16 threatened flora species recorded in the wetland. There are 25 threatened fauna species including the little tern (*Sterna albifrons*). The Benedore River is contained behind Ninety Mile Beach dunes, which may be open during times of high flow.

There is one additional NIW that is located just outside the EMBA on the southern NSW coast and is briefly described below:

- Nadgee Lake and tributary wetlands (NSW187) – this is an intermittently open/closed coastal lake. The lake is fed by large swamps and ephemeral creeks flowing from the Nagdee Range to the west and is more often closed to the ocean than open. The area is considered habitat for the ground parrot (*Pezoporous wallicus*), hooded plover (*Thinornis rubricollis*) and little tern (*Sterna albifrons subsp. sinensis*).

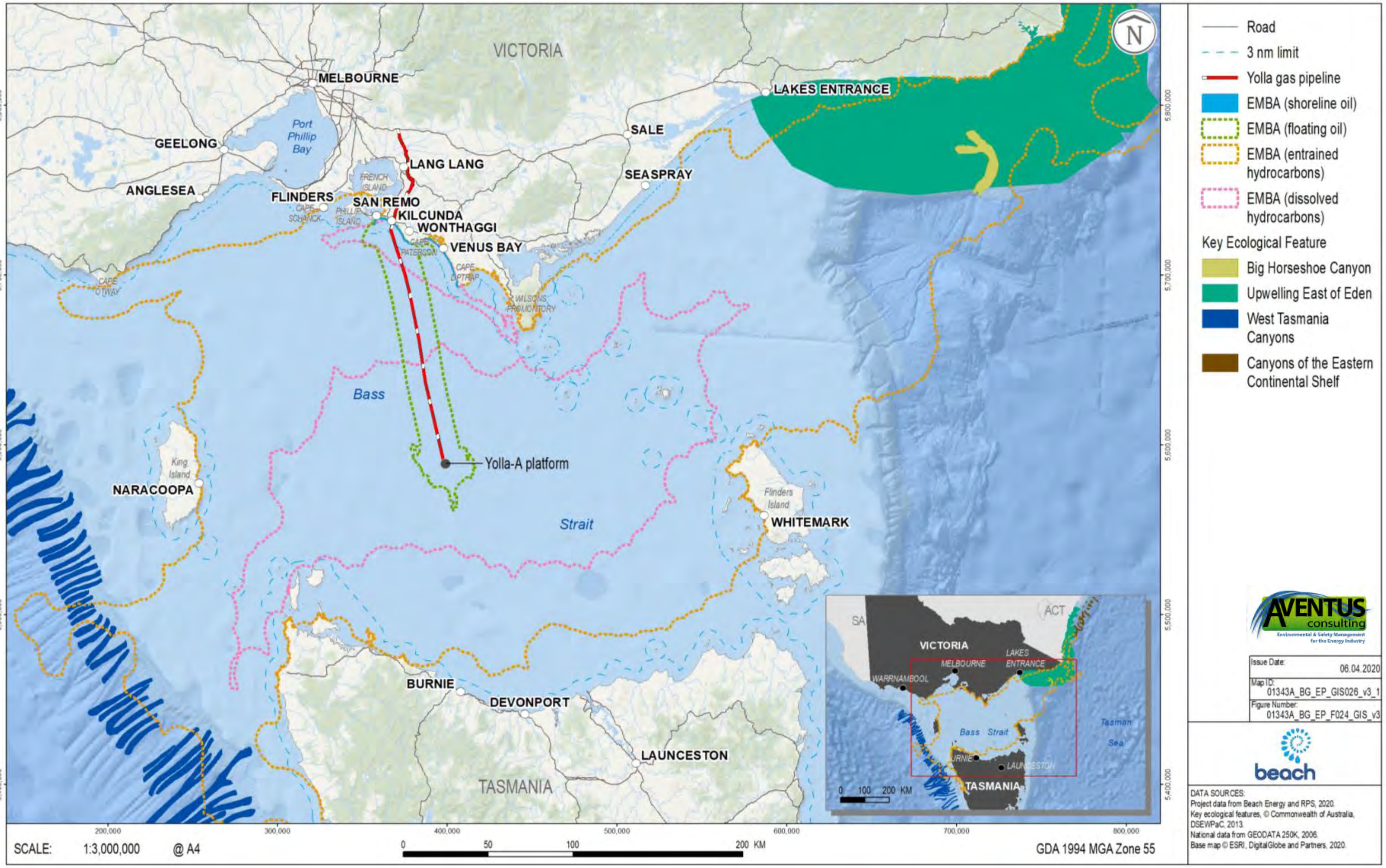


Figure 5.12. KEFs located in the EMBA

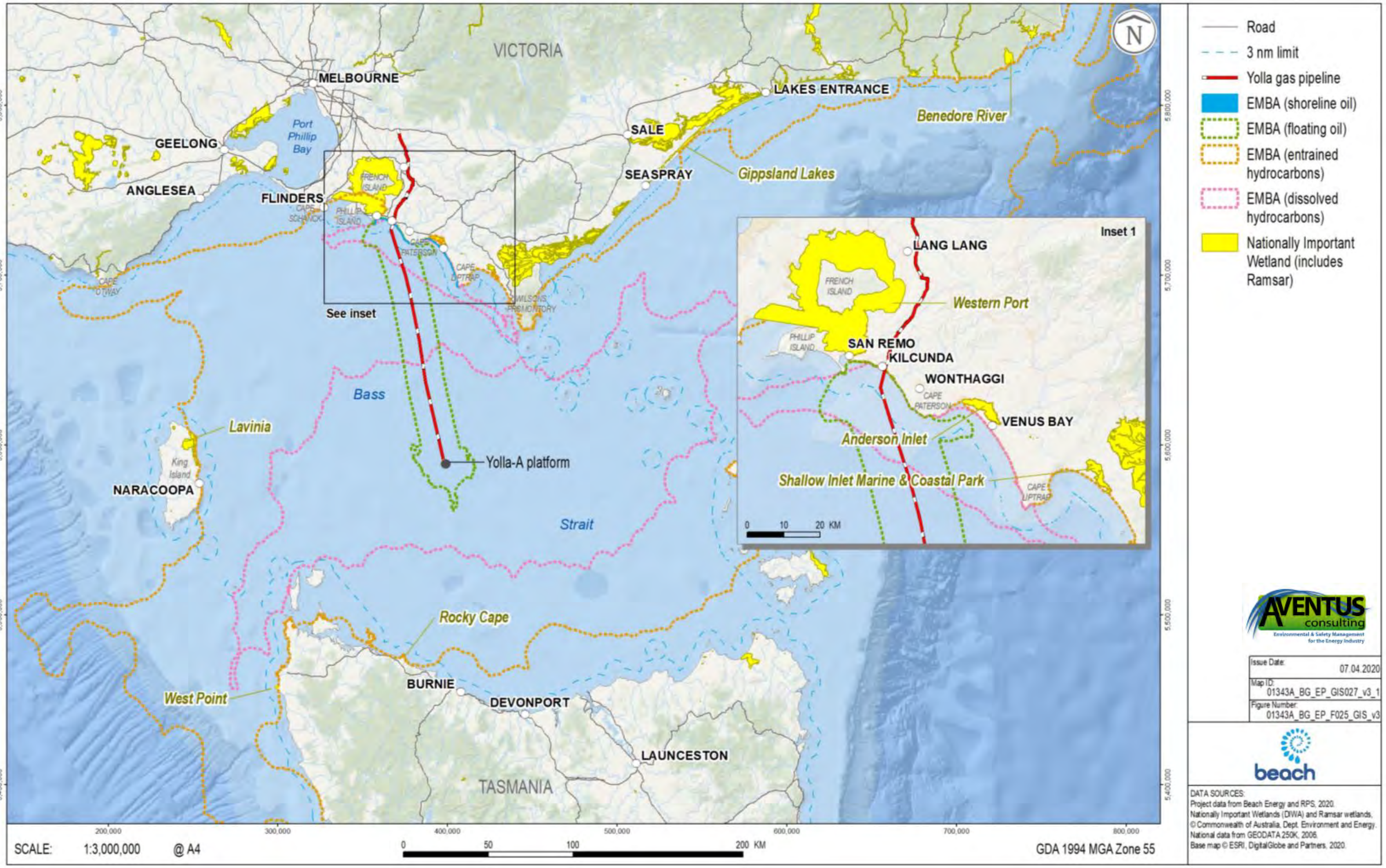


Figure 5.13. Nationally important wetlands and Ramsar wetlands in the EMBA

5.4.9 Victorian Protected Areas

Victoria has a large network of onshore and offshore protected areas that are established, protected and managed under the *National Parks Act 1982* (Vic) by Parks Victoria. Offshore, there are 24 Victorian marine national parks and sanctuaries.

The RGP intersects the Kilcunda Conservation Reserve (it was horizontally directionally drilled under/through it). There are nine marine protected areas and 16 onshore protected areas (i.e., reserves that extend to the low-water mark) intersected by the EMBA, shown in Figure 5.10 and described in Table 5.6, moving west to east along the EMBA.

5.4.10 Tasmanian Protected Areas

Tasmania has a large network of onshore and offshore protected areas that are established, protected and managed under the *National Parks and Reserves Management Act* 2002 (Tas) and *Nature Conservation Act* 2002 (Tas) by DPIPWE. Offshore, there are seven marine reserves and 14 marine conservation areas (with the latter restricted to waters around Hobart in southern Tasmania).

The operational area does not intersect any Tasmanian protected areas.

The two marine protected areas and 61 onshore protected areas intersected by the EMBA are shown in Figure 5.10 and described in Table 5.7, moving anti-clockwise through the spill EMBA beginning at King Island.

Note, where official management plans are not available for Tasmanian protected areas, information has been obtained from the Protected Planet (2020) database.

5.4.11 New South Wales Protected Areas

New South Wales has a large network of onshore and offshore protected areas that are established, protected and managed under the *National Parks and Wildlife* Act (1974) by the National Parks and Wildlife Service (NPWS).

The operational area does not intersect any NSW protected areas.

There are two onshore reserves intersected by the EMBA as shown in Figure 5.10 and described in Table 5.8, moving south to north.

Table 5.6. Victorian marine and coastal protected areas in the spill EMBA

Name	Location	Description
Marine protected areas		
Marengo Reefs Marine Sanctuary	218 km northwest of Yolla-A.	The Marengo Reefs Marine Sanctuary (12 ha) is in Victorian State waters near Marengo and Apollo Bay on the Great Ocean Road, approximately 220 km south-west of Melbourne. The sanctuary protects two small reefs and a wide variety of microhabitats. Protected conditions on the leeward side of the reefs are unusual on this high wave energy coastline and allow for dense growths of bull kelps and other seaweed. There is an abundance of soft corals, sponges, and other marine invertebrates, and over 56 species of fish have been recorded in and around the sanctuary. Seals rest on the outer island of the reef and there are two shipwrecks (the Grange and Woolamai) in the sanctuary (Parks Victoria, 2007a). The Marengo Reefs Marine Sanctuary Management Plan (Parks Victoria, 2007a) identifies the environmental, cultural and social values as: • Subtidal soft sediments, subtidal rocky reefs and intertidal reefs; • High diversity of algal, invertebrate and fish species; • Australian fur-seal haul-out area; • Evidence of a long history of Indigenous use, including many Indigenous places and objects nearby; • Wrecks of coastal and international trade vessels in the vicinity of the sanctuary; • Spectacular underwater scenery for snorkelling and scuba diving; • Intertidal areas for exploring rock pools; and • Opportunities for a range of aquatic recreational activities including seal watching.
Mushroom Reef Marine Sanctuary	164 km northwest of Yolla-A.	Mushroom Reef Sanctuary is located on the Bass Strait coast at Flinders near the western entrance to Western Port Bay and is 80 ha in size. The sanctuary abuts the Mornington Peninsula National Parkland and extends from the high-water mark to approximately 1 km offshore. The sanctuary's key natural values are listed in the Mushroom Reef Marine Sanctuary Management Plan (Parks Victoria, 2005b) as: • Numerous subtidal pools and boulders in the intertidal area that provide a high complexity of intertidal basalt substrates and a rich variety of microhabitats; • Subtidal reefs that support diverse and abundant flora including kelps, other brown algae, and green and red algae; • Sandy bottoms habitats that support large beds of Amphibolis seagrass and patches of green algae; • Diverse habitats that support sedentary and migratory fish species; • A range of reef habitats that support invertebrates including gorgonian fans, seastars, anemones, ascidians, barnacles and soft corals; • A distinctive basalt causeway that provides habitat for numerous crabs, seastars and gastropod species; • Intertidal habitats that support resident and migratory shorebird species including threatened species; • An important landmark and area for gathering fish and shellfish for the Boonwurrung people; and • Excellent opportunities for underwater recreation activities such as diving and snorkelling among accessible subtidal reefs.

Name	Location	Description
Churchill Island MNP	153 km northwest of Yolla-A.	Churchill Island is located south of Rhyll, on the eastern shore of Phillip Island. The park extends from Long Point to the north point of Churchill Island. Within the park are numerous marine habitats including mangroves, sheltered intertidal mudflats, seagrass beds, subtidal soft sediments and rocky intertidal shores. Churchill Island MNP is part of the Western Port Ramsar wetland site. Churchill Island is an important habitat for many bird species. Migratory waders roost and feed within the MNP including the bar-tailed Godwit and the red-necked stint. The seagrass beds are major food sources for many commercially viable species such as king George whiting, black bream and yellow-eyed mullet (Parks Victoria, 2007b).
Bunurong MNP	Located 124 km north of Yolla-A. Extends over 5 km of coastline 2.5 km east of Cape Patterson in south Gippsland and reaches offshore for 3 nm to the limit of Victorian waters.	Bunurong MNP is significant because of the mixed assemblage of brown algae and seagrass, supporting a high proportion of Victoria's marine invertebrates, including brittle stars, sea cucumbers, barnacles, sea anemones and chitons. Bunurong MNP supports a considerable diversity of habitats and communities. These habitats provide important substrate, food, shelter and spawning and nursery areas for a variety of marine flora and fauna. Six marine ecological communities are present: sandy beaches, intertidal reef platform, subtidal reef, subtidal soft sediments, seagrass and open waters. Intertidal and subtidal reef communities are the most common habitat type and incorporate many microhabitats. Red, brown and green alga species, seagrass and seaweeds along with rocky substrate combine to form many microhabitats (Parks Victoria, 2006a). Sandy beaches of the park provide important habitat for invertebrates such as amphipods, isopods, molluscs, polychaetes and crustaceans, and are also a feeding ground for fish and seabirds. Beach-washed materials in sandy beach habitats provide a significant source of food for scavenging birds and contribute to the detrital cycle that nourishes many of the invertebrates, such as bivalves, living in the sand. Overall, the marine flora and fauna are considered largely representative of the Central Victorian Marine Bioregion (Parks Victoria, 2006a).
Bunurong Marine and Coastal Park	Located 126 km north of Yolla-A. Extends 7 km west and 3 km east along the coast from the national park and extends 1 km into the sea.	Bunurong Marine and Coastal Park has rugged sandstone cliffs, broad rock platforms and underwater reefs and significant fossil sites where dinosaur bones over 115 million years old have been excavated (Parks Victoria, 2006a). Bunurong Marine National Park is significant because of the mixed assemblage of brown algae and seagrass, supporting a high proportion of Victoria's marine invertebrates, including brittle stars, sea cucumbers, barnacles, sea anemones and chitons.
Wilsons Promontory MNP	Located 86 km northeast of Yolla-A. Extends along 70 km of coastline on the southern tip of Wilsons Promontory National Park including Victorian state waters.	Wilsons Promontory MNP is a distinct bioregion of Victoria’s coastline due to the different types of rock present and its position at the boundary between two major ocean currents. Its offshore islands support several colonies of Australian fur-seals and provide breeding sites for many seabirds, including cape barren geese, little penguins, gulls, mutton birds and ospreys (Parks Victoria, 2006b). Wilsons Promontory MNP is the first in Australia to receive a Global Ocean Refuge Award, joining a group of ten marine protected areas that comprise the Global Ocean Refuge System. The award signifies that the park meets the highest science-based standards for biodiversity protection and best practices for management and enforcement. Located at the southernmost tip of mainland Australia, it’s one of the country’s best examples of marine biodiversity protection (Parks Victoria, 2006b).
Wilsons Promontory Marine Park	Located 91 km northeast of Yolla-A.	Wilsons Promontory Marine Park, together with the Marine Reserve and MNP, make significant contributions to Victoria’s marine protected areas. The marine park includes biological communities with distinct biogeographic patterns, including shallow subtidal reeds, deep subtidal reefs, intertidal rocky shores, sandy beaches, seagrass, subtidal soft substrates and expansive areas of open water (Parks Victoria, 2006b).

<table>
<tr><th>Name</th><th>Location</th><th>Description</th></tr>
<tr><td></td><td></td><td>The marine park provides important habitat for several threatened shorebird species and islands within the park act as important breeding sites for Australian fur seals (Parks Victoria, 2006b).</td></tr>
<tr><td>Point Hicks MNP</td><td>371 km northeast of Yolla-A.</td><td>The Point Hicks MNP covers 3,810 ha and extends along 9.6 km of coastline and offshore from the high-water mark to the 3 nm state waters limits to water depths of 88 m. The reefs directly below Point Hicks, Whaleback Rock and Satisfaction Reef are the best-known geological features of the park. Point Hicks itself is a granite headland with a wide rocky and bouldery shore formed up to 10,000 years ago.
The park’s key natural values are listed as:
• A diversity of habitats, including subtidal and intertidal reefs, subtidal soft sediment and sandy beaches;
• A very high diversity of fauna, including intertidal and subtidal invertebrates;
• Co-occurrence of eastern temperate, southern cosmopolitan and temperate species, as a result of the mixing of warm eastern and cool southern waters;
• A range of rocky habitats;
• Mammal mammals such as dolphins, whales and fur-seals;
• Transient reptiles from northern waters, including turtles and sea snakes;
• Threatened fauna, including whales and several bird species;
• Outstanding landscapes, seascapes and underwater scenery;
• Outstanding active coastal landforms, such as granite reefs and mobile sand dunes;
• Excellent opportunities for scientific investigation and learning; and
• Outstanding opportunities to build knowledge of marine protected areas and their management and to further understand marine ecological function and changes over time.
A prominent biological component of the subtidal reef areas is kelp and other seaweeds. Large species of brown algae, such as common kelp and crayweed, are present along the open coast in dense stands. Giant species of seaweeds such as string kelp and bull kelp also occur (Parks Victoria, 2006c). The front reefs and Whaleback Reef, which have high relief gutters of up to 15 m have high sessile invertebrate diversity and abundance on the vertical walls.
An important characteristic of Point Hicks MNP is its canopy-forming algae (a mixture of crayweed Phyllospora comosa and common kelp Ecklonia radiata) and small understorey algae. The reef beneath the canopy varies from encrusting and erect sponges to small fleshy red algae. The invertebrate community includes moderate abundances of blacklip abalone (Haliotis rubra) and the red bait crab (Plagusia chabrus).</td></tr>
<tr><td>Cape Howe MNP</td><td>441 km northeast of Yolla-A.</td><td>The Cape Howe MNP covers 4,060 ha and extends along 4.8 km of coastline and offshore from the high-water mark to the 3 nm state waters limit to water depths of 105 m (Parks Victoria, 2006d). The waters of the park contain both high-profile granite and low-profile sandstone reefs.
The park’s key natural values are listed as:
• Diversity of habitats including subtidal and intertidal reefs, subtidal soft sediment and sandy beaches;</td></tr>
</table>

Name	Location	Description
		• Co-occurrence of eastern temperate, southern cosmopolitan and temperate species, as a result of the mixing of warm eastern and cool southern waters; • Marine mammals such as whales, dolphins, Australian fur-seals and New Zealand fur-seals; • Transient reptiles such as green turtles from northern waters; • Threatened fauna including whales and birds; • Foraging area for a significant breeding colony of Little Penguins from neighbouring Gabo Island; • Outstanding active coastal landforms within and adjoining the park, such as granite and sandstone reefs; • Outstanding landscapes, seascapes and spectacular underwater scenery; • Victoria's most easterly Marine National Park abutting one of only three wilderness zones on the Victorian coast; • Excellent opportunities for scientific investigation and learning; • Outstanding opportunities to build knowledge of marine protected areas and their management, and to further understand marine ecological function and changes over time. Subtidal soft sediment communities are the most widespread communities in the park, with the diversity of invertebrates expected to be high. Common fish are herring cale (*Odax cyanomelas*), leatherjacket (*Meuschenia freycineti*), striped mado (*Atypichthys strigatus*), banded morwong (*Cheilodactylus spectabilis*) and damselfishes (*Parma microlepis* and *Chromis hypsilepis*). Its deep (30 to 50 m) sandstone reefs are heavily covered with a diverse array of sponges, ascidians and gorgonians. Transient mammals such as southern right whales, humpback whales, killer whales, Australian fur-seals, New Zealand fur-seals, bottlenose dolphins and common dolphins are transient visitors to the park.
Coastal/onshore protected areas (where the EMBA intersects shorelines)		
Great Otway National Park	222 km northwest from Yolla-A.	The Great Otway National Park (103,185 ha) is located near Cape Otway and stretches from the low water mark inland on an intermittent basis from Princetown to Apollo Bay (approximately 100 km). Landscapes within the park are characterised by tall forests and hilly terrain extending to the sea with cliffs, steep and rocky coasts, coastal terraces, landslips, dunes and bluffs, beaches and river mouths. There is a concentration of archaeological sites along the coast, coastal rivers and reefs. The park provides habitats for the conservation of the rufous bristlebird, hooded plover, white-bellied sea eagle, fairy tern, Caspian tern and Lewin's rail and native fish such as the Australian grayling. (Parks Victoria and DSE, 2009). The park's key natural values are listed as: • Large areas of intact native vegetation and habitats of the Otway Ranges, Otway Plain, Warrnambool Plain bioregions; • Areas of forest in excellent condition, including old growth forest, cool temperate rainforests and wet forests; • Large portions of the Barwon and Otway Coast river basins, linking largely unmodified headwaters to streams and rivers including the Aire, Gellibrand and Barwon rivers, then on to estuaries and the sea; • A large area of essentially unmodified coastline, linking the land to marine ecosystems and MNPs;. • An abundance of biodiversity, with many species and communities found nowhere else in Victoria, some of which are rare and threatened, and including some species of national significance such as the Spottailed Quoll, Smoky Mouse and Tall Astelia;

Name	Location	Description
		• Many sites of geological and geomorphological significance including Artillery Rocks, Dinosaur Cove, Lion Headland, Moonlight Head to Milanesia Beach, Point Sturt and View Point; and • The majority of the Aire Heritage River corridor.
Mornington Peninsula National Park	165 km northwest from Yolla-A	The Mornington Peninsula National Park is situated 70 km south of Melbourne and runs along the coast from Point Nepean, at the western tip of the peninsula, to Bushrangers Bay, where it turns inland along the Main Creek valley until it joins the Greens Bush section (Parks Victoria, 2013). A narrow coastal strip between Simmons Bay and Flinders also forms part of the park, as does the South Channel Fort in Port Phillip Bay. The park's key natural values are listed as: • Largest and most significant remaining areas of native vegetation on the Mornington Peninsula; • Numerous sites and features of geomorphic significance, particularly along the coast (cliffed calcarenite coast, sandy forelands and basalt shore platforms); • Only representation in the Victorian conservation reserve system of four particular land systems formed within the Southern Victorian Coastal Plains and the Southern Victorian Uplands; • Many significant native plants and vegetation communities, and the most extensive remnant coastal grassy forest habitat on the Mornington Peninsula; • Highly scenic landscape values along the ocean coast and at Port Phillip heads; and • Many significant fauna species, including populations of the nationally significant hooded plover, over 30 species of state significance and many species of regional significance. High quality marine and intertidal habitats, with some pristine areas within Point Nepean.
Phillip Island Coastal Reserve	Located 148 km north northwest from Yolla-A.	Phillip Island Coastal Reserve forms part of the greater network of protected areas on Phillip Island and spans from Cowes in the north of the island to Cape Woolamai in the east. The coastal reserve protects much of the sandy beaches that the Island's settlements are built behind. These protected areas are popular with holiday makers who enjoy surfing, swimming, fishing, walking, running, bike riding and playing among the foreshore beaches (PINP, 2018).
Phillip Island Nature Park	Located 148 km north northwest from Yolla-A.	Phillip Island Nature Park spans multiple locations across the island from Cape Woolamai in the east, Smiths Beach in the South, Summerlands in the west and Cowes in the north. Due to its proximity to adjacent settlements, the Nature Park hosts a range of recreational activities including surfing, swimming, fishing, walking, running and bike riding. Cape Woolamai's cliffs are used by experienced rock climbers that allow for spectacular views of coastal scenery. The Cape is also the home to Phillip Island's largest shearwater rookery and numerous little penguin colonies. The penguins' nightly return from the ocean to their nests (the 'Penguin Parade' at Summerlands beach, outside the EMBA) is a key drawcard for tourists to Victoria and this part of the coastline. The Park also encapsulates Seal Rocks in the west, which is an important seal haul out site (PINP, 2018).
Flinders Foreshore Coastal Reserve	165 km northwest of Yolla-A.	The Flinders Foreshore Coastal Reserve is located adjacent the township of Flinders on its eastern foreshore. The town is popular with holidaymakers and the reserve protects the beach and foreshore areas. There is no management plan for the Flinders Foreshore Coastal Reserve.

Name	Location	Description
Western Port Intertidal Coastal Reserve	161 km northwest of Yolla-A.	Western Port Intertidal Coastal Reserve is located on the eastern coast of Western Port Bay. The reserve protects substantial areas of unvegetated mudflats that provide important habitat for shorebirds and migratory waders. The reserve forms part of the Western Port Ramsar site (described in Section 5.4.4).
French Island National Park	162 km northwest of Yolla-A.	The French Island National Park is located 10 km south of Tooradin, and French Island MNP is adjacent to the northern shoreline of French Island National Park in Western Port Bay. Extending 15 km along the shoreline, the park covers an area of 2,800 ha. It includes one of Victoria's most extensive areas of saltmarsh and mangrove communities along with mudflats of state geomorphological significance (Parks Victoria, 1998).
San Remo Coastal Reserve	Located 146 km north-northwest of Yolla-A.	San Remo Coastal Reserve protects the foreshore area adjacent to the township of San Remo. The protected area is primarily sandy beach, rocky cliffs and dunes, some of which faces Bass Strait and others towards Western Port Pay. The township of San Remo is separated from neighbouring Phillip Island by a strip of fast flowing water known as 'the narrows.' The coastal reserve is important in protecting the activities and aesthetic that makes San Remo part of the network of popular Bass Coast holiday destinations such as surfing, swimming, fishing, walking, running, bike riding and boating.
Punchbowl Coastal Reserve	Located 145 km north of Yolla-A, west of the pipeline coastal crossing.	Punchbowl Coastal Reserve is for the protection of the coastline that was previously grazing farmland. The low vegetation allows for observing bird life where pacific gulls exploit the strong updraught created by the high cliffs. Black-shouldered kites and nankeen kestrels feed in the neighbouring farmlands. Through winter the high cliffs provide a vantage point to view southern right whales on their annual migration to the warmer waters along the southern coastline.
Kilcunda Coastal Reserve	Located 145 km north of Yolla-A, west of the pipeline coastal crossing. Adjacent to the Kilcunda township.	Kilcunda Coastal Reserve is located on the Bass Coast adjacent the township of Kilcunda. The reserve protects coves of sandy beaches, rocky cliffs, intertidal rock formations and patchy vegetation that separates the township from the foreshore. The reserve is important in preserving the recreational beach activities as well as its supporting facilities such as its picnic area, playground, walking trails and shelter (Parks Victoria, 2006a). The RGP was drilled under/through this reserve.
Kilcunda Harmers Haven Coastal Reserve	Located 132 km north of Yolla-A. Located 1 km west of Cape Paterson west to Kilcunda.	Kilcunda-Harmers Haven Coastal Reserve is a 180 ha reserve for the protection of the coastal flora habitat. Coastal habitat at Harmers Haven has a high diversity of vegetation communities, many of which are considered rare, depleted or endangered within the Bass Coast Shire, with almost 300 recorded flora species including plants of national, state and regional conservation significance (Parks Victoria, 2006a).
Cape Liptrap Coastal Park	Located 102 km north of Yolla-A.	Cape Liptrap Coastal Park protects extensive heathland and coastal forest vegetation communities, including scented paperbark, common heath, scrub she-oak, dwarf she-oak, pink swamp-heath, prickly teatree, silver banksia and bushy hakea. Several rare fauna species occur in the park including the hooded plover, swamp antechinus and powerful owl (Parks Victoria, 2003).
Shallow Inlet Marine and Coastal Park	Located 113 km northeast of Yolla-A, adjoining Wilsons Promontory National Park near Sandy Point.	Shallow Inlet is a large tidal bay closed from the sea by a sand barrier complex of spits, bars and mobile dunes. The sheltered western side of the inlet is dominated by a salt marsh terrace. The park protects a diverse range of vegetation including foredunes of spinifex, heathy woodlands of messmate and coastal banksia, paperbark swamps and saltmarsh communities. Extensive mudflats and intertidal areas are exposed at low tide.

Name	Location	Description
		Pied oystercatchers and red capped plovers nest in the dunes and on the spit. A diverse range of mammals including the koala, common ringtail possum, common wombat, swamp wallaby and echidna use the woodland and heathland habitats along the shoreline of Shallow Inlet (Parks Victoria, 2012).
Gippsland Lakes Coastal Park	217 km north-northeast of Yolla-A.	The Gippsland Lakes Coastal Park is a narrow coastal reserve, covering 17,584 ha along the Ninety Mile Beach (including the beach itself) from Seaspray to Lakes Entrance. The park supports valuable remnant vegetation including Coast Banksia Woodland, Heath Tea-Tree Heathland and Hairy Spinifex Grassland. The Park takes in extensive coastal dune systems, woodlands and heathlands, as well as water bodies such as Lake Reeve and Bunga Arm. These water bodies (listed as Ramsar wetlands) are protected from ocean processes via the dune barrier system that ranges in height between 5 and 8 m. The coastal vegetation strip is identified as containing Littoral Rainforest and Coastal Vine Thickets of Eastern Australia). The park's key natural values are listed as (use of the term 'parks' in this section references the adjacent Lakes National Park): • Supports valuable remnants of vegetation communities that have been disturbed throughout much of their range, including Coast Banksia Woodland, Heath Tea-tree Heathland and Hairy Spinifex Grassland; • Lake Reeve is of international significance and is a site of special scientific interest. This long, shallow lagoon is fringed by salt marsh with a number of plant species 'relatively uncommon in Victoria east of Seaspray'; • Six significant flora and over 20 significant fauna species have been recorded within the Parks; • Lake Reeve provides important breeding habitat for a number of waterfowl species and is one of Victoria's five most important areas for waders; • The wetlands are important nursery areas for many fish species; and • The Parks contain sites of National, State and regional geological and geomorphological significance mainly associated with the evolution of the barrier system that formed the Gippsland Lakes. More than 190 species of birds have been recorded on Sperm Whale Head. Although there have been few dedicated fauna surveys, 26 species of native mammals, 17 of reptiles and 11 of amphibians have been recorded in the parks. Gippsland Lakes Coastal Park is considered the most important site in Victoria for the endangered New Holland mouse (*Pseudomys novaehollandiae*).
Cape Conran Coastal Park	341 km northeast of Yolla-A.	Cape Conran Coastal Park covers an area of 11,700 ha and is bounded by Marlo Coastal Reserve to the west, Croajingolong National Park to the east (eastern shore of Sydenham Inlet), State forest and private property to the north, and the Tasman Sea, at low water mark, to the south. The park forms part of the Gippsland Lakes Ramsar site (see Section 5.4.4). The park's key natural values are listed as: • Rich and diverse vegetation, including damp and lowland forest, woodlands, various types of heathland, swamp, coastal and riparian communities; • The Dock Inlet catchment, a pristine example of a coastal stream system with Cape Conran Coastal Park and associated wetlands terminating in a freshwater coastal lagoon; • The undisturbed Yeerung River supporting predominantly native fish is one of only two entirely lowland rivers in the region draining directly to the sea; • Almost 50 species of threatened fauna including six endangered nationally, and 14 bird species listed under international migratory bird agreements;

Name	Location	Description
		• At least 40 species of threatened flora, including the Bonnet Orchid and Leafless Tongue-orchid which are both vulnerable nationally; • Extensive heathland areas in excellent condition harbouring populations of threatened fauna, including the Ground Parrot and Smoky Mouse; • Sydenham Inlet, part of the Bemm Heritage River corridor, supporting expansive seagrass meadows that provide important habitat for fish and waterbirds; • High scenic values associated with the diverse geological formations of the park's headlands, its coastal estuaries and heathy plains; and • Excellent examples of coastal dynamics such as sand movement, wave action and river outflows. The seagrass beds within Sydenham Inlet sustain a diverse range of native fish and are critical to the maintenance of regional fish populations.
Croajingolong National Park	363 km northeast of Yolla-A	Croajingolong National Park covers an area of 88,355 ha and extends along 100 km of the coast, from Sydenham Inlet in the west to the NSW border in the east, with the mean low water mark of the coast forming the park's southern boundary (Parks Victoria, 1996). Two major physiographic units are represented in the park, these being coastal tablelands and coast dune complexes (some vegetated and some mobile). The ocean beaches of the park attract migratory seabirds and waders, including little, crested and fairy terns and the hooded plover, while the wetlands provide habitat for a rich assemblage of waterfowl and native fish such as spotted galaxias, gudgeon, bass and the Australian grayling. The park's key natural values are listed as: • A wide variety of highly significant coastal landforms including tidal inlets, estuaries and lagoons, dune-blocked lake and swamp systems, freshwater interdune lakes, extensive sand dunes and sand sheets, and prominent rocky cliffs; • Many sites recognised for their geological and geomorphological significance; • Habitats supporting over 1,000 recorded native plant species, 87 of which are listed as threatened in Victoria and have their primary stronghold in the Park; • Ninety species of orchids, including all five of Australia's lithophytic and epiphytic orchids; • Significant and well-developed sites of Warm Temperate Rainforest in the lower reaches of a number of rivers; • Coastal Heathland, a community considered to be extremely species rich, and covering up to 10% of the park; • Habitats supporting 43 species of threatened native fauna, including the little tern, ground parrot, eastern bristle-bird, eastern broad-nosed bat, and Australian fur-seal; • The Skerries, one of only four Australian fur-seal colonies in Victoria and an important breeding site for penguins and other seabirds; • Records of one third of Victoria's, and one quarter of Australia's, bird species; • Some of the richest amphibian habitats in Victoria; • Highly significant coastal streams and catchments that are relatively undisturbed, with an absence of introduced fish species and good populations of native fish species; and

Name	Location	Description
		• Localities with among the highest wilderness quality in the State, outside the Mallee, and two of the three coastal wilderness areas in Victoria.

Table 5.7. Tasmanian marine and coastal protected areas in the spill EMBA

Note: where there are no official management plans available for protected areas, information has been obtained from the Protected Planet (2020) database.

Name	Location	Description
Marine Protected Areas		
Arthur Bay Conservation Area	187 km southeast of Yolla-A	Arthur Bay Conservation Area covers 7.5 km^2 and includes the coastline and marine areas south of Blue Rocks and north of Whitemark on the west coast of Flinders Island. There is no management plan in place.
Kent Group Marine Reserve and Kent Group National Park	Located 126 km east of Yolla-A. It is surrounded by the Beagle AMP. They occur in the middle of eastern Bass Strait, approximately halfway between the northern tip of Flinders Island and Wilsons Promontory.	Kent Group Marine Reserve comprises five granitic islands and extends from the high-water mark to three nautical miles offshore. The marine reserve is divided into two zones; the western half is a 'no-take' zone where all marine life is protected and the eastern half is a 'restricted-take' zone where some fishing is permitted. The Kent Group is the southern strong-hold for several species including the violet roughy, mosaic leatherjacket, Wilsons weedfish, maori wrasse and one spot puller. It is also the most southerly location to see the eastern shovelnose ray and the snakeskin wrasse. Giant cuttlefish (one of the largest cuttlefish species in the world, reaching up to 80 cm in length) are commonly seen at the Kent Group. Seagrass beds are found at depths of greater than 20 m in Murray Pass due to the very clear waters in the area. In deeper waters, sponge gardens are very common, covering 40% of habitat in water depths greater than 40 m. Unusual stony corals (*Plesiastrea versipora*) are found in deeper waters and in areas shaded by cliffs where light levels are too low for algae to grow. Kent Group National Park is an important Australian fur-seal breeding site and is the largest of only five sites in Tasmanian waters. It is secure from high seas when pups are young and vulnerable. The islands are also important sanctuaries for the common diving petrels and fairy prions and are home to significant colonies of short-tailed shearwaters, little penguins, sooty oystercatchers, cormorants and terns (PWST, 2017).
Onshore Protected Areas (where the EMBA intersects shorelines)		
Councillor Island Nature Reserve	140 km west of Yolla-A.	Councillor Island Nature Reserve is a 10.5 ha granite reserve east of King Island. There is no management plan for this reserve.
Lavinia State Reserve	144 km west of Yolla-A.	Lavinia State Reserve is located on the north-east coast of King Island. The reserve contains a number of rare birds, including the endangered orange-bellied parrot (DPIPWE, 2013). It includes the Lavinia Ramsar site and two freshwater lakes. Lavinia Beach is a popular location for surfing and fishing.
Sea Elephant Conservation Area	145 km west of Yolla-A.	Sea Elephant Conservation Area covers an area of 7.31 km^2 and is located on the east coast of King Island. The critically endangered orange-bellied parrot uses the Sea Elephant estuary as a stopover on its Bass Strait crossings. There is no management plan for this area.
City of Melbourne Bay Conservation Area	146 km southwest of Yolla-A.	The City of Melbourne Bay Conservation Area is located on the east coast of King Island and covers an area of 2.11 km^2. The area is designated as IUCN Category V, which is a protected landscape/seascape. There is no management plan for this area.

Name	Location	Description
Albatross Island Nature Reserve	115 km southwest of Yolla-A.	Albatross Island Nature Reserve is a land mass of approximately 18 ha located 12 kilometres west of Hunter Island. Albatross Island is reserved as the second largest shy albatross breeding colony, and the only one in Bass Strait, with an estimated 5,000 pairs.
Petrel Islands Game Reserve	116 km southwest of Yolla-A.	The Petrel Islands Game Reserve covers an area of 0.41 km^2 and is located between Hunter, Three Hummock and Robbins Island off the northwest Tasmanian coast. The Game Reserve is designated IUCN Category VI, which is a protected area with sustainable use of natural resources. Seabird and shorebird species including little penguins, short-tailed shearwaters, common diving-petrels, white-faced storm-petrels and pacific gulls are known to breed in the Reserve. There is no management plan for this reserve.
Nares Rocks Conservation Area	127 km southwest of Yolla-A.	Nares Rocks Conservation Area covers an area of 0.03 km^2 and is located off the west coast of Hunter Island. It is designated as IUCN Category V, which is a protected landscape/seascape. There is no management plan for this area.
Three Hummock Island State Reserve	100 km southwest of Yolla-A.	The Three Hummock Island State reserve covers the entirety of the 70 km^2 granite island, located off the northwest coast of Tasmania. The island forms part of the Hunter Island Group Important Bird Area (IBA), where seabirds and shorebirds including the pied and sooty oystercatcher, hooded plover and short-tailed shearwater are known to breed (BirdLife International, 2020). There is no management plan for this reserve.
Hunter Island Conservation Area	107 km southwest of Yolla-A.	The Hunter Island Conservation Area covers an area of 73 km^2 and is designated as IUCN Category V, which is a protected landscape/seascape. The Conservation Area forms part of the Hunter Island Group IBA because it lies on the migration route of the orange-bellied parrot (BirdLife International, 2020). There is no management plan for this area.
Harbour Islets Conservation Area	128 km southwest of Yolla-A.	The Harbour Islets are a group of two adjacent small rocky island, joined at low tide, part of Tasmania's Trefoil Island Group. The Harbour Islets Conservation Area is 0.13 km^2 and forms part of the Hunter Island Group Important Bird Area which has been detailed above. There is no management plan for the Harbour Islets Conservation Area.
Henderson Islets Conservation Area	127 km southwest of Yolla-A.	The Henderson Islets are a group of two adjacent small rocky islands, with a combined area of 0.41 km^2, lying close to Cape Grim, Tasmania's most north-westerly point in Bass Strait. The Conservation Area forms part of the Hunter Island Group IBA. There is no management plan for this area.
Seacrow Islet Conservation Area	126 km southwest of Yolla-A.	The Seacrow Islet Conservation Area covers an area of 0.05 km^2 and is located in Tasmania's Trefoil Island Group. Seabird and shorebird species include the little penguin, short-tailed shearwater, fairy prion, pacific gull and sooty oystercatcher breed on Seacrow Islet. The Conservation Area is designated as IUCN Category VI, which is a protected area with sustainable use of natural resources. There is no management plan for this area.
Bird Island Game Reserve	126 km southwest of Yolla-A.	The Bird Island Game Reserve is 0.59 km^2 and forms part of the Hunter Island Group IBA. The Conservation Area is designated as IUCN Category VI, which is a protected area with sustainable use of natural resources. There is no management plan for this reserve.
Stack Island Game Reserve	124 km southwest of Yolla-A.	Stack Island Game Reserve covers an area of 0.38 km^2 and is part of the Hunter Island Group IBA. The reserve is known to be used as a breeding location by seabirds and shorebirds. The reserve is designated as IUCN Category VI, which is a protected area with sustainable use of natural resources. There is no management plan for this reserve.
The Doughboys Nature Reserve	133 km southwest of Yolla-A.	The Doughboys Nature Reserve covers an area of 0.2 km^2 and is located near Cape Grim on the north western coast of Tasmania. The reserve forms part of the Trefoil Island Group and the Nature Reserve is designated as IUCN Category 1a, which is a strict nature reserve. There is no management plan for this reserve.
Calm Bay State Reserve	144 km southwest of Yolla-A.	The Calm Bay State Reserve covers an area of 3.21 km^2 and is located on the northwest coast of Tasmania. The reserve is designated as IUCN Category II. There is no management plan for this reserve.

Name	Location	Description
Slaves Bay Conservation Area	155 km southwest of Yolla-A.	Slaves Bay Conservation Area covers an area of 0.42 km^2 and is located on the northwest coast of Tasmania. This area is designated as IUCN Category VI, which is a protected area with sustainable use of natural resources. There is no management plan for this area.
West Point State Reserve	161 km southwest of Yolla-A.	West Point Conservation Area covers an area of 5.57 km^2 and is located on the west coast of northwest Tasmania. The reserve is designated IUCN Category III, which is a natural monument or feature. This region of the Tasmanian coast is characterised by moderate energy wave action and rocky shores with intermittent sandy beaches.
Arthur-Pieman Conservation Area	191 km southwest of Yolla-A.	The Arthur-Pieman Conservation Area stretches along the north-west coast of Tasmania and covers an area of 1,030 km^2. Much of the reserve is located between the Arthur River in the north, the Pieman River in the south and the Frankland and Donaldson Rivers to the east. The Conservation Area is renowned as homeland of the North West Aboriginal People where vast middens, hut depressions and rock art are evidence of the landscape's cultural heritage. The Conservation Area contains a large portion of Tasmania's extensive peatlands and some of the largest dune fields in the State. Several vegetation communities in the reserve have been identified to be of conservation significance (PWS, 2002).
Four Mile Beach Regional Reserve	221 km southwest of Yolla-A.	The Four Mile Beach Regional Reserve covers an area of 32.8 km^2 and is located on the west Tasmanian coast south of the Pieman River. The coast of the reserve is sandy beach with some isolated areas of rocky cliff face. The reserve is designated IUCN Category VI, which is a protected area with sustainable use of natural resources. There is no management plan in place for this reserve.
Mount Heemskirk Regional Reserve	236 km southwest of Yolla-A.	Mount Heemskirk Regional Reserve is located on the west coast of Tasmania with an elevation of 475 m and covers an area of 167.4 km^2. The reserve's coast is dominated by rocky shore and cliff faces. The reserve is designated IUCN Category VI, which is a protected area with sustainable use of natural resources. There is no management plan in place for this reserve.
Ocean Beach Conservation Area	264 km southwest of Yolla-A.	Ocean Beach Conservation Area covers an area of 62 km^2 and is located on the west coast of Tasmania adjacent the town of Strahan and Macquarie Heads. The coast is predominantly a long stretch of sandy beach. This Conservation Area is designated IUCN Category V and there is no management plan in place.
Bull Rock Conservation Area	111 km southwest of Yolla-A.	Bull Rock Conservation Area covers a tiny area of 0.01 km^2 and is located off the north coast of Stanley, Tasmania. The area is used by Australian fur-seals as a haul-out site and is designated IUCN Category V. There is no management plan for this area.
The Nut State Reserve	112 km southwest of Yolla-A.	The Nut State Reserve (59.28 ha) encompasses much of the distinctive headland known as Circular Head on the north-west coast of Tasmania, about 80 km west of Burnie. The Nut rises to 143 m and is almost completely ringed by sheer cliffs falling to the sea. It is the focal point for the regional tourism industry of the region. The reserve protects the nationally endangered straw daisy (*Leucochrysum albicans*) and provides an important breeding site for short-tailed shearwaters, peregrine falcons, Australian kestrels and little penguins. The Nut State Reserve is designated IUCN Category III.
Tatlows Beach Conservation Area	115 km south of Yolla-A.	Tatlows Beach Conservation Area covers an area of 0.66 km^2 and is located 1.5 km south of Stanley township. It covers the popular tourist beach and coastal heath and is designated IUCN Category VI. There is no management plan for this area.
Rocky Cape National Park	116 km southwest of Yolla-A.	Rocky Cape National Park (31 km^2) is located on the northwest coast of Tasmania on a geographical headland and surrounds the town of Sisters Beach. The vegetation at the park is windswept and salt-hardy, including coastal heathlands that bloom in spring and summer and several orchid species. There are sites of cultural significance within the park including vast cave middens, artefacts and rock shelters. The park is designated IUCN Category II. There is no management plan for this park.

Name	Location	Description
Boxen Island Conservation Area	188 km southeast of Yolla-A.	Boxen Island is a flat dolerite island with an area of 7 ha in eastern Bass Strait's Furneaux Group. The reserve is considered part of an IBA Area because it supports hundreds of breeding pairs of black-faced cormorants. The area is designated IUCN Category V. There is no management plan in place.
Goose Island Conservation Area	178 km southeast of Yolla-A.	Goose Island, part of the Badger Group within the Furneaux Group, is a 109-ha unpopulated granite island. The Conservation Area hosts breeding pairs of seabird and shorebird species including short-tiled shearwaters, pacific gulls and sooty oystercatchers. Goose Island Conservation Area is designated IUCN Category VI and does not have a management plan in place.
Badger Island Indigenous Protection Area	182 km southeast of Yolla-A.	The Badger Island Indigenous Protected Area covers an area of 12.43 km^2 and is located on an unpopulated low-lying granite and limestone island in eastern Bass Strait. The island and its surrounds previously supported a community of Tasmanian Aboriginal people but is no longer inhabited. The area is designated IUCN Category V and does not have a management plan in place.
Mount Chappell Island Indigenous Protected Area	187 km southeast of Yolla-A.	Mount Chappell Island Indigenous Protected Area is found in Bass Strait and forms parts of the Furneaux Group of islands. The island has long been regarded by Aboriginal people as an important part of the seasonal food-gathering cycle, and the Tasmanian Government handed it back to the Aboriginal community in 1995. The small island is now managed as an Indigenous Protected Area by the Tasmanian Aboriginal Centre. There is no management plan in place.
Fotheringate Bay Conservation Area	195 km southeast of Yolla-A.	Fotheringate Bay Conservation Area covers 1.24 km^2 and is located on the west coast of Flinders Island in Bass Strait. The Conservation Area is adjacent to the Strzelecki National Park and contains a popular beach and camping ground among locals. There is no management plan for the Fotheringate Bay Conservation Area.
Big Green Island Nature Reserve	189 km southeast of Yolla-A.	Big Green Island is located 3 km off the west coast of Flinders Island and is part of the Furneaux Group. The reserve covers the entire 122 ha granite island and is a recorded breeding site for seabird and wader species. There is no management plan for the reserve.
East Kangaroo Island Nature Reserve	182 km southeast of Yolla-A.	East Kangaroo Island is located 8.5 km off the west coast of Flinders Island and is part of the Furneaux Group. The reserve covers the entire 157 ha limestone island and is a recorded breeding site for seabird and wader species. The reserve is part of the Chalky, Big Green and Badger Island Groups IBA. There is no management plan for this reserve.
Chalky Island Conservation Area	180 km east of Yolla-A.	Chalky Island is located 5 km off the west coast of Flinders Island and is part of the Furneaux Group. The area covers the entire 41 ha unpopulated granite island and is a recorded breeding site for seabird and wader species. The conservation area is part of the Chalky, Big Green and Badger Island Groups IBA. There is no management plan for this reserve.
Isabella Island Nature Reserve	185 km southeast of Yolla-A.	Isabella Island is located 3.5 km off the west coast of Flinders Island and is part of the larger Furneaux Group. The nature reserve covers the entire 11.5 ha unpopulated granite island and is a recorded breeding site for seabird and wader species. The Nature Reserve is part of the Chalky, Big Green and Badger Island Groups IBA. There is no management plan for this reserve.
Prime Seal Island Conservation Area	167 km southeast of Yolla-A.	Prime Seal Island is located 6.5 km off the west coast of Flinders Island and is part of the Furneaux Group. The conservation area covers the entire 1,220 ha limestone and granite island and is a recorded breeding site for seabird and wader species. There is no management plan in place for this area.
Settlement Point Conservation Area	177 km southeast of Yolla-A.	Settlement Point Conservation Area covers an area of 0.63 km^2 and is located on the west coast of Flinders Island. The coastline of this area is primarily rocky shore, cliff face and intermittent stretches of beach. There is no management plan for this area.

Name	Location	Description
Emita Nature Recreation Area	178 km east of Yolla-A.	The Emita Nature Recreation Reserve covers an area of 1.34 km^2 is located on the west coast of Flinders Island adjacent the township of Emita. The coastline of the reserve is predominantly sandy beach with intermittent rocky shore. There is no management plan for this area.
Marshall Beach Conservation Area	176 km east of Yolla-A.	Marshall Beach Conservation Area covers 1.9 km^2 of the coast on the western coast of Flinders Island. The conservation area primarily encompasses a long stretch of sandy beach and extends only 100-200 m inland. There is no management plan for this conservation area.
Marriott Reef Conservation Area	175 km east of Yolla-A.	The Marriott Reef Conservation Area covers an area of 0.16 km^2 of the marine environment and begins 500 m off the west coast of Flinders Island. The Area is designated IUCN Category V and there is no management plan in place.
Mount Tanner Nature Recreation Area	166 km east of Yolla-A.	Mount Tanner Nature Recreation Area covers an area of 42.25 km^2 and is located on the northwest coast of Flinders Island. The area protects inland remnant vegetation and its coastal areas are a combination of sandy beach and rocky shores. Mount Tanner Nature Recreation Area is designated IUCN Category VI and does not have a management plan.
Bun Beetons Point Conservation Area	168 km southeast of Yolla-A.	Bun Beetons Point Conservation Area covers an area of 1.01 km^2 and is located on the northwest coast of Flinders Island. It protects a coastline of rocky shores and sandy beaches and stretches 100-150 m inland. There is no management plan in place.
Pasco Group Conservation Area	168 km southeast of Yolla-A.	Pasco Group Conservation Area covers an area of 1.11 km^2 and spans four islands, the closest of which to shore is located 1.5 km off the northwest coast of Flinders Island. The area is a known site for seabird breeding. There is no management plan in place.
Roydon Island Conservation Area	168 km southeast of Yolla-A.	Roydon Island Conservation Area covers an area of 37 ha and is located 750 m off the northwest coast of Flinders Island. It is a known site for seabird breeding. There is no management plan in place.
Low Point Conservation Area	171 km east of Yolla-A.	Low Point Conservation Area covers an area of 2.8 km^2 and is located on the north coast of Flinders Island. The coastline of this area is a mix of rocky shores and stretches of sandy beach. Low Point Conservation Area is designated IUCN Category VI and there is no management plan in place.
Sentinel Island Conservation Area	167 km east of Yolla-A.	Sentinel Island is located 1.2 km off the north coast of Flinders Island. The Conservation Area covers an area of 0.15 km^2 and is a known site for seabird breeding. There is no management plan in place.
Killiecrankie Nature Recreation Area	174 km east of Yolla-A.	Killiecrankie Nature Recreation Area covers an area of 8.5 km^2 and is located on the north coast of Flinders Island. The coastline of this area is a mix of rocky shores and stretches of sandy beach. Killiecrankie Nature Recreation Area is designated IUCN Category VI and there is no management plan in place.
Blyth Point Conservation Area	176 km east of Yolla-A.	Blyth Point Conservation Area covers an area of 1.1 km^2 and is located on the north coast of Flinders Island. The coastline of this area is a mix of rocky shores and stretches of sandy beach and stretches 100-150 m inland. Blyth Point Conservation Area is designated IUCN Category V and there is no management plan in place.
Palana Beach Nature Recreation Area	178 km east of Yolla-A.	Palana Beach Nature Recreation Area covers an area of 0.6 km^2 and is located on the north coast of Flinders Island. The coastline of this Nature Recreation Area is predominantly sandy beach. Palana Beach Nature Recreation Area is designated IUCN Category V and there is no management plan in place.
Jacksons Cove Conservation Area	180 km east of Yolla-A.	Jacksons Cove Conservation Area covers an area of 2.4 km^2 and is located on the north coast of Flinders Island. The coastline of this conservation area is a mix of rocky shores and stretches of sandy beach. Jacksons Cove Conservation Area is designated IUCN Category VI and there is no management plan in place.

Name	Location	Description
Sister Islands Conservation Area	182 km northeast of Yolla-A.	The Sister Islands Conservation Area covers an area of 13.8 km^2 over two main granite and dolerite islands located 2 and 7 km off the north coast of Flinders Island. The conservation area is a recorded breeding site for seabird and wader species and is designated IUCN Category VI with no management plan in place.
Curtis Island Nature Reserve	Located 82 km northeast of Yolla-A. It is surrounded by the Beagle AMP.	Curtis Island Nature Reserve supports up to 390,000 breeding pairs of short-tailed shearwaters (*Puffinus tenuirostris*). Tasmanian Aborigines have harvested shearwaters (or muttonbirds as they are also referred to) and their eggs for many generations and a number of families continue this important cultural practice. The shearwater is one of the few Australian native birds that is commercially harvested. During the shearwater season, chicks are taken for their feathers, flesh and oil. The industry was established by early European sealers and their Aboriginal families. The recreational harvesting of short-tailed shearwaters is limited to the period of the open season that is declared each year where a licence must be obtained. The shearwater is the most abundant Australian seabird. Approximately 23 million short-tailed shearwaters breed in about 285 colonies in south-eastern Australia from September to April. About 18 million of these arrive in Tasmania each year after a six-week flight from the Arctic region. There are known to be at least 167 colonies in Tasmania and an estimated 11.4 million burrows. The largest colony is on Babel Island off the east coast of Flinders Island (outside the EMBA), which has three million burrows. Their colonies are usually found on headlands (that allow for an easy take-off and landing) and islands covered with tussocks and succulent vegetation such as pigface and iceplant (PWST, 2017).
Devils Tower Nature Reserve	94 km northeast of Yolla-A.	Devils Tower are two small granite islands that are part of the Curtis Group and are located in the Bass Strait between Wilsons Promontory and Tasmania. It is designated IUCN 1a, which is a strict nature reserve, which allows minimal human use and is noted as being important for breeding seabirds and waders. There is no management plan for this reserve.
Craggy Island Conservation Area	160 km east of Yolla-A.	Craggy Island Conservation Area is located 15 km off the northwest coast of Flinders Island and covers an area of 0.36 km^2 of the rugged granite island. The conservation area hosts breeding pairs of seabird and shorebird species including short-tiled shearwaters, little penguins, fairy prions and sooty oystercatchers. Craggy Island Conservation Area is designated IUCN Category V and does not have a management plan.
East Moncoeur Island Conservation Area	91 km northeast of Yolla-A.	East Moncoeur Island is part of Tasmania's Rodondo Group. It is designated as IUCN Category V which is a protected landscape/seascape. There is no management plan for the East Moncoeur Island Conservation Area.
West Moncoeur Island Nature Reserve	91 km northeast of Yolla-A.	West Moncoeur Island Nature Reserve is an area of 0.14 km^2 that is situated 2.5 km east of East Moncoeur Island. West Moncoeur is part of the Rodondo Group. It supports large breeding colonies of Australia fur-seals (Carlyon *et al.*, 2015).
Hogan Group Conservation Area	122 km northeast of Yolla-A.	The Hogan Group is located in Bass Strait south of Wilsons Promontory. The Hogan archipelago is an important seabird location and supports major breeding colonies of many species (Carlyon *et al.*, 2015). It is designated as IUCN Category IV which is habitat/species management area. There is no management plan for the Hogan Group Conservation Area.
Cone Islet Conservation Area	83 km northeast of Yolla-A.	Cone Islet Conservation Area covers an area of 0.06 km^2 and is part of the Curtis Island group. Cone Islet lies in the northern Bass Strait between Furneaux Group and Wilsons Promontory in Victoria. There is no management plan for the area.
North East Islet Nature Reserve	124 km northeast of Yolla-A.	North East Islet (or Boundary Islet) Nature Reserve covers an area of 0.01 km^2 and is part of the Hogan Island Group. It is a haul-out site for the Australia fur-seal (Carlyon *et al.*, 2011). It is designated IUCN 1a, which is a strict nature reserve. There is no management plan for the reserve.

Name	Location	Description
Rodondo Island Nature Reserve	83 km northeast of Yolla-A.	Rodondo Island is located in Bass Strait, approximately 10 km south of Wilsons Promontory. Both Australian and New Zealand fur-seal have haul-out sites on Rodondo Island (Carlyon et al, 2015). It hosts a number of breeding seabirds, with the short-tailed shearwater being the most common (Carlyon et al, 2015).
Sugarloaf Rock Conservation Area	80 km northeast of Yolla-A.	Sugarloaf Rock is a small granite island that covers an area of 1.07 ha. It is part of Tasmania's Curtis Group, lying in northern Bass Strait between the Furneaux Group and Wilson's Promontory. This island is a known breeding site for the fairy prion and common diving-petrel along with known haul-out site for the Australian fur-seals. There is no management plan for Sugarloaf Rock Conservation Area.

Table 5.8. New South Wales coastal protected areas in the spill EMBA

Name	Location	Description
Nadgee Nature Reserve	448 km northeast of Yolla-A	The park's key natural values are listed by NPWS (2003) as: • The only coastal wilderness area in NSW; • A variety of coastal landforms, including dissected low tablelands, coastal plain, estuaries and lagoons, cliffs and sea caves; • Coastline has national significance for its diversity of geology and geomorphological features; • The catchments of all creeks and rivers are contained wholly in the reserve (except for a small area); • Features a complex variety of plant communities, including rainforest, tall open forest, woodland, coastal scrub and estuarine wetlands; • Contains several NSW-listed threatened plant species listed; • Contains 48 species of native mammal, 216 bird species, 28 reptile species and 16 amphibians; • Intertidal rock platforms have a rich, well-developed littoral fauna and Nadgee Point/Black Head has the most diverse biota of any headland in NSW south of Narooma; and • Contains some extensive Aboriginal shell middens in sand dunes. Seabirds reported as using the rock platforms and beaches include short-tailed shearwater, crested and little terns, hooded plover, pied oystercatcher and gannet.
Ben Boyd National Park	468 km northeast of Yolla-A.	The park's key natural values are listed by NPWS (2010): • Contains some of the oldest rocks on the NSW coast. The barrier sand in Merimbula Bay in the northern section of the park are regionally significant as one of only four major stationary barriers in southern NSW; • A diverse array of coastal habitats including forest, woodland, heathland, sandy and rocky coastline and estuaries. A concentration of significant species occurs at Saltwater Creek. Saltmarsh and mangrove woodland are present in the estuaries; • Contains 30 threatened fauna species. Nearly 150 bird species have been recorded, with 48 of these being waterbirds; and • Contains more than 50 Aboriginal sites, mostly shell middens. Seabirds reported as using the coastline of the park include fleshy-footed shearwater, pied and sooty oystercatchers and hooded plover.

5.5 Biological Environment

The key source of information for the species that may be present in the operational area and spill EMBA include the EPBC Act PMST and the VBA.

5.5.1 Benthic Assemblages

Bass Strait

Marine invertebrates in Bass Strait include porifera (e.g., sponges), cnidarians (e.g., jellyfish, corals, anemones, seapens), bryozoans, arthropods (e.g., sea spiders), crustaceans (e.g., rock lobster, brine and fairy shrimps), molluscs (e.g., scallops, sea slugs), echinoderms (e.g., 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, and the distribution of species was irregular with little evidence of any distinct biogeographic regions. The results of invertebrate sampling undertaken in shallower inshore sediments indicate a high diversity and patchy distribution. In these areas crustaceans, polychaetes, and molluscs were dominant (Parry et al., 1990). Surveys of the seabed near the Yolla-A platform prior to drilling and construction showed sparsely scattered clumps of solitary sponges, sea cucumbers, sea squirts and predatory snails (whelk) (Thales GeoSolutions, 2001).

Whilst there is little information available on the nature or distribution of epibiota in central Bass Strait, data is available for eastern Bass Strait from the Museum of Victoria biological sampling programs conducted from 1979 to 1984 (Wilson and Poore 1987), from scientific dredging conducted in 1989 (Parry *et al*., 1990), and from targeted investigations for pipeline and power link proposals in the area. This information can be used to extrapolate existing conditions for central Bass Strait.

Generally, the epibiota of the region is sparse and characterised by scallops and other large bivalve molluscs, crabs, seasquirts, seapens, sponges and bryozoans. A variety of mobile crabs, prawns and brittle stars are also relatively common. Many of the mobile epibiota appear to occur in aggregations from time to time (scallops, prawns and crabs) while some of the fixed epibiota occur in patches (sponges and bryozoans). For example, trawling conducted for the Museum of Victoria biological sampling programs recorded large hauls of sponges along some trawl transects. The main hauls of sponges were located in an arc around southern Bass Strait (Butler *et al*., 2002).

According to DPIPWE (2020), very little is known of Tasmania's offshore marine ecosystems as there have only been limited surveys of benthic biota. However, it is known that unvegetated soft sediments (sand, mud and unconsolidated substrates) are the dominant feature of subtidal marine environment in Tasmania, comprising around 75% of the seabed in nearshore areas (Parsons, 2011). The apparently barren appearance of these areas is deceptive and hides a diversity of life, as well as important nursery habitats and rare species limited to Tasmanian waters. There are few places to hide, so many species living on sand and mud have developed special mechanisms for protection, such as camouflage or being adept at quickly burrowing into the sediment, such as the spotted flounder (*Ammoteris lituratus*) and girdled goby (*Nesogobius maccullochi*) (Parsons, 2011). These sediments generally have a lower productivity than seagrass and macroalgal beds (such as those found in abundance off the west coast of Flinders Island) due to the absence of large photosynthesising plants, however they are often rich in small invertebrates that live on microscopic algae, bacteria and food particles in the passing water. These in turn provide food for larger surface dwelling and burrowing invertebrates, which in Tasmanian waters are dominated by crustaceans, polychaete worms, gastropods and bivalve molluscs (Parsons, 2011).

Spill EMBA

The PMST results do not identify any benthic species. The VBA supports the findings of these previous works. Thirty species of marine gastropods have been recorded. The black-lip abalone (*Haliotis rubra*), the common periwinkle (*Austrocochlea constricta*) and the common warrener (*lunella undulata*) and are the most common gastropod recordings. 11 species of crustaceans have been recorded with the cleft-fronted shore crab (*Guinusia* *chabrus*) and the red rock lobster (*Jasus edwardsii*) being the most numerous. In addition, two species of feather star (*Cenolia tasmaniae* and *Cenolia trichoptera*), 12 species of seastar, eight species of sea urchin, seven species of sea slug and one species of scallop (*Mimachlamys asperrima*) are recorded in the database (DEWLP, 2020). The full listing of benthic fauna species is available in **Appendix 6.**

The Bunurong MNP, located 25 km southwest of the BassGas pipeline near Kilcunda in Victorian state waters, has extensive intertidal rock platforms that exhibit a diverse range of marine life. The subtidal rocky reefs include numerous microhabitats extending several kilometres offshore in relatively shallow water (Parks Victoria, 2006a).

The diversity of intertidal and shallow subtidal invertebrate fauna is the highest recorded in Victoria on sandstone. A high proportion of the common invertebrates occurring along the Victorian coast are found in the Bunurong MNP (Parks Victoria, 2006a), which is also described in Table 5.6. For example:

- Seven of the eight species of brittle stars;
- Nine of 11 sea cucumbers;
- Eight of 11 barnacles;
- All five sea anemones; and
- 15 of 20 chitons (flat eight-plated grazing molluscs).

The underwater reefs in the Bunurong MNP look different to those in other parts of Victoria. For example, crayweed, a large brown seaweed that covers many Victorian reefs, is mostly absent here. Instead a multitude of more unusual plants and animals flourish. The species richness of the Bunurong seaweeds is comparatively high and includes green, blue-green, brown and encrusting coralline red algal species (Parks Victoria, 2006a).

The subtidal marine flora of the area is characterised by a mixed group of brown, red and green algae. The seagrass *Amphibolis antarctica* is also an important component. Invertebrates found in the subtidal zone include limpets, barnacles, blacklip abalone, crabs, seastars, urchins, feather stars and brittle stars, sea snails and small crustaceans (Parks Victoria, 2006a).

The Point Hicks MNP, located 371 km northeast of Yolla-A, features a diverse assemblage of sessile invertebrates that inhabit its subtidal reef areas including sponges, bryozoans, corals, gorgonians and octocorals (Parks Victoria, 2006c). Within the holdfasts of the marine flora present in and around the park, a rich assemblage of bryozoans, hydroids, sponges and ascidians have been recorded. Large invertebrates including sea stars, ophiuroids, crinoids, gastropods, fan worms and nudibranchs are also present.

5.5.2 Plankton

Plankton is a key component in oceanic food chains and comprises two elements; phytoplankton and zooplankton, as described herein.

Phytoplankton (photosynthetic microalgae) comprise 13 divisions of mainly microscopic algae, including diatoms, dinoflagellates, gold-brown flagellates, green flagellates and cyanobacteria and prochlorophytes (McLeay *et al.*, 2003).

Phytoplankton drift with the currents, although some species have the ability to migrate short distances through the water column using ciliary hairs. Phytoplankton biomass is greatest at the extremities of Bass Strait (particularly in the northeast) where water is shallow and nutrient levels are high.

Zooplankton is the faunal component of plankton, comprising small crustaceans (such as krill), fish eggs and fish larvae. Zooplankton includes species that drift with the currents and also those that are motile. More than 170 species of zooplankton have been recorded in eastern and central Bass Strait, with copepods making up approximately half of the species encountered (Watson & Chaloupka, 1982). The high diversity may be due to considerable intermingling of distinctive water bodies and may be higher in eastern than in western Bass Strait. Although a high diversity of zooplankton has been recorded, Kimmerer and McKinnon (1984) found that seven dominant species make up 80% of individuals.

As part of a marine seismic survey undertaken in early 2018, the CarbonNet Project commissioned plankton sampling across nine sites in shallow waters off Golden Beach, Gippsland (227 km to the northeast of Yolla-A). The results of this work (CarbonNet, 2018) found that:

- The composition of zooplankton was a typical healthy example of those expected for temperate coastal waters; and
- Copepods were the dominant group, with varying proportions of appendicularians, cladocerans and doliolids. Numerous other groups occurred in small numbers, including siphonophores, fish larvae, fish eggs, polychaetes, ghost shrimps and cnidarians (jellies).

Although this work was undertaken to the northeast of the BassGas development, it is likely that a similar plankton assemblage would occur in the spill EMBA given the well-mixed nature of Bass Strait waters.

5.5.3 **Marine Flora**

Literature searches indicate there is a paucity of public information regarding the distribution and abundance of marine flora in Bass Strait, particularly in relation to the deeper water of the operational area and spill EMBA.

The VBA records 167 algae species made up of a mix of brown, red and green algae. The most frequently recorded species is the brown algae *Phyllospora comosa*. The subtidal and intertidal rocky reefs of Bass Strait, located closer to the shoreline of Victoria and Tasmania, are understood to have a high diversity of plant species including seagrasses and macroalgae. In sheltered parts of bays, inlets and estuaries, (such as those found in Western Port Bay or on the west coast of Flinders Island) seagrasses establish extensive underwater meadows that are critical in the early life stages of many fish species. Seagrasses trap soil and other material washed from the land by binding them together and stopping it from clouding the water column, which would otherwise prevent sunlight reaching plants on the seabed (DELWP, 2017).

Variation exists among rocky reefs depending on the level of exposure to waves, the rock type, its weathering and the presence of rock pools, crevices and boulders which all in turn determine the composition of marine fauna. In the nearshore environment, seaweed forests are made up of a large brown kelp. In these environments the marine plants attach themselves to solid structures and extend their blades into the waters reaching toward the sunlight. Together the plants form a dense canopy of blades blocking out light and shading the surface of the solid substrate allowing for smaller species of algae to form. The kelp species typically populating these forests include giant kelp (*Macrocystis pyrifera*) (described in Section 5.4.4) and bull kelp (*Durvillea potatorum*). At Point Hicks MNP, which is located within the EMBA, kelp and seagrasses are a prominent part of the subtidal reefs. Common kelp (*Ecklonia radiata*) and crayweed (*Phyllospora comosa*) are found along the open coast in dense stands (Parks Victoria, 2006c). Giant species of seaweeds such as string kelp (*Macrocystis pyrifera*) and bull kelp also occur.

Tasmanian marine flora remains poorly known because of a lack of professional algal workers (DPIPWE, 2020). However, the cold temperate species of Tasmania include the largest Australian seaweeds, most notably giant kelp, bull kelp, strap kelp, common kelp and other large brown algae including crayweed. At King Island, bull kelp is commercially harvested where it washes onto beaches in large quantities (Parsons, 2010) (see Section 5.7.6).In the Boags Bioregion on the north coast of Tasmania are the southern most beds of the long-lived seagrass the southern strapweed (*Posidonia australis*), as well as the majority of habitat for another seagrass, sea nymph (*Amphibolis antarctica*) (Parsons, 2011). There are extensive marine flora communities in the strait between Robbins Island and the north coast. This area also contains prolific beds of southern strapweed and is one of only two known Tasmanian sites for a warm temperate seagrass species, the fibrous strapweed (*Posidonia angustifolia*) Whilst updated seabed mapping is required in this area, 1990s data suggest that this small section of Tasmania's coast may contain more than 10% of the state's seagrass beds (Parsons, 2011).

At Flinders Island, mapping in the 1990s revealed exceptional seagrass beds along its western shores that are significant in their magnitude, density and unusually large depth range (Parsons, 2011). Vast beds, extending as far as 10 km offshore from the coast were detected, and are likely to be a major contributor to nutrients in eastern Bass Strait. While the dominant species (southern strapweed), generally occurs to maximum depths of 15 m, beds have been recorded in depths of up to 20 m along the west coast of Flinders Island, reflecting the exceptional water clarity in this region. Even at this depth, the limit of surveying, seagrass reaches a high density suggesting that the beds extend into even deeper water45. This area is only one of two locations in Tasmania where the related fibrous strapweed has been observed.

5.5.4 Birds

The EPBC PMST identifies 69 bird species as threatened or migratory whose habitat or migratory path may occur within the EMBA (listed in Table 5.9). These primarily comprise 17 albatross, six petrels, two parrots, three shearwaters, three godwits, six terns, one swift, two curlew, one prion, four snipes, three gulls, seven plovers, two tattlers and seven sandpipers.

Six of these bird species are listed as critically endangered, nine are endangered and 23 are listed as vulnerable.

Many of the bird species listed in Table 5.9 are protected by international agreements (Bonn Convention, JAMBA, CAMBA and ROKAMBA) and periodically pass through Bass Strait to and from the Bass Strait islands, mainland Victoria and Tasmania (DAWE, 2020b). Species listed as threatened are described in this section.

In addition to the EPBC Act-listed species listed in Table 5.9 and described below, an additional 68 bird species may be present in the EMBA based on VBA search results (the full VBA list is available in **Appendix 6**). The species identified exclusively by the VBA search that are threatened under the FFG Act are described here as well.

Table 5.9. EPBC Act-listed bird species that may occur within the operational area and spill EMBA

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
True seabirds (32 species)							
Albatross							
Diomedea antipodensis	Antipodean albatross	V	Yes	Yes	-	FFR	Generic RP in place for all albatross in Australia, + AS for all albatross
Diomedea gibsoni	Gibson's albatross	V	Yes	Yes	-	FFR	
Diomedea epomophora (sensu stricto)	Southern royal albatross	V	Yes	Yes	T	FFR	
Diomedea exulans (sensu lato)	Wandering albatross	V	Yes	Yes	T	FFR	
Diomedea sanfordi	Northern royal albatross	E	Yes	Yes	-	FFR	
Phoebetria fusca	Sooty albatross	V	Yes	Yes	T	-	
Thalassarche bulleri	Buller's albatross	V	Yes	Yes	T	-	

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Thalassarche bulleri platei	Northern Buller's albatross	V	-	-	-	-	
Thalassarche cauta	Shy albatross	V	Yes	Yes	T	FFR	
Thalassarche cauta steadi	White-capped albatross	V	Yes	Yes	-	FFR	
Thalassarche chrysostoma	Grey-headed albatross	E	Yes	Yes	T	-	
Thalassarche eremita	Chatham Albatross	E	Yes	Yes	-	FFR	
Thalassarche impavida	Campbell albatross	V	Yes	Yes	-	FFR	
Thalassarche melanophris	Black-browed albatross	V	Yes	Yes	-	FFR	
Thalassarche salvini	Salvin's albatross	V	Yes	Yes	-	FFR	
Thalassarche steadi	White-capped albatross	V	Yes	Yes	-	FFR	
Thalassarche sp. Nov.	Pacific albatross	V	-	Yes	-	FFR	
Petrels							
Fregetta grallaria grallaria	White-bellied storm-petrel	V	-	-	-	-	-
Halobaena caerulea	Blue petrel	V	-	Yes	-	-	CA
Macronectes giganteus	Southern giant petrel	E	Yes	Yes	T	-	Generic RP and AS for giant petrels
Macronectes halli	Northern giant petrel	V	Yes	Yes	T	-	
Pterodroma leucoptera leucoptera	Gould's petrel	E	-	-	-	-	RP
Pelagodroma marina	White-faced storm-petrel	-	-	Yes	-	-	-
Pelecanoides urinatrix	Common diving petrel	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Pterodroma mollis	Soft-plumaged petrel	V	-	Yes	-	-	CA
Other seabirds							
Ardenna carneipes	Flesh-footed shearwater	-	Yes	Yes	-	FFR	-
Ardenna grisea	Sooty Shearwater	-	Yes	Yes	-	-	-
Ardenna tenuirostris	Short-tailed shearwater	-	Yes	Yes	-	B	-
Catharacta skua	Great skua	-	-	Yes	-	-	-
Haliaeetus leucogaster	White-bellied sea-eagle	-	-	Yes	T	-	-
Pachyptila turtur subantarctica	Fairy prion (southern)	V	-	-	-	-	CA
Pandion haliaetus	Osprey	-	Yes	Yes	-	-	-
True shorebirds (52 species)							
Actitis hypoleucos	Common sandpiper	-	Yes	Yes	-	-	-
Apus pacificus	Fork-tailed swift	-	Yes	Yes	-	-	-
Ardea alba	Great egret	-	-	Yes	-	-	AS
Ardea ibis	Cattle egret	-	-	Yes	-	-	-
Arenaria interpres	Ruddy turnstone	-	Yes	Yes	-	-	-
Botaurus poiciloptilus	Australasian bittern	E	-	-	T	-	CA
Calidris acuminata	Sharp-tailed sandpiper	-	Yes	Yes	-	R	-
Calidris alba	Sanderling	-	Yes	Yes	-	R	-
Calidris canutus	Red knot	E	Yes	Yes	-	-	CA
Calidris ferruginea	Curlew sandpiper	CE	Yes	Yes	T	-	-
Calidris melanotos	Pectoral sandpiper	-	Yes	Yes	-	-	-
Calidris ruficollis	Red-necked stint	-	Yes	Yes	-	-	-
Calidris tenuirostris	Great knot	CE	Yes	Yes	T	R	CA

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Charadrius bicinctus	Double-banded plover	-	-	Yes	-	R	-
Charadrius leschenaultii	Greater sand plover	V	Yes	Yes	-	-	CA
Charadrius mongolus	Lesser sand plover	E	Yes	Yes	-	-	CA
Charadrius ruficapillus	Red-capped plover	-	-	Yes	-	-	-
Eudyptula minor	Little penguin	-	-	Yes	-	B, F	-
Himantopus himantopus	Pied stilt	-	-	Yes	-	-	-
Hydroprogne caspia	Caspian tern	-	Yes	Yes	T	-	-
Gallinago hardwickii	Latham's snipe	-	Yes	Yes	-	-	-
Gallinago megala	Swinhoe's snipe	-	Yes	Yes	-	-	-
Gallinago stenura	Pin-tailed snipe	-	Yes	Yes	-	-	-
Larus dominicanus	Kelp gull	-	-	Yes	-	-	-
Larus novaehollandiae	Silver gull	-	-	Yes	-	-	-
Larus pacificus	Pacific gull	-	-	Yes	-	-	-
Lathamus discolour	Swift parrot	CE	-	Yes	-	-	AS
limicola falcinellus	Broad-billed sandpiper	-	Yes	Yes	-	R	-
Limosa lapponica baueri	Bar-tailed godwit	V	Yes	Yes	-	-	-
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	CE	Yes	Yes	-	-	-
Limosa limosa	Black-tailed godwit	-	Yes	Yes	-	-	-
Neophema chrysogaster	Orange-bellied parrot	CE	-	Yes	T	-	RP, AS
Numenius madagascariensis	Eastern curlew	CE	Yes	Yes	T	-	CA
Numenius minutus	Little curlew	-	Yes	Yes	-	-	-

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Numenius phaeopus	Whimbrel	-	Yes	Yes	-	-	-
Phalacrocorax fuscescens	Black-faced cormorant	-	-	Yes	-	-	-
Philomachus pugnax	Ruff	-	Yes	Yes	-	-	-
Pluvialis fulva	Pacific golden plover	-	Yes	Yes	-	-	-
Pluvialis squatarola	Grey plover	-	Yes	Yes	-	-	-
Rostratula australis	Australian painted snipe	E	-	Yes	T	-	CA
Sterna (Sternula) albifrons	Little tern	-	Yes	Yes	T	-	AS
Sterna fuscata	Sooty tern	-	-	Yes	-	-	-
Sterna (Sternula) nereis nereis	Australian fairy tern	V	-	-	T	-	CA
Sterna striata	White-fronted tern	-	-	Yes	-	-	-
Thalasseus bergii	Crested tern	-	Yes	Yes	-	-	-
Thinornis rubricollis rubricollis	Hooded plover (eastern)	V	-	Yes	T	-	AS
Tringa brevipes	Grey-tailed tattler	-	Yes	Yes	T	R	-
Tringa glareola	Wood sandpiper	-	Yes	Yes	-	-	-
Tringa incana	Wandering tattler	-	Yes	Yes	-	FFR	-
Tringa nebularia	Common greenshank	-	Yes	Yes	-	-	-
Tringa stagnatilis	Marsh sandpiper	-	Yes	Yes	-	-	-
Xenus cinereus	Terek sandpiper	-	Yes	Yes	T	-	-

Definitions	
Listed threatened species:	A native species listed in Section 178 of the EPBC Act as either extinct, extinct in the wild, critically endangered, endangered, and vulnerable or conservation dependent.
Listed migratory species:	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 EPBC Act.
Listed marine species:	As listed in Section 248 of the EPBC Act.

Key		
EPBC Act status (@ February 2020)	V	Vulnerable
	E	Endangered
	CE	Critically endangered
FFG Act status (@ February 2020)	CE	Critically endangered
	R	Restricted
	T	Threatened
BIA (Biologically Important Area)	A	Aggregation
	B	Breeding
	D	Distribution (i.e., presence only)
	F	Foraging
	FFR	Foraging, feeding or related behaviour
	M	Migration
	R	Roosting
Recovery plans	AS	Action Statement
	CA	Conservation Advice
	CMP	Conservation Management Plan
	RP	Recovery Plan

Figure 5.14 illustrates the presence of these bird species throughout the year.

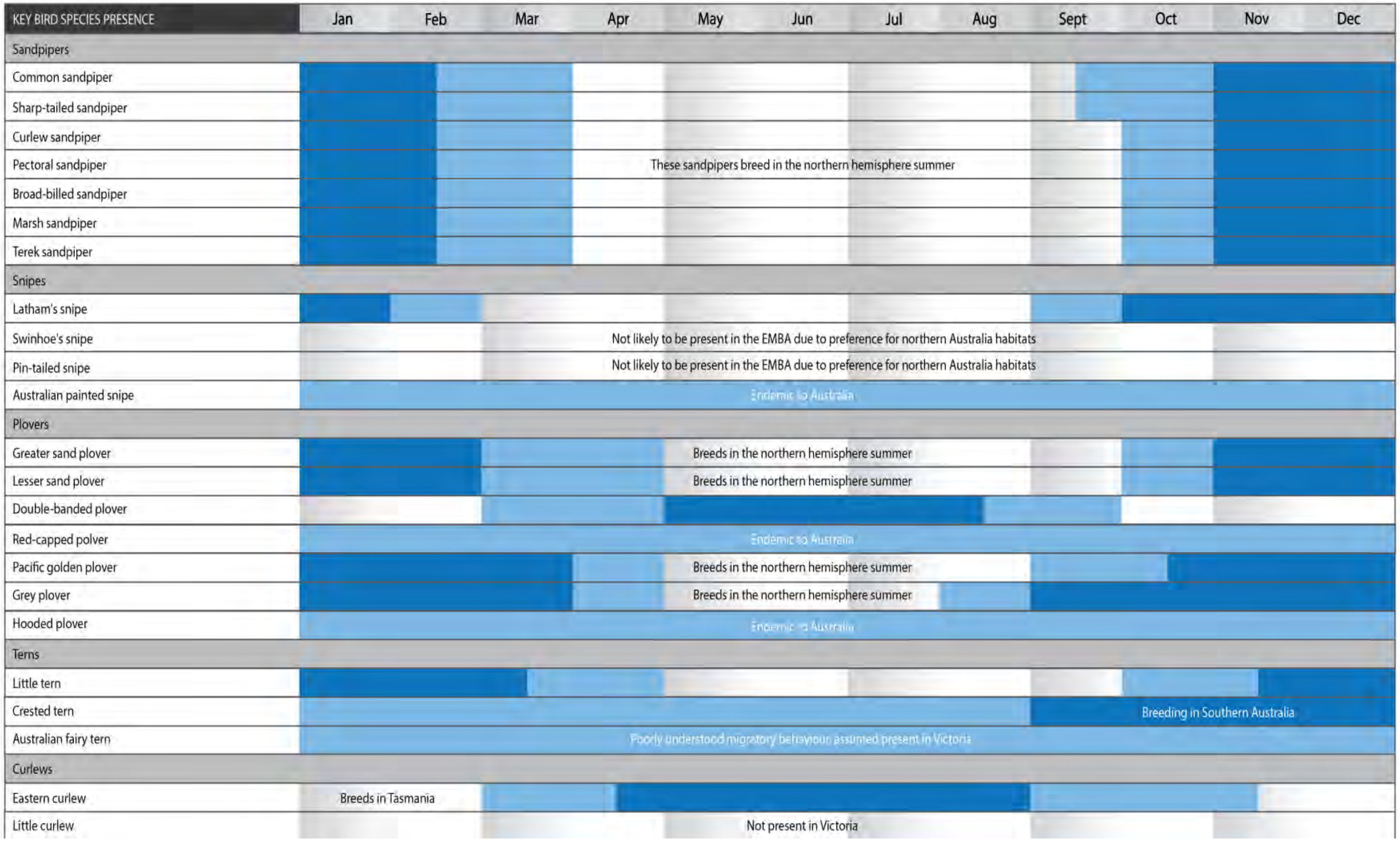


Figure 5.14. The annual presence and absence of seabirds and shorebirds in the spill EMBA.

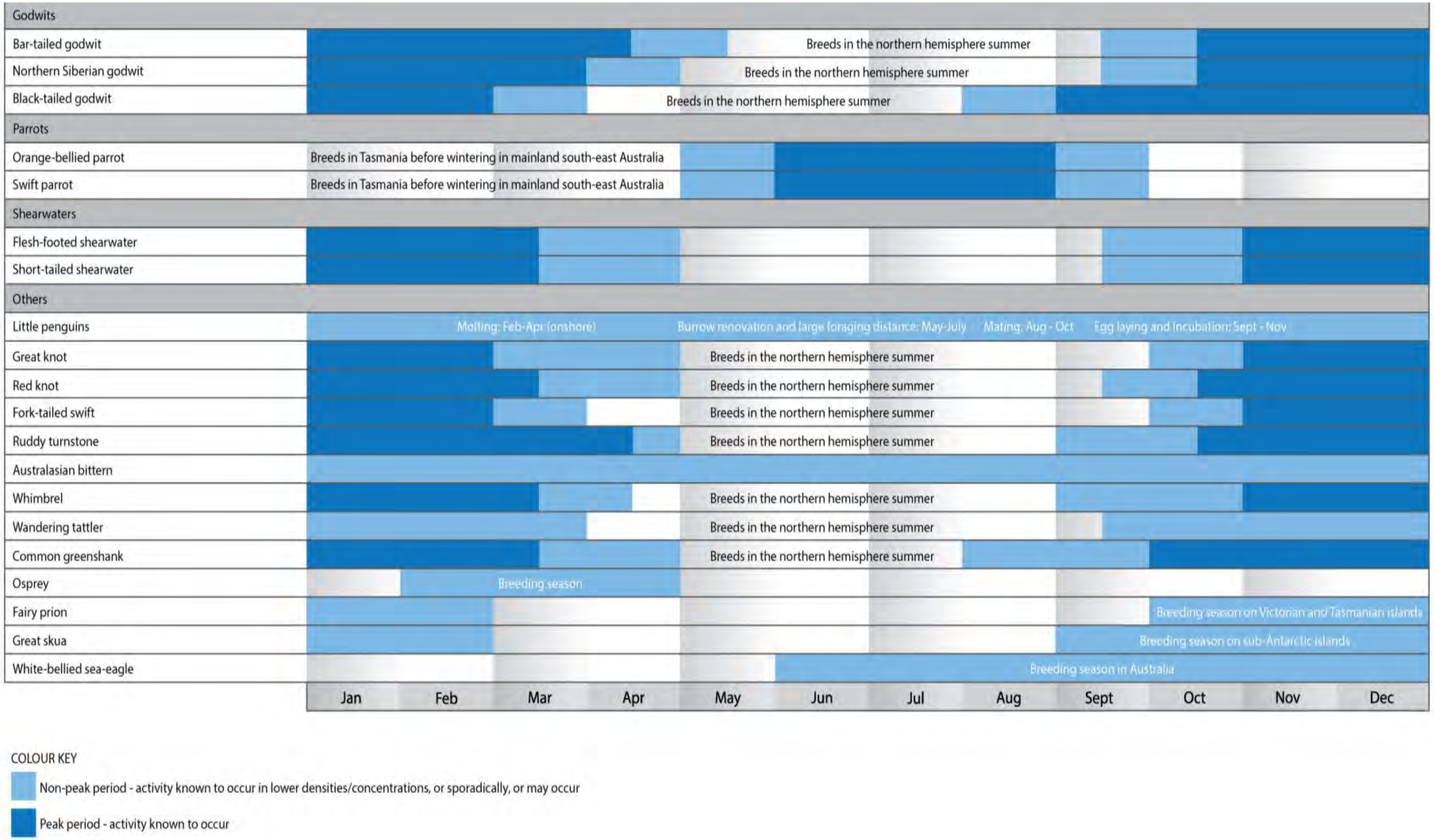


Figure 5.14 (cont'd). The annual presence and absence of seabirds and shorebirds in the spill EMBA.

True seabirds

Albatross and Petrels

The majority of the EPBC Act listed seabird species (with an additional four from the VBA database) are albatrosses and petrels that are considered to be the most dispersive and oceanic of all birds, spending more than 95% of their time foraging the Southern Ocean in search of prey and usually only returning to land to breed (DSEWPC, 2011a).

Albatrosses prefer small, remote islands in the Southern Ocean (DSEWPC, 2011a) for breeding. Albatross Island is the closest breeding habitat to Yolla-A platform (approximately 110 km to the southwest) and is within the EMBA. The petrel species listed in Table 5.9 are widely distributed throughout the southern hemisphere. They nest on isolated islands and breed on sub-Antarctic and Antarctic islands. The northern giant-petrel and southern giant-petrel share the same breeding areas listed for the albatross (DSEWPC, 2011a). Outside the breeding season (October to February), petrels disperse widely and move north into sub-tropical waters (DSEWPC, 2011a). Most petrel species feed on krill, squid, fish, other small seabirds and marine mammals (DSEWPC, 2011a).

Seabirds spend much of their lives at sea in search of prey (marine crustaceans and fish) only to return for a short time to breed and raise chicks. The Victorian and Tasmanian coastlines and the islands in Bass Strait provide feeding and nesting areas for coastal and migratory bird species (DSEWPC, 2011a). Consequently, there are large varieties and numbers of seabirds that utilise Bass Strait.

Other Seabirds

Other seabirds listed in the PMST or VBA that may occur within the operational area and spill EMBA are described here.

- The great skua (*Catharacta skua*) is a large migratory seabird distributed throughout all southern Australian waters (though not listed as migratory under the EPBC Act). This species breeds in summer on nested elevated grasslands or sheltered rocky areas on sub-Antarctic islands, with most adult birds leaving their colonies in winter. Great skuas feed on other seabirds, fish, molluscs and crustaceans, and may be present in the operational area and EMBA (though scarce) during winter (Flegg, 2002).
- The osprey (*Pandion haliaetus*) is a common, medium-sized raptor that is present around the entire Australian coastline, with the breeding range restricted to the north coast of Australia (including many offshore islands) and an isolated breeding population in South Australia (DAWE, 2020b). Breeding occurs from February to April. Ospreys occur mostly in coastal areas but occasionally travel inland along waterways, where they feed on fish, molluscs, crustaceans, reptiles, birds and mammals. They are mostly resident or sedentary around breeding territories, and forage more widely and make intermittent visits to their breeding grounds in the non-breeding season (Birdlife Australia, 2019). Due to their broad habitat, osprey may be present in the EMBA.
- The southern fairy prion (*Pachyptila turtur subantarctica*) is mainly found offshore. The species diet is comprised mostly of crustaceans (especially krill), but occasionally includes some fish and squid. It feeds mainly by surface-seizing and dipping, but can also catch prey by surface-plunging or pattering (TSSC, 2015a). In Australia, it is known to breed only on Macquarie Island (1,910 km southeast of Yolla-A), and on the nearby Bishop and Clerk islands (TSSC, 2015a).
- The white-bellied sea eagle (*Haliaeetus leucogaster*) is distributed along the coastline in coastal lowlands with breeding from Queensland to Victoria in coastal habitats and terrestrial wetlands in temperate regions (DAWE, 2020b). The breeding season is from June to January with nests built in tall trees, bushes, cliffs or rock outcrops. Breeding pairs are generally widely dispersed. The species forages over open water (coastal and terrestrial) and feeds on fish, birds, reptiles, mammals and crustaceans and normally launches into a glide to snatch its prey, usually with one foot, from the ground or water surface (Birdlife Australia, 2019). The species is

widespread and makes long-distance movements. This species may be present along the coastlines adjacent to the EMBA.

Shearwaters (Sooty, Flesh-footed, Short-tailed)

Shearwaters are medium-sized long-winged seabirds most common in temperate and cold waters. They come to islands and coastal cliffs to breed, nesting in burrows and laying a single white egg. Shearwaters feed on small fish, cephalopod molluscs (squid, cuttlefish, nautilus and argonauts), crustaceans (barnacles and shrimp), and other soft-bodied invertebrates and offal. These species forage almost entirely at sea and very rarely on land. (TSSC, 2014)

The three EPBC Act-listed species (sooty, flesh-footed and short-tailed) are trans-equatorial migrants that cross the Pacific Ocean for the Northern Hemisphere summer (TSSC, 2014). It is possible these species may overfly the EMBA. Of the three species, the short-tailed is most likely to be encountered in the spill EMBA due to the proximity of breeding locations among the Furneaux Group (Flinders Island, etc).

True Shorebirds

Plovers

The seven EPBC Act-listed plovers that may occur within the spill EMBA (double-banded, greater sand, lesser sand, red-capped, Pacific golden, grey and hooded) are medium- to large-sized migratory wading birds that have wide-ranging coastal habitats comprising estuaries, bays, mangroves, damp grasslands, sandy beaches, sand dunes, mudflats and lagoons (Flegg, 2002), with roosting also taking place on sand bars and spits.

Plovers feed on a range of molluscs, worms, crustaceans and insects. Plovers (with the exception of the hooded and red-capped lovers) breed in Asia and the Artic region and are present in Australia throughout the year, depending on the species. The hooded plover (*Thinornis rubricollis rubricollis*) and red-capped plover (*Charadrius ruficapillus*) breed in Australia, building their nests in sandy oceanic beaches. The location of these nests presents the greatest threat to this species' population, as nests, eggs and chicks are vulnerable to predation and trampling (DoE, 2014a; Birdlife Australia, 2019). The sandy beaches of the Ninety Mile Beach are recognised habitat for the hooded plovers.

Terns

There are six EPBC Act-listed tern species that may occur within the spill EMBA (Caspian, fairy, little, sooty, white-fronted and crested) and one additional species from the VBA database (Australian gull-billed). Many of the tern species present along the southern Australian coastline are widespread and occupy beach, wetland, grassland and beach habitats. Terns rarely swim; they hunt for prey in flight, dipping to the water surface or plunge-diving for prey usually small baitfish in coastal waters and typically close to land (DSEWPaC, 2011b).

The NCVA (DAWE, 2020c) indicates that the foraging BIA for the fairy tern (*Sterna nereis nereis*) (listed as vulnerable under the EPBC Act and threatened under the FFG Act) occur in and offshore of the gulfs of South Australia. They are also known to breed on the offshore islands and coast of Spencer Gulf (Edyvane, 1999). Flegg (2002) reports that the species is widespread on southern and western Australian coasts, and breeds on coastal beaches and islands.

There are two distinct populations of little tern (*S. albifrons*) in Australia, with the south-eastern population being that which occurs within the EMBA. The little tern (listed as migratory and marine under the EPBC Act) has an estimated population of 3,000 breeding pairs in eastern Australia (DAWE, 2020b). It is a migratory species that breeds in eastern Australia during spring and summer, leaving the colonies in late summer-autumn and vacating southern Australia (Birdlife Australia, 2019). In eastern Australia, breeding normally occurs within wetland areas. Little terns inhabit sheltered coastal environments, including lagoons, estuaries, river mouths, lakes and exposed ocean beaches (Birdlife Australia, 2019). Near the EMBA, habitat for this species occurs at the Gippsland Lakes, Corner Inlet and Western Port Bay (Birdlife Australia, 2019). Little terns feed on small fish, crustaceans, insects and molluscs by plunging in shallow water or gleaning from the water surface. The little tern may occur within the EMBA.

The crested tern (*Thalasseus bergii*) is widely distributed around the coast of Australia and breeds on offshore islands in nests densely packed together. The crested tern lives along the coast of ocean beaches and in coastal lagoons. The species rarely flies far from shore out to sea or inland. It flies above the water in search of prey on the surface before plunging down to take small fish from the surface (Birdlife Australia, 2019). Due to its known distribution in Bass Strait, it is likely that the crested tern will be present in the spill EMBA.

<u>Knots</u>

The red knot and great knot are the only two EPBC Act-listed species of knot that may occur within the spill EMBA. These species have a coastal distribution around the entire Australian coastline when they are present during the southern hemisphere summer (breeding in eastern Siberia in the northern hemisphere summer). Knots are a medium-sized wader that prefer sandy beach, tidal mudflats and estuary habitats, where they feed on bivalve molluscs, snails, worms and crustaceans (Birdlife Australia, 2019). Lake Reeve has supported the largest concentration (5,000) of red knot (*Calidris canutus*) recorded in Victoria.

Knots may be present along shorelines of the spill EMBA.

<u>Godwits</u>

There are three EPBC Act-listed godwit species that may occur within the EMBA (bar-tailed, Northern Siberian and black-tailed).

Godwits are large waders that are found around all coastal regions of Australia during the southern hemisphere summer (breeding in Europe during the northern hemisphere summer), though the largest numbers remain in northern Australia. Godwits are commonly found in sheltered bays, estuaries and lagoons with large intertidal mudflats or sandflats, or spits and banks of mud, sand or shell-grit where they forage on intertidal mudflats or sandflats, in soft mud or shallow water and occasionally in shallow estuaries (Birdlife Australia, 2019). They have been recorded eating annelids, crustaceans, arachnids, fish eggs and spawn and tadpoles of frogs, and occasionally seeds. The Nooramunga Marine and Coastal Park (133 km to the north-east of Yolla-A) has recorded the largest concentrations of bar tailed godwit (*Limosa lapponica*) in south-eastern Australia.

Most Australian sightings of northern Siberian bar-tailed godwits are in northwest Australia with no known sightings in the EMBA (TSSC, 2016a). Godwits may be present along shorelines of the spill EMBA.

<u>Sandpipers</u>

There are eight EPBC Act-listed sandpiper species (common, sharp-tailed, curlew, pectoral, wood, broad-billed marsh, terek) that may occur within the operational area and the EMBA. They breed in Europe and Asia and migrate to Australia during the southern summer. Sandpipers are small wader species found in coastal and inland wetlands, particularly in muddy estuaries, feeding on small marine invertebrates (Birdlife Australia, 2019; DoE, 2015b). Up to 3,000 sharp-tailed sandpiper and up to 1,800 curlew sandpiper are known to congregate to feed at the Gippsland Lakes.

Sandpipers may be present along shorelines of the spill EMBA.

<u>Snipes</u>

There are four EPBC-Act listed snipe species that may occur within the EMBA (Latham's, Swinhoe's, pin-tailed and Australian painted). These snipe species (other than the Australian painted snipe, which is endemic to Australia) are present during the southern hemisphere summer (breeding in Asia and Russia in the northern hemisphere summer). They are medium-sized waders that roost among dense vegetation around the edge of wetlands during the day and feed at dusk, dawn and during the night on seeds, plants, worms, insects and molluscs. There are few if no confirmed records of the pin-tailed and Swinhoe's snipe in Victoria (Birdlife Australia, 2019), while the Australian painted snipe is known to occur at Mallacoota Inlet (430 km to the east of Yolla-A) (DSEWPC 2013a).

Snipes may be present along shorelines of the spill EMBA.

Swift parrot

The swift parrot (*Lathamus discolour*) is a small parrot that has rapid, agile flight. During summer, it breeds in colonies in blue gum forest of south-east Tasmania. Infrequent breeding also occurs in north-west Tasmania. The entire population migrates to the mainland for winter. On the mainland it disperses widely and forages on flowers and psyllid lerps in eucalypts. The birds mostly occur on inland slopes, but occasionally occur on the coast (TSSC, 2016b). Given its habitat preferences, this species is unlikely to occur within the spill EMBA.

Orange-bellied parrot

The orange-bellied parrot (*Neophema chrysogaster*) breeds in Tasmania during summer, migrates north across Bass Strait in autumn and over-winters on the mainland. Birds depart the mainland for Tasmania from September to November (Green, 1969). The southward migration is rapid (Stephenson, 1991), so there are few migration records. The northward migration across western Bass Strait is more prolonged (Higgins, 1999).

The parrot's breeding habitat is restricted to southwest Tasmania, where breeding occurs from November to mid-January mainly within 30 km of the coast (DEWLP, 2016). The species forage on the ground or in low vegetation (Brown and Wilson, 1980; DEWLP, 2016, Loyn *et al*., 1986).

During winter, on mainland Australia, orange-bellied parrots are found mostly within 3 km of the coast (DELWP, 2016). In Victoria, they mostly occur in sheltered coastal habitats, such as bays, lagoons and estuaries, or, rarely, saltworks. They are also found in low samphire herbland dominated by beaded glasswort (*Sarcocornia quinqueflora*), sea heath (*Frankenia pauciflora*) or sea-blite (*Suaeda australis*), and in taller shrubland dominated by shrubby glasswort (*Sclerostegia arbuscula*).

Most known breeding activity occurs within 10 km of Melaleuca Lagoon, outside of the spill EMBA, which is 393 km from the Yolla-A platform. Key non-breeding habitat is known to occur around Corner Inlet in Victoria which is outside of the EMBA and 114 km from the Yolla-A platform. King Island is known as a key location in the migration route between breeding and non-breeding sites and is located 140 km from the Yolla-A platform and outside the EMBA (DELWP, 2016).

Tattlers

The two EPBC Act-listed tattler species (grey-tailed and wandering) are a small, foraging shorebird with long wings and tail. Their breeding habitat is along rocky rivers in the remote mountains of eastern Siberia during June and July. They then migrate along the East Asian-Australasian Flyway towards Australia. They are usually seen in small flocks along sheltered coasts with reefs and rock platforms or intertidal mudflats. They are also found in intertidal rocky, coral or stony reefs, platforms and islets that are exposed at high tide, as well as shores of rock, shingle, gravel and shells and on intertidal mudflats in embayments, estuaries and coastal lagoons fringed with mangroves. They feed by day on polychaete worms, molluscs, crustaceans, insects and, occasionally, fish. (Birdlife Australia, 2019).

These tattlers may be present in the EMBA during the Australian summer.

Curlews

The two EPBC Act-listed curlews (eastern and little) are medium-sized migratory birds that breed in the far north of Siberia and winters in Australasia. The eastern curlew (*Numenius madagascariensis*) is the world's largest shorebird and is widespread in coastal regions in the north-east and south of Australia, including Tasmania. It is commonly found on intertidal mudflats and sandflats where it uses its long beak to pick the surface and probes for crabs. Curlews are also found on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons (DoE, 2015c)

The eastern curlew was amended from endangered to critically endangered in 2015 because research shows population decline potentially caused by wetland reclamation in some areas of Asia. In Victoria, the main strongholds are in Corner Inlet (115 km north from Yolla-A) and Western Port Bay (160 km from Yolla-A), with smaller populations in Port Phillip Bay and scattered elsewhere along the coast. Eastern curlews are found on islands in Bass Strait and along the northwest, northeast, east and southeast coasts of Tasmania. Historically, sightings have been recorded in Bass Strait and depending on the time of year, curlews may be present in the spill EMBA. (DoE, 2015c).

The little curlew breeds in Siberia and is seen on passage through Mongolia, China, Japan, Indonesia and New Guinea. In Australia, the little curlew is a bird of coastal and inland plains of the north where it often occurs around wetlands and flooded ground. They often form large flocks, occasionally comprising thousands of birds and sometimes associate with other insectivorous migratory shorebirds. Given the little curlew is present in Queensland and the Northern Territory but not in Victoria, it is unlikely to be encountered in the operational area or the EMBA (Birdlife Australia, 2019).

<u>Brolga</u>

The brolga (*Antigone rubicunda*) (listed as threatened under the FFG Act) is a large grey crane found across tropical northern Australia, southwards through north-east and east central areas of Queensland as well as New South Wales and Victoria. It inhabits large open wetlands, grassy plains, coastal mudflat and irrigated croplands and, less frequently, mangrove-lined creeks and estuaries. Brolgas are omnivorous, feeding on both plants and animal matter but primarily on tubers and some crops (Birdlife Australia, 2019).

As its preferred habitat is poorly represented among the shoreline of the spill EMBA, it is unlikely that brolgas will be encountered in the spill EMBA.

<u>Egrets</u>

Two species of egret (little and plumed) are recorded in the VBA database search results for the EMBA. The plumed egret (*Ardea intermedia plumifera*) is primarily found in freshwater swamps, billabongs, floodplains and wet grasslands and as such is unlikely to be present in the EMBA. The little egret (*Egretta garzetta*) (listed as threatened under the FFG Act) frequents tidal mudflats, saltwater and freshwater wetlands, and mangroves. Little egrets feed on a wide variety of invertebrates, as well as fish and amphibians. Due to its preference for coastal and saltwater habitats, the little egret may be encountered in the EMBA.

<u>Little penguins</u>

There is a little penguin BIA (foraging) that is intersected by the spill EMBA off the south coast of Phillip Island and a breeding BIA located on onshore Phillip Island, which are both displayed in Figure 5.15. Little penguins are an important tourism drawcard to the region, with the number of tourists visiting the nightly penguin parade at the Phillip Island Nature Parks near Seal Rocks in 2016-17 reported as 730,000 (PINP, 2018).

Little penguins are known to breed throughout southern Australia from Western Australia to New South Wales, including Bass Strait and Tasmania. Most little penguins stay at sea throughout autumn and winter, although some will return frequently to their burrows all year round. Little penguins breed from August to October, nesting from late September to about late October with incubation through to mid-November while chick raising occurs over the subsequent summer months (Arnould and Berlincourt, 2013; CSIRO, 2000; Gormley and Dann, 2009). Table 5.10 summarises little penguin daily and seasonal behaviour.

Little penguins have an annual breeding cycle that results in their behaviour and activity changing considerably throughout the year. Little penguins are known to travel considerable distance during the non-breeding season and display much shorter foraging behaviour during the chick raising phase of their cycle. During the breeding period, the penguins forage close to the colonies to attend to their chicks daily. By winter the chicks have fledged and the adults have moulted and can undertake foraging trips of extended duration in order to regain the weight lost during the autumn moulting period (CSIRO, 2000; Gormley and Dann, 2009). Little penguins tracked from Phillip Island during the winter were shown to travel hundreds of kilometres and stay away from the colony for periods lasting a couple of weeks. Port Phillip Bay was heavily utilised, suggesting that this area is an important feeding ground for the little penguin (Arnould and Berlincourt, 2013).

There are many little penguin colonies along the Victorian coast and their size varies considerably from six to 35,000 birds at Pyramid Rock and Gabo Island respectively. One of Australia's largest little penguin colonies of approximately 26,000 breeding individuals exist on the Summerland Peninsula, Phillip Island (within the spill EMBA). There are also smaller colonies on rocky islands off Wilsons Promontory, Flinders Island and King Island (Arnould and Berlincourt, 2013).

Table 5.10. Summary of little penguin seasonal behaviour

Behaviour	**Description**
Residency at nesting sites	All year
Daily cycle to and from shore: - Leaving - Arriving	 1 - 2 hr before sunrise Majority (60%) arrive in the first 50 min of sunset, the rest within 2 hours
Feeding	Mainly small fish such as pilchards, anchovies and squid
Swimming speed	1 -4 km per hr
Diving depth	Usually less than 10 m but can dive to 70 m
Underwater time	Usually 4 - 45 seconds
Travel distance each day	15 – 50 km
Mating period	August - October
Egg laying	September - October (on Phillip Island)
Incubation period	35 days
Age when chicks go to sea	8 - 10 weeks after hatching
Moulting	Feb - April for about 17 days - birds remain onshore
Renovation of burrows and courtship	May – August, depending on food supply

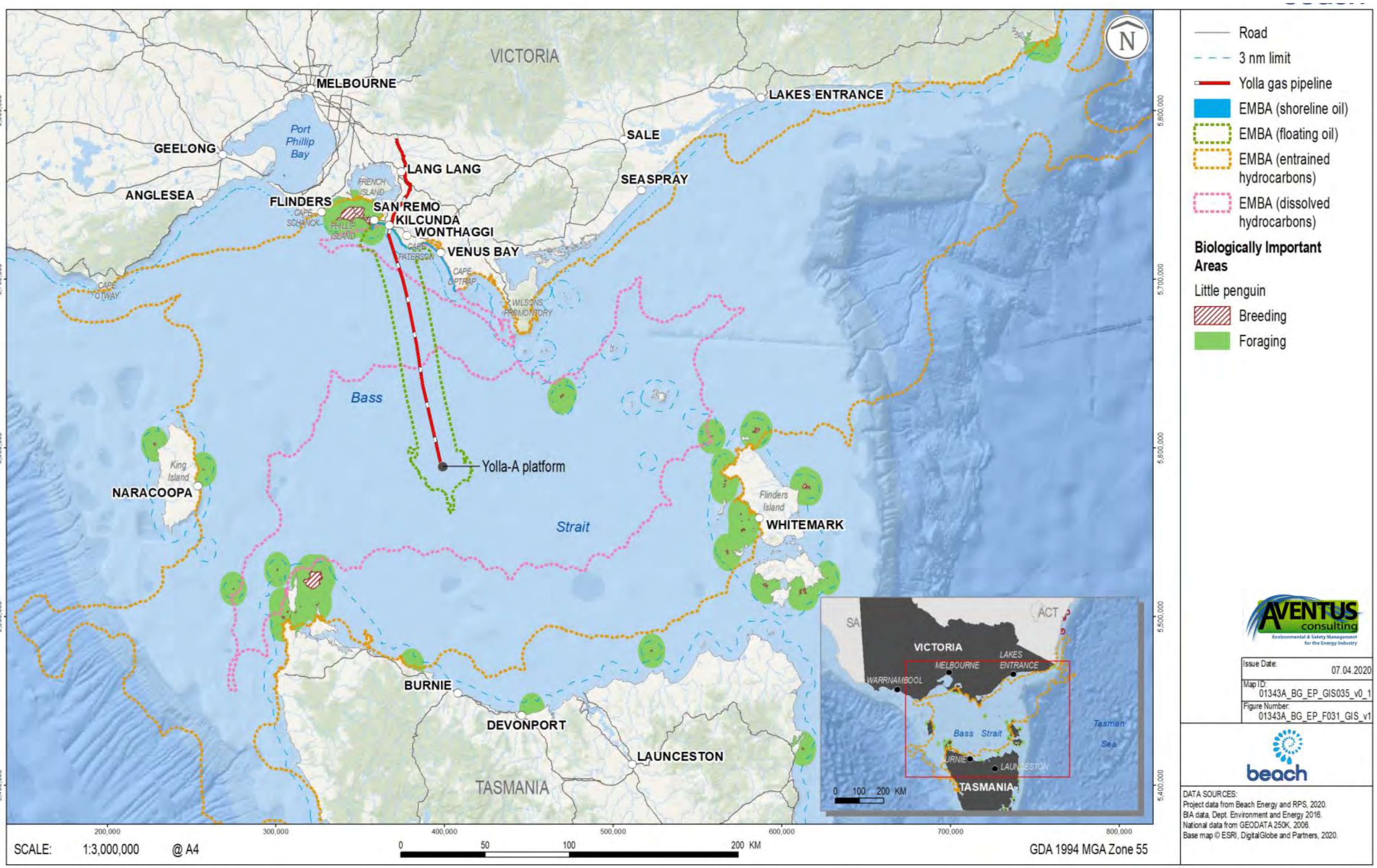


Figure 5.15. Little penguin breeding and foraging BIA

5.5.5 Cetaceans

The PMST identifies that 22 whale species and eight dolphin species may reside within or migrate through the operational area and spill EMBA, as listed in Table 5.11. A description of species listed in Table 5.11 is focused on threatened species.

A search of the VBA database indicates that 11 whales have been sighted in the EMBA (the most common being the southern right and humpback whales), along with five dolphins (the most common being the short-beaked common dolphin). Each whale species sighted from the VBA database was also captured by the PMST results of the EMBA. Only the Burrunan dolphin captured in the VBA database was not also captured by the PMST results for the EMBA. Figure 5.16 illustrates the presence and absence of the threatened cetacean species through the year.

Table 5.11. EPBC Act-listed cetaceans that may occur within the operational area and spill EMBA

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Whales							
Balaenoptera acutorostrata	Minke whale	-	-	Yes	-	-	-
Balaenoptera borealis	Sei whale	V	Yes	Yes	-	-	CA
Balaenoptera bonaerensis	Antarctic Minke Whale	-	Yes	Yes	-	-	-
Balaenoptera edeni	Bryde's Whale	-	Yes	Yes	-	-	-
Balaenoptera musculus	Blue whale	E	Yes	Yes	T	F, D	RP
Balaenoptera physalus	Fin whale	V	Yes	Yes	-	-	CA
Erardius arnuxii	Arnoux's beaked whale	-	-	Yes	-	-	-
Caperea marginata	Pygmy right whale	-	Yes	Yes	-	-	-
Eubalaena australis	Southern right whale	E	Yes	Yes	-	M	CMP, AS
Globicephala macrorhynchus	Short-finned pilot whale	-	-	Yes	-	-	-
Globicephala melas	Long-finned pilot whale	-	-	Yes	-	-	-
Kogia breviceps	Pygmy sperm whale	-	-	Yes	-	-	-
Kogia simus	Dwarf sperm whale	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Megaptera novaeangliae	Humpback whale	V	Yes	Yes	T	-	CA, AS
Mesoplodon bowdoini	Andrew's beaked whale	-	-	Yes	-	-	-
Mesoplodon densirostris	Blainville's beaked whale	-	-	Yes	-	-	-
Mesoplodon grayi	Gray's beaked whale	-	-	Yes	-	-	-
Mesoplodon hectori	Hector's beaked whale	-	-	Yes	-	-	-
Mesoplodon layardii	Sharp-toothed beaked whale	-	-	Yes	-	-	-
Mesoplodon mirus	True's beaked whale	-	-	Yes	-	-	-
Physeter macrocephalus	Sperm whale	-	Yes	Yes	-	-	-
Ziphius cavirostris	Cuvier's beaked whale	-	-	Yes	-	-	-
Dolphins							
Delphinus delphis	Common dolphin	-	-	Yes	-	-	-
Grampus griseus	Risso's dolphin	-	-	Yes	-	-	-
Lagenorhynchus obscurus	Dusky dolphin	-	Yes	Yes	-	-	-
Lissodelphis peronii	Southern right whale dolphin	-	-	Yes	-	-	-
Orcinus orca	Killer whale	-	Yes	Yes	-	-	-
Pseudorca crassidens	False killer whale	-	-	Yes	-	-	-
Tursiops aduncus	Indian bottlenose dolphin	-	-	Yes	-	-	-
Tursiops truncates s. str.	Bottlenose dolphin	-	-	Yes	-	-	-

Definitions and key as per Table 5.9.

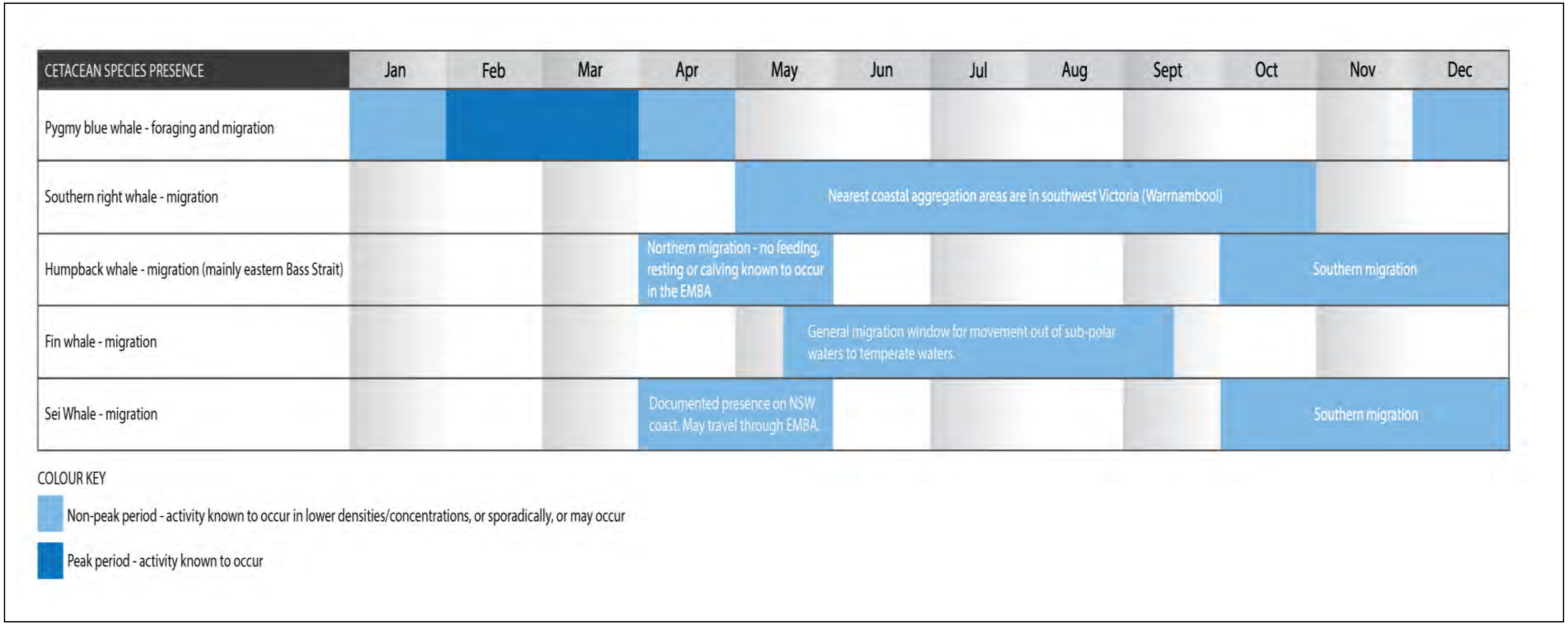


Figure 5.16. The annual presence and absence of threatened cetacean species known to migrate through the EMBA

Sei Whale

Sei whales (*Balaenoptera borealis*) are primarily found in deep water oceanic habitats and their distribution, abundance and latitudinal migrations are largely determined by seasonal feeding and breeding cycles (Horwood 2009 in TSSC, 2015b).

Sei whale global population is estimated to have declined by 80% over the previous three generation period (TSSC, 2015b). Sei whales were the most commonly observed whales during Australian National Antarctic Research Expedition voyages in the 1960s and 1970s, with the majority recorded south of 60°S in the Southern Ocean (TSSC, 2015b).

These whales are thought to complete long annual seasonal migrations from subpolar summer feeding grounds to lower latitude winter breeding grounds (TSSC, 2015b); details of this migration and whether it involves the entire population are unknown.

In the Australian region, sei whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, New South Wales, Queensland, the Great Australian Bight, Northern Territory and Western Australia (TSSC, 2015b).

Sightings of sei whales within Australian waters includes areas such as the Bonney Upwelling off South Australia (TSSC, 2015b), where opportunistic feeding has been observed between November and May (TSSC, 2015b).

Based upon the species preference for offshore waters, the absence of a BIA for the species in Australia and the small number of sei whale sightings in southeast Australia, it is considered unlikely that this species occurs within the operational area, but may occur at the extremities of the EMBA where there is very deep water.

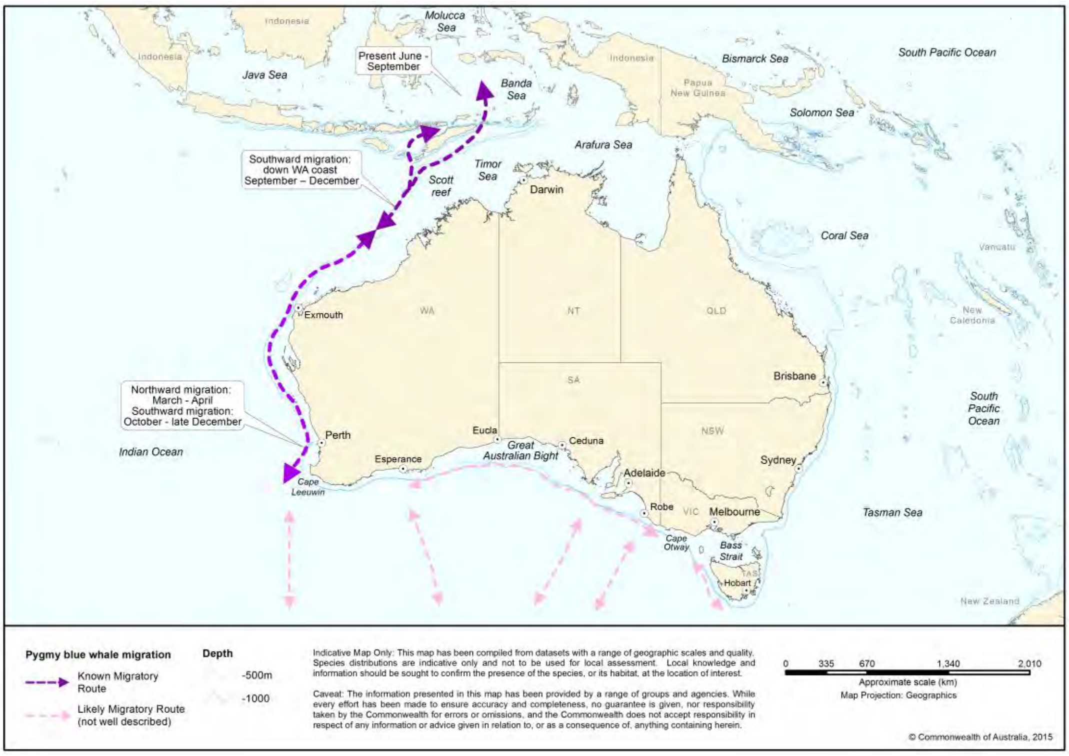
Blue Whale

Blue whales (*Balaenoptera musculus)* are the largest living animals on earth, growing to a length of over 30 m, weighing up to 180 tonnes and living to 90 years (DoE. 2015d). The DoE (2015d) recognises three overlapping populations:

- Antarctic blue whale population (*B. musculus intermedia*) are those blue whales occupying or passing through Australian waters that feed on krill predominantly if not exclusively in Antarctic waters.
- Indo-Australian pygmy blue whales (*B. musculus brevicauda*) are those pygmy blue whales occupying or passing through waters from Indonesia to western and southern Australia and are not generally found in Antarctic waters, and appear to feed in more temperate waters.
- Tasman-Pacific pygmy blue whales (*B. musculus brevicauda*) are those pygmy blue whales generally considered to be occupying or passing through waters in southeast Australia and the Pacific Ocean and are not generally found in Antarctic waters, and appear to feed in more temperate waters.

The Antarctic sub-species has been acoustically detected off the west and north coasts of Tasmania predominately from May to December. Based on the seasonality of recordings, these areas possibly form part of their migratory route, breeding habitat or a combination of the two (DoE, 2015d).

Indo-Australian pygmy blue whales inhabit Australian waters as far north as Scott Reef, the Kimberley region and west of the Pilbara and as far south as southwest Australia across to the Great Australian Bight and the Bonney Upwelling, and to waters as far east off Tasmania (Figure 5.17). They have known feeding grounds in the Perth Canyon off Western Australia and the Bonney Upwelling System and adjacent waters off Victoria, South Australia and Tasmania. These areas are utilised from November to May. They migrate between these feeding aggregation areas, northwards and southwards along the west coast of Australia, to breeding grounds that are likely to include Indonesia.



Source: DoE (2015).

Figure 5.17. Pygmy blue whale migration routes

The Tasman-Pacific pygmy blue whale is the sub-species that migrates through Bass Strait, found in waters north of 55°S (DoE, 2015d). Blue whales are a highly mobile species that feed on krill (euphausids, *Nyctiphane australis*).

A BIA for 'likely foraging' for the pygmy blue whale covers most of Bass Strait, including the operational area and spill EMBA, with known foraging areas (abundant food source/annual high use area) occurring off the southwest Victorian coast (Figure 5.18).

The time and location of the appearance of blue whales in the South-east Marine Region generally coincides with the upwelling of cold water in summer and autumn along the southeast South Australian and southwest Victoria coast (the Bonney Upwelling) and the associated aggregations of krill that they feed on (DoE, 2015d; Gill and Morrice, 2003). This is a key feeding area for the species. The Bonney Upwelling generally starts in the eastern part of the Great Australian Bight in November or December and spreads eastwards to the Otway Basin around February as southward migration of the sub-tropical high-pressure cell creates favourable winds for upwelling. Pygmy blue whales predominately occupy the western area of the Bonney Upwelling from November to December, and then move southeast during January to April, though the within-season distribution trends in Bass Strait are unknown (DoE, 2015d).

The DoE (2015d) states that migratory routes for pygmy blue whales off the east coast of Australia are unknown (as seen by the absence of migratory routes in Figure 5.17). However, blue whale migration patterns are thought to be similar to those of the humpback whale, with the species feeding in mid-to high-latitudes (south of Australia) during the summer months and moving to temperate/tropical waters in the winter for breeding and calving. Pygmy blue whale migration is oceanic and no specific migration routes have been identified in the Australasian region (DoE, 2015d).

The Tasman-Pacific pygmy blue whale, which only occupies waters north of 55°S, potentially migrates through Bass Strait although there is little information about this (DoE, 2015d). The DoE (2015d) states that migratory routes for pygmy blue whales off the east coast of Australia are unknown (as seen by the absence of migratory routes in Figure 5.17).

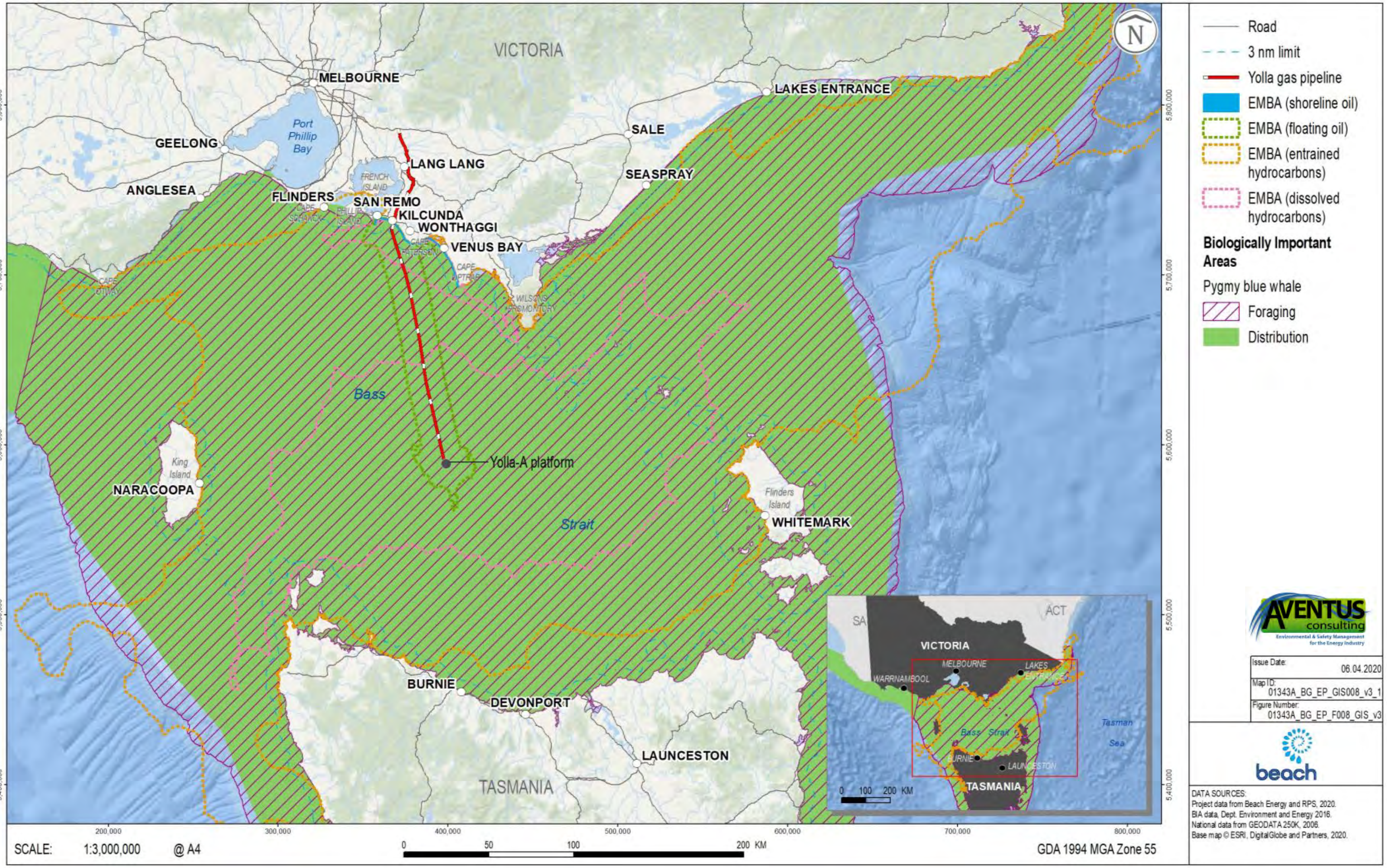


Figure 5.18. Pygmy blue whale BIA

A sea noise logger was deployed near to Yolla-A from April to October 2004 during the platform's construction period. The presence of several whale species was evident in the recordings although the proximity of the whales could not be determined; blue whales were mainly evident in winter and in late autumn pygmy blue whales passed through Bass Strait. There was no obvious evidence of humpback whales, other whale species or fish choruses (McCauley, 2005).

Fin Whale

The fin whale (*B. physalus)* is the second largest whale species after the blue whale, growing up to 27 m long and weighing up to 70 tonnes (TSSC, 2015c). Fin whales are considered a cosmopolitan species and occur from polar to tropical waters, and rarely in inshore waters. The full extent of their distribution in Australian waters is uncertain but they occur within Commonwealth waters and have been recorded in most state waters and from Australian Antarctic Territory waters (TSSC, 2015c).

Fin whales are generally thought to undertake long annual migrations from higher latitude summer feeding grounds to lower latitude winter breeding grounds (TSSC, 2015c). It is likely they migrate between Australian waters and Antarctic feeding areas (the Southern Ocean), sub-Antarctic feeding areas (the Southern Subtropical Front) and tropical breeding areas (Indonesia, the northern Indian Ocean and south-west South Pacific Ocean waters) (TSSC, 2015c).

Fin whales have been sighted inshore in the proximity of the Bonney Upwelling along the continental shelf in summer and autumn months (TSSC, 2015c). The sighting of a cow and calf in the Bonney Upwelling in April 2000 and the stranding of two fin whale calves in South Australia suggest that this area may be important to the species' reproduction, perhaps as a provisioning area for cows with calves (TSSD, 2015c). However, there are no defined mating or calving areas in Australia waters.

The conservation advice (TSSC, 2015c) identifies vessel strike and anthropogenic noise as threats to the species. Based on the fin whale preference for offshore waters, the absence of a BIA in Australian waters and the minimal sightings in Bass Strait, it is considered unlikely that this species occurs within the operational area or spill EMBA.

Pygmy Right Whale

Pygmy right whales (*Caperea marginata*) are a little-studied baleen whale species found in temperate and sub-Antarctic waters in oceanic and inshore locations. The species, which has never been hunted commercially, is thought to have a circumpolar distribution in the southern hemisphere between about 30°S and 55°S. Distribution appears limited by the surface water temperature as they are almost always found in waters with temperatures ranging from 5° to 20°C (Baker, 1985).

There are few confirmed sightings of pygmy right whales at sea (Reilly *et al*., 2008), with few or no records from eastern Victoria and no population estimates available for Australian waters. The largest reported group sighted (100+) occurred near Portland in June 2007 (Gill *et al*., 2008).

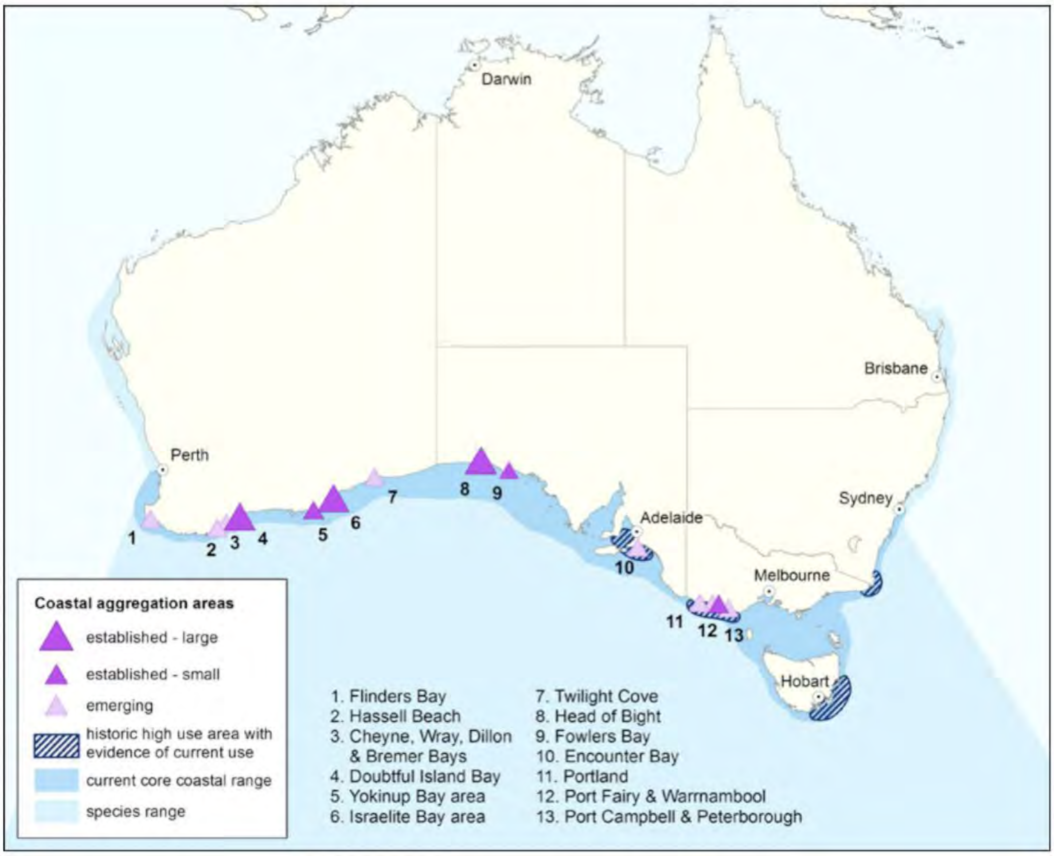
Based upon the lack of sightings off eastern Victoria and the absence of a BIA in Australian waters, it is considered unlikely that this species occurs within the operational area or spill EMBA.

Southern Right Whale

Southern right whales (*Eubalaena australis*) are medium to large black (or less commonly grey-brown) baleen whales (DSEWPC, 2012b). They are recognisable by the lack of a dorsal fin, rotund body shape and whitish callosities (patches of keratinised skin colonised by cyamids - small crustaceans) on the head. They have a maximum length of approximately 17.5 m and an approximate weight of 80 tonnes, with mature females slightly larger than males (DSEWPC, 2012b).

Nineteenth century whaling drastically reduced southern right whale numbers. An estimated 55,000 to 70,000 whales were present in the southern hemisphere in the late 1700s (DSEWPC, 2012b). By the 1920s there may have been fewer than 300 individuals remaining throughout the southern hemisphere (DSEWPC, 2012b). Other reports suggest the number of individuals in Australia was reduced to 1,500 (Charlton *et al*., 2014). The current Australian population is estimated at 3,500 individuals (Charlton *et al*., 2014).

The southern right whale is typically distributed between 16°S and 65°S in the southern hemisphere and is present off the Australian coast between May and October (sometimes as early as April and as late as November) (DSEWPC, 2012b) (Figure 5.19).



Source: DSEWPC (2012).

Figure 5.19. Southern right whale aggregation areas

Southern right whales tend to be distinctly clumped in aggregation areas (DSEWPC, 2012b). Aggregation areas are well known with a well-recognised area in Victoria at Warrnambool. The number of whales visiting Victoria is a small fraction of the main population that spends winter along the coasts of South Australia and Western Australia (DSEWPC, 2012b). A number of additional aggregation areas for southern right whales are emerging that might be of importance particularly to the south-eastern population. In these areas small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria located more than 400 km west of the BassGas development, with waters less than 10 m deep preferred (DSEWPC, 2012b).

The NCVA identifies a BIA for migration/resting of the southern right whale through all of Bass Strait (Figure 5.19). The closest known aggregation/breeding/calving area to the BassGas Development is at Logan's Beach on the coast near Warrnambool approximately 425 km to the west. The area around Wilson's Promontory is a migration/resting area where breeding may occur. The southeast Tasmanian coast is designated as a migration/resting area where breeding is likely to occur.

A defined near-shore coastal migration corridor is considered unlikely given the absence of any predictable directional movement for the species (DSEWPC, 2012b). Critical habitat for the southern right whale is not defined under the EPBC Act (DSEWPC, 2012b) though the BIA shown in Figure 5.20 around Warrnambool, Wilson's Promontory and southwest Tasmania may be considered critical habitat as female southern right whales show calving site fidelity, which combined with their low and slow reproductive rate make calving sites of critical importance to the species recovery (DSEWPC, 2012b).

Humpback Whale

The humpback whale (*Megaptera novaeangliae*) is a moderately large (15-18 m long) baleen whale that has a worldwide distribution and a geographic segregation. In the 19th and 20th centuries, humpback whales were hunted extensively throughout the world's oceans and as a result it is estimated that 95% of the population was eliminated. Commercial whaling of humpback whales ceased in 1963 in Australia, at which time it is estimated that humpback whales were reduced to between 3.5 and 5% of pre-whaling abundance (TSSC, 2015d).

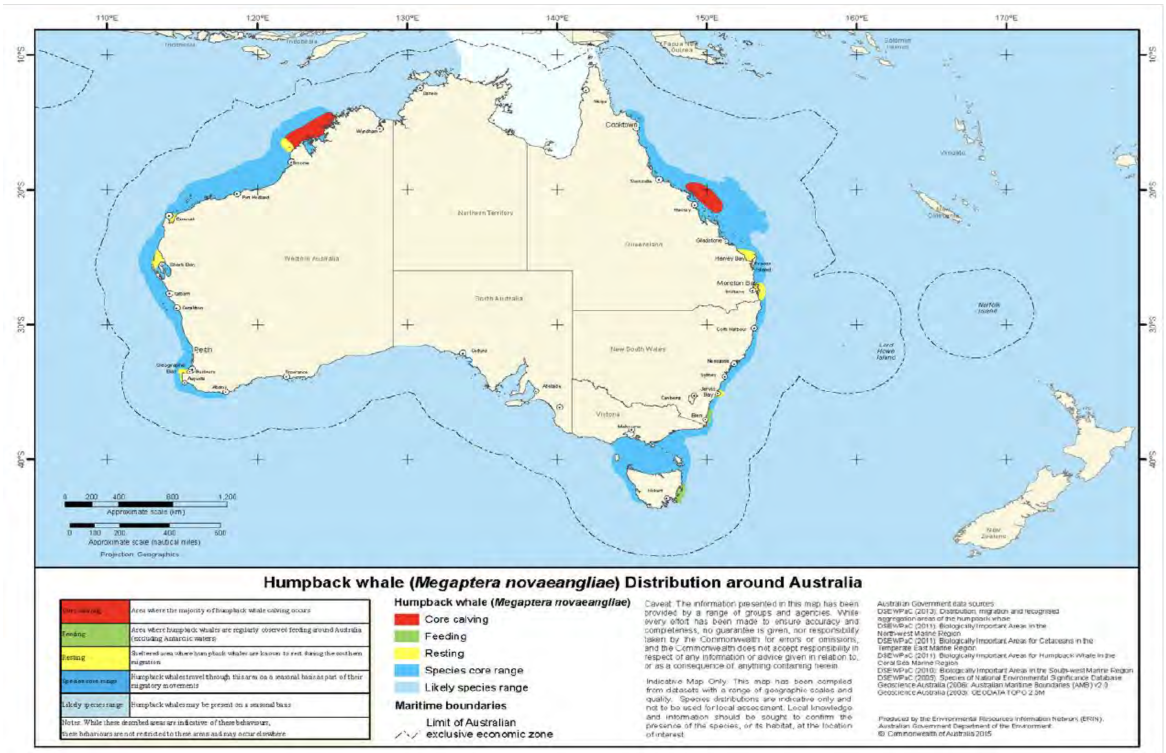
The EPBC Act Threatened Species Scientific Committee (TSSC) (TSSC, 2015d) states that a 2012 and 2014 review of the conservation status of the species considered that it no longer meets any criteria for listing as threatened under the EPBC Act though it remains listed as vulnerable.

Humpback whales are found in Australian offshore and Antarctic waters. They primarily feed on krill in Antarctic waters south of 55°S. The eastern Australian population of humpback whales is referred to as Group E1 by the International Whaling Commission, one of seven distinct breeding stocks in the southern hemisphere (TSSC, 2015d).

Bass Strait represents part of the core range of the E1 Group. Feeding, resting or calving is not known to occur in Bass Strait (TSSC, 2015d) though migration through Bass Strait occurs (Figure 5.21). The nearest area that humpback whales are known to congregate and potentially forage is at the southern-most part of NSW near the eastern border of Victoria, approximately 600 km northeast of Yolla-A (Figure 5.22) at Twofold Bay, Eden off the New South Wales south coast.

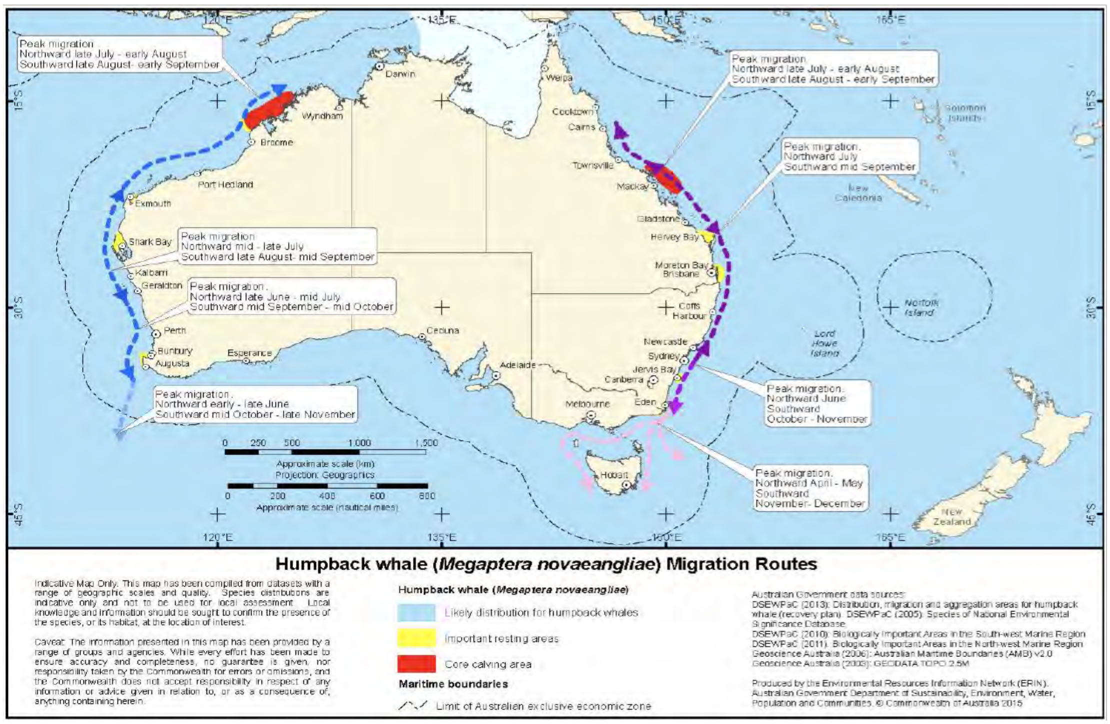
Humpback whales migrate from their summer feeding grounds in Antarctic waters northward up the Australian east coast to their breeding and calving grounds in sub-tropical and tropical inshore waters (TSSC, 2015d). The northern migration off the southeast coast starts in April and May with the southern migration occurring from November to December. This migration tends to occur close to the coast along the continental shelf boundary in waters about 200 m deep (TSSC, 2015d) (Figure 5.22).

Figure 5.20. Southern right whale BIA



Source: TSSC (2015d).

Figure 5.21. Humpback whale distribution around Australia



Source: TSSC (2015d).

Figure 5.22. Humpback whale migration routes around Australia

The conservation advice for the humpback whale (TSSC, 2015d) identifies vessel strike and anthropogenic noise as threats to the species. The operational area and spill EMBA overlaps the core migration range of humpback whales. Operators on Yolla-A regularly observe humpback whales close to the platform during their migration season (Plate 5.2), noting that they appear inquisitive and closely approach the platform, mill around and perform fluke slapping. Humpback whales migrate through the spill EMBA during April, May, November and December.

Plate 5.2. A humpback whale observed from Yolla-A

Dusky Dolphin

The dusky dolphin (*Lagenorhynchus obscurus*) is primarily found from approximately 55°S to 26°S though sometimes further north associated with cold currents. They are considered to be primarily an inshore species but can also be oceanic when cold currents are present (Gill *et al*., 2000; Ross, 2006).

Only 13 reports of the dusky dolphin have been made in Australia since 1828 (the very first described specimen of the species by French naturalists was from off the coast of Tasmania in 1826 and key locations are yet to be identified (Bannister *et al*., 1996).

The dusky dolphin occurs across southern Australia from Western Australia to Tasmania and there are confirmed sightings near Kangaroo Island and off Tasmania. No key localities or critical habitats in Australian waters have been identified (Bannister *et al*., 1996).

Given the lack of sightings in Australian waters, it is unlikely that significant numbers of dusky dolphins are present in the spill EMBA.

Killer Whales

The killer whale (*Orcinus orca*) is the largest member of the dolphin family and is thought to be the most cosmopolitan of all cetaceans. It appears to be more common in cold deep waters though killer whales have often been observed along the continental slope and shelf particularly near seal colonies (Bannister *et al*., 1996).

The killer whale is widely distributed from polar to equatorial regions and has been recorded in all Australian waters with concentrations around Tasmania. The only recognised key locality in Australia is Macquarie Island and

Heard Island in the Southern Ocean (Bannister *et al*., 1996). The habitat of killer whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions in both warm and cold waters (DAWE, 2020b).

In Victoria, sightings of killer whales peak in June/July where they have been observed feeding on sharks, sunfish and Australian fur seals (Mustoe, 2008). The breeding season is variable and the species moves seasonally to areas of food supply (Bannister *et al*., 1996; Morrice *et al*., 2004).

It is possible that killer whales may occur in the spill EMBA, however given the distance to the nearest seal colonies is approximately 100 km from Yolla-A, the area around Yolla-A and the pipeline is unlikely to represent an important habitat for killer whales and significant numbers of this species are not expected in the spill EMBA.

Burrunan Dolphin

The Burrunan dolphin (*Tursiops australis*) is a species of bottlenose dolphin only recognised as a separate species in 2011. The species is listed as threatened under the FFG Act (and is not listed under the EPBC Act).

Only two resident populations of Burrunan dolphin are known to occur, comprising about 50 individuals in the Gippsland Lakes and 100 individuals in Port Phillip Bay (Charlton-Robb *et al*., 2011). It is unclear whether migration occurs between these sites, though the Marine Mammal Foundation notes that there are genetic similarities between the dolphins in the Gippsland Lakes and around Tasmania's Freycinet Peninsula (ABC, 2017). The taxonomic validity of this new species has been questioned by the Committee for Taxonomy for the International Society for Marine Mammology (DRI, 2016). The Marine Mammal Foundation believes a transient group of male dolphins swim between Gippsland and eastern Tasmania to breed with two different populations of female dolphins. Thus, Burrunan dolphins may be present in the spill EMBA, though not in high numbers given that their resident populations are outside the spill EMBA.

5.5.6 Pinnipeds

There are two pinniped species recorded under the EPBC Act PMST as potentially occurring within the operational area and the spill EMBA (Table 5.12) (DAWE, 2020a). These species are not listed as threatened under the FFG Act.

The VBA database records an additional four species of pinniped; the southern elephant seal (*Mirounga leonine)* the leopard seal (*Hydrurga leptonyx*), the subantarctic fur seal (*Arctocephalus tropicalis*) and the Australian sea lion (*Neophoca cinerea*).

Table 5.12. EPBC Act-listed pinnipeds that may occur in the operational area and spill EMBA

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Arctocephalus forsteri	New Zealand fur-seal	-	-	Yes	-	-	-
Arctocephalus pusillus	Australian fur-seal	-	-	Yes	-	B	-

Definitions and key as per Table 5.9.

Figure 5.23 illustrates the presence of the two EPBC Act-listed pinniped species in the EMBA throughout the year.

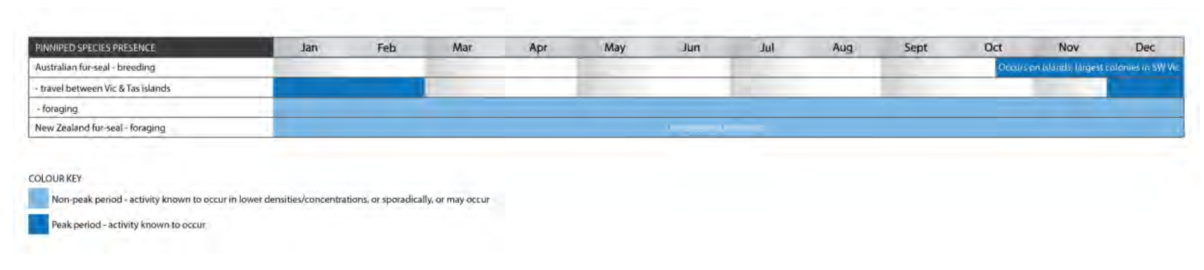


Figure 5.23. The annual presence and absence of EPBC Act-listed pinnipeds in the EMBA

<u>Australian fur-seal</u>

The Australian fur-seal (*Arctocephalus pusillus*) is common in the operational area and spill EMBA and is not listed as a threatened or migratory species under the EPBC Act. Australian fur-seals are regularly sighted milling around the Yolla-A platform jacket (Plate 5.3) and as an inquisitive marine mammal, are also often observed at the seabed around the platform jacket during inspection and maintenance activities (Plate 5.4).

Australian fur seals are endemic to south-eastern Australian waters and have a relatively restricted distribution around the rocky islands of Bass Strait. It is estimated that there are 60,000 Australian fur seals in Bass Strait and the waters around Tasmania. The species has been recorded in the waters off South Australia, Victoria, Tasmania and New South Wales and are the only species of seal known to breed on Victorian and Tasmanian islands in Bass Strait (Kirkwood *et al*., 2009).

There are 10 established breeding colonies of the Australian fur-seal that are restricted to islands in the Bass Strait; six occurring off the coast of Victoria and four off the coast of Tasmania (Kirkwood *et al*., 2009). The largest of the established colonies occur at Lady Julia Percy Island (26% of the breeding population and 360 km west of Yolla-A) and at Seal Rocks (25% of the breeding population and 160 km west of Yolla-A), in Victoria. These areas are located within the spill EMBA.

Other Australian fur-seal breeding colonies in Bass Strait include:

- Rag Island (1,000 fur seal & 270 pups in 2007, 122 km northeast of Yolla-A);
- Kanowna Island (15,000 adults and 3,000 pups, 85 km northeast of Yolla-A);
- Anser Group of Islands (all more than 87 km northeast of Yolla-A);
- The Skerries (394 km northeast of Yolla-A) – 11,500 individuals and 3,000 pups (in 2002); and
- Judgment Rock in the Kent Island Group (~2,500 pups per year, 135 km east of Yolla-A) (Kirkwood *et al*., 2009, Shaughnessy, 1999; OSRA) (Figure 5.24).

Barton et al (2012), Carlyon et al (2011) and OSRA (2015) list the haul-out sites known in Bass Strait (only Beware Reef is not located within the spill EMBA):

- Beware Reef (341 km northeast of Yolla-A) – a haul-out site where the seals are present most of year;
- Gabo Island (435 km northeast of Yolla-A) – 30-50 individuals; and
- The Hogan Island group (120 km northeast of Yolla-A) – about 300 animals.

Australian fur-seals have a relatively restricted distribution around the islands of Bass Strait where it is the most common seal (Kirkwood *et al*., 2005). Adult tagged seals have shown travel paths from Flinders Island to King Island presumably passing through central Bass Strait. Their preferred habitat, especially for breeding, is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges.

During the summer months Australian fur-seals are observed repeatedly travelling between northern Bass Strait islands and southern Tasmania waters following the Tasmanian east coast. Lactating female fur-seals and some territorial males are restricted to foraging ranges within Bass Strait waters. Lactating female Australian fur-seals forage primarily within the shallow continental shelf of Bass Strait, including off Cape Otway in western Victoria. They forage on benthos at depths of between 60 m and 80 m (Hume *et al*., 2004; Arnoud and Kirkwood, 2007; Robinson *et al*., 2008) generally within 100 km to 200 km of the breeding colony for up to five days at a time (Hume *et al*., 2004). The lactation period lasts for between 10 and 11 months and some females may nurse pups for up to three years (Arnoud and Hindell, 2001).

Male Australian fur-seals are bound to colonies during the breeding season from late October to late December. Outside the breeding season they forage up to several hundred kilometres (Hume *et al*., 2004) and are away for long periods even up to nine days (Kirkwood *et al*., 2005). The sexes generally forage in the same environment (Kirkwood *et al*., 2005); this suggests that males target different prey than females as observed in similar New Zealand fur-seals where males prey on larger fish and seabird species compared to females.

Plate 5.3. A pod of Australian fur-seals observed under Yolla-A

Plate 5.4. Fur-seal observed during ROV inspection around the base of Yolla-A

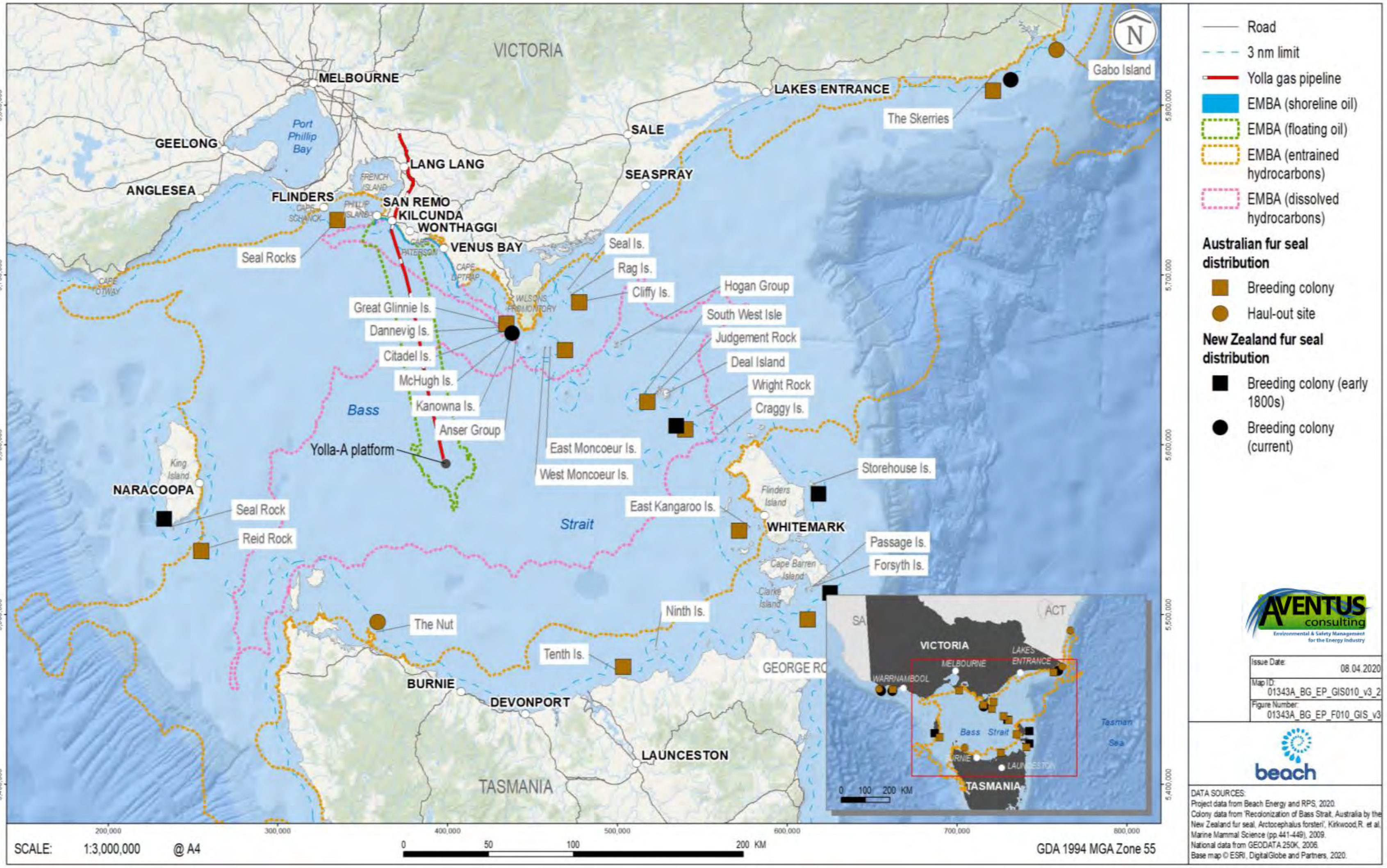


Figure 5.24. Australian and New Zealand fur-seal colonies and haul-out sites

New Zealand fur-seal

New Zealand fur-seals (*A. fosteri*, also sometimes referred to as long-nosed fur-seals) are mostly found in central South Australian waters (Kangaroo Island to South Eyre Peninsula); 77% of their population is found here (Shaughnessy, 1999).

There are 51 known breeding sites for New Zealand fur-seals in Australia, with most of these outside of Victoria (47 in SA and WA) (Kirkwood *et al*., 2009) (see Figure 5.24). Lower density breeding areas occur in Victoria (Shaughnessy, 1999). Breeding locations in Victoria occur at Kanowna Island, off Wilson's Promontory (located 85 km northeast of Yolla-A) and the Skerries (located approximately 394 km northeast of Yolla-A) (Kirkwood *et al*., 2009) – both are located within the spill EMBA.

During the non-breeding season (November to January) the breeding sites are occupied by pups/young juveniles, whilst adult females alternate between the breeding sites and foraging at sea (Shaughnessy, 1999).

New Zealand fur-seals feed on small pelagic fish, squid and seabirds, including little penguins (Shaughnessy, 1999). Juvenile seals feed primarily in oceanic waters beyond the continental shelf, lactating females feed in mid-outer shelf waters (50-100 km from the colony) and adult males forage in deeper waters.

The total Australian population of New Zealand fur seals is 58,000. The population has been slow to recover from the previous intense sealing operations from 1798 to 1820, partially as the species are slow reproducers, producing one pup per year when they reach sexual maturity at four years. Up to 15% of pups die before they reach two months of age, primarily as a result of fishing net and other marine debris entanglements.

Haul-out sites in Bass Strait, as reported by Barton et al (2012) and OSRA mapping, are listed below (only Beware Reef is outside the EMBA):

- Beware Reef (341 km northeast of Yolla-A);
- Kanowna Island (85 km northeast of Yolla-A) – about 300 individuals;
- The Hogan Islands Group (120 km northeast of Yolla-A); and
- West Moncoeur Island (south of Wilson's Promontory, 88 km northeast of Yolla-A).

The species prefers the rocky parts of islands with jumbled terrain and boulders and prefers smoother igneous rocks to rough limestone. Breeding colonies in Bass Strait recorded by Shaughnessy (1999) and OSRA mapping are listed below (all of which occur in the EMBA):

- Rag Island (1,000 fur seal & 235 pups in 2006, 122 km northeast of Yolla-A);
- Kanowna Island (10,700 adults and 2,700 pups, 85 km northeast of Yolla-A);
- Anser Group of Islands (all more than 87 km northeast of Yolla-A);
- The Skerries (394 km northeast of Yolla-A) – 300 individuals and 78 pups (in 2002); and
- Judgment Rock in the Kent Island Group (about 2,500 pups per year, 135 km east of Yolla-A) (Kirkwood *et al*., 2009)

There is no BIA for the New Zealand fur-seal in Bass Strait. Given the close proximity of the BassGas Development to breeding colonies and haul-out sites, it is likely that the species feeds in the operational area, and certainly within the spill EMBA. These waters are unlikely to represent important critical feeding or breeding habitat.

Southern elephant seal

There are five records of the southern elephant seal (*Mirounga leonine*) in the VBA database for the spill EMBA. In 2005, the world population was estimated at between 664,000 and 740,000 animals occurring in the South

Atlantic, South Indian and Pacific Oceans. Tracking studies have indicated the routes travelled by elephant seals, demonstrating their main feeding area is at the edge of the Antarctic continent.

Elephant seals have a nearly circumpolar Southern Hemisphere distribution with most breeding colonies and haul-out areas occurring on subantarctic islands north of the seasonal pack ice zone (TSSC, 2016c). Within Australian jurisdiction, southern elephant seals breeds and hauls-out on Macquarie Island (1,900 km southeast) and Heard Island (5,500 km southwest). Historically, southern elephant seal populations occurred on islands of western Bass Strait before these were extirpated by European sealers (TSSC, 2016c). Currently, occasional pupping is seen on Maatsuyker Island (426 km south) in southern Tasmania where 12 individuals were recorded in 2015. Given the known distribution of southern elephant seals, it is unlikely they occur in significant numbers in the operational area or the spill EMBA.

Leopard seal

There are 31 records of the leopard seal (*Hydrurga leptonyx*) in the VBA database for the spill EMBA. It is the second largest seal species and primarily inhabits the Antarctic pack ice between 50ºS and 80ºS. There are an estimated 220,000 to 444,000 individuals in the population. Sightings of vagrant leopard seals have been recorded off the coasts of Australia, New Zealand, South America and South Africa. While solitary seals can be found in areas of lower latitude, breeding rarely occurs in these areas. It is highly unlikely that the operational area or spill EMBA provides essential habitat for leopard seals.

Subantarctic fur-seal

There are three records of the subantarctic fur-seal (*Arctocephalus tropicalis*) in the VBA database for the spill EMBA. The species has a wide southern hemisphere distribution and a dispersed breeding distribution on isolated subantarctic and subtemperate islands north of the Antarctic polar front. In the Australian region, the only established breeding colony occurs on Macquarie Island (TSSC, 2016d). Juvenile vagrants have been recorded to reach the southern shores of Tasmania and the mainland with 50 individuals recorded from New South Wales to Western Australia since the 1970s. Given the locations of recordings of subantarctic fur-seals in the EMBA, it is possible that the species may be present in the operational area and spill EMBA, though in low numbers as vagrant individuals.

Australian sea lion

There are three records of the Australian sea lion (*Neophoca cincerea*) in the VBA database for the spill EMBA. The species is endemic to southern Australia and is found from Kangaroo Island (870 km west of Yolla-A) to the Houtman Abrolhos Islands in Western Australia (3,100 km west) (TSSC, 2010). Like many species of seal, Australian sea lions regularly visit haul-out sites and breeding colonies on remote sections of coastline and has been sighted at over 200 locations. The species may be present in the operational area and spill EMBA, though in low numbers as vagrant individuals given the low number of sightings.

5.5.7 Fish

It is estimated that there are over 500 species of fish found in the waters of Bass Strait, including a number of species of importance to commercial and recreational fisheries (LCC, 1993). Fish species commercially fished in the EMBA are listed in Section 5.7.8.

There are 39 fish species (31 of which are seahorses and pipefish, the signathid family') recorded in the EPBC Act PMST (DAWE, 2020a) as potentially occurring in the spill EMBA. The threatened and migratory species are described in this section. Table 5.13 lists the fish species known or likely to occur in the EMBA. The full list of fish species recorded in the EMBA from the VBA database is available in **Appendix 6.**

Table 5.13. EPBC Act-listed fish that may occur in the operational area and spill EMBA

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Freshwater							
Galaxiella pusilla	Eastern Dwarf Galaxia	V	-	-	-	-	AS, RP
Prototroctes maraena	Australian Grayling	V	-	-	-	-	RP, AS
Oceanic							
Carcharodon carcharias	Great white shark	V	Yes	-	T	FFR	RP
Carcharius Taurus	Grey nurse shark, east coast population	CE	-	-	T	-	RP
Epinephelus daemelii	Black rockcod	V	-	`-	-	-	CA
Isurus oxyrinchus	Shortfin mako	-	Yes	-	-	-	-
Lamna nasus	Porbeagle	-	Yes	-	-	-	-
Rhincodon typus	Whale shark	V	Yes	-		-	RP, AS
Pipefish, seahorses and seadragons (signathids)							
Heraldia nocturna	Eastern Upside-down Pipefish	-	-	Yes	-	-	-
Hippocampus abdominalis	Big-bellied Seahorse	-	-	Yes	-	-	-
Hippocampus breviceps	Short-head Seahorse	-	-	Yes	-	-	-
Hippocampus minotaur	Bullneck Seahorse	-	-	Yes	-	-	-
Hippocampus whitei	White's Seahorse	-	-	Yes	-	-	-
Histiogamphelus briggsii	Brigg's Crested Pipefish	-	-	Yes	-	-	-
Histiogamphelus cristatus	Rhino Pipefish	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatene d species	Listed migratory species	Listed marine species			
Hypselognathus rostratus	Knifesnout Pipefish	-	-	Yes	-	-	-
Kaupus costatus	Deepbody Pipefish	-	-	Yes	-	-	-
Kimblaeus bassensis	Trawl Pipefish	-	-	Yes	-	-	-
Leptoichthys fistularius	Brushtail Pipefish	-	-	Yes	-	-	-
Lissocampus caudalis	Australian Smooth Pipefish	-	-	Yes	-	-	-
Lissocampus runa	Javelin Pipefish	-	-	Yes	-	-	-
Maroubra perserrata	Sawtooth Pipefish	-	-	Yes	-	-	-
Mitotichthys mollisoni	Mollison's Pipefish	-	-	Yes	-	-	-
Mitotichthys semistriatus	Halfbande d Pipefish	-	-	Yes	-	-	-
Mitotichthys tuckeri	Tucker's Pipefish	-	-	Yes	-	-	-
Notiocampus ruber	Red Pipefish	-	-	Yes	-	-	-
Physodurus eques	Leafy seadragon	-	-	Yes	-	-	-
Phyllopteryx taeniolatus	Common seadragon	-	-	Yes	-	-	-
Pugnaso curtirostris	Pugnose Pipefish	-	-	Yes	-	-	-
Solegnathus robustus	Robust Pipehorse	-	-	Yes	-	-	-
Solegnathus spinosissimus	Spiny Pipehorse	-	-	Yes	-	-	-
Stigmatopora argus	Spotted Pipefish	-	-	Yes	-	-	-
Stigmatopora nigra	Widebody Pipefish	-	-	Yes	-	-	-
Stipecampus cristatus	Ringback Pipefish	-	-	Yes	-	-	-

Scientific name	Common name	EPBC Act Status			FFG Act status	BIA within the EMBA?	Recovery Plan in place?
		Listed threatened species	Listed migratory species	Listed marine species			
Syngnathoides biaculeatus	Double-end Pipehorse	-	-	Yes	-	-	-
Urocampus carinirostris	Hairy Pipefish	-	-	Yes	-	-	-
Vanacampus margaritifer	Mother-of-pearl Pipefish	-	-	Yes	-	-	-
Vanacampus phillipi	Port Phillip Pipefish	-	-	Yes	-	-	-
Vanacampus poecilolaemus	Longsnout Pipefish	-	-	Yes	-	-	-

Definitions and key as per Table 5.9.

Figure 5.25 illustrates the presence and absence of the non-signathid oceanic and freshwater fish species (along with some crustaceans and molluscs) throughout the year, noting that the signathids are present year-round.

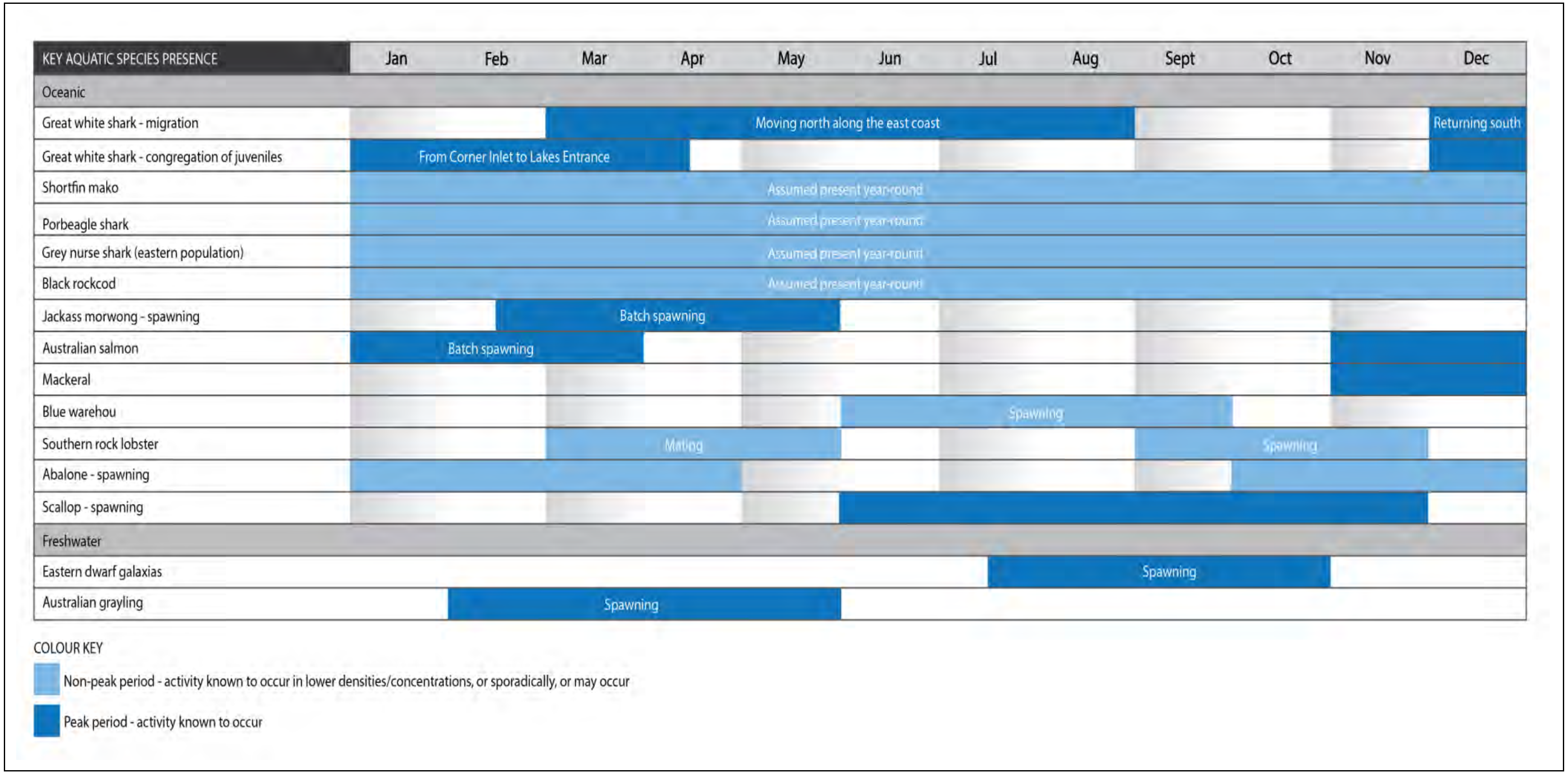


Figure 5.25. The annual presence and absence of key threatened fish species and fish, crustacean and molluscs species of commercial value in the spill EMBA

Eastern dwarf galaxias (EPBC Act: Vulnerable, FFG Act: Threatened)

Habitat suitable to the eastern dwarf galaxias (*Galaxiella pusilla*) is slow flowing and still, shallow, permanent and temporary freshwater habitats such as swamps, drains and the backwaters of streams and creeks, often containing dense aquatic macrophytes and emergent plants (Saddlier *et al*., 2010).

Given the marine nature of the activity, it is not likely that eastern dwarf galaxias' will be encountered in the operational area or spill EMBA due to its preference for freshwater habitats.

Australian grayling (EPBC Act: Vulnerable, FFG Act: Threatened)

The Australian grayling (*Prototroctes maraena*) is a dark brown to olive-green fish attaining 19 cm in length. The species typically inhabits the coastal streams of New South Wales, Victoria and Tasmania migrating between streams and the ocean (Backhouse *et al*., 2008; DELWP, 2015). The species spends most of its life in freshwater (DELWP, 2015) and migrates to lower reaches of rivers to spawn in autumn (Museums Victoria, 2019), though timing is dependent on many variables including latitude and varying temperature regimes (Backhouse *et al*., 2008), with increased stream flows also thought to initiate migration (Backhouse *et al*., 2008).

The Australian Grayling Action Statement (DELWP, 2015) lists Victorian rivers that flow into Bass Strait that are known habitat for this species. The Cann, Thurra, Wingan and Tarwin river mouths are intersected by the EMBA. The Australian grayling is known to occur on King Island however its mapped habitat occurs on the western coast of the island which is not intersected by the EMBA. The National Recovery Plan for the Australian Grayling (Backhouse *et al*., 2008) lists the Pieman, Arthur and Detention rivers in Tasmania as important rivers for the species, which are intersected by the EMBA at the respective river mouths The Australian Grayling Action Statement (DELWP, 2015) list the threatening processes to this species as barriers to movement, river regulation, poor water quality, siltation, introduced fish, climate change, diseases and fishing. It is unlikely that the Australian grayling is present in the operational area or spill EMBA due to its preference for freshwater stream and river habitats.

Black rockcod (EPBC Act: Vulnerable, FFG Act: Not listed)

The black rockcod (*Epinephelus daemelii)* is a large cod species distributed in warm temperate to temperate marine waters of south-eastern Australia, from southern Queensland to Mallacoota in Victoria (428 km northeast of Yolla-A and within the EMBA), and rarely west of this point (DSEWPC, 2012c). The species inhabits caves, gutters and crevices generally to depths of 50 m, with juveniles found inshore. Individuals are highly territorial and have small home ranges (DSEWPC, 2012c). The black rockcod is a protogynous hermaphrodite, meaning it changes sex from female to male during its life cycle. The species has declined in number due to angling and spearfishing (DSEWPC, 2012c). Given their known distribution, the black rockcod may occur in suitable habitat within the far-eastern area of the EMBA but is not likely to occur in the operational area. There are no records for this species in the VBA search for the EMBA.

Grey nurse shark (east coast population) (EPBC Act: CE, FFG Act: Threatened)

The grey nurse shark (*Carcharius Taurus)* (eastern population) is a large robust species that has become critically endangered due to commercial fishing, spearfishing and protective beach meshing (TSSC, 2001). It was historically widespread in sub-tropical and warm temperate seas and previously recorded from all Australian states except Tasmania, and have all but disappeared from Victorian waters (TSSC, 2001). Only one record of the species occurs from Gippsland, at Mallacoota Inlet in the early 1970s.

The species currently has a broad inshore distribution throughout sub-tropical to cool temperate waters on the continental shelf, with separate east coast and west coast populations (DoE, 2014b). The east coast population extends from central Queensland to southern NSW, occasionally as far south as the NSW/Victoria border (DoE, 2014b), which coincides with the BIA for their distribution and breeding (October to November).

Preferred habitat for grey nurse sharks is inshore rocky reefs or islands, generally aggregating near the seabed in water depths of 10-40 m in deep sandy or gravel filled gutters, or in rocky caves (DoE, 2014b). There are no aggregation sites located off the Victorian coast (DoE, 2014b).

Given the current distribution of the grey nurse shark, it is unlikely to occur within the operational area or spill EMBA in significant numbers. There are no records for this species in the VBA search for the EMBA.

Syngnathids (EPBC Act: Listed marine species, FFG Act: Not listed)

There are 31 species of syngnathids (pipefish, seahorse and pipehorse) recorded in the EPBC Act PMST as potentially occurring in the operational area and EMBA (see Table 5.13). The majority of these fish species are associated with seagrass meadows, macroalgal seabed habitats, rocky reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep (Museums Victoria, 2019). They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as *Sargassum*.

The PMST species profile and threats profiles indicate that the sygnathids listed for the EMBA are widely distributed throughout southern, south-eastern and south-western Australian waters (DAWE, 2020b). The diverse range of ecological niches afforded by the shallow waters of the operational area and EMBA would be expected to provide suitable habitat for these species, possibly including the RGP itself. Considering the preferred depth range for these species, it is unlikely that there will be any suitable habitat in the area for these species around Yolla-A, but they are likely to be present within the shallow nearshore waters of the operational area and spill EMBA at all times of the year.

Great white shark (EPBC Act: Vulnerable, FFG Act: Threatened)

The great white shark (*Carcharodon carcharias*) is widely distributed and located throughout temperate and sub-tropical waters. The known range in Australian waters includes all coastal areas except the Northern Territory (DSEWPC, 2013b) (Figure 5.26).

Studies indicate that the great white shark is usually a solitary animal, largely transient in areas it inhabits for days to weeks (DSEWPC, 2013b). Individuals are known to return to feeding grounds on a seasonal basis (Klimley and Anderson, 1996). The species moves seasonally along the south and east Australian coasts, moving northerly along the coast during autumn and winter and returning to southern Australian waters by early summer.

Observations of adult great white sharks in or near the spill EMBA area are more frequent around Australian fur-seal colonies (see Figure 5.24) including Wilsons Promontory and Seal Rocks, Phillip Island.

Juveniles are known to congregate along Ninety Mile Beach from Corner Inlet to Lakes Entrance. Museums Victoria (2019) indicates that Corner Inlet may be an important nursery area for the eastern population of great white sharks mostly from mid-summer through to autumn (DSEWPC, 2013b).

Key threats to the species as listed in the White Shark Recovery Plan (DSEWPC, 2013b) are mortality from targeted fishing, accidental fishing bycatch and illegal fishing and mortality from shark control activities such as beach meshing and drum-lining.

It is likely that great white sharks transit through the operational area and spill EMBA throughout the year, with a presence in the breeding area between Wilsons Promontory and Lakes Entrance from mid-summer through to autumn.

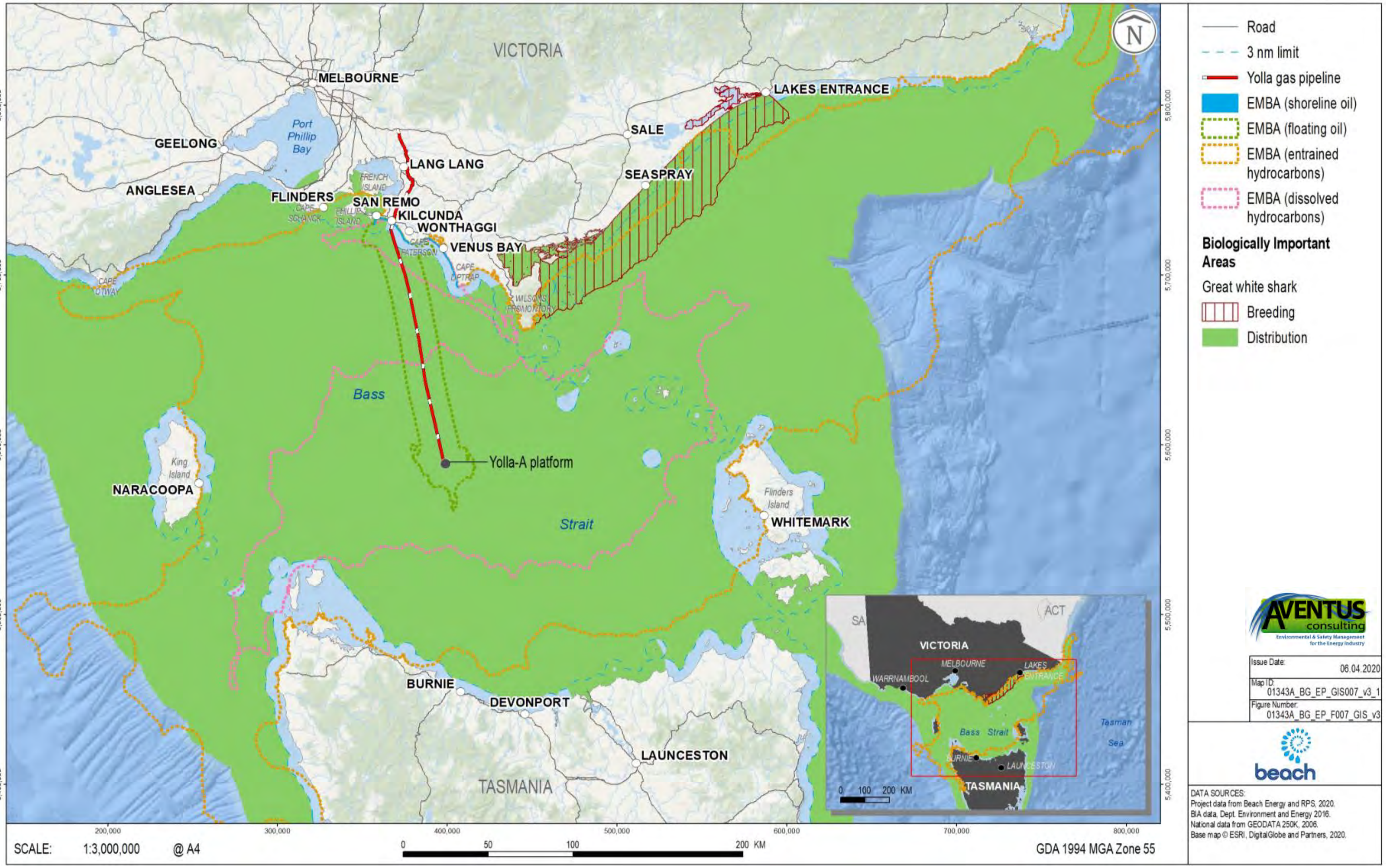


Figure 5.26. Great white shark BIA

Whale shark (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

The whale shark (*Rhincodon typus*) is the world's largest fish and one of only three filter feeding shark species (TSSC, 2015e). They have a broad distribution in warm and tropical waters of the world and in Australia are known only to occur on the west coast of Western Australia with a feeding aggregation occurring off the Ningaloo Reef between March and July each year (TSSC, 2015e). The species is not known to migrate through Bass Strait, and it is highly unlikely to migrate through the operational area or the spill EMBA.

Shortfin mako shark (EPBC Act: Listed migratory, FFG Act: Not listed)

The shortfin mako shark (*Isurus oxyrinchus*) is a pelagic species with a circum-global wide-ranging oceanic distribution in tropical and temperate seas (Mollet *et al*., 2000). It is widespread in Australian waters, commonly found in water with temperatures greater than 16°C (Museums Victoria, 2019). Populations of the shortfin mako shark are considered to have undergone a substantial decline globally. These sharks are common by-catch species of commercial fisheries (Mollet *et al*., 2000).

Due to their widespread distribution in Australian waters, shortfin mako sharks may migrate through the operational area and the spill EMBA throughout the year.

Porbeagle shark (EPBC Act: Listed migratory, FFG Act: not listed)

The porbeagle shark (*Lamna nasus*) is widespread in the southern waters of Australia (Museums Victoria, 2019). The species preys on bony fishes and cephalopods and is an opportunistic hunter that regularly moves up and down in the water column, catching prey in mid-water as well as at the seafloor. It is most commonly found over food-rich banks on the outer continental shelf and makes occasional forays close to shore or into the open ocean down to depths of approximately 1,300 m. It also conducts long distance seasonal migrations generally shifting between shallower and deeper water (Pade *et al*., 2009).

Due to their widespread distribution in Australian waters, porbeagle sharks may migrate through the operational area and the spill EMBA throughout the year.

Fish Species Recorded in the VBA

In addition to the EPBC Act-listed fish species addressed above, the VBA records indicate that 113 fish species have been recorded within the EMBA. The flatback mangrove goby (*Mugilogobius platynotus*) (one sighting) and Macquarie perch (*Macquaria australasica*) (two sightings) are listed as threatened under the FFG Act. The most commonly sighted fish species are wrasse, leatherjacket and perch (DELWP, 2020). The key species groups are described here. Unless otherwise referenced, this information is sourced from the *Fishes of Australia* online database (Museums Victoria, 2019).

Leatherjackets

Sightings of ten species of leatherjacket (toothbrush, gunn's, brown-striped, yellow-striped, six-spine, blue-lined, horseshoe, velvet, yellow-fin and rough) are recorded in the VBA database.

The toothbrush leatherjacket is the most commonly recorded with 164 sightings. Together, the leatherjacket species described here are widespread throughout Australia's southern waters, from Dongara, WA to Coffs Harbour, NSW. They are characterised by a set of spines at the rear of the body, sometimes in the form of bristles on each side of the body. Smaller leatherjacket species prefer estuary and harbour habitats with plenty of weed and reef cover while larger species are more likely encountered in offshore water ranging from 5 – 500 m in depth. Wharves, rock walls, jetties and wrecks are also preferred by leatherjackets where they shelter from predators and feed. As such, leatherjackets are most likely to found in the shallow nearshore waters of the operational area and spill EMBA.

Wrasse

Sightings of eight species of wrasse (castelnau's, snakeskin, purple, blue throated, southern Maori, senator, luculent and rosy) are recorded in the VBA database within the spill EMBA. The blue throated wrasse is the most commonly recorded with 471 sightings. Wrasses are typically small fish (less than 20 cm long), widespread in southern Australian water, brightly coloured and most found at depths of 2 – 60 m (though the rosy wrasse occurs in depths up to 200 m). They are efficient carnivores, feeding on a wide range of hard-shelled benthic invertebrates such as gastropods, bivalve molluscs, crabs, chitons, limpets and sea urchins. Juveniles feed mostly on small crustaceans such as amphipods and isopods and have also been seen removing parasites from other fish. Generally, wrasses are found in shallow-water habitats such as coral reefs, rocky shores, sheltered sandy areas and in general association with reef habitat where they live close to the substrate. Given their habitat preferences, it is likely that wrasse are present within the shallow nearshore waters of the operational area and spill EMBA at all times of the year.

Perch

Nine species of perch (butterfly, barber, magpie, reef ocean, blackbanded, halfbanded, banded, Macquarie and estuary) are recorded in the VBA database for the EMBA. The barber perch is most commonly sighted. The species described here (with the exception of estuary perch) are widely distributed across southern Australia and vary in their feeding behaviours.

Butterfly and barber perch form large schools that feed on plankton above high-profile rocky reefs, outcrops and drop-offs of 4-100 m water depth. They shelter in caves and crevices at night. The magpie perch typically inhabits protected and exposed coastal reefs, often sheltering in small groups in caves, where they feed by sucking benthic invertebrates such as molluscs and polychaete worms from the bottom sediment and patches of turf algae. Reef ocean perch feed on squid, shrimp and other fish among coastal rocky reefs and sandy areas usually in deeper water (up to 425 m). Estuary perch are endemic to coastal rivers and estuaries of south-eastern Australia, including coastal rivers in Bass Strait. Adults inhabit brackish water, preferring the upper reaches of estuaries. Adults migrate to the mouths of estuaries to spawn during winter. According to the Approved Conservation Advice for Macquarie parch, the species is found in the inland Murray-Darling basin river systems and are as such not expected to be present in the operational area or spill EMBA (DoE, 2013).

Other than Macquarie perch, the remaining perch are likely to be present in the operational area and spill EMBA.

Port Jackson Shark (EPBC Act: Not listed)

The Port Jackson shark (*Heterodontus portusjacksoni*) is a non-threatened migratory species endemic to the temperate water around the southern coast of Australia from southern Queensland, south to Tasmania, and west to the central coast of Western Australia. The shark's territory is on or near the sea bottom, which is also its feeding area. Rocky reefs are its most common habitat, though sandy sediments, mud flats and seagrass beds also comprise its habitat. During the day, when it is usually least active, it can be found sheltering in caves or under rocky outcrops. Its diet includes sea urchins, molluscs, crustaceans and fish.

Due to the Port Jackson shark's habitat preference and its known distribution, the species is unlikely to be present in the operational area but likely to be present in the spill EMBA.

5.5.8 Reptiles

Four species of marine turtle are listed under the EPBC Act as potentially migrating through the operational area and spill EMBA, as listed in Table 5.14. No BIAs for turtles occur within Bass Strait. EA (2003) reports that the turtles known to occur in Victorian waters are considered to be rare vagrants outside their usual range. No turtles are listed as threatened under the FFG Act 1988 (Vic), except for the leatherback turtle. The VBA search for the spill EMBA does not include any additional records for marine turtles.

Additionally, Wilson and Swan (2005) report that 31 species of sea snake and two species of sea kraits occur in Australian waters, though none of these occurs in waters of the southern coast of Australia, with the exception of the yellow-bellied sea snake (*Pelamis platurus*) that extends into waters off the Victorian coast, with 14 records in the VBA database for the spill EMBA. This species is the world's most widespread sea snake and feeds on fish at the sea surface (Wilson and Swan, 2005).

Table 5.14.EPBC Act-listed reptiles that may occur in the operational area and spill EMBA

Scientific name	**Common name**	**EPBC Act Status**			**FFG Act status**	**BIA within the EMBA?**	**Recovery Plan in place?**
		Listed threatened species	**Listed migratory species**	**Listed marine species**			
Caretta caretta	Loggerhead turtle	E	Yes	Yes	-	-	Generic RP in place for all marine turtle species, + AS or leather-back turtle
Chelonia mydas	Green turtle	V	Yes	Yes	-	-	
Dermochelys coriacea	Leatherback turtle	E	Yes	Yes	T	-	
Eretmochelys imbricate	Hawksbill turtle	V	Yes	Yes	-	-	

Definitions and key as per Table 5.9.

Loggerhead turtle (EPBC Act: Endangered, listed migratory, FFG Act: Not listed)

The loggerhead turtle (*Caretta caretta*) is globally distributed in sub-tropical waters (Limpus, 2008a) including eastern, northern and western Australia (DoEE, 2017), and is rarely sighted off the Victorian coast.

The main Australian breeding areas for loggerhead turtles are generally confined to southern Queensland and Western Australia (Cogger *et al*., 1993). Loggerhead turtles will migrate over distances in excess of 1,000 km, and show a strong fidelity to their feeding and breeding areas (Limpus, 2008a). Loggerhead turtles are carnivorous, feeding primarily on benthic invertebrates such as molluscs and crabs in depths ranging from nearshore to 55 m (DoEE, 2017) in tidal and sub-tidal habitats, reefs, seagrass beds and bays (DoEE, 2017).

No known loggerhead foraging areas have been identified in Victoria waters (DoEE, 2017). As such, this species is only likely to occur within the operational area or spill EMBA as vagrant individuals.

Green turtle (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

The green turtle (*Chelonia mydas*) is distributed in sub-tropical and tropical waters around the world (Limpus, 2008b; DoEE, 2017). In Australia, they nest, forage and migrate across tropical northern Australia. Mature turtles settle in tidal and sub-tidal habitat such as reefs, bays and seagrass beds where they feed on seagrass and algae (Limpus, 2008b; DoEE, 2017).

There are no known nesting or foraging grounds for green turtles in Victoria and they occur only as rare vagrants (DoEE, 2017). The DoEE (2017) maps the green turtle as having a 'known' or 'likely' range within Bass Strait and as such, there is a low probability that this species occurs within the operational area or spill EMBA.

Leatherback turtle (EPBC Act: Endangered, listed migratory, FFG Act: Threatened)

The leatherback turtle (*Dermochelys coriacea*) is widely distributed throughout tropical, sub-tropical and temperate waters of Australia (DoEE, 2017) including oceanic waters and continental shelf waters along the coast of southern Australia (Limpus, 2009). Unlike other marine turtles, the leatherback turtle utilises cold water foraging areas with reported foraging along the coastal waters of central Australia (southern Queensland to central New South Wales), southeast Australia (Tasmania, Victoria and eastern South Australia) and southern Western Australia (Limpus, 2009).

This species feeds on soft-bodied invertebrates including jellyfish (Limpus, 2009).

No major nesting has been recorded in Australia, with isolated nesting recorded in the Northern Territory, Queensland and northern New South Wales (DoEE, 2017). This species nests only in the tropics. The DoEE (2017) maps the leatherback turtles as having a known or likely range within Bass Strait and a migration pathway in southern waters.

The operational area and spill EMBA area do not represent critical habitat for the species; it may occur in low numbers during migration.

Hawksbill turtle (EPBC Act: Vulnerable, listed migratory, FFG Act: Not listed)

The hawksbill turtle is widely distributed in the tropical and sub-tropical waters of Australia. Their eggs are laid on warm beaches with the most important nesting sites for the species located in northern Queensland, north-east Arnhem Land and Western Australia (DoEE, 2017). Adult hawksbill turtles are primarily found in tropical reefs where they are usually seen resting in caves and ledges or otherwise feeding on sea sponges. No major nesting sites have been recorded in Victoria or Tasmania, however the DoEE (2017) maps the hawksbill turtle as having a known or likely range in eastern Bass Strait.

The operational area and spill EMBA area do not intersect any known nesting beaches of the hawksbill turtle; it may occur as vagrant individuals during migration.

5.5.9 **Marine Pests**

It is widely recognised that marine pests can become invasive and cause significant impacts on economic, ecological, social and cultural values of marine environments. Impacts can include the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities (Brusati and Grosholz, 2007).

In the South-east Marine Region, 115 marine pest species have been introduced and an additional 84 have been identified as possible introductions, or 'cryptogenic' species (NOO, 2002). Several introduced species have become pests either by displacing native species, dominating habitats or causing algal blooms.

Marine pests known to occur in Bass Strait, according to Parks Victoria (2015) and Butler et al (2012) include:

- Pacific oyster (*Crassostrea gigas*) – small number of this oyster species are reported to occur in Western Port Bay and at Tidal River in the Wilsons Promontory National Park.
- Northern pacific seastar (*Asterias amurensis*) – prefer soft sediment habitat, but also use artificial structures and rocky reefs, living in water depths usually less than 25 m (but up to 200 m water depths). It is thought to have been introduced in 1995 through ballast water from Japan. In the VFA's recent scallop abundance survey (see Section 5.4.1), it is noted that no northern pacific seastars were observed.
- New Zealand screw shell (*Maoricolpus roseus*) – lies on or partially buried in sand, mud or gravel in waters up to 130 m deep. It can densely blanket the sea floor with live and dead shells and compete with native scallops and other shellfish for food. This species is known to be present in the Port Phillip and the Western Port region.
- European shore crab (*Carcinus maenas*) – prefers intertidal areas, bays, estuaries, mudflats and subtidal seagrass beds, but occurs in waters up to 60 m deep. It is widespread across Victorian intertidal reef and common in Western Port.
- Dead man's fingers (*Codium fragile ssp. fragile*) – Widespread in Port Phillip and known to inhabit San Remo and Newhaven in Western Port. It grows rapidly to shade out native vegetation and can regenerate from a

broken fragment enabling easy transfer from one area to another. Attaches to subtidal rocky reed and other hard surfaces.

- Asian date mussel (*Musculista senhousia*) – prefers soft sediments in waters up to 20 m deep, forming mats and altering food availability for marine fauna.
- Cord grass (*Spartina anglica* and *Spartina x townsendii sp*) – found at the mouth of Bass River and in drain outlets near Tooradin in Western Port. Widespread in South Gippsland including Anderson's Inlet and Corner Inlet. Invades native saltmarsh, mangroves and mudflats, altering the mud habitat and excluding other species.

5.6 Cultural Heritage

Cultural heritage can be broadly defined as the legacy of physical science artefacts and intangible attributes of a group or society that are inherited from past generations, maintained in the present and bestowed for the benefit of future generations. Cultural heritage includes tangible culture such as buildings, monuments, landscapes, books, works of art, and artefacts, as well as intangible culture such as folklore, traditions, language, and knowledge, and natural heritage including culturally significant landscapes.

This section describes the cultural heritage values broadly categorised as Aboriginal and European heritage within the operational area and spill EMBA, noting that the boundary of the spill EMBA includes the coastline up to the high-water mark.

5.6.1 Aboriginal Heritage

<u>Victoria</u>

Gunaikurnai people are the traditional owners of Gippsland. There are currently approximately 3,000 Gunaikurnai people and the territory includes the coastal and inland areas to the southern slopes of the Victorian Alps. Gunaikurnai people are made up of five major clans (GLaWAC, 2018).

The Gippsland, northern Tasmanian and Bass Strait islands coastlines are of Aboriginal cultural heritage significance. Coastal fishing is an important part of Aboriginal culture with fishing methods including hand gathering, lines, rods and reels, nets, traps and spears (DoE, 2015a). It has been estimated that between 5,000 and 10,000 indigenous Australians occupied Tasmania prior to European settlement. Indigenous peoples in the area fished and collected shellfish, and seals and mutton birds were also important sources of food (DoE, 2015a).

The Victorian Aboriginal Heritage Register contains details of Aboriginal cultural heritage places and objects areas along the coastline and is not publicly accessible in order to maintain culturally sensitive information.

Crustaceans (e.g., rock lobster, crab) and shellfish formed an important part of the diet of Aboriginals living along the coast. There are numerous areas containing Aboriginal shell middens (i.e., the remains of shellfish eaten by Aboriginal people) along the sand dunes of the Gippsland coast. Coastal shell middens are found as layers of shell exposed in the side of dunes, banks or cliff tops or as scatters of shell exposed on eroded surfaces. These areas may also contain charcoal and hearth stones from fires, and items such as bone and stone artefacts, and are often located within sheltered positions in the dunes, coastal scrub and woodlands. Other archaeological sites present along the Gippsland coast include scar trees and assorted artefact scatters (Basslink, 2001).

<u>Tasmania</u>

Aboriginal people have inhabited Tasmania for at least 35,000 years. At the end of the last ice age the sea level rose, and Tasmania became isolated from the mainland of Australia. They survived in the changing landscape partly due to their ability to harvest aquatic resources, such as seals and shellfish. Following conflict between the European colonists and the Tasmanian Aboriginal peoples, leading to the relocation of people to missions on Bruny Island, Flinders Island and other sites, and finally to Oyster Cove, their numbers diminished drastically. The Aboriginal Heritage Register (AHR) lists over 13,000 sites; however, there is no searchable database to identify any sites in the EMBA. There are known sites that occur on the west coast of Tasmania associated with the West Tasmanian Aboriginal Cultural Landscape (as described in Section 5.4.3). It must be assumed that sites will be scattered along the coast of King Island, Flinders Island and the broader area of the spill EMBA.

5.6.2 Native Title

Victoria

In 2010, the Federal Court recognised that the Gunaikurnai holds native title over much of Gippsland. On the same day the state entered into an agreement with the Gunaikurnai under the *Traditional Owner Settlement Act 2010*. The agreement area extends from west Gippsland near Warragul and Inverloch east to the Snowy River and north to the Great Dividing Range. It also includes 200 metres of sea country offshore. The determination of native title under the *Native Title Act* 1993 covers the same area (GLaWAC, 2019). The agreement and the native title determination only affect undeveloped Crown land within the Gippsland region.

The Gunaikurnai and Victorian Government Joint Management Plan was approved by the Minister for Energy, Environment and Climate Change in July 2018. The plan guides the partnership between the Gunaikurnai people and the Victorian Government in the joint management of the ten parks and reserves for which the Gunaikurnai have gained Aboriginal Title as a result of their 2010 Recognition and Settlement Agreement with the Victorian Government.

An additional native title claim is intersected by the EMBA that includes Cape Otway and the waters 100 m seaward from the mean low-water mark of the coastline. In 2012, the Eastern Maar traditional owner group lodged a native title determination application in the Federal Court of Australia which was registered on 20 March 2013. The Eastern Maar Aboriginal Corporation manages these native titles rights for Eastern Maar Peoples. The Eastern Maar traditional owner group and the State of Victoria have agreed to negotiate a Recognition and Settlement Agreement under the *Traditional Owner Settlement Act* 2010.

New South Wales

In 2017, the South Coast People lodged a native title claim in the Federal Court of Australia that was registered on 31 January 2018. The South Coast people's claim covers 16,808 km^2, extending south from Sydney to Eden, along the south coast of NSW and west towards Braidwood and also extends 3 nm seaward.

Tasmania

There are no registered native title claims in Tasmania.

5.6.3 Maritime Archaeological Heritage

Shipwrecks

Shipwrecks over 75 years old are protected within Commonwealth waters under the *Historic Shipwrecks Act* 1976 (Cth), in Victorian waters under the *Victorian Heritage Act* 1995 (Vic), and in Tasmanian waters under the *Historic Cultural Heritage Act* 1995 (Tas).

There are 255 shipwrecks mapped within the spill EMBA using a search of the Australian National Shipwreck Database (DAWE, 2020g) (Figure 5.27).

The nearest shipwreck to Yolla-A is the *Victoria* (shipwreck ID 6769), located 49 km east-northeast of Yolla-A. There is little information about this shipwreck other than the fact it was wrecked in 1908.

The nearest shipwrecks to the offshore RGP are the:

- *Agnes* – shipwreck ID 5931, located 2 km west of the pipeline and 12 km from the nearest shoreline;
- *Maori* – shipwreck ID 6393, located 1.5 km west of the pipeline and 4 km from the nearest shoreline; and

- *Eli Lafond* – shipwreck ID 6145, located 100 m east of the pipeline and 900 m from the nearest shoreline.

Shipwreck Protection Zones

Of the 650 shipwrecks in Victoria, nine have been placed within protected zones (a no-entry zone of 500-m radius [78.5 ha] around a particularly significant and/or fragile shipwreck) (DAWE, 2020g). Five of these are located within Port Phillip Bay, and two along the west Gippsland coast, these being the *PS Clonmel* (just outside Corner Inlet) and the *SS Glenelg* (187 km northeast of Yolla-A). The *SS Glenelg* is intersected by the spill EMBA and is described below.

SS Glenelg (1900) is one of the worst maritime disasters in Victorian history with the deaths of 38 people and only three survivors. After the wreck was discovered, it was subject to heavy looting and was placed in a protected zone to help prevent further theft. Maritime archaeologists also want to study the remains of the hull as the may provide unknown technical details of iron ship building, details of the refit the vessel underwent in 1898 and information pertaining to life on board a typical cargo/passenger vessel at the turn of the century (DAWE, 2020g).

Lighthouses

There are numerous lighthouses in central Bass Strait (Figure 5.28), with the nearest lighthouse to Yolla-A being that on Citadel Island to the west of Wilsons Promontory, 100 km north of Yolla-A. There are 28 lighthouses in line of site to Yolla-A in the circle encompassing Wilsons Promontory, Flinders Island, King Island and the north coast of Tasmania.

All these lighthouses are located above the high-water mark and therefore outside the spill EMBA.

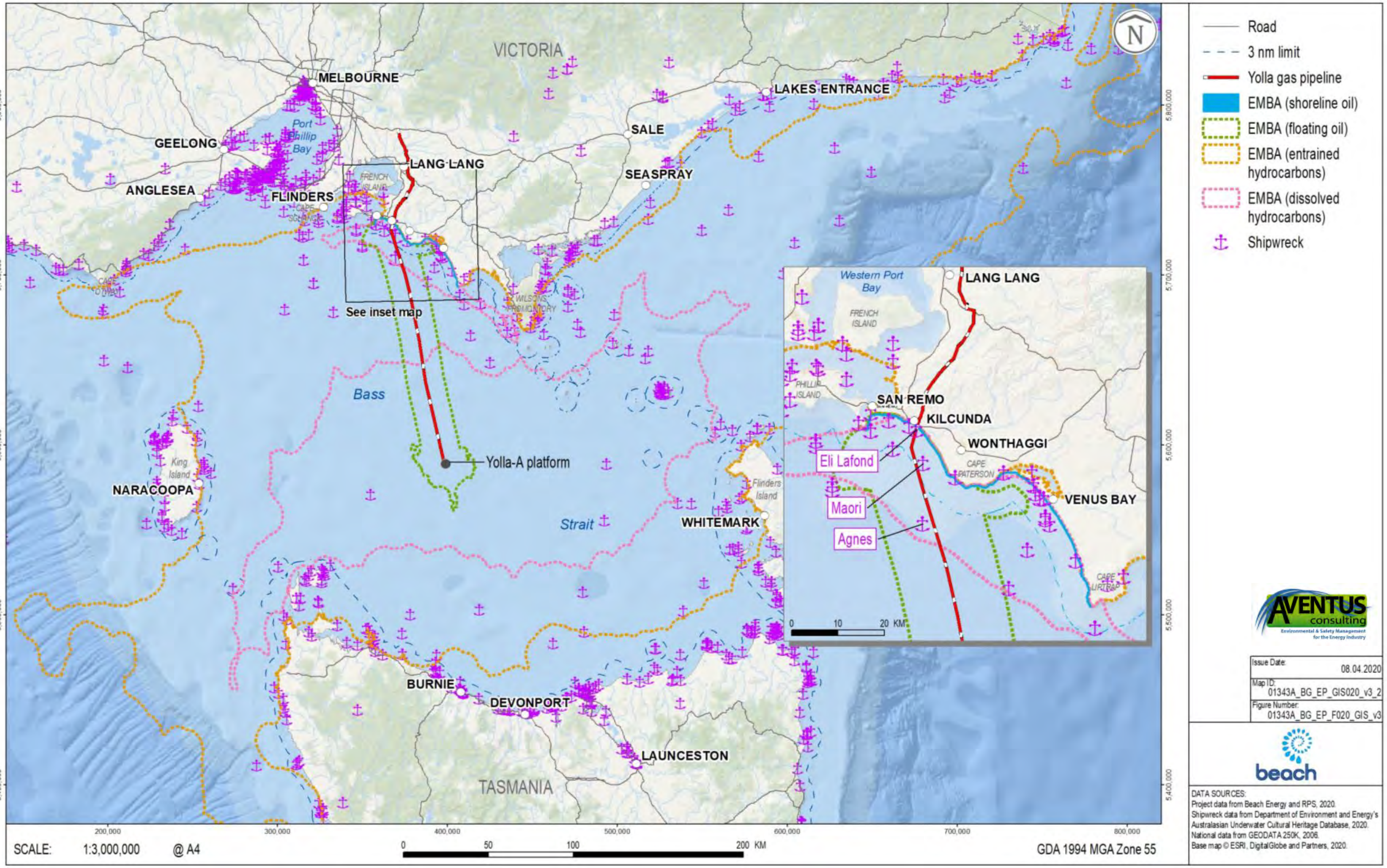


Figure 5.27. Known shipwrecks in the EMBA

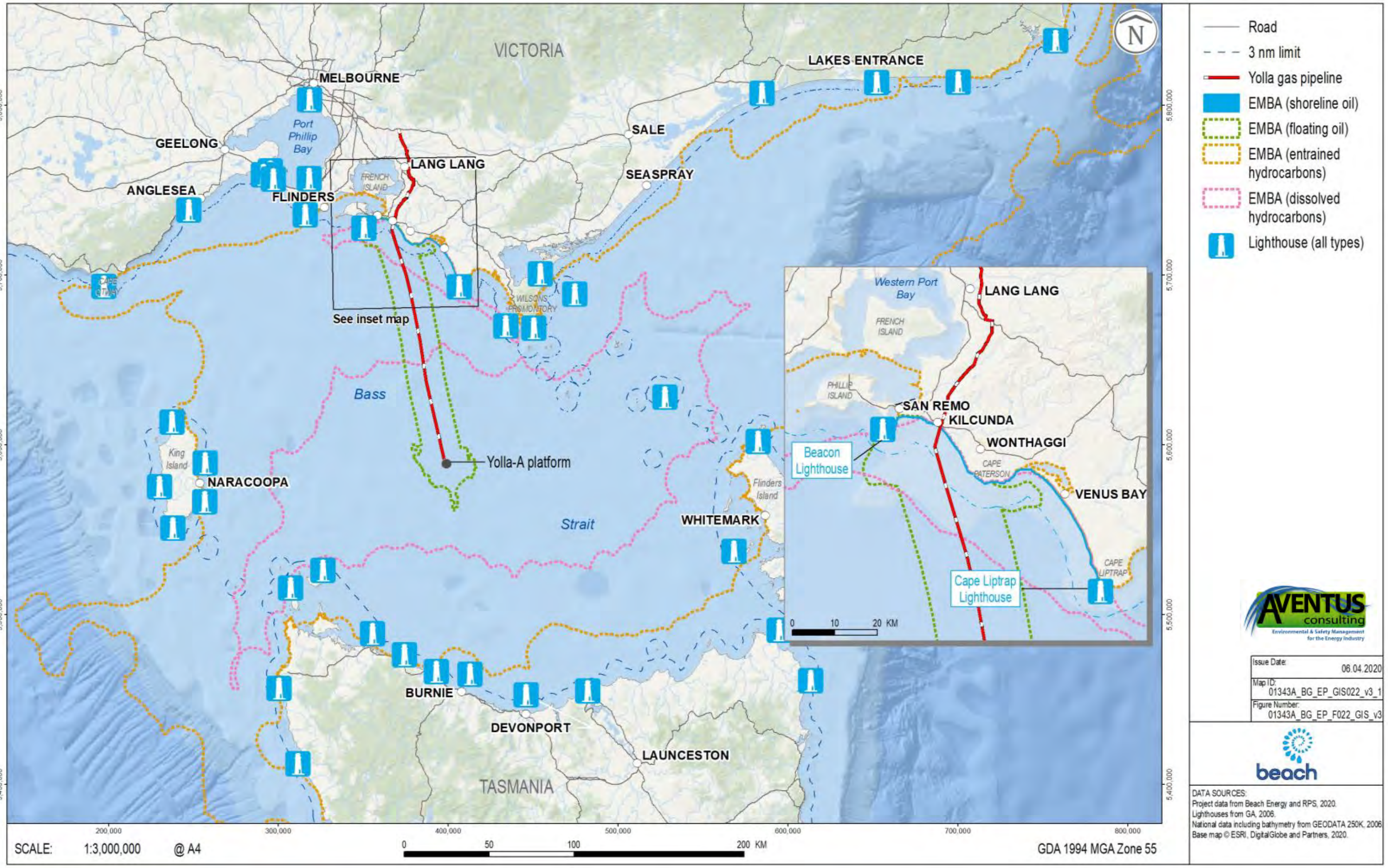


Figure 5.28. Bass Strait lighthouses

5.7 Socio-economic Environment

This section describes the social and economic environment of the operational area and spill EMBA. Note, only coastal settlements that are modelled to be potentially exposed to shoreline loading of hydrocarbons under the spill scenarios are described here.

5.7.1 Coastal Settlements

Victoria

The pipeline shore crossing is located in the Bass Coast Shire. The Bass Coast Shire is located in south-eastern Victoria, about 130 kilometres south-east of the Melbourne CBD and is a popular holiday destination. Bass Coast Shire is bounded by Western Port Bay in the north and west, Cardinia Shire in the north-east, South Gippsland Shire in the east, and Bass Strait in the south.

Australian Bureau of Statistics (ABS) data from the 2016 census for the Bass Coast Shire indicates that it has a population of 34,804 with a median age of 50 and with Aboriginal people making up 0.9% of the population. The Shire covers an area of 864 km^2, 88% of which is used for primary production.

The nearest towns to the RGP shore crossing and along the coast of the EMBA are briefly described below based on ABS (2016) census data:

- Kilcunda has a population of 396 people and a median age of 51. Of those in the labour force, 51.7% worked full-time and 37.8% worked part-time. Professionals, managers and technicians and trade workers made up 52.4% of the population's occupations.
- Wonthaggi has a population of 4,965 people and a median age of 52, occupying 2,400 dwellings. The greatest proportion of the population are employed as technicians, trade workers and labourers.
- Cape Paterson has a population of 891 people and a median age of 52. There are 1,077 private dwellings and the median weekly household income is $897. Professionals and technicians and trades workers were the two most common occupations at 22.4% and 17.6%, respectively.
- Cape Woolamai (Phillip Island) has a population of 1,549 and a median age of 38. It has 1,629 private dwellings, of which only 35.1% are permanently occupied, reflecting its popularity as a holiday home destination.
- Inverloch, with a population of 5,437, had 47.6% of its 4,290 dwellings permanently unoccupied. The area is a popular tourist destination, particularly for swimming, kitesurfing and windsurfing in the calm waters of Anderson Inlet. Fishing and surfing are also popular.

Tasmania

There are no Tasmanian coastal settlements along shorelines modelled to be potentially exposed to shoreline loading of hydrocarbons in the event of a spill.

New South Wales

There are no NSW coastal settlements along shorelines modelled to be potentially exposed to shoreline loading of hydrocarbons in the event of a spill.

5.7.2 Offshore energy exploration and production

In 2018, Victoria accounted for 11% of Australia's crude oil production, 11% of Australia's condensate production, 49% of Australia's LPG production and 10% of Australia's conventional gas production (APPEA, 2019). Production has been trending down since it peaked in 2000.

The spill EMBA intersects the Gippsland oil and gas production province, which contains numerous offshore platforms, subsea wells and pipelines. Petroleum production from the offshore Gippsland Basin is centred on the

Esso Australia Resources Pty Ltd (EARPL) operations for the Gippsland Basin Joint Venture. EARPL produces oil and gas from 23 platforms and subsea developments, hundreds of wells and some 880 km of associated pipelines, tied back to the Longford Gas Plant and Long Island Point. Production first commenced in 1969 from the Barracouta field. The latest fields to come into production were the Kipper-Tuna-Turrum oil and gas fields in 2013.

The spill EMBA overlaps the Tasmanian Gas Pipeline, which connects the Victorian and Tasmanian gas networks (Figure 5.29). The subsea section of this pipeline is 301 km long and has a capacity of 47 PJ/annum (TGP, 2019).

The spill EMBA intersects the investigation area of the Star of the South Wind Farm (130 km northeast of Yolla-A), which is the first proposed offshore wind farm in Australia. The project involves installation of offshore wind turbines and offshore substations, submarine cables from the wind farm to the Gippsland coast and a transmission network of cables and substations connecting to the La Trobe Valley. The project is currently in its feasibility phase with preliminary site investigations such as metocean, geophysical, geotechnical and environmental studies underway.

5.7.3 Other Infrastructure

The Victorian Desalination Plant, located at Wonthaggi, is located 140 km north of Yolla-A. Operation of the plant commenced in December 2012. The seawater intake and outlet structures are connected to the onshore plant via a 1.2 km and 1.5 km underground tunnel, respectively. The BassGas RGP is located approximately 3 km west of the intake and outlet structures (Figure 5.29). The two intake structures are 8 m high, 13 m in diameter, situated 50 m apart and located in a water depth of 20 m. They draw in water at very low speeds (the suction effect is not strong enough to draw fish in).

There are two Telstra telecommunications cables located 5 km and 6.5 km east of Yolla-A, with another telecommunications cable located 29 km to the west of Yolla-A (see Figure 5.29). This western telecommunication cable intersects the offshore RGP at a point 33 km off the Victorian coast.

5.7.4 Tourism

Marine-based tourism and recreation in Bass Strait is primarily associated with recreational fishing, boating and ecotourism.

Seaside towns are the primary destinations that attract tourists and holidaymakers to the south coast of Victoria and northwest coast of Tasmania. These coastal communities are popular tourist towns for their boating and fishing activities, along with bushwalking, bird watching and other nature-focused activities. Towns including Inverloch, Venus Bay, Cape Paterson and Cape Woolamai in Victoria are especially popular in summer as well. The George Bass Coastal Walk is one such nature-focused activity that stretches from the outskirts of San Remo to Kilcunda and features a cliff-top trail that follows the route of explorer George Bass and offers spectacular views of the coastline. It is estimated that the tourism industry in Bass Coast has generated approximately $245 million and supports approximately 1,426 jobs in the region (Remplan, 2019).

At Stanley on the northwest coast of Tasmania, The Nut provides a range of tourism and recreational opportunities including scenic viewing, walking, picnicking and nature study, which were enjoyed by an estimated108,500 interstate and overseas visitors in 1999 (PWS, 2003).

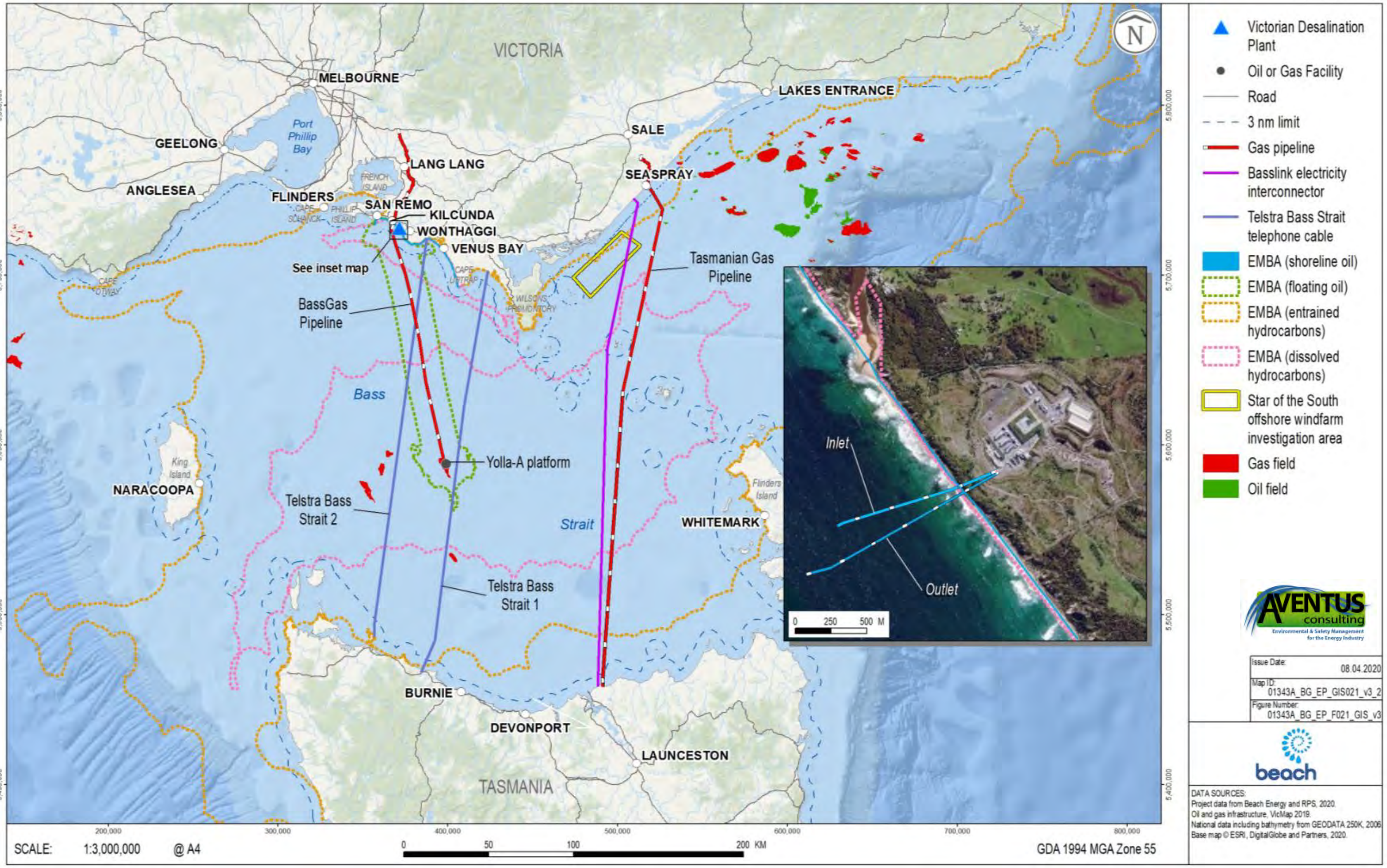


Figure 5.29. Bass Strait subsea infrastructure in the EMBA

5.7.5 Recreation

Recreational fishing along the Bass, Gippsland typically targets snapper, King George whiting, flathead, bream, sharks, tuna, calamari, and Australian salmon. Along the Tasmanian north coast, a range of recreational species are targeted including salmon, bream, tuna and rock lobster using gear including rods, nets and pots.

The Kilcunda Lobster Festival is held annually in late January in the town of Kilcunda (where the pipeline comes ashore) as a fundraising event. The festival draws nearly 7,000 people each year and celebrates all things lobster. The Sam Remo fishing festival (located 11 km from the RGP shore crossing) is held in September each year, with the main event being the 'blessing of the fleet' (to ensure safe journeys and a bountiful season).

As Bass Strait is relatively shallow, the water currents through the Bass Strait can create unpredictable seas, reducing the numbers of small recreational boats from venturing long distances from shore. Larger game fishing boats are likely to fish further out to sea and use boat ramps and marinas along the Victorian coast of the spill EMBA (e.g., Inverloch, San Remo, Cape Paterson and New Haven).

Businesses provide for the equipment needs of fishermen and fishing tours along the Bass Coast. Competitions such as the San Remo Easter Fishing Competition, held annually over the Easter long weekend, and community groups such as the Anderson Inlet Angling Club are examples of recreational fishing's popularity in the region.

Recreational diving and snorkelling are popular activities with a diverse range of sites in around the Victorian and Tasmanian coast. Open water dives to shipwrecks off the coast of Wilsons Promontory, such as the wreck of the *SS Cambridge* and the *SS Gulf of Carpentaria* are also common spots for recreational divers.

5.7.6 Commercial Fisheries

The operational area and spill EMBA intersects several Commonwealth-, Victorian- and Tasmanian-managed commercial fisheries. These are described here.

<u>Commonwealth-managed fisheries</u>

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA) under the *Fisheries Management Act* 1991 (Cth). AFMA jurisdiction covers the area of ocean from 3 nm from the coast out to the 200 nm limit (the Australian Fishing Zone (AFZ)). Commonwealth commercial fisheries with jurisdictions to fish within the EMBA are the:

- Bass Strait Central Zone Scallop Fishery (50% overlap with the spill EMBA);
- Eastern Tuna and Billfish Fishery (3.3% overlap with the spill EMBA);
- Eastern Skipjack Tuna Fishery (3.3% overlap with the spill EMBA);
- Southern Bluefin Tuna Fishery (1.3% overlap with the spill EMBA);
- Small Pelagic Fishery (eastern sub-area) (3.5% overlap with the spill EMBA);
- Southern Squid Jig Fishery (4.5% overlap with the spill EMBA); and
- Southern and Eastern Scalefish and Shark (SESS) Fishery, incorporating.
  - Gillnet and Shark Hook sector (8.0% overlap with the spill EMBA).
  - Commonwealth Trawl sector (10.0% overlap with the spill EMBA).
  - Scalefish Hook sector (4.7% overlap with the spill EMBA).

Table 5.15 summarises the key information for each of these fisheries and indicates that the Bass Strait Central Zone Scallop Fishery, the Small Pelagic Fishery, the Southern Squid Jig Fishery and the shark gillnet sector of the

SESS Fishery are actively fishing in the spill EMBA. Detailed mapping is provided where there is overlap between recent fishing intensity and the spill EMBA.

As detailed in Table 4.3, Beach's consultation with Commonwealth fishery industry representatives indicates they have no material concerns about potential conflicts between their operations and the ongoing BassGas operations. The small area of overlap between the spill EMBA and Commonwealth fisheries, together with the fact that many of the Commonwealth fisheries listed above do not actively fish around the BassGas development or in the spill EMBA, is likely to be the key reason for the lack of concern expressed to Beach.

Table 5.15. Commonwealth-managed commercial fisheries in the operational area and spill EMBA

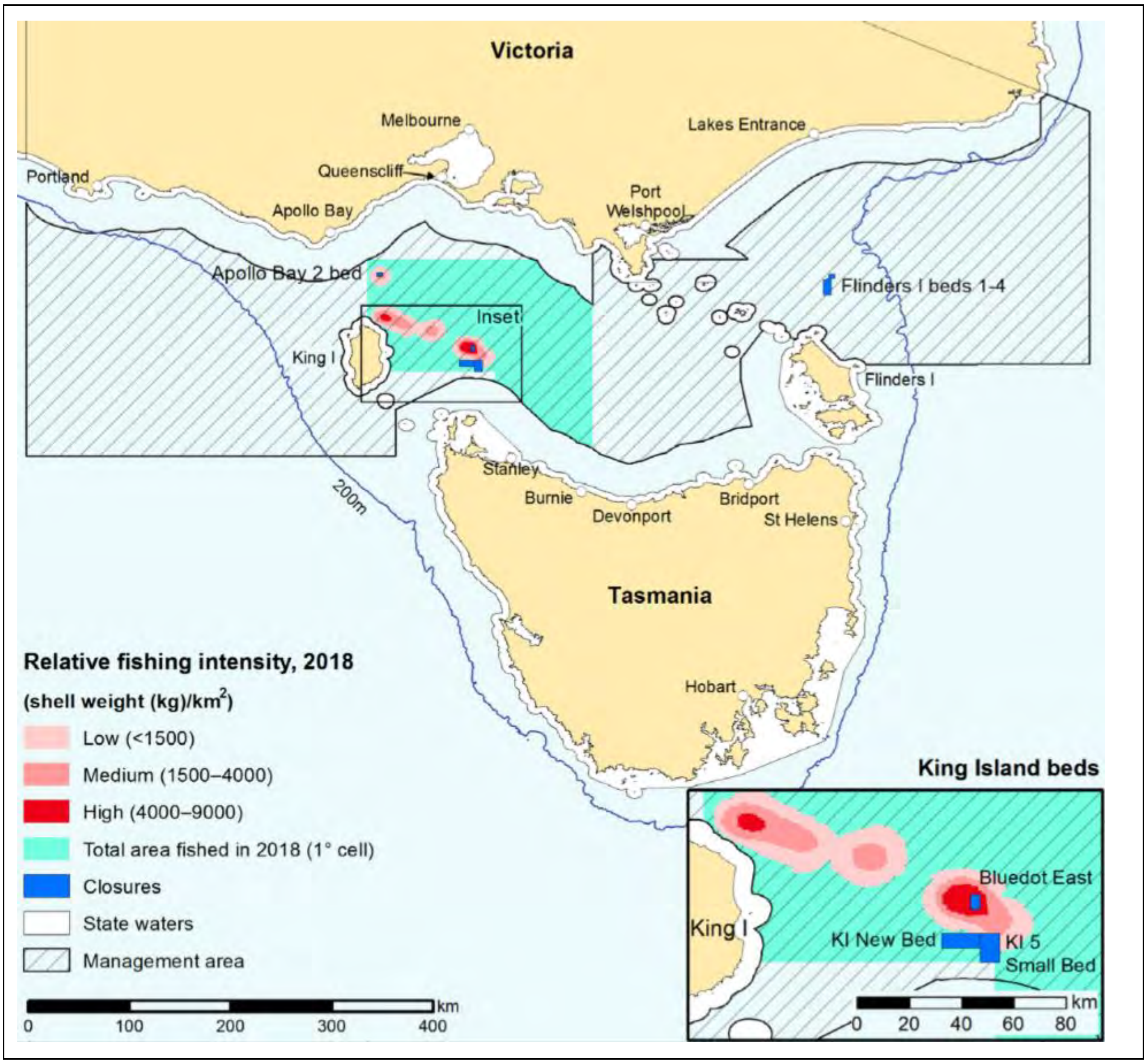
Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Bass Strait Central Zone Scallop Fishery (Figure 5.30)	Commercial scallop (*Pecten fumatus*)	Central Bass Strait area that lies within 20 nm of the Victorian and Tasmanian coasts. Fishery does not operate in state waters. Fishing effort is concentrated east of King Island, off Apollo Bay and north of Flinders Island.	**Yes.** There is a very tiny overlap between the western extent of the EMBA and the King Island scallop fishing grounds. The spill EMBA intersects 50% of the fishery. Scallop fishers have advised Beach that the muddy sediments around Yolla-A are not suitable for scallop settlement and therefore there is no catch effort around Yolla-A.	1st April to 31st December.	Towed scallop dredges that target dense aggregations ('beds') of scallops. 65 fishing permits are in place. 12 vessels were active in the fishery in 2018, a decrease from 26 active vessels in 2009, reflecting the 'boom or bust' nature of the fishery.	• 2018 – 3,253 tonnes. The economic value data was not available at time of writing. • 2017 – 2,929 tonnes worth $6.7 million. • 2016 – 2,885 tonnes worth $4.6 million. • 2015 – 2,260 tonnes worth $2.8 million. • 2014 – 1,418 tonnes worth $0.5 million. Scallop spawning occurs from winter to spring (June to November), with timing dependent on environmental conditions such as wind and water temperature.
Eastern Tuna and Billfish Fishery (Figure 5.31)	Albacore tuna (*Thunnus alulunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*), broadbill swordfish (*Xiphias gladius*), striped marlin (*Tetrapturus audux*)	Fishery extends from Cape York in Queensland to the South Australian/Victorian border. Fishing occurs in both the AFZ and adjacent high seas.	**No.** The spill EMBA intersects 3.3% of the fishery, but in an area that is not fished (see Figure 5.31).	12-month season begins 1st March.	Pelagic longline is the key fishing method, with small quantities taken using minor line methods (such as handline, troll, rod and reel). Active vessel numbers were 40 in 2018 (down from about 150 in 2002). No Victorian or Tasmanian ports are used to land catches.	• 2018 – 4,046 tonnes worth $38.4 million. • 2017 – 4,624 tonnes worth $35.7 million. • 2016 – 5,139 tonnes worth $47.1 million. • 2015 – 5,408 tonnes worth $33 million. • 2014 – 4,368 tonnes worth $30.7 million. Spawning occurs through most of the year in water temperatures greater than 26°C (Wild Fisheries Research Program, 2012).

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Eastern Skipjack Tuna Fishery (Figure 5.32)	Skipjack tuna (*Katsuwonus pelamis*)	Extends from the border of Victoria and South Australia to Cape York, Queensland.	**No.** The spill EMBA intersects 3.3% of the fishery, but in an area that is not fished (see Figure 5.32).	Not currently active.	Purse seine fishing gear is used in this fishery. There are 19 permits in the eastern zone, though no vessels currently work the fishery. Port Lincoln was the main landing port until its tuna cannery closed down.	Not currently active.
Southern Bluefin Tuna (Figure 5.33)	Southern bluefin tuna (*Thunnus maccoyii*)	The fishery extends throughout all waters of the AFZ. AFMA manages Southern Bluefin Tuna stocks in Victorian state waters under agreements set up within the OCS (DEH, 2004). The nearest fishing effort is concentrated along the NSW south coast around the 200 m depth contour.	**No.** The spill EMBA intersects 1.3% of the fishery, but in an area that is not fished (see Figure 5.33).	12-month season begins 1st December.	Purse sein catch in the Great Australian Bight for transfer to aquaculture farms off Port Lincoln in South Australia (five to eight vessels consistently fish this area). Port Lincoln is the primary landing port. On the east coast, pelagic longline fishing is the key fishing method. 2017-18 – 38 active vessels. 2016-17 – 22 active vessels. 2015-16 - 25 active vessels. 2014-15 - 24 active vessels.	No recent fishing effort in Bass Strait. The latest data for the east coast pelagic longline catches are: • 2017-18 – 6,159 tonnes worth $39.73 million. • 2016-17 – 5,334 tonnes worth $38.57 million. • 2015-16 – 5,636 tonnes worth $37.29 million. • 2014-15 – 5,519 tonnes worth $37.29 million. • 2013-14 – 5,420 tonnes worth $39.5 million.
Small Pelagic Fishery (eastern and western sub-area) (Figure 5.34)	Australian sardine (Sardinops sagax), jack mackerel (*Trachurus declivis*), blue mackerel (*Scomber australasicus*), redbait (*Emmelichthys nitidus*)	Operates in Commonwealth waters extending from southern Queensland around southern Western Australia.	**No.** The spill EMBA intersects 3.5% of the fishery, but in an area that is not fished (see Figure 5.34).	12-month season begins 1st May.	Purse seine and mid-water trawl, with the latter being the main method. Thirty (31) entities held licences in 2018-19 using four active vessels. The main landing ports are in Tasmania, South Australia and New South Wales, along with Geelong in Victoria.	A Total Allowable Commercial Catch (TACC) in recent years has not been reached. Catch values are confidential due to the small number of fishers. • 2018-19 – 9,424 tonnes. • 2017-18 – 5,713 tonnes. • 2016-17 – 8,038 tonnes. • 2015-16 – 10,394 tonnes.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Southern Squid Jig Fishery (Figure 5.35)	Arrow squid (*Nototodarus gouldi*)	The fishery extends from the SA/WA border east to southern Queensland. AFMA does not control squid fishing in Victorian state waters.	**Yes.** The area of the fishery overlapped by the spill EMBA may be fished by less than 5 fishers, so there is no fishing intensity data available. Fishing intensity is higher in eastern Gippsland, as seen in Figure 5.35. The spill EMBA intersects 4.5% of the fishery.	12-month season begins 1st January and ends 31 December.	Squid jigging is the fishing method used, mainly at night time and in water depths of 60 to 120 m. High-powered lamps are used to attract squid. In 2018 there were 9 active vessels. Hobart, Portland and Queenscliff are the primary landing ports.	The species' short life span, fast growth and sensitivity to environmental conditions result in strongly fluctuating stock sizes. • 2018 – 1,649 tonnes worth $5.26 million. • 2017 – 828 tonnes worth $2.24 million. • 2016 – 981 tonnes worth $2.57 million. • 2015 – 824 tonnes worth $2.33 million.
Southern and Eastern Scalefish and Shark Fishery (SESSF)						
Shark Gillnet and Shark Hook Sector (Figure 5.36a&b)	Gummy shark (*Mustelus antarcticus*) is the key target species, with bycatch of elephant fish (*Callorhinchus milii*), sawshark (*Pristiophorus cirratus, P. nudipinnis*), and school shark (*Galeorhinus galeus*).	Waters from the NSW/Victorian border westward to the SA/WA border, including the waters around Tasmania, from the low water mark to the extent of the AFZ. Most fishing occurs in waters adjacent to the coastline in Bass Strait.	**Yes.** Based on 2017-18 fishing intensity data, the spill EMBA overlaps areas of low and medium intensity fishing. The spill EMBA intersects 8% of the fishery.	12-month season begins 1st May.	Demersal gillnet and a variety of line methods. Landing ports in Victoria are Lakes Entrance, San Remo and Port Welshpool. 2018-19 – 74 permits and 78 active vessels. 2017-18 – 74 permits and 76 active vessels. 2016-17 – 74 permits and 62 active vessels. 2015-16 – 74 permits and 61 active vessels.	In 2015-16, the SESS Fishery was the largest Commonwealth fishery in terms of volume produced. • 2018-19 – 2,126 tonnes with no value assigned. • 2017-18 – 2,216 tonnes worth $19.1 million. • 2016-17 – 2,118 tonnes worth $18.3 million. • 2015-16 – 2,233 tonnes worth $18.4 million.
Commonwealth Trawl Sector (CTS) (Figure 5.37)	Key species targeted are eastern school whiting (*Sillago flindersi*), flathead (*Platycephalus richardsoni*) and	Covers the area of the AFZ extending southward from Barrenjoey Point (north of Sydney) around the New South Wales, Victorian and Tasmanian	**No.** Based on 2017-18, 2016-17 and 2015-16 fishing intensity data that shows no CTS	12-month season begins 1st May. Highest catches from September to April.	Multi gear fishery, but predominantly demersal otter trawl and Danish-seine methods.	Logbook catches have been gradually declining since 2001. • 2018-19 – 7,574 tonnes with no value assigned.

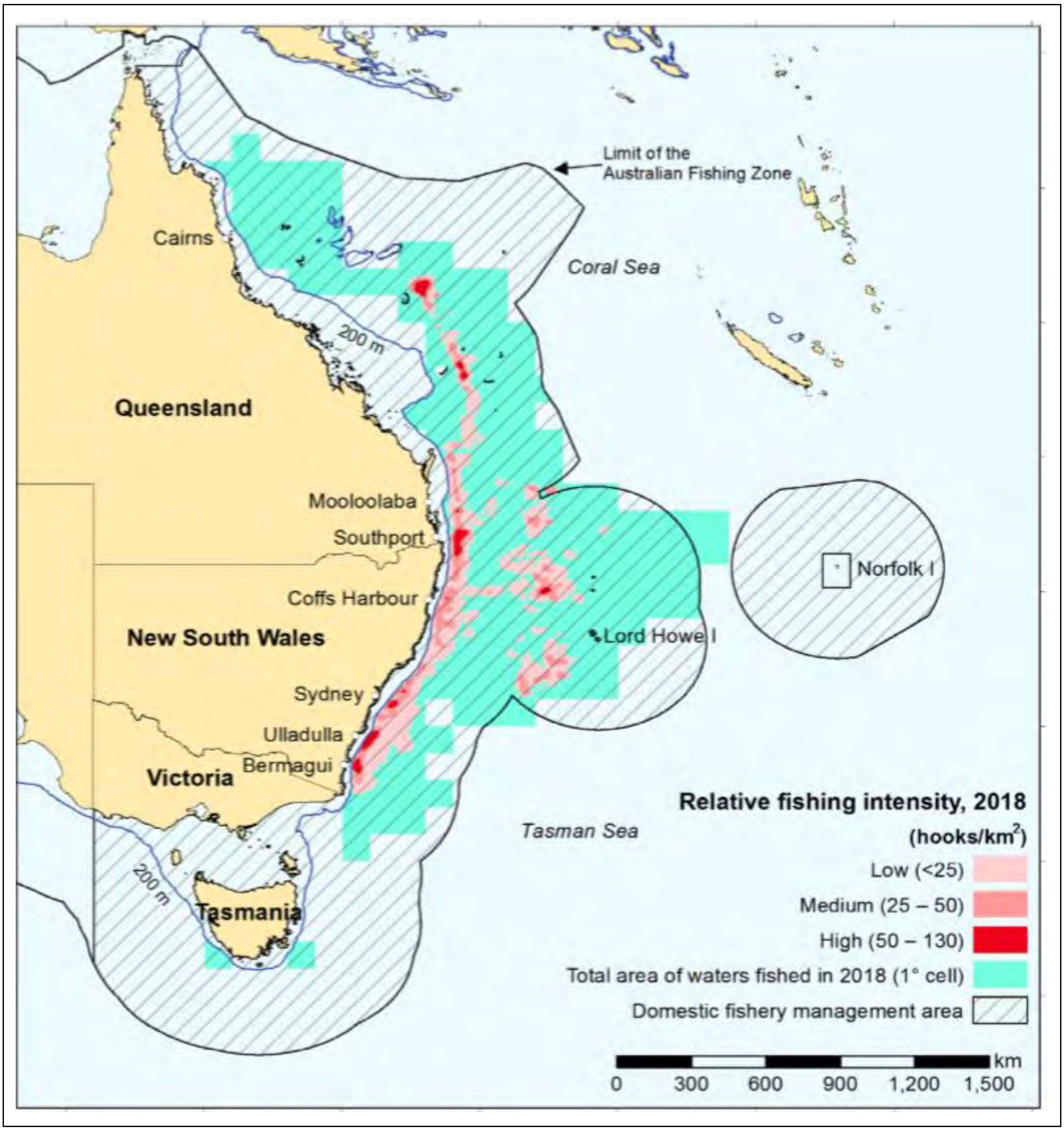
Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
	gummy shark (*Mustelus antarcticus*).	coastlines to Cape Jervis in South Australia.	intensity recorded in the spill EMBA. The spill EMBA intersects 10% of the fishery.		Primary landing ports in NSW, and Lakes Entrance and Portland in Victoria. For 2017-2018, there were 57 trawl fishing rights with 50 active trawl and Danish-seine vessels.	• 2017-18 – 8,631 tonnes with no value assigned. • 2016-17 – 8,691 tonnes, worth $46.42 million. • 2015-16 – 9,025 tonnes, worth $41.5 million.
Scalefish Hook Sector (SHS) (Figure 5.38)	Key species targeted are gummy shark (*Mustelus antarcticus*), elephantfish (*Callorhinchus milii*) and draughtboard shark (*Cephaloscyllium laticeps*).	Includes all waters off South Australia, Victoria and Tasmania from 3 nm to the extent of the AFZ.	**No.** Based on 2017-18, 2016-17 and 2015-16 fishing intensity data that shows no SHS intensity recorded in the spill EMBA. The spill EMBA intersects 4.7% of the fishery.	12-month season begins 1st May. Effort highest from January to July.	Multi gear fishery, using different gear types in different areas or depth ranges. Predominantly demersal longline fishing methods, some of which are automated, and demersal gillnets. For 2017-18, there were 37 fishing rights 29 active vessels. Primary landing ports in NSW, and Lakes Entrance and Portland in Victoria.	Logbook catches have been gradually declining since 2006 and are now <2,000 t/year. Catch data is combined with that for the CTS.

Sources: Patterson et al (2019, 2018; 2017; 2016), AFMA (2017a), Status of Australian Fish Stocks reports (2019).



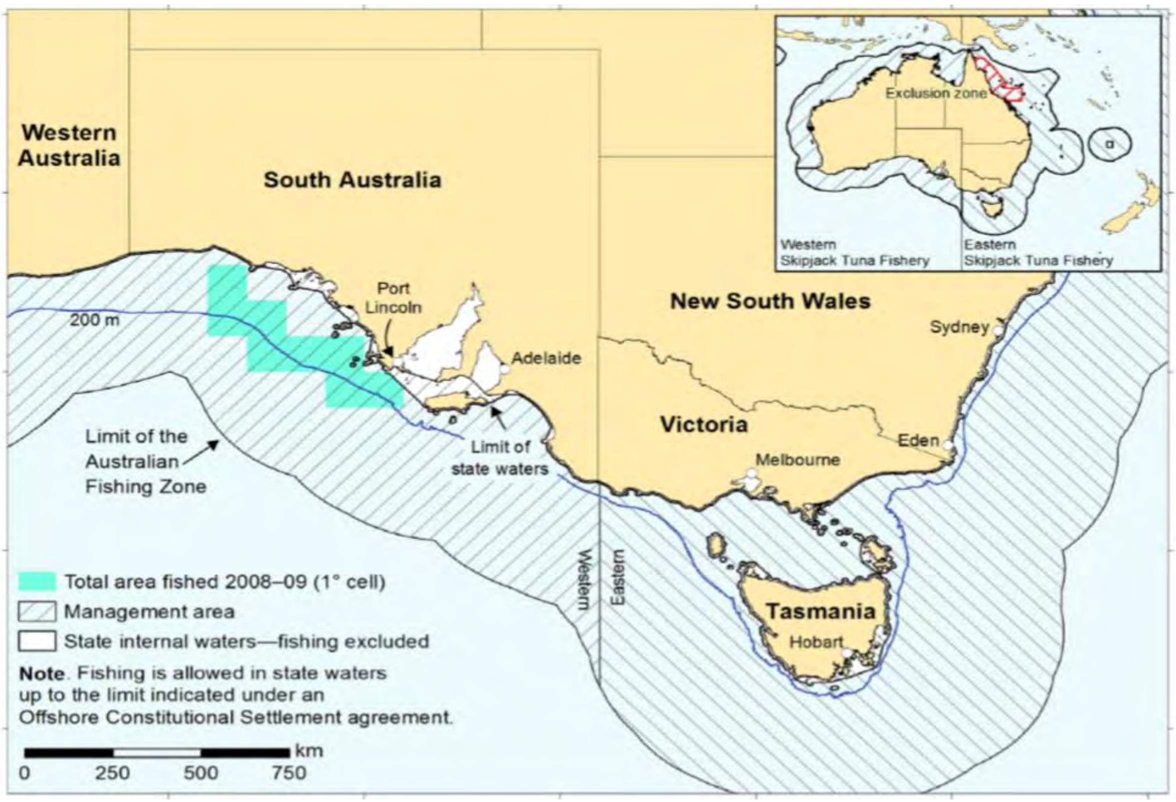
Source: Patterson et al (2019).

Figure 5.30. Jurisdiction of and fishing intensity in the Commonwealth Bass Strait central zone scallop fishery



Source: Patterson et al (2019).

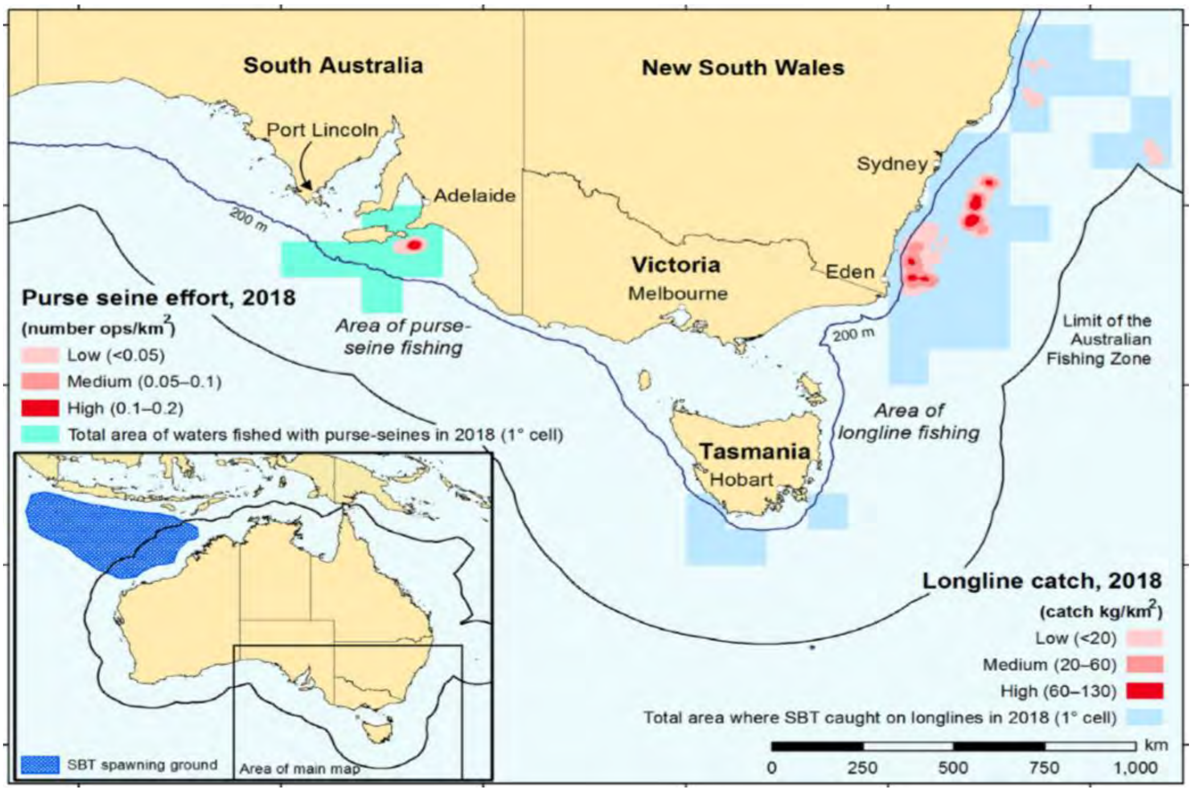
Figure 5.31. Jurisdiction of and fishing intensity in the Commonwealth Eastern tuna and billfish fishery



Last fishing effort occurred in 2008-09.

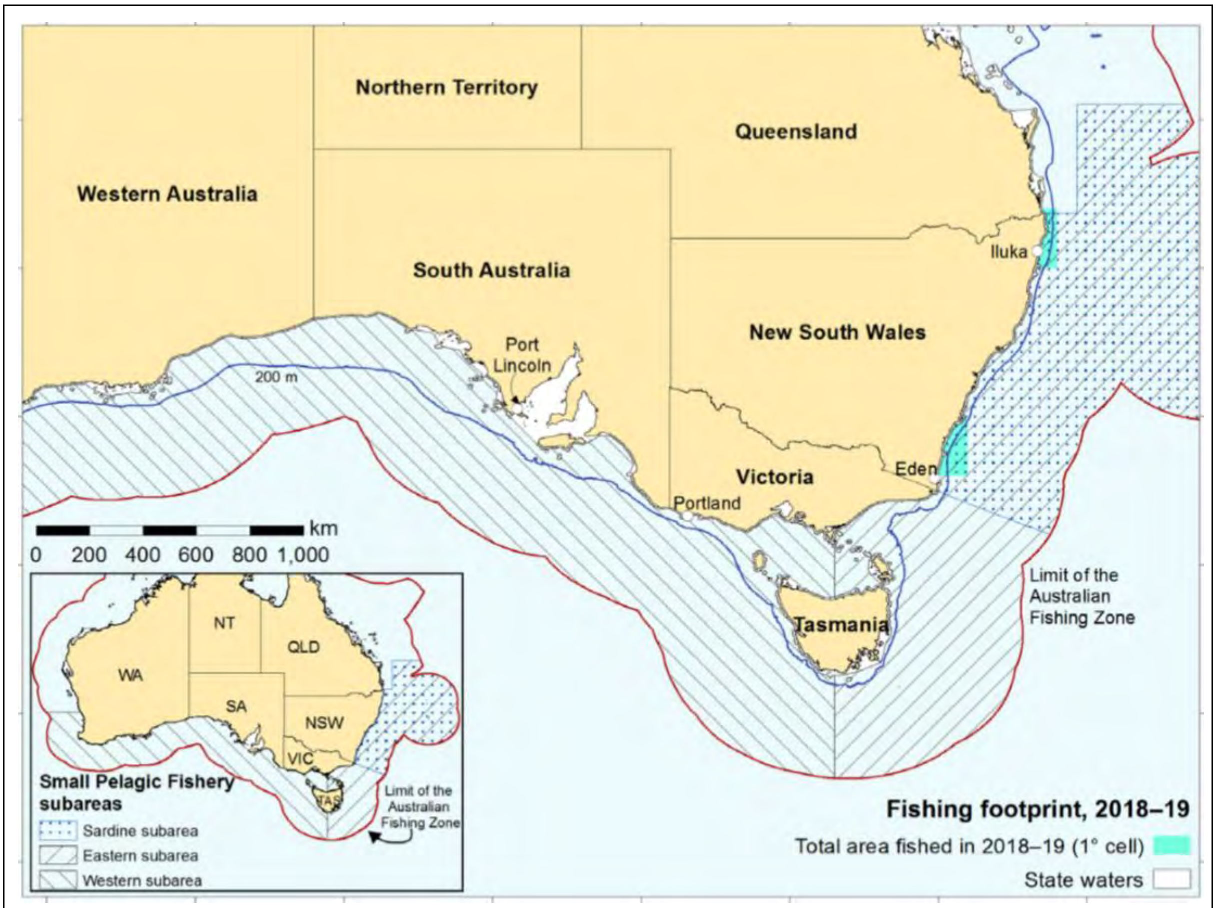
Source: Patterson et al (2019).

Figure 5.32. Jurisdiction of and fishing intensity in the Commonwealth eastern skipjack tuna fishery



Source: Patterson et al (2019).

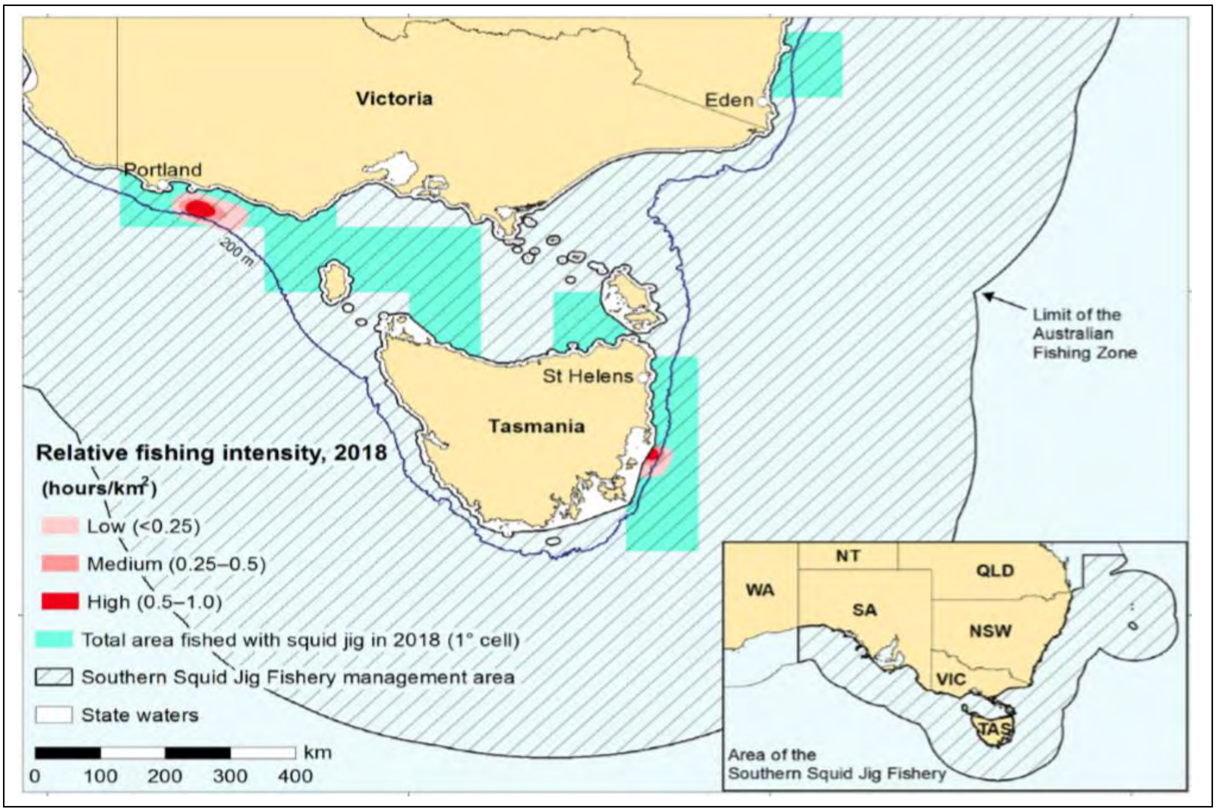
Figure 5.33. Jurisdiction of and fishing intensity in the Commonwealth southern bluefin tuna fishery



Some effort data not shown for confidentiality reasons.

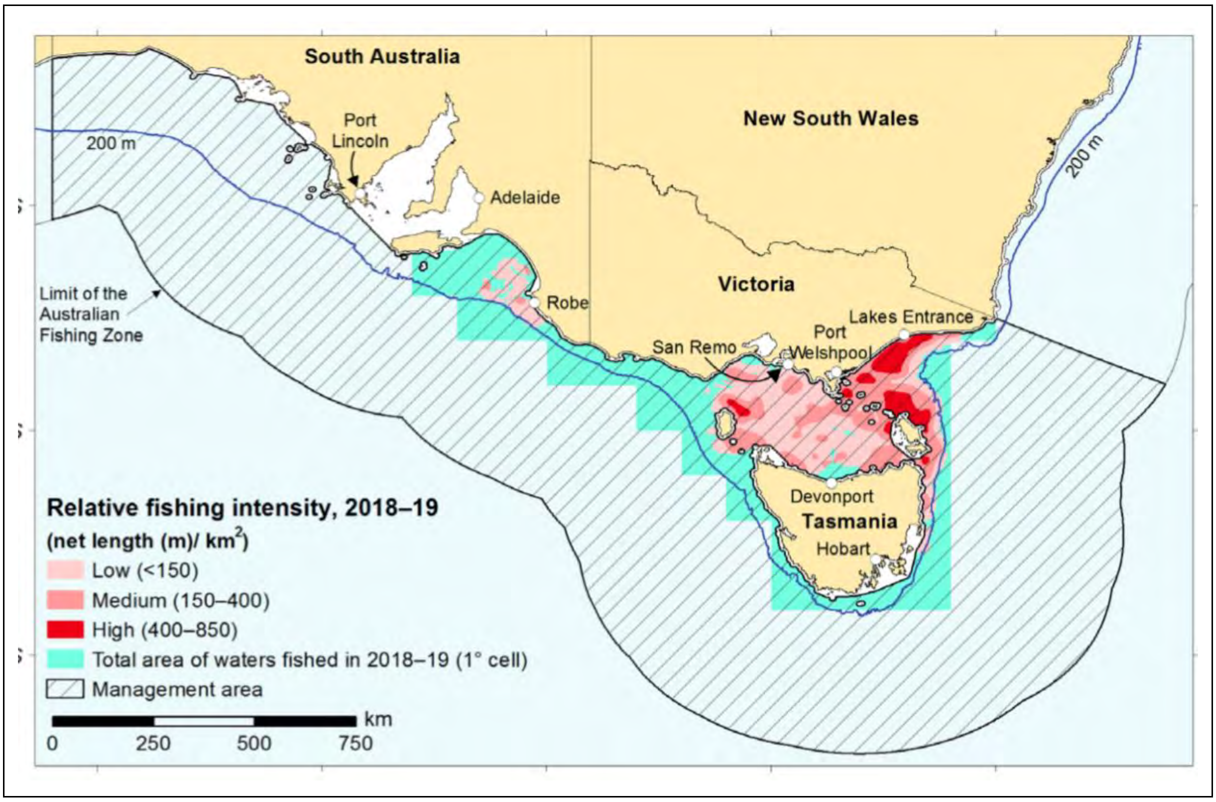
Source: Patterson et al (2019).

Figure 5.34. Jurisdiction of and fishing intensity in the Commonwealth small pelagic fishery



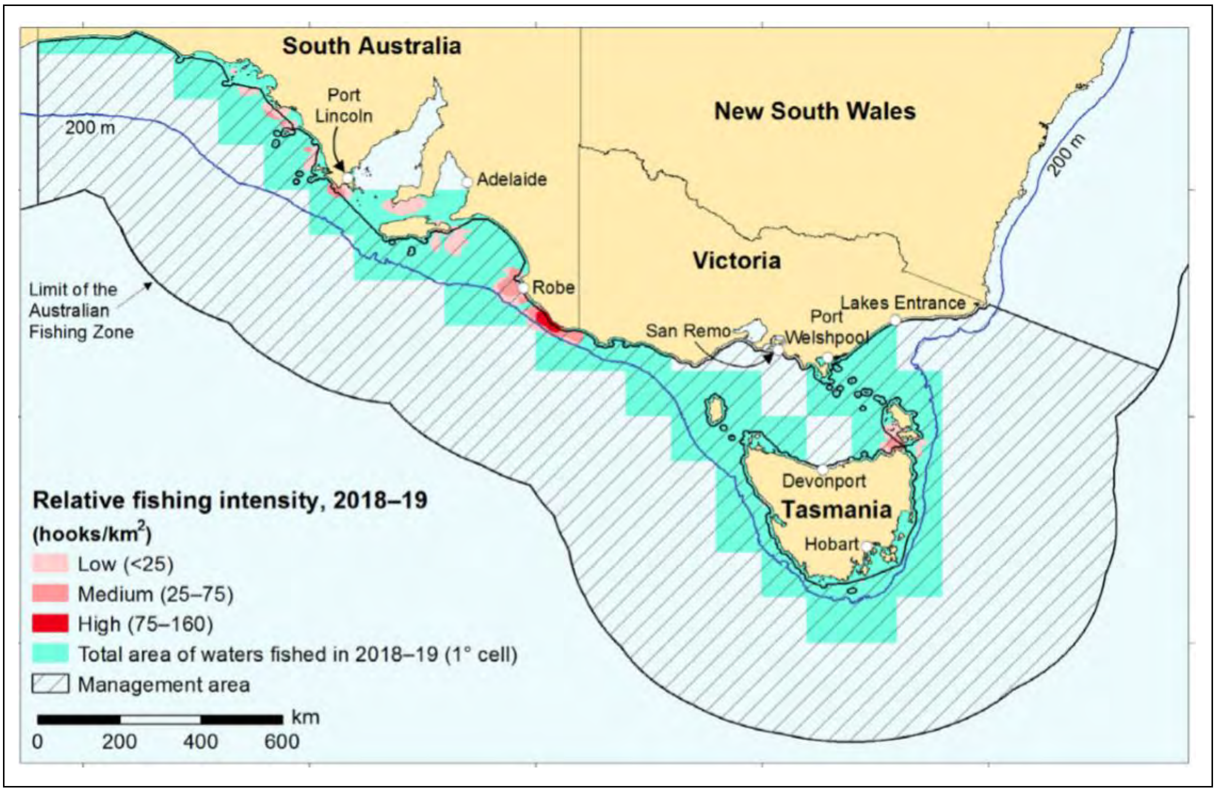
Source: Patterson et al (2019).

Figure 5.35. Jurisdiction of and fishing intensity in the Commonwealth southern squid jig fishery



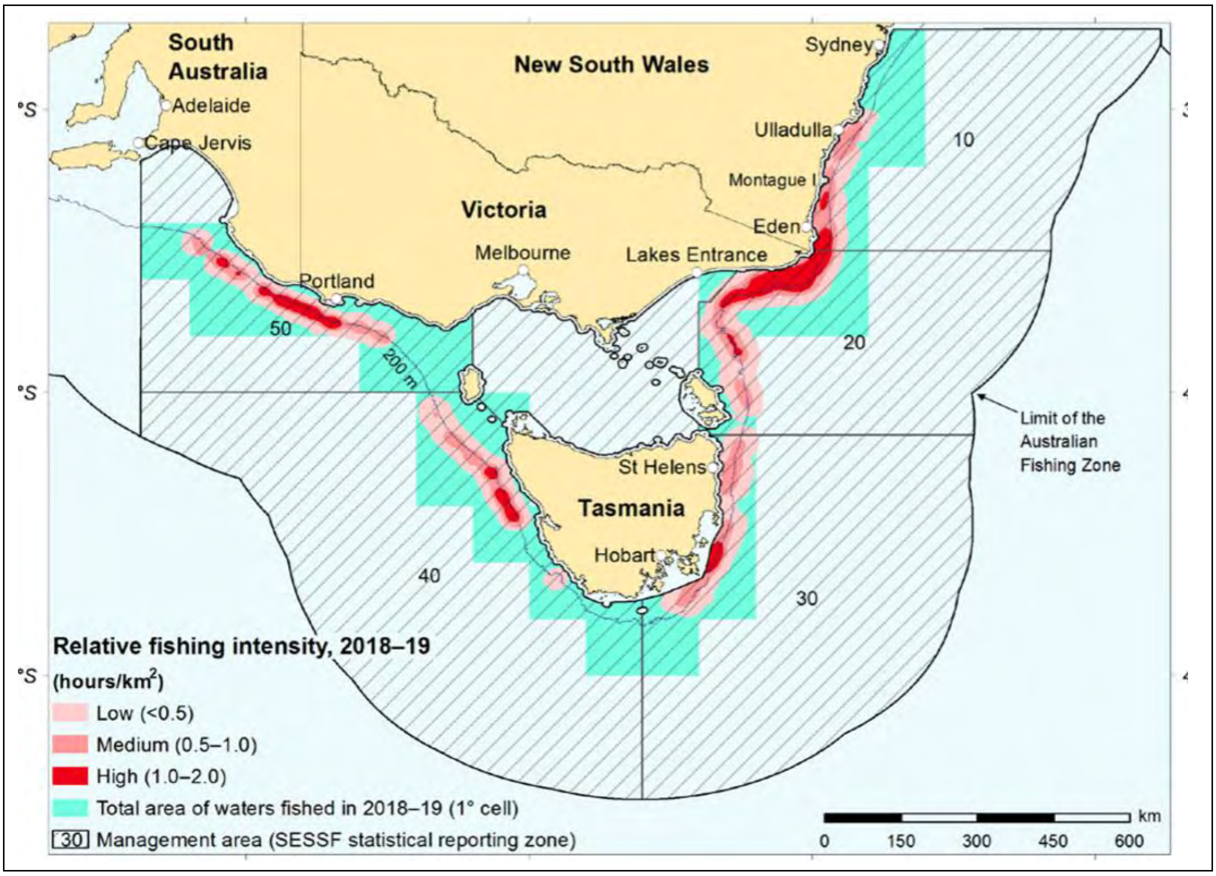
Source: Patterson et al (2019).

Figure 5.36a. Jurisdiction of and fishing intensity in the Commonwealth SESS – shark gillnet sector



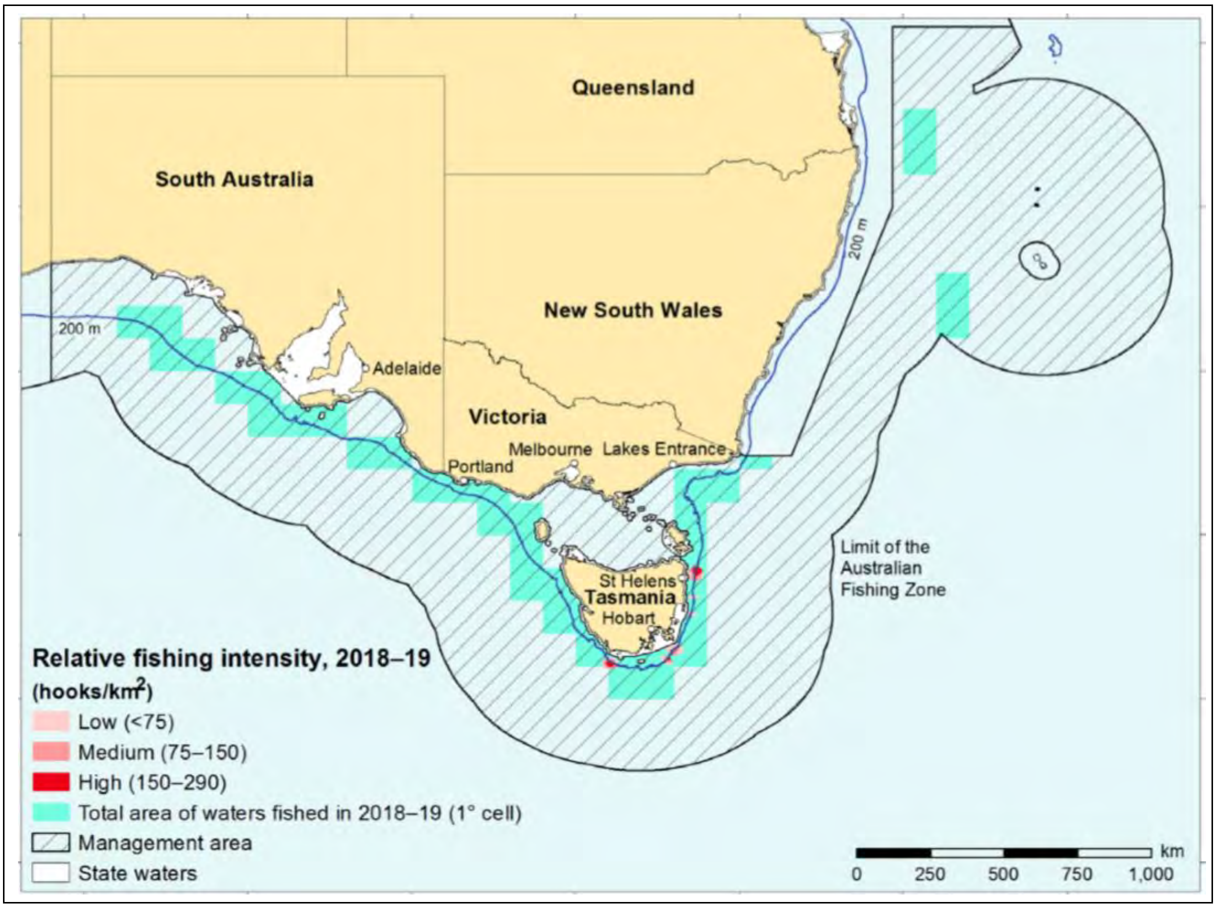
Source: Patterson et al (2019)

Figure 5.36b. Jurisdiction of and fishing intensity in the Commonwealth SESS – shark hook sector



Source: Patterson et al (2019).

Figure 5.37. Jurisdiction of and fishing intensity in the Commonwealth SESS – Commonwealth trawl sector



Source: Patterson et al (2019).

Figure 5.38. Jurisdiction of and fishing intensity in the Commonwealth SESS – scalefish hook sector

Victorian-managed Fisheries

Victorian-managed commercial fisheries with access licences that authorise harvest in the waters of the operational area and spill EMBA include the following:

- Scallop;
- Abalone;
- Rock Lobster;
- Wrasse;
- Ocean Access (General);
- Pipis (the entire Victorian coastline);
- Ocean Purse Seine;
- Inshore trawl; and
- Giant crab.

The VFA catch and effort grid cell network is based on divisions of 10’ latitude (approximately 10 nm) and 12.1’ longitude (approximately 12.1 nm). The RGP intersects catch and effort cells G27, H27, H28, J28 and K28, L28, L29, M29, N29, P29 and Q29 (Figure 5.39).

Table 5.16 summarises the key information for each of these fisheries and indicates that all the above-listed fisheries, except the scallop and inshore trawl, are actively fishing in the spill EMBA.

As detailed in Table 4.3, Beach's consultation with Victorian fishery industry representatives indicates they have no material concerns about potential conflicts between their activities and the ongoing operation of the BassGas Development.

Tasmanian-managed Fisheries

Tasmanian-managed commercial fisheries with access licences that authorise harvest in the waters of the spill EMBA include the following (DPIPWE, 2020):

- Abalone;
- Giant crab;
- Rock lobster;
- Scalefish;
- Scallop;
- Seaweed;
- Shellfish;
- Octopus; and
- Commercial dive.

Table 5.17 summarises the key information for each of these fisheries and indicates that all the above-listed fisheries, except the seaweed and shellfish fisheries, are actively fishing in the spill EMBA.

As detailed in Table 4.3, Beach's consultation with Tasmanian fishery industry representatives indicates they have no material concerns about potential conflicts between their activities and the ongoing BassGas operations. This is likely to be because the Tasmanian fisheries listed above do not actively fish around the BassGas development or in the spill EMBA.

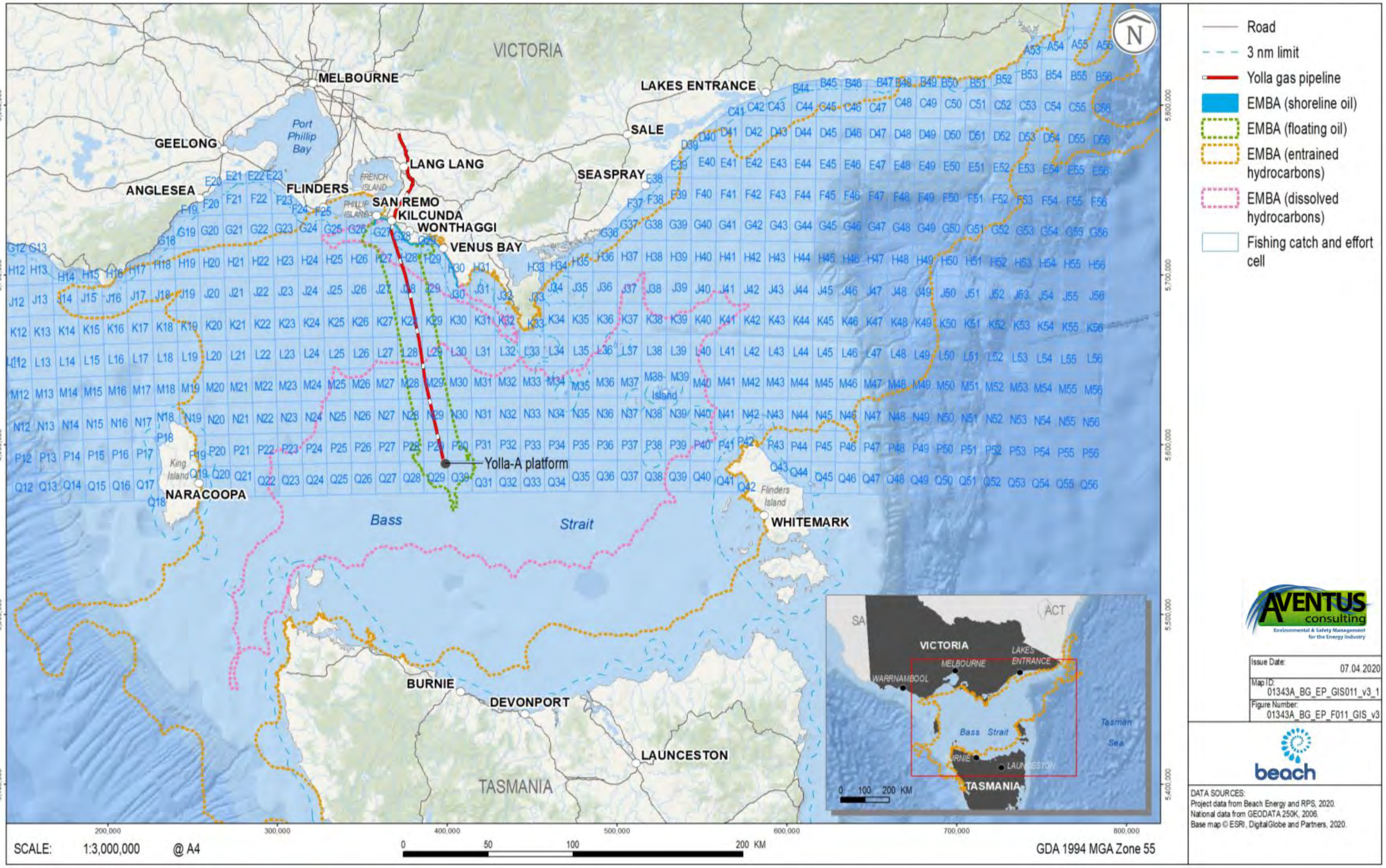


Figure 5.39. VFA fishing catch and effort grid cells overlapped by the BassGas Development and the EMBA

Table 5.16. Victorian-managed commercial fisheries in the operational area and spill EMBA

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Bass Strait Scallop Fishery (Victorian zone) (Figure 5.40)	Commercial scallop (*Pecten fumatus*).	Extends 20 nm from the high tide water mark of the entire Victorian coastline (excluding bays and inlets where commercial scallop fishing is prohibited). Management of the Bass Strait Scallop fishery was split between the Commonwealth, Victoria and Tasmania in 1986 under an Offshore Constitutional Settlement, whereby Commonwealth central, Victorian and Tasmanian zones were created. The spill EMBA intersects 54% of the fishery.	**No.** Fishing effort is east of Wilsons Promontory. The Tasmanian sector is currently closed.	12-month season, beginning 1st April. Fishing usually occurs during the winter months, but can occur from May to the end of November. While scallops are still present in the region, they are believed to be present in much lower numbers than historically. Scallops have highly variable levels of natural mortality, with an historical 'boom' or 'bust' nature. Fishing activity in the area is low, although the VFA is implementing management arrangements designed to increase fishing activity in the area.	Towed scallop dredges (typically 4.5 m wide) that target dense aggregations ('beds') of scallop. A tooth-bar on the bottom of the mouth of the dredge lifts scallops from the seabed and into the dredge basket. There are a maximum of 90 licences available with 89 currently assigned. Only a few vessels fishing these licenses operate in any one year (generally between 12 and 20). Vessels are typically based out of Lakes Entrance or Port Welshpool, although licence holders may fish the entire coastline. Some licence holders also have entitlements to fish the Commonwealth scallop fishery, inshore trawl, Commonwealth SESS fishery and the southern squid jig fishery (see Table 5.15).	Zero quotas were in place for the 2010-11, 2011-12 and 2012-13 seasons due to a lack of commercial scallop quantities. The TACC has been set at 135 tonnes for the 2013-14, 2014-15, 2015-16, 2016-17 and 2017-18 fishing seasons, and is likely to remain at this level for the foreseeable future. Scallop spawning normally occurs from late winter to early spring, with larvae drifting as plankton for up to six weeks before first settlement. Juvenile scallops reach marketable size within 18 months.
Abalone Fishery (Figure 5.41)	Blacklip abalone (*Haliotis rubra*) is the primary target, with greenlip abalone (*H. laevigata*)	Victorian Central Abalone Zone is located between Lakes Entrance and the mouth of the Hopkins River. Most abalone live on rocky reefs from the shore out to depths of 30 m.	**Yes.** Based on catch distribution along the Victorian coast. The Kilcunda abalone lease	12-month season, beginning 1st April.	Abalone diving activity occurs close to shoreline (generally no greater than 30 m depth) using hookah gear (breathing air supplied via hose connected to an air compressor on the vessel).	In the central zone, catches for the last five seasons were: • 2018/19 – 274 tonnes. • 2017/18 – 277 tonnes. • 2016/17 – 280 tonnes. • 2015/16 – 306 tonnes.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
	taken as a bycatch.	The spill EMBA intersects: • 44% of the entire Victorian fishery. • 53.7% of the central zone.	occurs to the immediate east of the gas pipeline near the coastal crossing. Waters around Yolla-A are too deep for this fishery.		Commercial divers do not use SCUBA gear. Divers use an iron bar to prise abalone from rocks. The fishery consists of 71 fishery access licences, of which 34 operate in the central zone.	• 2014/15 – 310 tonnes. Across all Victorian zones, the catches for the last five seasons with available data were: • 2018/19 – 693 tonnes valued at $31.3 million. • 2017/18 – 756 tonnes valued at $26.9 million. • 2016/17 – 721 tonnes valued at $20.49 million. • 2015/16 – 725 tonnes valued at $19.8 million.
Rock Lobster Fishery (Figure 5.42)	Southern rock lobster (*Jasus edwardsii*). Very small bycatch of species including southern rock cod (*Lotella* and *Pseudophycis spp*), hermit crab (family *Paguroidea*), leatherjacket (*Monacanthidae spp*) and octopus (*Octopus spp*).	The eastern zone stretches from Apollo Bay in southwest Victoria to the Victorian/NSW border. Rock lobster abundance decreases moving from western Victoria to eastern Victoria. Larval release occurs across the southern continental shelf, which is a high-current area, facilitating dispersal. The spill EMBA intersects: • 44.3% of the entire Victorian fishery. • 88.8% of the San Remo region.	**Yes.** Based on catch data in the San Remo Region and prevalence of rocky reef in the coastal area of the pipeline. Waters around Yolla-A are too deep for this fishery.	Closed season for: • Female lobsters – 1 June to 15 November to protect females in berry during spawning period. • Male lobsters – 15 September to 15 November to protect males during their moulting period when soft shells increase their vulnerability. Catches generally highest from August to January.	Fished from coastal rocky reefs in waters up to 150 m depth, with most of the catch coming from inshore waters less than 100 m deep. Baited pots are generally set and retrieved each day, marked with a surface buoy. As of June 2019, there were 33 fishery access licences in the eastern zone.	The Rock Lobster Fishery is Victoria's most valuable fishery. In the eastern zone, catches for the last five seasons with available data were: • 2018/19 – 45 tonnes values at $4.04 million. • 2017/18 – 57 tonnes valued at $4.67 million. • 2016/17 – 52 tonnes valued at $4.28 million. • 2015/16 – 58 tonnes valued at $5.1 million. • 2014/15 – 59 tonnes valued at $5 million.
Wrasse Fishery (Figure 5.43)	Blue-throat wrasse (*Notolabrus tetricus*), saddled wrasse (*N.*	Entire Victorian coastline out to 20 nm (excluding marine reserves, bays and inlets).	**Yes.** In recent years, catches have been highest off the central coast	Year-round.	Handline fishing (excluding longline), rock lobster pots (if in possession of a rock lobster access fishing licence).	Catches of all wrasse species for the last five seasons were: • 2018/19 – 33 tonnes valued at $672,000.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
	fucicola), orange-spotted wrasse (*N. parilus*).	The spill EMBA intersects 54.2% of the fishery.	(Port Phillip Heads, Western Port and Wilson's Promontory) and the west coast.		Preferred water depths for blue-throat wrasse is 20-40 m, while saddled wrasse prefer depths of 10-30 m. As of June 2019, there were 22 fishery access licences.	• 2017/18 – 38 tonnes valued at $767,000. • 2016/17 – 24 tonnes valued at $557,000. • 2015/16 – 30 tonnes valued at $627,000. • 2014/15 – 29 tonnes valued at $490,000. Prior to this time, catches varied from 30-40 tonnes per annum from 2005-09, and 40-50 tonnes per annum from 2000-04.
Pipi fishery (Eastern Zone) (Figure 5.44)	Pipi (*Donax deltoids*)	Covers the entire Victorian coastline, with pipis found in the surf zone of high-energy sandy beaches. The spill EMBA intersects 21.5% of the fishery (being the Victorian shoreline).	**Yes.** Wherever there are high-energy sandy beaches. Venus Bay is a popular harvesting area.	Year-round.	This fishery opened in 2017-2018. Other than three bait fisheries that operate outside the EMBA (e.g., Snowy River and Mallacoota), only Ocean Access Fishery licence holders are permitted to harvest pipis.	To date, Ocean Access Fishery licence holders have harvested 95% of the commercial pipi harvest. Pipis are sold for bait and for human consumption. There is no publicly available information regarding catch data and associated value.
Giant crab (Western Zone)	Giant crab (*Pseudocarcinus gigas*)	The boundaries of the fishery mimic those of the Rock Lobster Fishery, however the fishery is based in the Western Zone.	**Yes.** However, fishing is concentrated west of Apollo Bay; the western most extent of the EMBA intersects this area.	Closed season from: • Female lobsters – 1 June to 15 November to protect females in berry during spawning period. • Male lobsters – 15 September to 15 November to protect males during their moulting period when soft shells increase their vulnerability.	Fishers target giant crabs using baited rock lobster pots. As of June 2019, there were 11 fishery access licenses.	Catches of giant crab for the last five seasons were: 2018/19 – not available. 2017/18 – 9.8 tonnes. 2016/17 – 10.0 tonnes. 2015/16 – 10.0 tonnes. 2014/15 – 10.5 tonnes.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Multi-species ocean fishery						
Ocean Purse Seine Fishery	Australian sardine (*Sardinops sagax*), Australian salmon (*Arripis trutta*) and sandy sprat (*Hyperlophus vittatus*) are the main species. Southern anchovy (*Engraulis australis*) caught in some years.	Entire Victorian coastline, excluding marine reserves, bays and inlets.	**Yes.** An assumption, based on limited data availability.	Year-round.	Purse seine is generally a highly selective method that targets one species at a time, thereby minimising bycatch. The purse seine method does not touch the seabed. A lampara net may also be used. Only one licence is active in Victorian waters (based out of Lakes Entrance), with fishing focused close to shore and during the day. This licence is held by Mitchelson Fisheries Pty Ltd, a family business that catches primarily sardines, salmon, mackeral, sandy sprat, anchovy and white bait using the *Maasbanker* purse seine vessel.	Confidential data (due to operation of only one fisher).
Ocean Access (or Ocean General) Fishery	Gummy shark (*Mustelus antarcticus*), school shark (*Galeorhinus galeus*), Australian salmon (*Arripis trutta*), snapper (*Pagrus auratus*). Small bycatch of flathead (*Platycephalidae spp*).	Entire Victorian coastline, excluding marine reserves, bays and inlets.	**Yes.** An assumption, based on limited data availability.	Year-round.	Utilises mainly longlines (200 hook limit), but also haul seine nets (maximum length of 460 m) and mesh nets (maximum length of 2,500 m per licence). As of June 2019, there were 157 fishery access licences. Fishing usually conducted as day trips from small vessels (<10 m).	There is insufficient catch data (catch data is combined with other fisheries and therefore unable to be distinguished on a standalone basis).
Inshore Trawl Fishery	Key species are eastern king prawn (*Penaeus*	Entire Victorian coastline, excluding marine reserves, bays and inlets.	**No.** Based out of Lakes Entrance	Year-round, although the majority of prawn fishing	Otter-board trawls with no more than a maximum head- line	The catch of eastern school prawn in 2015 was 75 t, the largest for the previous 10 years.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
	plebejus), school prawn (*Metapenaeus macleayi*) and shovelnose lobster/Balmain bug (*Ibacus peronii*). Minor bycatch of sand flathead (*Platcephalus bassensis*), school whiting (*Sillago bassensis*) and gummy shark (*Mustelus antarcticus*).	Most operators are based at Lakes Entrance.	with catch locations being distant from the spill EMBA.	occurs in the warmer months up until Easter.	length of 33 m, or single mesh nets are used. As of June 2019, there were 54 fishery access licences, with only about 15 active to various degrees.	

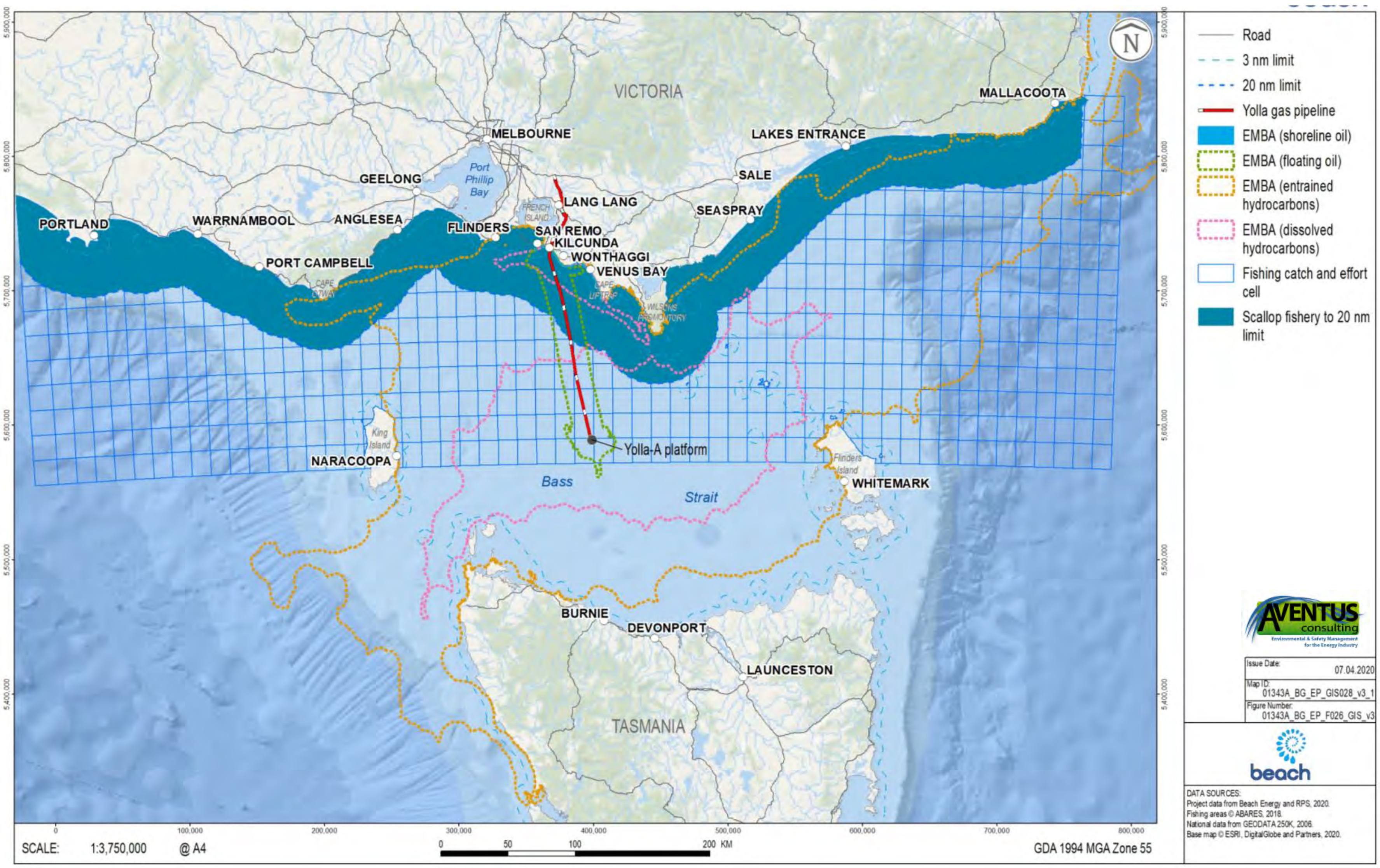


Figure 5.40. Jurisdiction of the Victorian scallop fishery and its intersection with the operational area and spill EMBA

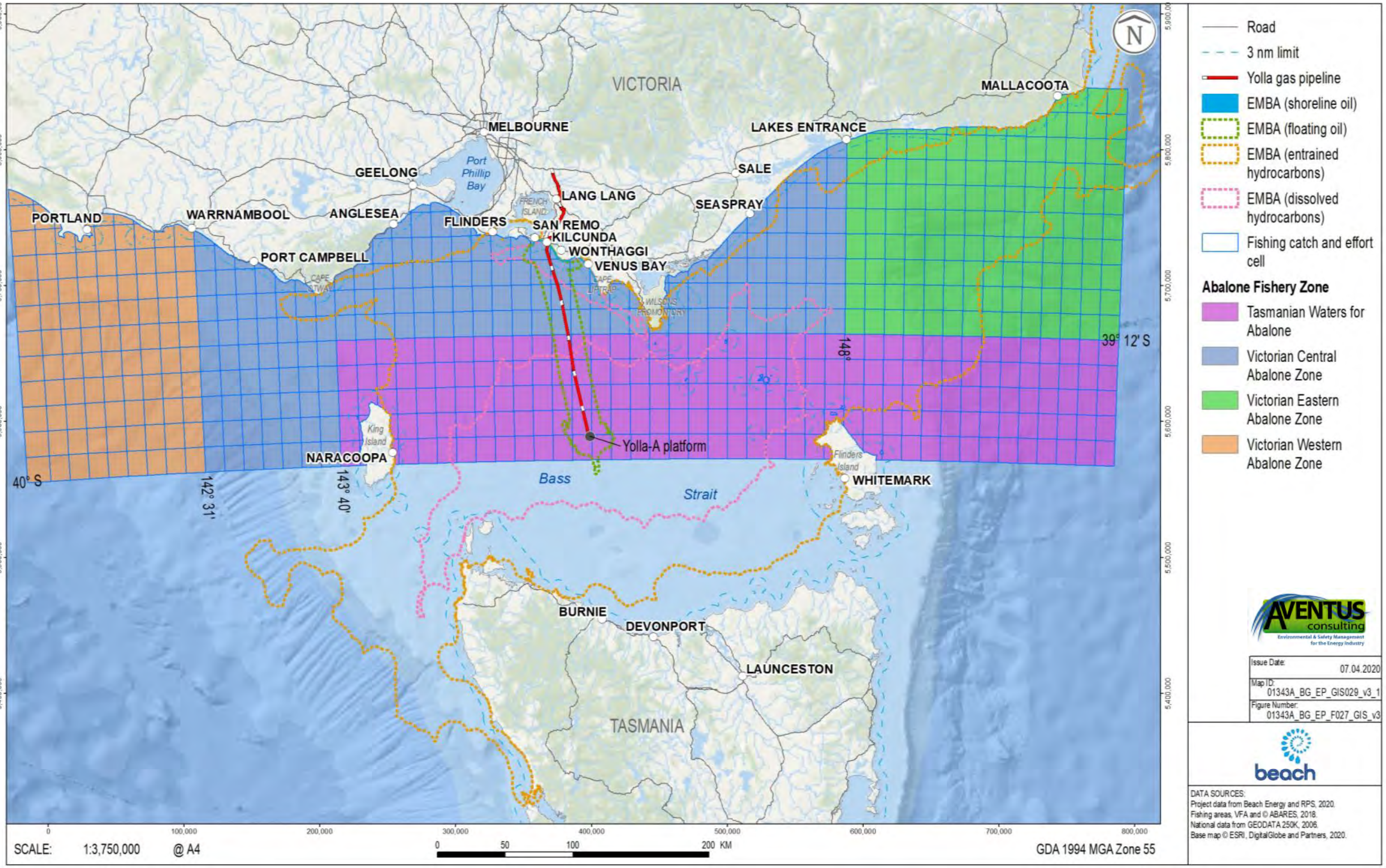


Figure 5.41. Jurisdiction of the Victorian (and Tasmanian) abalone fishery and its intersection with the operational area and spill EMBA

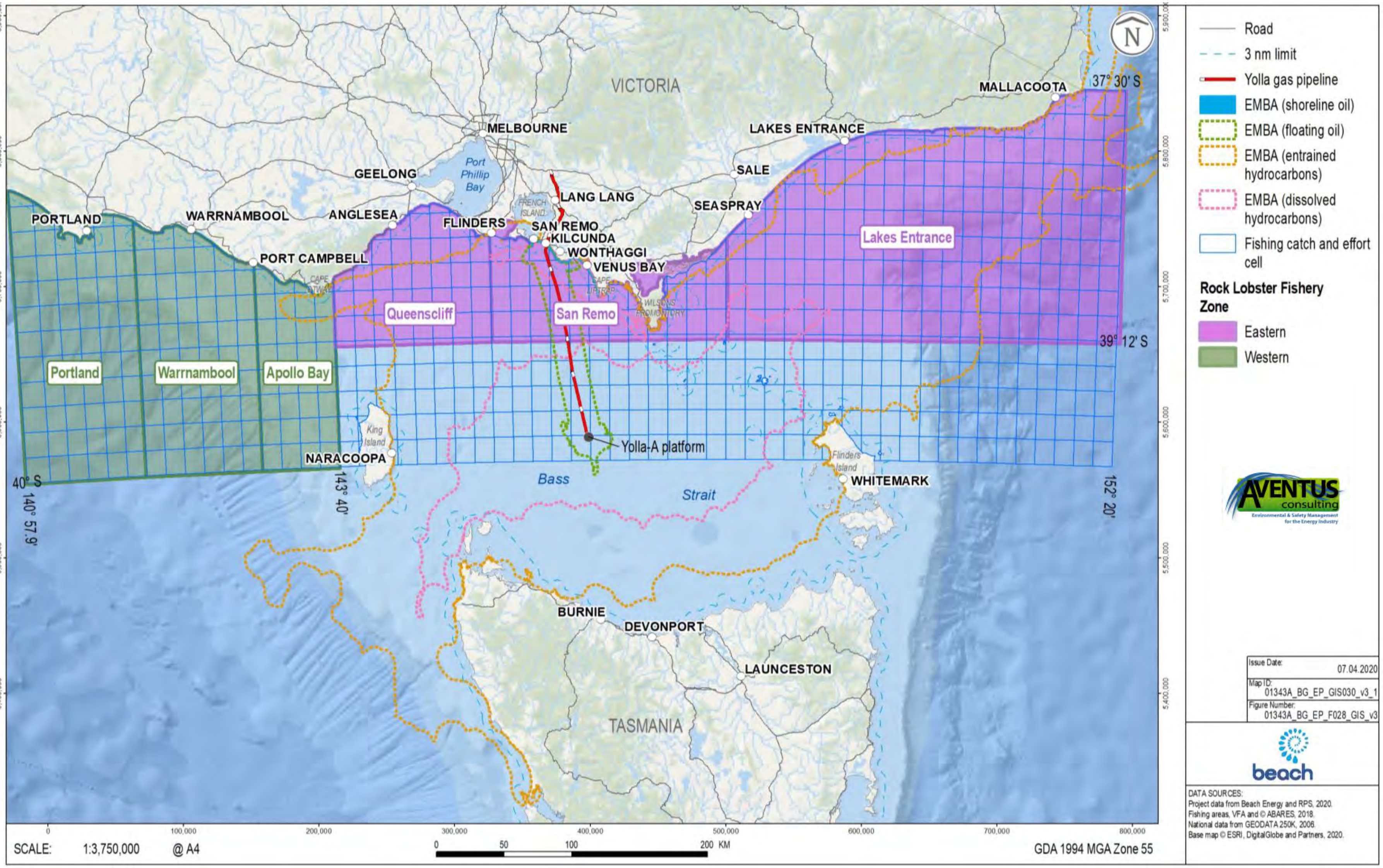


Figure 5.42. Jurisdiction of the Victorian southern rock lobster fishery and its intersection with the operational area and spill EMBA

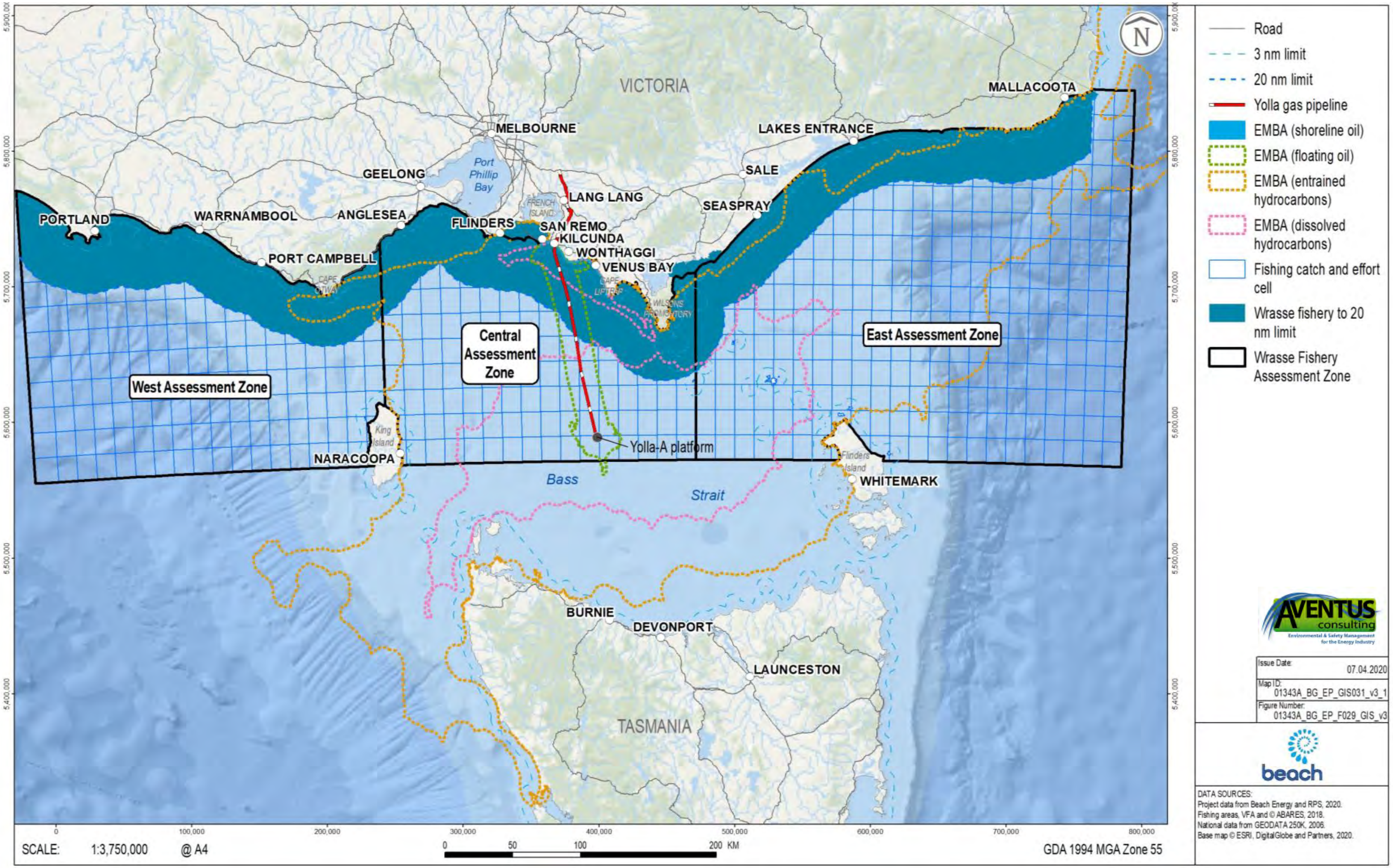
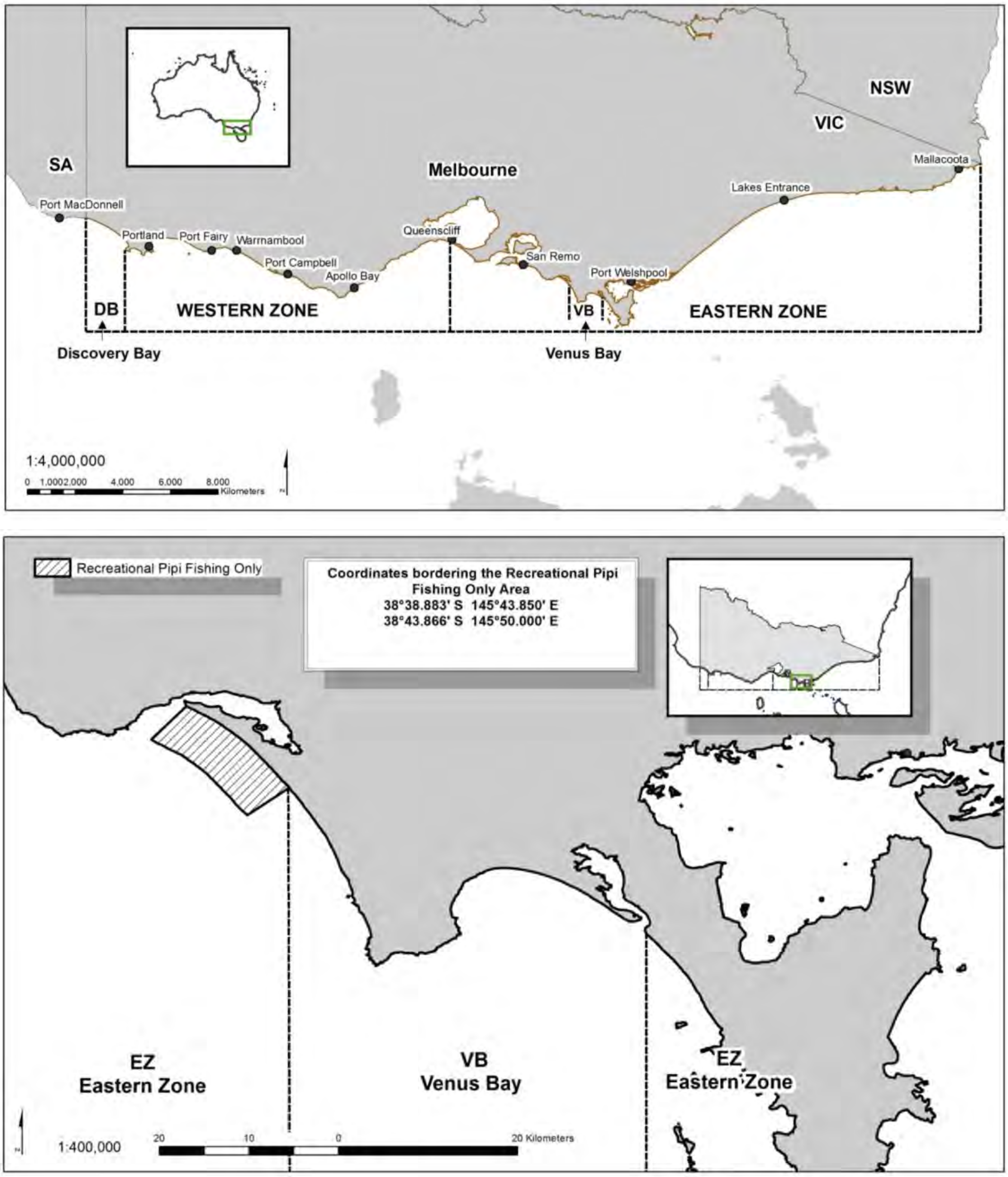


Figure 5.43. Jurisdiction of the Victorian wrasse fishery and its intersection with the operational area and spill EMBA



Source: VFA (2018).

Figure 5.44. Jurisdiction of the Victorian pipi fishery (top), and the 'recreational only' area (bottom)

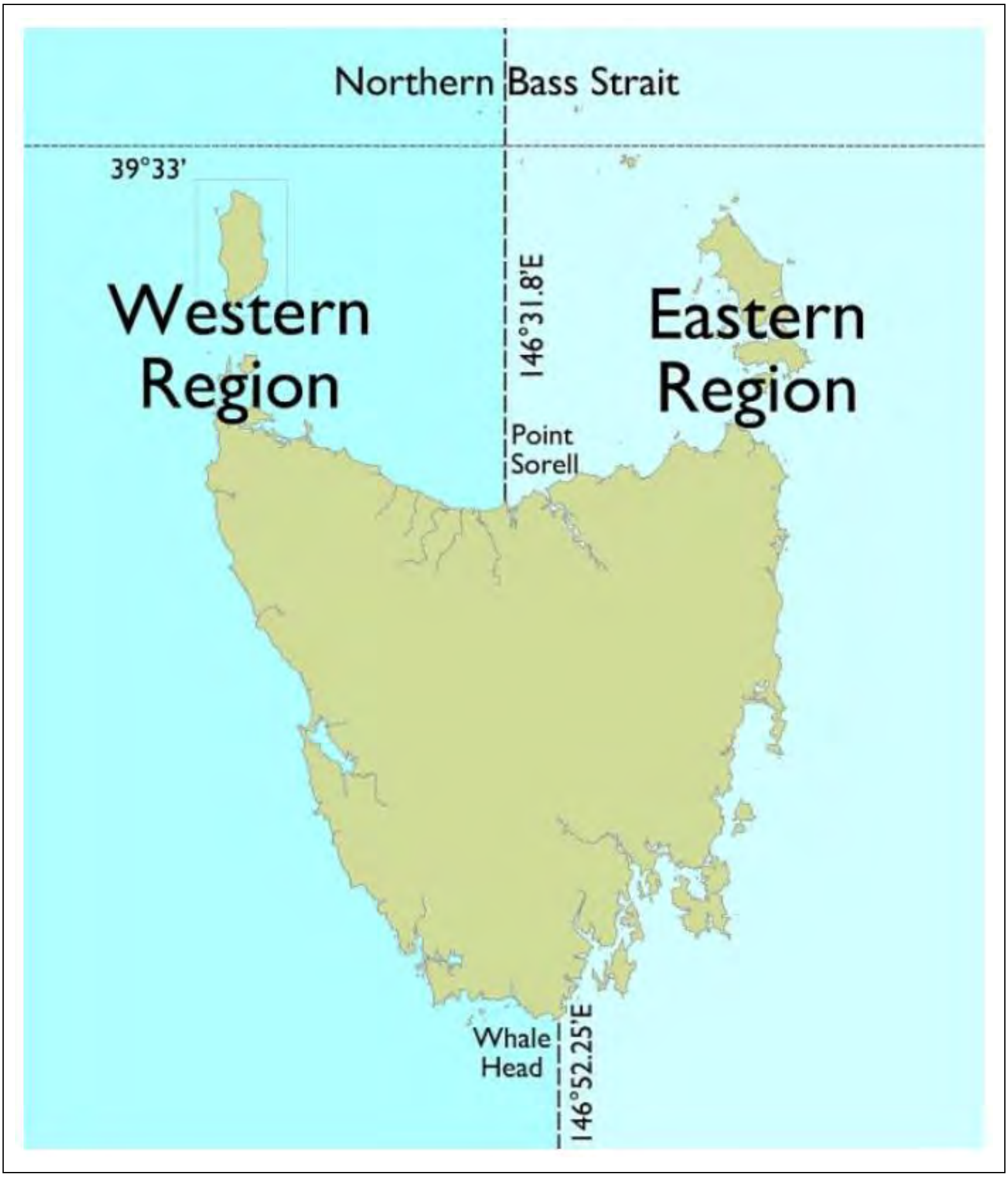
Table 5.17. Tasmanian-managed commercial fisheries in the spill EMBA

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Scallop Fishery	Commercial scallop (*Pecten fumatus*).	Entire Tasmanian coastline	**No.** Fishery currently closed for stock assessment.	Fishery closed.	Towed scallop dredges (typically 4.5 m wide) that target dense aggregations ('beds') of scallop. A tooth-bar on the bottom of the mouth of the dredge lifts scallops from the seabed and into the dredge basket.	Closed since 2016.
Abalone Fishery	Blacklip abalone (*Haliotis rubra*) is the primary target, with greenlip abalone (*H. laevigata*) taken as a bycatch.	Entire Tasmanian coastline including King Island and the Furneaux Group.	**Yes.** Fishing blocks occur in the EMBA.	Year-round.	Abalone diving activity occurs close to shoreline (generally no greater than 30 m depth) using hookah gear (breathing air supplied via hose connected to an air compressor on the vessel). Commercial divers do not use SCUBA gear. Divers use an iron bar to prise abalone from rocks.	Total state-wide catch of the abalone fishery for the last five seasons (subject to available data) were: • 2018 – 1,310 t. • 2017 – 1,561 t. • 2016 – 1,694 t. • 2015 – 1,855 t. • 2014 – 1,932 t.
Rock Lobster Fishery	Southern rock lobster (*Jasus edwardsii*).	All Tasmanian waters. East Coast Stock Rebuilding Zone subject to temporary closures (see Figure 5.45).	**Yes.** The EMBA intersects the North-east Catch Area.	12-month season, from March to February. • Female - 1 May 2018 for all State waters. • Male - 1 September 2018 for all waters south of St Helens around to Sandy Cape. • Male - 1 October 2018 all other State waters.	Fished from coastal rocky reefs in waters up to 150 m depth, with most of the catch coming from inshore waters less than 100 m deep. Baited pots are generally set and retrieved each day, marked with a surface buoy. There are 312 licences as of 2018.	Catches of the rock lobster commercial fishery for the last five seasons (subject to available data) were: • 2018/19 – 1,050 t. • 2017/18 – 1,050 t. • 2016/17 – 1,050 t. • 2015/16 – 1,050 t. • 2014/15 – 1,050 t.

Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Shellfish Fishery	Pacific oyster (*Crassostrea gigas*), Native oyster (*Ostrea angasi*), Venerupis clam (*Venerupis largillierti*) and Katelysia cockle (*Katelysia scalarina*).	Georges Bay Zones and Ansons Bay Zones on the east coast of Tasmania (see Figure 5.46).	**No.** The designated zones occur off the east coast of Tasmania.	Assumed year-round.	The shellfish targeted by the fishery can be collected by hand in shallow water using a basket rake. In deeper water a dredge is used.	Available data of catches for the last five seasons were: • 2014/15 – 25 t. • 2013/14 – 42 t. • 2012/13 – 49 t. • 2011/12 – 44 t. • 2010/11 – 44 t.
Seaweed Fishery	Bull kelp (*Nereocystis luetkeana*) and Wakame (*Undaria pinnatifida*).	Kelp harvesting occurs on the west coast of Tasmania and King Island. *Undaria pinnatifida* harvesting occurs on the east coast of Tasmania.	**No.** The primary sites of the fishery occur off the east coast of Tasmania and west coast of King Island.	Year-round (assumed).	Seaweeds are harvested as they wash ashore. Bull kelp is dried and alginates are extracted which are used in thickening solutions. Some is bagged and sold as garden mulch.	No catch data available.
Scalefish Fishery	Multi-species fishery including banded morwong (*Cheilodactylus spectabilis*), Tiger flathead (*Neoplatycephalus richardsoni*) and southern school whiting (*Sillago flindersi*).	Entire Tasmanian coastline. (see Figure 5.47).	**Yes.** Fishing blocks occur in the EMBA.	Year-round. Some seasonal closures depending on the target species.	The fishery targets multiple species and therefore uses multiple gear-types including drop-line, Danish seine, fish trap, hand-line and spear. There were 259 vessels operating in 2017/18 across the fishery.	Catches of key scalefish species for the last five seasons were: • 2017/18 – 318 t. • 2016/17 – 312 t. • 2015/16 – 348 t. • 2014/15 – 273 t. • 2013/14 – 320 t.
Giant Crab Fishery	Tasmanian giant crab (*Pseudocarcinus gigas*).	Entire Tasmanian coastline.	**Yes.** Majority of catch occurs off the southern coast of Tasmania.	Males – year-round. Females – 15 November to 31 May.	Giant crabs are harvested on the continental shelf, with the most abundant catches at water depths of 110-180 m. They are harvested via baited pots.	Catches for the last five seasons were: • 2018/19 – 20 t. • 2017/18 – 16 t. • 2016/17 – 30 t. • 2015/16 – 20 t. • 2014/15 – 23 t.

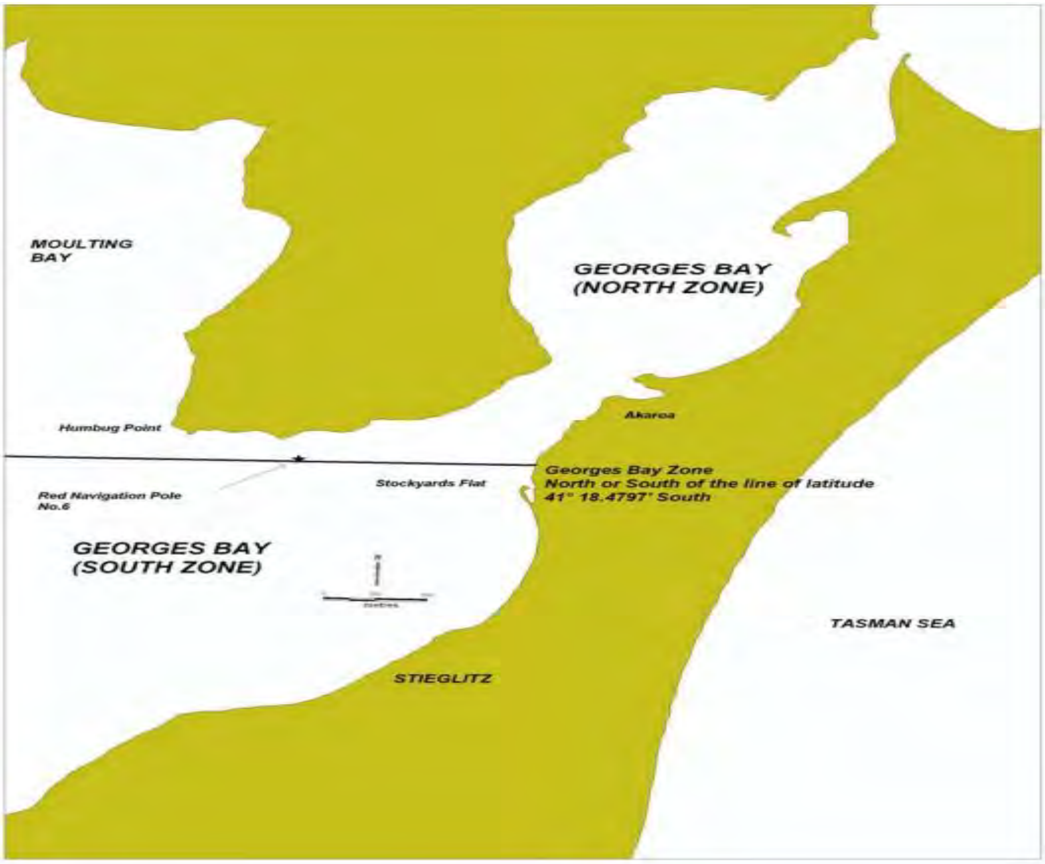
Fishery	Target species	Geographic extent of fishery	Does fishing occur in the EMBA?	Fishing season	Fishing methods, vessels and licences	Catch data and other information
Commercial Dive Fishery	Short spined sea urchin (*Heliocidaris erythrogramma*), long spined sea urchin (*Centrostephanus rodgersii*), periwinkles (genus *Turbo*) and Japanese kelp (*Undaria pinnatifida*).	Entire Tasmanian coastline (refer to Figure 5.48).	**Yes** EMBA intersects the northern and western zones of the fishery.	1 September – 31 August.	There are currently 52 commercial dive licences.	Catch data for the north and western zones: from the 2019/2020 season at date of reporting was 76 tonnes with no value assigned. Historic catch data is not available.
Octopus Fishery	Pale octopus (*Octopus pallidus*).	Entire Tasmanian coastline (refer to Figure 5.49).	**Yes** EMBA intersects the northern catch area of the fishery.	Year round.	There are only two active vessel licences.	Catch and value data is confidential due to low number of operators.

Source: DPIPWE (2020a-h)



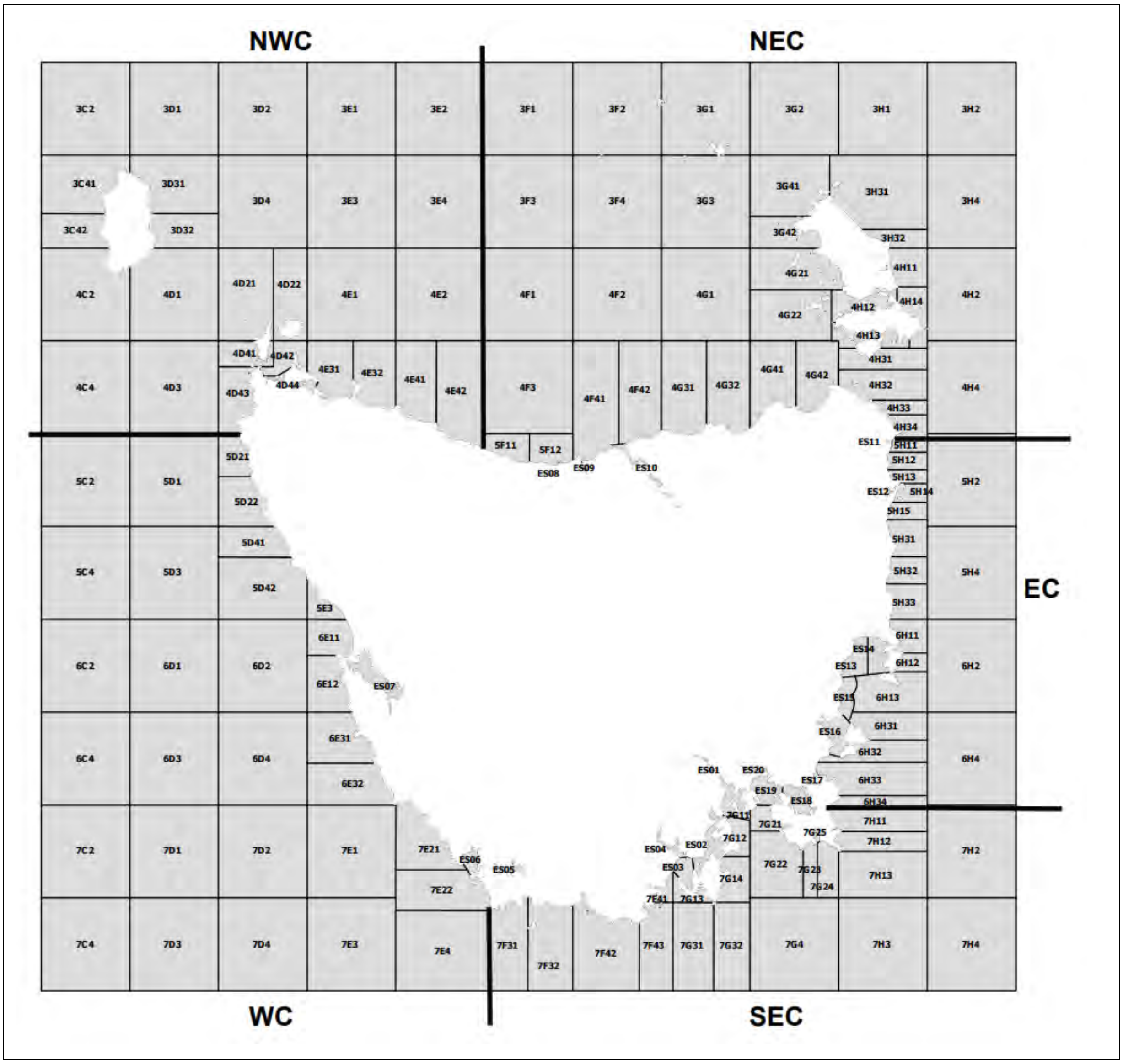
Source: DPIPWE (2020c)

Figure 5.45. Jurisdiction and regions of the Tasmanian Rock Lobster Fishery



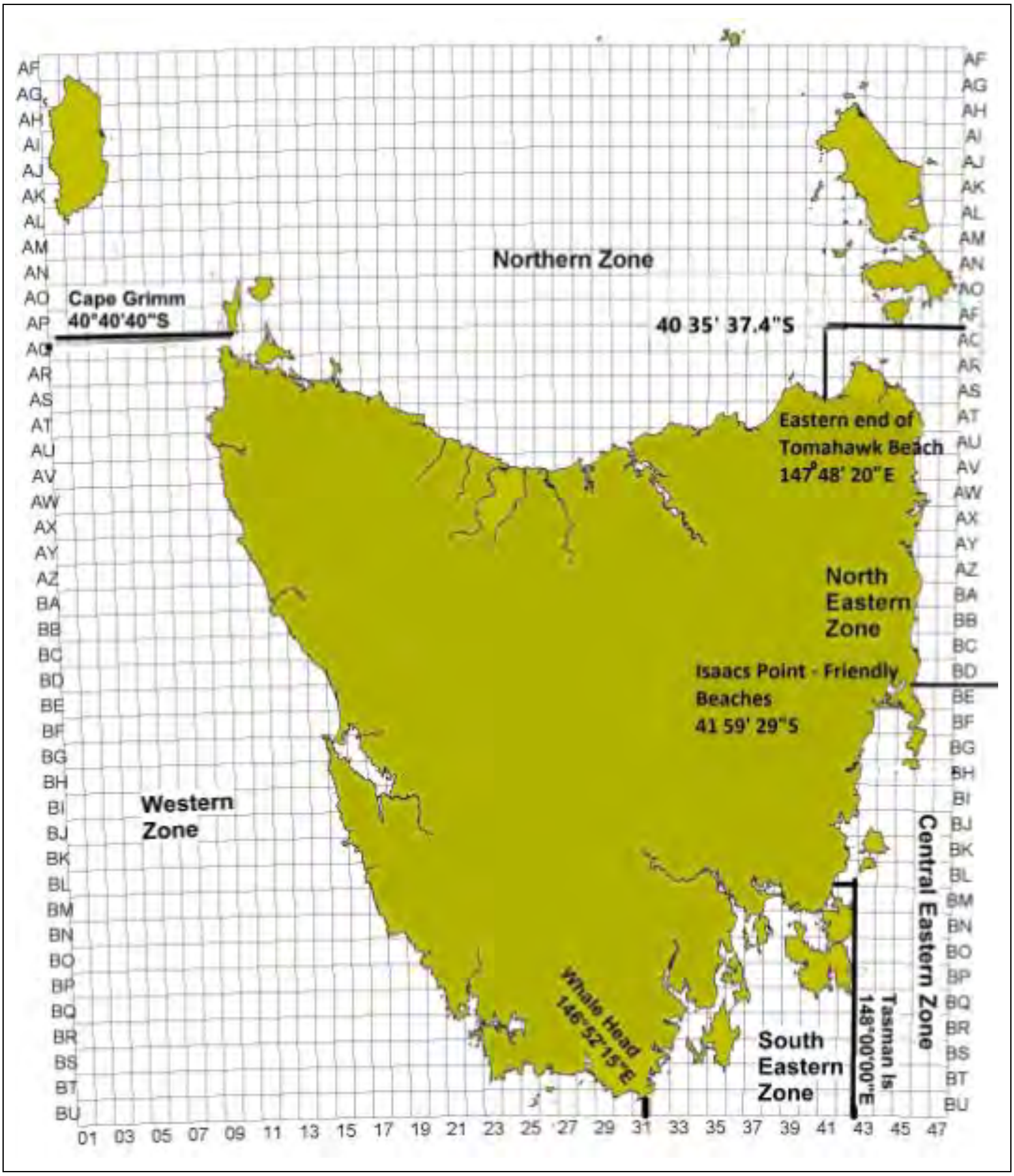
Source: DPIPWE (2020d)

Figure 5.46. Tasmanian Shellfish Fishery zones of high catch and effort



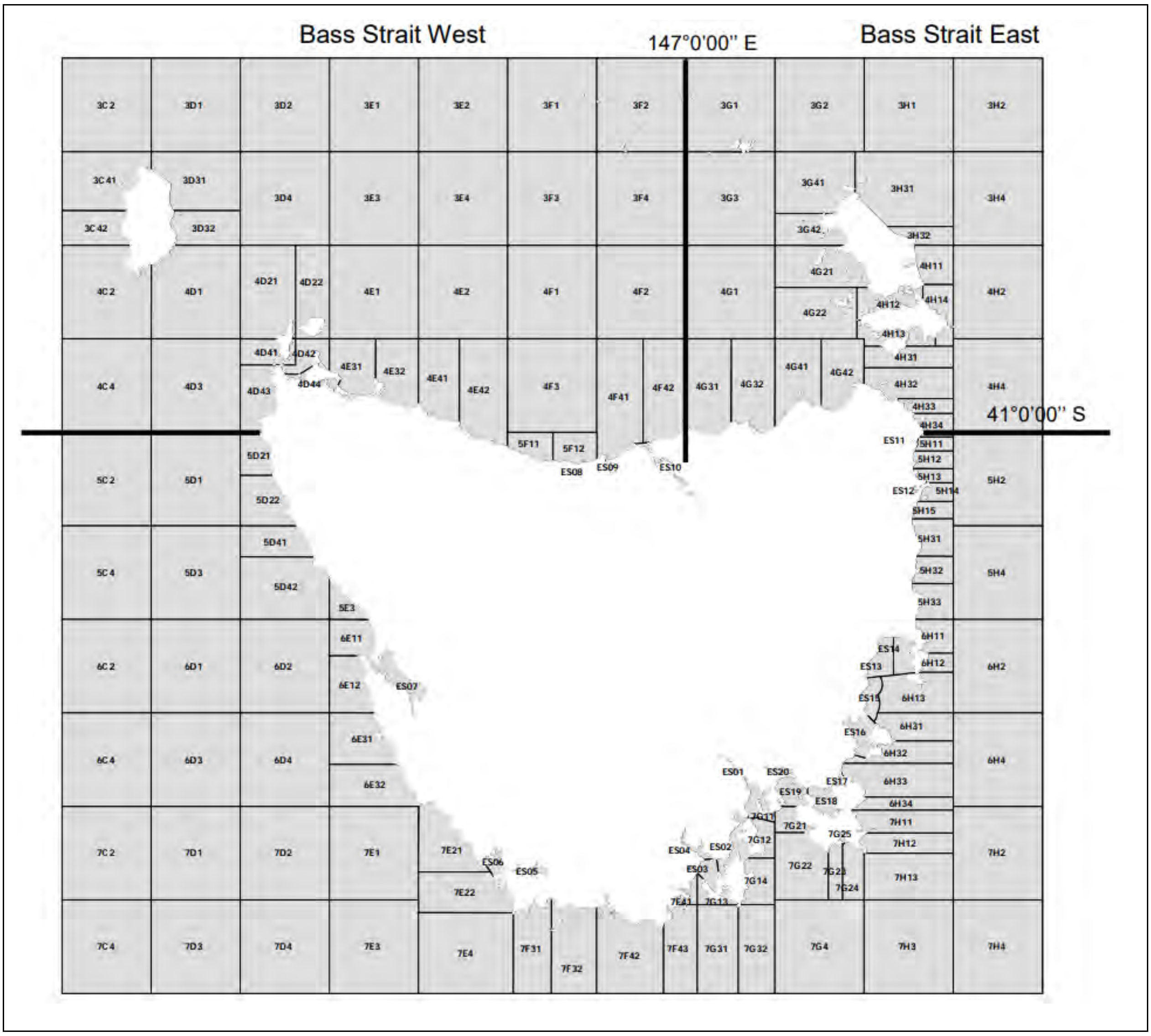
Source: DPIPWE (2020f)

Figure 5.47. Jurisdiction and zones of the Tasmanian Scalefish Fishery



Source: DPIPWE (2020h)

Figure 5.48. Jurisdiction of the Tasmanian Commercial Dive Fishery



Source: DPIPWE (2020)

Figure 5.49. Tasmanian Octopus Fishery jurisdiction and zones

5.7.7 Commercial Shipping

The South-east Marine Region (which includes Bass Strait) is one of the busiest shipping regions in Australia (DoE, 2015a). Shipping consists of international and coastal cargo trade, passenger services and cargo and vehicular ferry services across Bass Strait (DoE, 2015a).

The 'Spirit of Tasmania' ferry service runs between Melbourne and Devonport (northern Tasmania) on a daily basis. Traffic volume data areas clearly illustrates this route (Figure 5.50), which is located about 40 km southwest of Yolla-A.

The route for other maritime traffic that flows between Melbourne and the Australian east coast passes close to Wilsons Promontory and across the BassGas pipeline (see Figure 5.50).

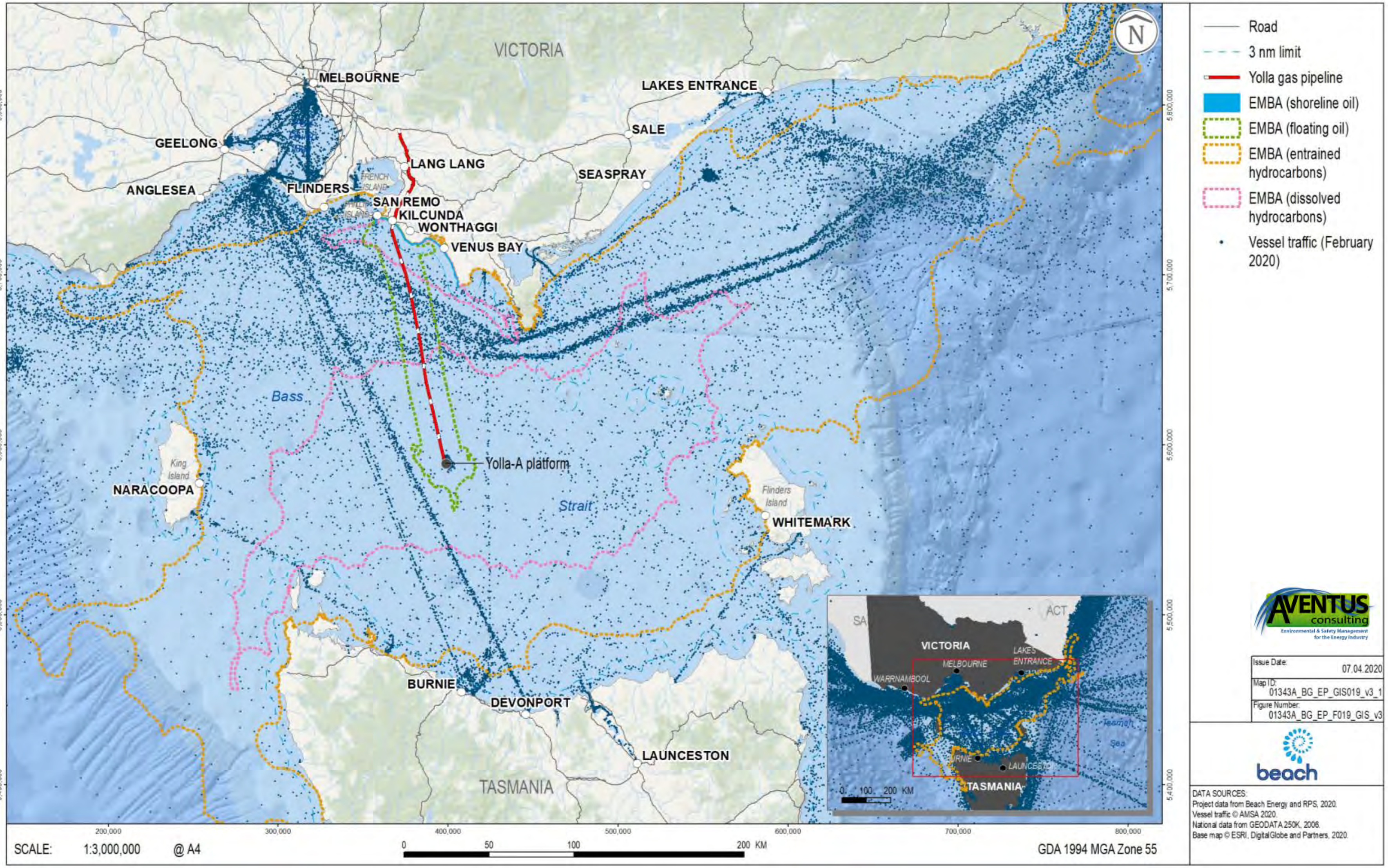


Figure 5.50. Commercial shipping traffic in the EMBA

6. Environmental Impact and Risk Assessment Methodology

As required under Regulation 13(5) of the OPGGS(E) and Regulation 15(3) of the OPGGS Regulations, this chapter describes the environmental impact and risk assessment methodology used in this EP. Beach uses its Corporate Risk Assessment Framework and risk toolkit for all its activities. This methodology is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, *Risk Management – Principles and Guidelines*).

Figure 6.1 outlines the Beach risk assessment management process, with each step of this process described in this chapter.

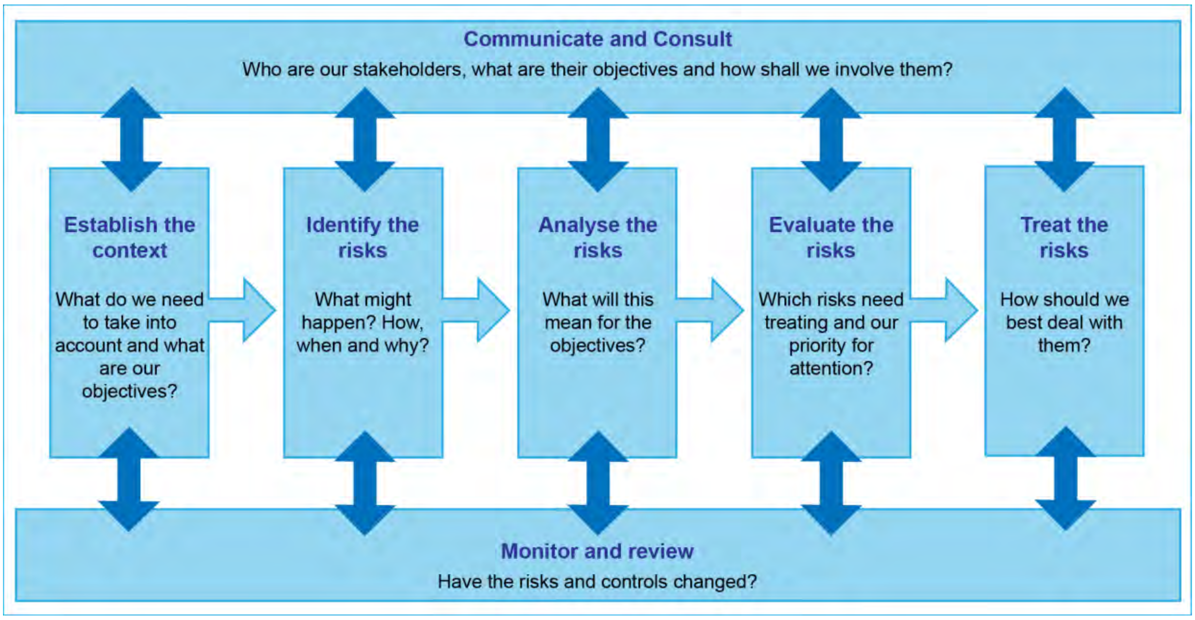


Figure 6.1. Beach risk assessment process

6.1 Step 1 - Communicate and Consult

In accordance with Regulations 11A and 14(9) of the OPGGS(E) and Regulation 16(8) of the OPGGS Regulations, Beach has consulted with relevant persons (stakeholders) in the revision of this EP to obtain information about their functions, activities and interests and assess how the BassGas operations may impact on these. This information has been used to inform the impact and risk assessment in the EP. The stakeholder consultation process is described in detail in Chapter 4.

6.2 Step 2 - Establish the Content

The first step in the risk assessment process (outlined in Figure 6.1) is to establish the context. This involves:

- Understanding the regulatory framework in which the activity takes place (described in the 'Regulatory Framework' in Chapter 2);
- Defining the activities that will cause impacts and create risks (outlined in the 'Activity Description' in Chapter 3);
- Understanding the concerns of stakeholders and incorporating those concerns into the design of the activity where appropriate (outlined in Chapter 4, 'Stakeholder Consultation'); and

- Describing the environment in which the activity takes place (the 'Existing Environment' is described in Chapter 5).

Once the context has been established, the hazards of the activity can be identified, along with the impacts and risks of these hazards. This process is described in the following sections.

6.3 Step 3 - Identify the Risks

Beach's Corporate Risk Assessment Framework requires the following steps to be implemented:

- Identify the activities and the potential impacts associated with them;
- Identify the sensitive environmental resources at risk within and adjacent to the operational area;
- Identify the environmental consequences of each potential impact, corresponding to the maximum reasonable impact;
- Identify the likelihood (probability) of occurrence of each potential environmental impact (i.e., the probability of the event occurring);
- Identify applicable control measures; and
- Assign a level of risk to each potential environmental impact using a risk matrix.

In accordance with this framework, all risks must be reduced to a level that is considered to be As Low As Reasonably Practicable (ALARP) (see Section 6.3.3).

A risk identification and assessment workshop was undertaken by Beach on the 12th of February 2019 to re-examine the originally identified BassGas environmental hazards and their associated impacts and risks. The workshop involved a multi-disciplinary team, including personnel from operations, environment and community. In addition to this, in 2019 Beach commissioned AECOM to prepare an ALARP and Acceptability assessment of PFW discharges, the results of which are incorporated within this EP (see Sections 3.5.6 and 7.6).

Following the review of each hazard and their associated impacts and risks, control measures were also reviewed to ensure the impact consequence or risk rating is ALARP. An assessment of what is 'reasonably practicable' requires professional judgements to be made against the relevant matrices using the advice of technical experts as well as published standards, availability of mitigation measures and industry practice.

The information from this workshop was captured within the BassGas offshore operations environmental impact and risk register, which has been used to update this EP.

6.3.1 Definitions

For context, Table 6.1 provides the definitions of impacts and risk according to the OPGGS(E) and OPGGS Regulations and international risk management standards.

The OPGGS(E) Regulations 14(5)(6) and Regulations 15(3)(4) of the OPGGS Regulations require that the EP detail and evaluate the environmental impacts and risks for an activity, including control measures used to reduce the impacts and risks of the activity to ALARP and an acceptable level. This must include impacts and risks arising directly or indirectly from all activity operations (i.e., planned events) or potential emergency or incident conditions (i.e., incident events).

NOPSEMA distinguishes between environmental impacts and risks. Environmental impact is defined in Table 6.1 in accordance with the OPGGS(E) and OPGGS Regulations. Table 6.1 also highlights that environmental risk is not defined in both sets of regulations.

Table 6.1. Definitions of impact and risk

Source	Impact	Risk
OPGGS(E)	Any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity.	Not defined.
OPGGS Regulations		
ISO AS/NZS 31000: 2018 (Risk management – Principles and guidelines)	Not defined.	The effect of uncertainty on objectives.
ISO AS/NZS 14001: 2016 (Environmental management systems – Requirements with guidance for use)	Not defined.	The effect of uncertainty on objectives.
ISO AS/NZS 4360: 2004 (Risk management)	Not defined.	The chance of something happening that will have an impact on objectives.
HB203: 2012 (Managing environment-related risk)	Any change to the environment or a component of the environment, whether adverse or beneficial, wholly or partly resulting from an organisation's environmental aspects.	The effect of uncertainty on objectives. The level of risk can be expressed in terms of a combination of the consequences and the likelihoods of those consequences occurring.

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

- **Impacts** result from **planned events** – there *will* be consequences (known or unknown) associated with the event occurring. Impacts are an inherent part of the activity. For example, there will be atmospheric emissions associated with flaring.
  - For impacts, only a consequence is assigned in this EP (likelihood is irrelevant given that the event does occur).
- **Risks** result from **unplanned events** – there *may* be consequences if an unplanned event occurs. Risks are not an inherent part of the activity. For example, a hydrocarbon spill may occur if the raw gas pipeline is ruptured by vessel anchoring, but this is not a certainty. The risk of this event is determined by multiplying the consequence of the impact (using factors such as the type and volume of hydrocarbons and the nature of the receiving environment) by the likelihood of this event happening (which may be determined objectively or subjectively, qualitatively or quantitatively).
  - For risks, the consequence and likelihood are combined to determine the risk rating (Table 6.2).

6.4 Step 4 – Analyse the Risks

After the impacts and risks have been identified, environmental performance outcomes (EPO) (or objectives) are developed to provide a measurable level of performance for each environmental hazard to ensure that the environmental impacts and risks are managed to be ALARP and acceptable.

Table 6.2. Beach risk assessment matrix

Consequence Rating	Natural Environment	Reputational and/or Community damage / impact / social / cultural heritage	Likelihood of Occurrence					
			Remote (1)	Highly Unlikely (2)	Unlikely (3)	Possible (4)	Likely (5)	Almost Certain (6)
			<1% chance of occurring within the next year. Occurrence requires exceptional circumstances. Exceptionally unlikely event in the long-term future. Only occur as a 100-year event.	>1% chance of occurring within the next year. May occur but not anticipated. Could occur years to decades.	>5% chance of occurring in the next year. May occur but not for a while. Could occur within a few years.	>10% chance of occurring within the next year. May occur shortly but a distinct possibility it will not. Could occur within months to years.	>50% chance of occurring within the next year. Balance of probability that it will occur. Could occur within weeks to months.	99% chance of occurring within the next year. Impact is occurring now. Could occur within days to weeks.
Catastrophic (6)	Long-term destruction of highly valued ecosystem or very significant effects on endangered species or habitats (formally managed).	Irreparable damage of highly valued items or structures of great cultural significance. Negative international or prolonged national media (e.g., 2 weeks).	High	High	Severe	Severe	Extreme	Extreme
Critical (5)	Significant impact on highly valued (formally managed) species or habitats to the point of eradication or impairment of ecosystem. Widespread long-term impact.	Major irreparable damage to highly valued structures/ items of cultural significance. Negative national media for 2 days or more. Significant public outcry.	Medium	Medium	High	Severe	Severe	Extreme
Major (4)	Very serious environmental effects, such as displacement of species and partial impairment of ecosystem (formally managed). Widespread medium and some long-term impact.	Significant damage to items of cultural significance. Negative national media for one day. Adverse attention from non-government organisations (NGOs).	Medium	Medium	Medium	High	Severe	Severe
Serious (3)	Moderate effects on biological or physical environment (formally managed) and serious short-term effects but not affecting ecosystem functions.	Permanent damage to items of cultural significance. Negative State media. Heightened concern from local community. Criticism by NGOs.	Low	Medium	Medium	Medium	High	Severe
Moderate (2)	Minor short-term damage to area of limited significance (not formally managed). Short-term effects but not affecting ecosystem functions.	Some damage to items of cultural significance. Minor adverse local public or media attention and complaints.	Low	Low	Medium	Medium	Medium	High
Minor (1)	No lasting effects. Low-level impacts on biological and physical environment to an area of low significance (not formally managed).	Low level repairable damage to commonplace structures. Public concern restricted to local complaints.	Low	Low	Low	Medium	Medium	Medium

6.5 Step 5 – Evaluate the Risks

The purpose of impact and risk evaluation (herein referred to simply as risk assessment) is to assist in making decisions, based on the outcomes of analysis, about the sorts of controls required to reduce an impact or risk to ALARP. Planned and unplanned events are subject to risk assessment in the same manner.

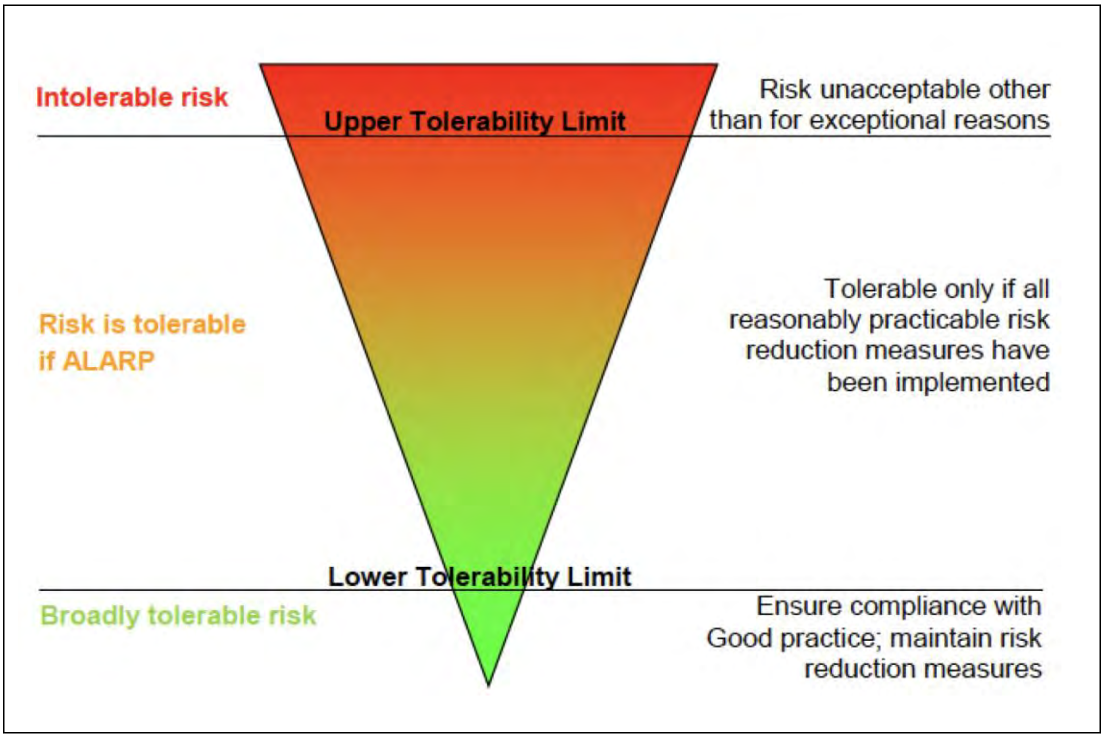
Beach's risk assessment process is described below and was followed in the risk identification and assessment workshop described in Section 6.3:

- Identify and describe the risks (see Chapter 7).
- Determine the maximum credible consequence (to the natural environment and community/social/cultural heritage) arising from the impact or risk without introducing additional controls. This determination is provided in the risk assessment tables throughout Chapter 7.

- Adopt controls for each impact or risk.
- Undertake an assessment of the consequence of the impact or risk, corresponding to the maximum credible impact across the consequence categories (see Table 6.2, following page) considering the controls identified and their effectiveness.
- Identify the likelihood of occurrence of those consequences ('remote' through to 'almost certain'), considering the controls identified and their effectiveness, as outlined in Table 6.2.
- For risks, multiply the consequence and likelihood to determine the overall risk raking, outlined in Table 6.2.

6.5.1 Demonstration of ALARP

The ALARP principle states that it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. The ALARP principle arises from the fact that infinite time, effort and money could be spent attempting to reduce an impact or risk to zero. This concept is shown diagrammatically in Figure 6.2.



Source: CER (2015).

Figure 6.2. The ALARP Principle

Beach's approach to demonstrating ALARP includes:

- Systematically identify and assess all potential environmental impacts and risks associated with the activity;
- Where relevant, apply industry 'good practice' controls to manage impacts and risks; and
- Assess the effectiveness of the controls in place and determine whether the controls are adequate according to the 'hierarchy of control' principle; and
- For higher order impacts and risks, implement further controls if feasible and reasonably practicable to do so.

NOPSEMA's *Environment Plan decision making* guideline (GL1721, Rev 6, November 2019) states that in order to demonstrate ALARP, a titleholder must be able to implement all available control measures where the cost is not grossly disproportionate to the environmental benefit gained from implementing the control measure.

There is no universally-accepted guidance to applying the ALARP principle to environmental assessments. For this EP, the guidance provided in NOPSEMA's Environment Plan decision making guideline has been applied, and augmented where deemed necessary.

The level of ALARP assessment is dependent upon the:

- Residual impact and risk level (high versus low); and
- The degree of uncertainty associated with the assessed impact or risk.

An iterative risk evaluation process is employed until such time as any further reduction in the residual risk ranking is not reasonably practicable to implement. At this point, the impact or risk is reduced to ALARP. The determination of ALARP is outlined in Table 6.3.

Table 6.3. Alignment of ALARP with impacts (using consequence ranking) and risks (using risk ranking)

Consequence ranking	Minor	Moderate	Serious	Major	Critical	Catastrophic
ALARP level – planned event	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual impact category	Lower order		Higher order			
Risk ranking	Low	Medium	High	Severe	Extreme	
ALARP level - unplanned event	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual risk category	Lower order risks			Higher order risks		

Hierarchy of Controls

Beach demonstrates ALARP, in part, by adopting the 'Hierarchy of Controls' philosophy (Figure 6.4). The Hierarchy of Controls is a system used across hazardous industries to minimise or eliminate exposure to hazards. The hierarchy of controls is, in order of effectiveness:

- Elimination;
- Substitution;
- Engineering controls;
- Administrative controls; and
- Personal protective equipment (PPE) – this has not been included here as it is specific to the assessment of safety risks rather than environmental management.

Although commonly used in the evaluation of occupational health and safety hazard control, the Hierarchy of Controls philosophy is also a useful framework to evaluate potential environmental controls to ensure reasonable and practicable solutions have not been overlooked.

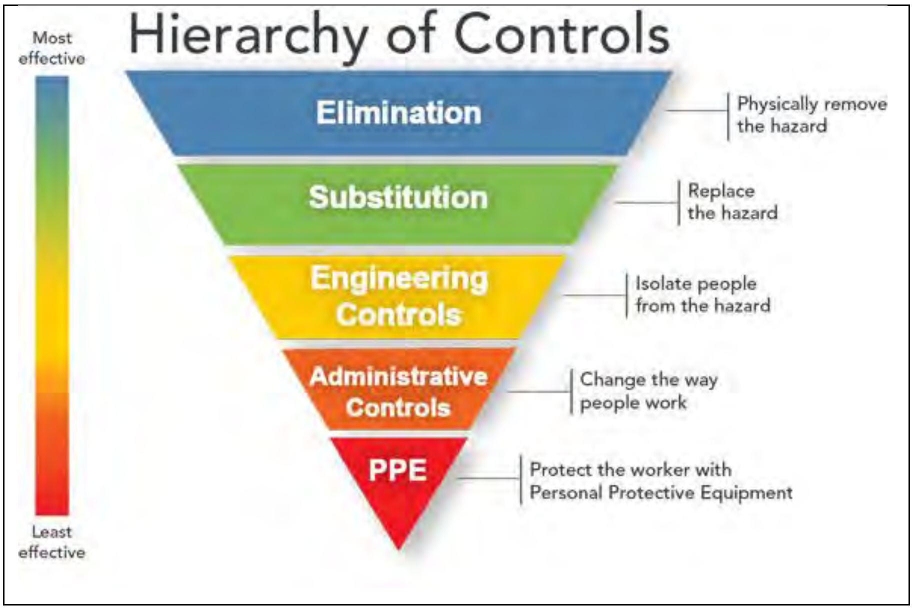


Figure 6.3. The Hierarchy of Controls

When deciding on whether to implement the proposed impact/risk reduction measure, the following issues are considered:

- Does it provide a clear or measurable reduction in risk?
- Is it technically feasible and can it be implemented?
- Will it be supported and utilised by site personnel?
- Is it consistent with national or industry standards and practices?
- Does it introduce additional risk in other operational areas (e.g., will the implementation of an environmental risk reduction measure have an adverse impact on safety)?
- Will the change be effective, taking into account the:
  - Current level of risk (i.e., with the existing controls);
  - Amount of additional risk reduction that the control will deliver;
  - Level of confidence that the risk reduction impact will be achieved; and
  - Resources, schedule and cost required to implement the control.

Reducing impacts and risks to ALARP is an ongoing process and new risk reduction measures may be identified at any time, including during operations. Beach actively encourages recording and review of observations through the HSE management system (HSEMS) in the incident management system (CMO database). Incidents and lessons learned within Beach and from the wider industry are reviewed and utilised to identify hazards and controls.

The following section details how the guidance provided in NOPSEMA's *Environment Plan decision making* guideline.

6.5.2 Residual Impact and Risk Levels

Lower-order Environmental Impacts and Risks

NOPSEMA defines lower-order environmental impacts and risks as those where the environment or receptor is not formally managed, less vulnerable, widely distributed, not protected and/or threatened and there is confidence in the effectiveness of adopted control measures.

Impacts and risks are considered to be lower-order and ALARP when, using the Beach risk matrix (see Table 6.2), the impact consequence is rated as 'minor' or 'moderate' or risks are rated as 'low', 'medium' or 'high' (see also Table 6.3). In these cases, applying 'good industry practice' (see Section 6.5.3) is sufficient to manage the impact or risk to ALARP.

Higher-order Environmental Impacts and Risks

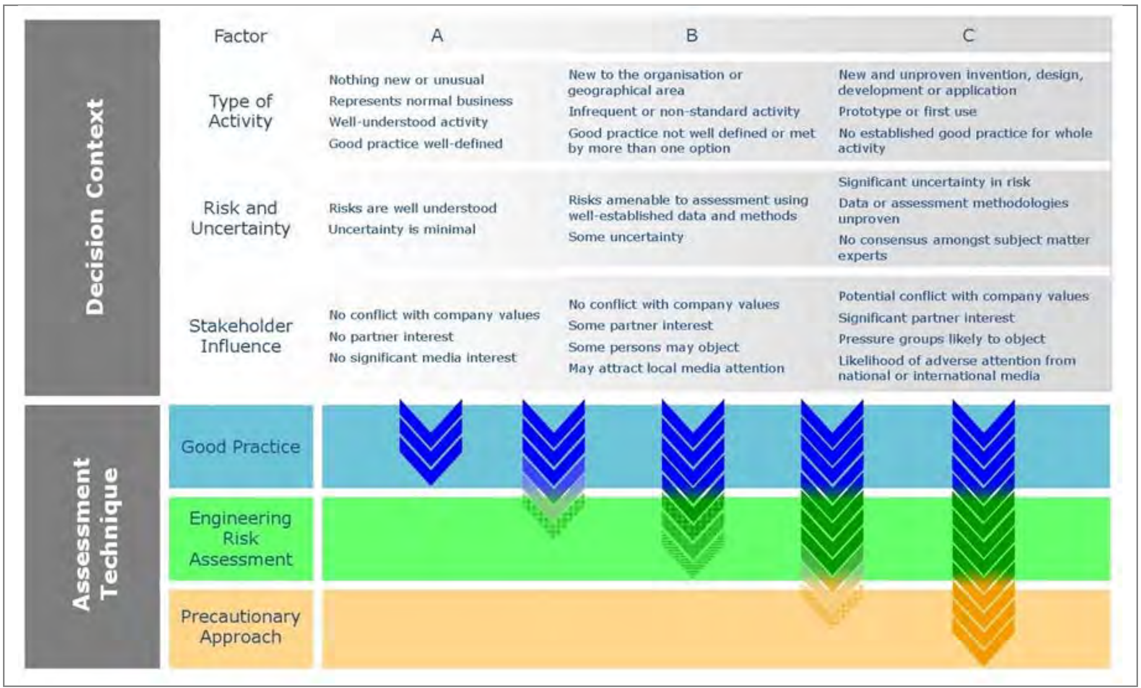
NOPSEMA defines higher-order environmental impacts and risks as those that are not lower order risks or impacts (i.e., where the environment or receptor is formally managed, vulnerable, restricted in distribution, protected or threatened and there is little confidence in the effectiveness of adopted control measures).

Impacts and risks are considered to be higher-order when, using the Beach risk matrix (see Table 6.2), the impact consequence is rated as 'serious', 'major', 'critical' or 'catastrophic', or when the risk is rated as 'severe' or 'extreme' (see also Table 6.3). In these cases, further controls must be considered as per Section 6.5.3.

6.5.3 Uncertainty of Impacts and Risks

Based upon the level of uncertainty associated with the impact or risk, the following framework, adapted by NOPSEMA (2015) from the Guidance on Risk Related Decision Making (Oil & Gas UK, 2014) (Figure 6.4) 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 6.4.



Source: CER (2015).

Figure 6.4. Impact and risk 'uncertainty' decision-making framework

Table 6.4. ALARP decision-making based upon level of uncertainty

Decision type	Decision-making tools
A	Good industry practice Identifies the requirements of legislation, codes and standards that are to be complied with for the activity. Applies 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. Identifies further engineering control standards and guidelines that may be applied over and above that required to meet the legislation, codes and standards.
B	*In addition to decision type A:* Engineering risk-based tools Engineering risk-based tools to assess 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.
C	*In addition to decision type A and B:* Precautionary Principle Application of the Precautionary Principle is to be applied when good industry practice and engineering risk-based tools fail to address uncertainties.

The decision-making tools outlined in Table 6.4 are explained further below.

Good Practice

In the absence of an Australian definition, the OGUK (2014) and the Irish Commission for Energy Regulation (CER) (2015) define 'Good Practice' as:

> *The recognised risk management practices and measures that are used by competent organisations to manage well-understood hazards arising from their activities.*

NOPSEMA has not endorsed any 'approved codes of practice' or standards to give them a legal status in terms of good practice. Good practice is taken to refer to any well-defined and established standard or codes of practice adopted by an industrial/occupational sector, including 'learnings' from incidents that may yet be incorporated into standards.

Good practice can also be used as the generic term for those standards for controlling risk that have been judged and recognised as satisfying the law when applied to a particular relevant case in an appropriate manner. For this EP, sources of good practice, adapted from CER (2015) are:

- Commonwealth and Victorian legislation and regulations (outlined in Section 2.2);
- Relevant government policies (outlined in Section 3.5);
- Relevant government guidance (outlined in Section 2.3);
- Relevant industry standards (outlined in Section 2.5 and Section 2.6); and
- Relevant international conventions (outlined in Section 2.2.1).

Good practice also requires that hazard management is considered in a hierarchy, with the concept being that it is inherently safer to eliminate a hazard than to reduce its frequency or manage its consequences (CER, 2015). This being the case, the 'Hierarchy of Controls' philosophy is applied to reduce the risks associated with hazards (described in Section 6.5.1).

Engineering Risk Assessment

All impacts and risks that require assessment beyond that of good practice (i.e., decision type A) are subject to an engineering risk assessment.

Engineering risk-based tools can include, but are not limited to, engineering analysis (e.g., structural, fatigue, mooring, process simulation) and consequence modelling (e.g., ship collision, dropped object) (CER, 2015). A cost-benefit analysis to support the selection of control measures identified during the risk assessment process may also be undertaken.

Beach believes the methodology most suited to the BassGas operations is a comparative assessment of risks, costs and environmental benefit. A cost-benefit analysis should show the balance between the risk benefit (or environmental benefit) and the cost of implementing the identified measure, with differentiation required such that the benefit of the control can be seen and the reason for the benefit understood.

Precautionary Principle

All impacts and risks that do meet decision type A or type B and require assessment beyond that of good practice and engineering risk assessment are subject to the 'Precautionary Principle'. CER (2015) states that if the assessment, taking account of all available engineering and scientific evidence, is insufficient, inconclusive or uncertain, then the precautionary principle should be adopted in the hazard management process. While there is no globally-recognised definition of the Precautionary Principle, it is generally accepted to mean:

> *Uncertain analysis is replaced by conservative assumptions which will increase the likelihood of a risk reduction measure being implemented.*

The degree to which this principle is adopted should be commensurate with the level of uncertainty in the assessment and the level of danger (hazard consequences) believed to be possible.

Under the precautionary principle, environmental considerations are expected to take precedence over economic considerations, meaning that an environmental control measure is more likely to be implemented. In this decision context, the decision could have significant economic consequences to an organisation.

6.5.4 Demonstration of Acceptability

Regulation 13(5)(c) of the OPGGS(E) and Regulation 15(3)(e) of the OPGGS Regulations require the EP to demonstrate that environmental impacts and risks are acceptable.

NOPSEMA's Environment Plan decision making guideline states that stakeholder consultation plays a large part in establishing the context for defining an acceptable level of environmental impact or risk may be.

Beach considers a range of factors to demonstrate the acceptability of the environmental impacts and risks associated with its activities. This evaluation works at several levels, as outlined in Table 6.5. The criteria for demonstrating acceptability were developed based on Beach's interpretation of NOPSEMA's *Guidance Note for EP Content Requirements* (N04750-GN1344, Rev 0, February 2014 [noting that this has since been superseded]) and NOPSEMA's Environment Plan decision making guideline.

Table 6.5. Acceptability criteria

Test	Question	Acceptability demonstrated
Internal context		
Policy compliance	Is the proposed management of the hazard aligned with Beach's Environmental Policy?	The impact or risk must be compliant with the objectives of the company policies.
Management System Compliance	Is the proposed management of the hazard aligned with Beach's HSEMS?	Where specific Beach procedures, guidelines, expectations are in place for management of the impact or risk in question, acceptance is demonstrated.
External context		
Stakeholder engagement	Have stakeholders raised any concerns about activity impacts or risks? If so, are measures in place to manage those concerns?	Merits of claims or objections raised by stakeholders must have been adequately assessed and additional controls adopted where appropriate.
Legislation, industry standard and best practice		
Legislative context	Do the management controls meet the expectations of existing Victorian or Commonwealth legislation?	The proposed management controls align with legislative requirements.
Industry practice	Do the management controls align with international and Australian industry guidelines and practices?	The proposed management controls align with relevant industry guidelines and practices.
Environmental context	What are the overall impacts and risks to MNES and other areas of conservation significance? Do environmental controls aligned with the aims and objectives of marine park management plans and species conservation advice, recovery plans or threat abatement plans?	There are no long-term impacts to MNES and the proposed management controls do not conflict with the aims and objectives of marine park management plans and species conservation advice, recovery plans or threat abatement plans.
ESD Principles*	Are the management controls aligned with the principles of ESD?	The EIA presented throughout Chapter 7 is consistent with the principles of ESD.

* See Table 6.6 for further information.

6.5.5 Principles of Ecologically Sustainable Development

Based on Australia's National Strategy for Ecologically Sustainable Development (Council of Australian Governments, 1992), Section 3A of the EPBC Act defines ESD as:

> *Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased.*

Table 6.6 outlines the principles of ESD as defined under the EPBC Act and describes how this EP aligns with these principles.

Table 6.6. Assessment of ESD principles

Principle		EP demonstration
A	Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations.	This principle is inherently met through the EP assessment process.
B	If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	Serious or irreversible environmental damage resulting from BassGas operations has been eliminated through the project design (see Chapter 3). None of the residual impacts is rated higher than 'minor' and none of the residual risks is rated higher than 'medium.' Scientific certainty has been maximised by employing a spill EMBA as a risk assessment boundary.
C	The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The EP assessment methodology ensures that risks from the activity are managed to be ALARP and acceptable.
D	The conservation of biodiversity and ecological integrity should be a fundamental consideration in decision making.	This principal is considered for each hazard in the adoption of environmental controls (i.e., environmental performance outcomes and environmental performance standards) that aim to minimise environmental harm. There is a strong focus in this EP on conserving biodiversity and ecological integrity by understanding the marine environment (Chapter 5) and implementing controls to minimise impacts and risks (Chapter 7).
E	Improved valuation, pricing and incentive mechanisms should be promoted.	This principle is not relevant to this activity.

6.6 Step 6 – Treat the Risks

The BassGas offshore operations environmental impact and risk register (discussed in Section 6.3) records the environmental control measures (e.g., measures to prevent, minimise and mitigate impacts and risks) that were determined by an expert team familiar with the BassGas operations.

These controls are listed throughout the EIA and ERA tables in Chapter 7.

6.7 Step 7 - Monitor and Review

Monitoring and review activities are incorporated into the impact and risk management process to ensure that controls are effective and efficient in both design and operation. This is achieved through the environmental performance outcomes (EPO), environmental performance standards (EPS) and measurement criteria that are described for each environmental hazard. Monitoring and review are described in detail in the Implementation Strategy (Chapter 8).

7. Environmental Impact and Risk Assessment

This chapter presents the EIA and ERA for the environmental impacts and risks identified for BassGas operations using the methodology described in Chapter 6, as required under Regulations 13(5)(6) of the OPGGS(E) and Regulations 15(3)(4)(5) of the OPGGS Regulations.

This chapter also presents the EPO, EPS and measurement criteria required to manage the identified impacts and risks. The following definitions are used in this section, as defined in Regulation 4 of the OPPGS(E) and Regulation 6 of the OPGGS Regulations:

- **EPO** – a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level (i.e., the environmental objective);
- **EPS** – a statement of the performance required of a 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 impact consequence rankings and risk ranking for each hazard identified and assessed in this chapter is presented in Table 7.1.

Table 7.1. BassGas offshore operations environmental impacts and risk summary

No.	Hazard	Inherent	Residual
Impact		Consequence rating	
1	Physical presence of infrastructure and vessels	Minor	Minor
2	Infrastructure inspection and maintenance	Minor	Minor
3	Routine emissions – light	Minor	Minor
4	Routine emissions – atmospheric	Minor	Minor
5	Routine emissions – noise and vibration	Minor	Minor
6	Routine discharges overboard – PFW	Moderate	Minor
7	Routine discharges overboard – putrescible waste	Minor	Minor
8	Routine discharges overboard – sewage and grey water	Minor	Minor
9	Routine discharges overboard – cooling and brine water	Minor	Minor
10	Routine discharges overboard – bilge water/deck drainage	Minor	Minor
Risk		Risk rating	
1	Accidental discharge of waste to the ocean	Medium	Low
2	Vessel collision with megafauna	Medium	Low
3	Introduction of invasive marine species	Medium	Medium
4	LoC (chemicals) – platform	Low	Low
5	LoWC (gas condensate) – wells	Medium	Low
6	LoC (gas condensate) – raw gas pipeline	Medium	Low
7	LoC (MDO) – vessels	Medium	Low
8	Oil spill response activities – excluding well relief drilling	Low	Low
9	Oil spill response activities – relief well drilling	Low	Low

The following sections assess environmental impacts (arising from planned events, being events that do or will happen), as listed in Table 7.1 and presented pictorially in Figure 7.1.

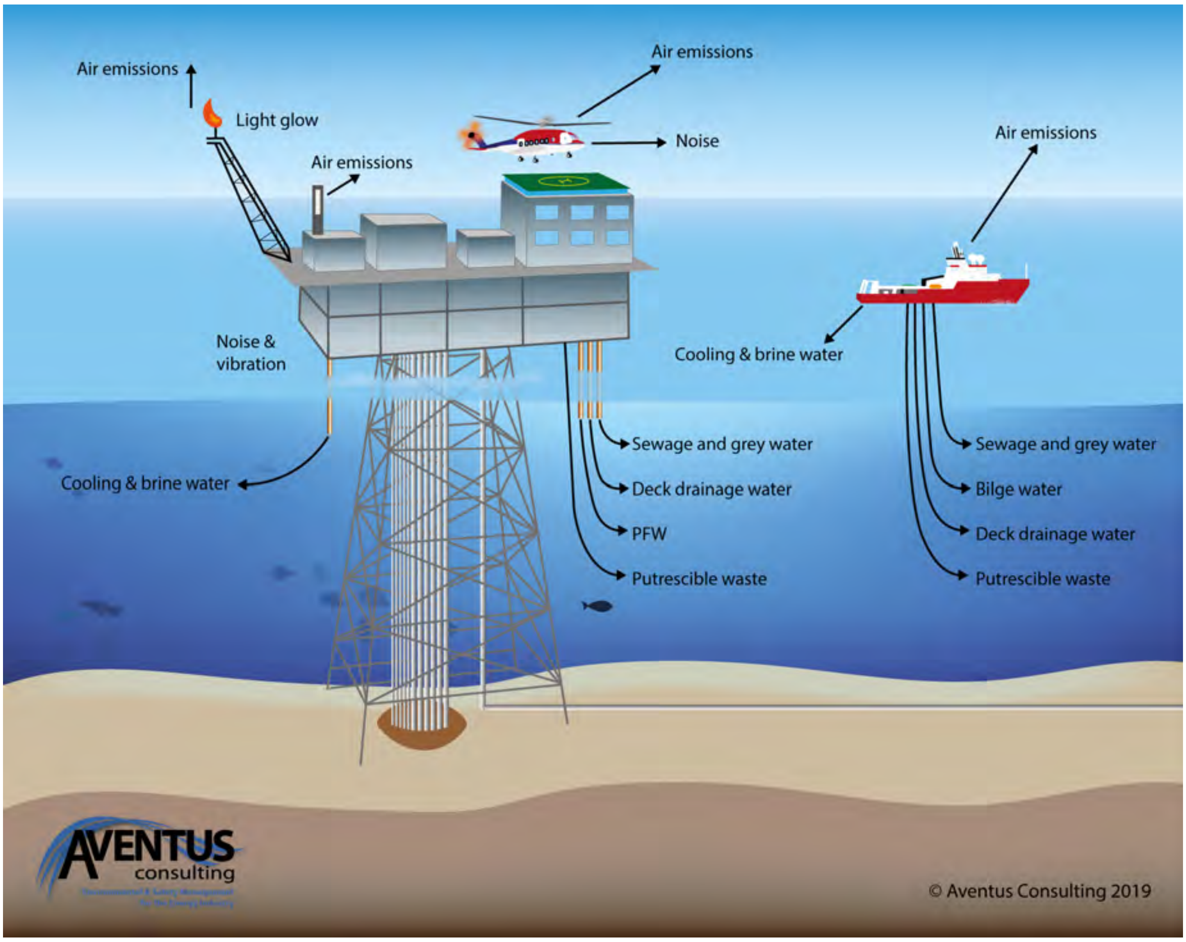


Figure 7.1. Simplified pictorial representation of impacts arising from the BassGas operations

7.1 IMPACT 1 - Physical Presence of Infrastructure and Vessels

7.1.1 Hazard

The Yolla-A platform and the RGP are physical hazards in the marine environment, noting that they have been in place since 2006 and that key fisheries stakeholders are aware of the presence of this infrastructure. The 500-m radius PSZ surrounding the platform prevents some marine activities, such as fishing. The RGP is a potential hazard to trawl fishing (it does not have an exclusion zone).

The presence of the PSV in the Yolla-A PSZ will have no impacts to third-party vessels, as third-party vessels are not permitted entry in the PSZ. Impacts to marine users from vessels undertaking inspection and maintenance activities will only occur when they are operating along the raw gas pipeline, which is infrequent and for short durations.

7.1.2 Known and potential environmental impacts

The physical presence of the platform and RGP has the potential to create the following impacts:

- Loss of benthic habitat over the small area of the seabed impacted by the platform and pipeline footprint;

- Ship collision with platform and restricted vessel navigation around platform;
- Commercial fishing restriction in the gazetted Yolla-A PSZ;
- Commercial fishing trawl equipment damage from snagging with the raw gas pipeline; and
- Potential for the subsea platform structure to act as an artificial substrate for marine growth, thereby changing the spatial distribution of fish and marine life.

The physical presence of vessels working alongside the RGP has the potential to create the following impacts:

- Collision potential with third-party vessels (and damage in the case of collision);
- Diversion of third-party vessels from their navigation paths; and
- Damage to or loss of fishing equipment and/or loss of commercial fish catches.

7.1.3 EMBA

The EMBA for physical presence of infrastructure is 78.5 ha (0.785 km^2/0.303 square miles) for the platform (representing the PSZ) and 5.14 ha (0.05 km^2/0.019 square miles) for the raw gas pipeline (representing the length of the pipeline multiplied by its diameter).

Receptors in the EMBA include:

- Pelagic fauna (plankton, fish, cetaceans);
- Benthic invertebrates;
- Benthic habitat (sandy seabed);
- Commercial fishers;
- Commercial and recreational fishing vessels; and
- Merchant vessels.

7.1.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
The platform and its PSZ, along with 96% of the length of the RGP, exist within Commonwealth waters.	Four percent (4%) of the length of the RGP exists within Victorian waters.
Vessels could be working along any part of the RGP.	

7.1.5 Evaluation of environmental impacts

<u>Loss of benthic habitat over a small area of the seabed</u>

The area of benthic habitat disturbed by the BassGas Development is limited to that occupied by the platform and the offshore RGP.

There are no known sensitive seabed features in the EMBA for this hazard. Surveys of the seabed around the Yolla-A platform have identified three depressions located on the east side of the platform formed from the spud cans of the jack-up drill rig that drilled the Yolla-5 and -6 wells (see Figure 5.9). The 36-m diameter depressions are preserved in a clay seabed base and the total depression volume has not substantially changed over the course of surveys conducted between 2007 and 2019.

The pipeline, including locations previously subject to free span rectification, shows recovery of benthic fauna and soft sediment substrates over time.

The areas of seabed disturbed by the platform and pipeline area is miniscule compared with the overall extent of the equivalent seabed habitat in the region. Consequently, there will be no long-term impacts to the diversity and abundance of benthic fauna, with impacts considered to be minor.

Ship collision with platform and restricted vessel navigation around platform

Bass Strait is one of the busiest shipping routes in Australia. The BassGas offshore assets are close to two minor shipping lanes, as detailed in Section 5.7.7. There are no impacts to shipping activity due to the pipeline during routine operations, while the loss of 78.5 ha of ocean (the PSZ area) for commercial shipping is insignificant in the context of the area of Bass Strait available for shipping. This presence of the platform would result in a negligible increase in travel time and fuel use for marine users who have to change navigation path to avoid it.

The platform has a fully automatic navigational aid system, as described in Section 3.5.12, that detects radar signals from passing ships and returns a coded response, and four navigational lights to provide cover in all directions with battery back-up. There have been no breaches of the PSZ since BassGas become operational.

Vessel-to-Vessel Interactions

In the event of a vessel-to-vessel collision along the pipeline, health and safety impacts are more likely than environmental impacts. Should the force of a collision be enough to breach a vessel hull (which is unlikely due to the high visibility of the vessels, sophisticated navigation aids used by large vessels and stakeholder consultation for maintenance campaigns), an MDO spill may eventuate (this is addressed in Section 7.15).

Commercial fishing trawl equipment damage due to snagging with the offshore RGP

While there is not an exclusion zone around the offshore RGP, there is the potential for fishing equipment on the seabed to be damaged if it comes into contact with the pipeline. Both the pipeline and platform are identified on navigational charts for the area. Trawl fishing activity along the length of the pipeline is low (see Section 5.7.6), and to date there have been no recorded incidents of fishing gear snag with the pipeline, inferring that the risk of snagging is low. Regular inspection, and free span repairs (where required), ensure the snagging risk remains low.

Commercial fishing restriction within Yolla-A PSZ

Fishing and other maritime activities are not permitted within the Yolla-A PSZ. The platform is not in an area identified as being of high fishing intensity (see Section 5.7.6), and the area covered by the PSZ is small in comparison to the overall fishing area available in Bass Strait.

Of the Commonwealth- and Victorian-managed fisheries identified as having the right to fish in the region (see Section 5.7.6), only the Commonwealth-managed Small Pelagic Fishery (western sub-area) is impacted by the PSZ. This fishery continues to operate in the region without impacts from the BassGas Development.

Beach has in place a compensation scheme for genuine loss of catch or displacement claims in order to maintain a stable and fair working relationship with the fishing industry. The following process enables both the fishing and petroleum industries to carry on their lawful business with minimum interference to each other's activities:

- Communication to achieve on the water cooperation for safety and to avoid gear damage. Radio contact is via VHF channel 16 call up and then to a designated working frequency.

- Cooperation that recognises that neither party has overriding rights of access, all fishermen will use their best endeavours to minimise disruption to Beach activities and Beach applies the same principle.
- Beach has adopted the recommended transit routes that have been used since BassGas operations began, except when there are occasions where bad weather, safety concerns or unforeseen circumstance may cause vessel masters to change route.
- Compensation where Beach activities result in loss or damage to fishers' equipment or catch for genuine substantiated claims, but reserves the right to refuse this if fishers deliberately operate in the path of the support vessels or otherwise interfere or incite interference with BassGas operations.
- Dispute resolution where in the event of a claim being disputed, an 'alternative dispute resolution' mechanism will be employed by the parties as follows:
  - Notification in writing from the party claiming that there is a dispute to the other party and what the dispute is about.
  - Beach will then organise a meeting between the parties to the dispute within seven days of the notification being received and the other party to the dispute shall attend such meeting.
  - If within seven days of the meeting being held the meeting fails to settle the dispute, Beach will immediately appoint a mediator to the dispute.
  - The mediation will be conducted in accordance with the Beach Mediation Code of Practice. The costs and expenses of the mediation will be shared between the parties equally and if a party pays more than its share, it may recover the excess from the other party. Otherwise, the parties will be responsible to pay their own costs and expenses incurred in relation to the mediation. From the date of the notification to Beach that there is a dispute until the mediation is concluded, neither party shall commence any legal proceedings against the other in relation to the dispute.
  - If mediation fails to resolve the dispute then as stated in Clause 6 of the Mediation Code of Practice, either party may issue legal proceedings against the other in relation to the dispute.

<u>Potential for the platform to act as an artificial substrate for marine growth</u>

The presence of subsea infrastructure creates a new habitat, allowing for the recruitment of flora and fauna onto and surrounding the artificial substrate.

Subsea equipment, such as platform jackets and pipelines, can offer a long-term benefit of providing a habitat for marine life and a localised increase in biodiversity. Studies have shown that the ecology of the Gulf of Mexico is enhanced by using abandoned oil and gas facility platform jackets as artificial reefs (Fikes, 2013).

Offshore platforms and associated facilities provide highly productive and optimal micro- ecosystems (Neira, 2005). The jacket structure of the platform (containing cross beams, support struts and vertical pilings) provide hard, reef-like surfaces for sessile invertebrates such as mussels and barnacles, which in turn provide abundant food and shelter for other organisms. In addition, platform jackets occupy the entire water column, thereby providing alternative microhabitats from the sea surface to the seabed. They can also concentrate and collect fish and larval invertebrates that drift passively, thereby attracting species such as small invertebrates, fish and even large predators. There is a greater abundance of juvenile and adult fishes reported around Bass Strait platforms than adjacent natural reefs and surrounding waters. This supports the view that these artificial structures act as effective nurseries and marine refuges (Neira, 2005).

Seals in Bass Strait are routinely observed on and near offshore platforms, including at Yolla-A. Platform jackets benefit seals by providing a resting place and access to larger volumes of food (i.e., the fish attracted to the jacket fouling). It is possible platforms may adversely impact seals by exposure to hydrocarbon contamination from waste discharges, although the dispersion of discharged PFW is rapid in central Bass Strait (see Section 7.6).

The raw gas pipeline crosses the seabed perpendicular to shore for a distance of approximately 147 km. Thales Geosolutions (2001) shows that, other than within a 19 km radius of the platform, where sediment is mainly very soft to soft sandy clay, the pipeline passes mostly over sand of medium to loose density and localised pockets of clay and gravel. In sections where it is emergent from the seabed, it provides a hard substrate for colonisation by epibenthic species. The extent to which the pipeline attracts biota depends on the proportion not buried or scoured by sand.

A 2007 inspection of the raw gas pipeline showed a small number of sections in the 60 km section nearest the HDD exit of the pipeline were found to be buried completely. Survey photos show some evidence of light marine growth (mainly soft hydroids and tubeworm) on the outer surface of the pipeline.

7.1.6 Impact Assessment

Table 7.2 presents the impact assessment for the physical presence of infrastructure.

Table 7.2. Impact assessment for the physical presence of infrastructure and vessels

Summary		
Summary of impacts	Shipping/commercial fishing disruption and disturbance of benthic habitat/organisms due to presence of platform.	
Extent of impacts	Localised to the Yolla-A PSZ and immediate area around the pipeline.	
Duration of impacts	Long-term (life of asset).	
Level of certainty of impacts	High – the impacts of the physical presence of platform, pipeline and vessels are well understood.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Platform & pipeline		
Third-party marine users are not disadvantaged by the physical presence of the BassGas infrastructure.	The BassGas offshore infrastructure and PSZ are marked on maritime nautical charts (nautical charts Aus 150, 487 & 801).	Maritime nautical charts for central Bass Strait have BassGas facilities marked.
	Navigational lights are operated on Yolla-A in accordance with *Navigation Act* 2012 (Cth) (Chapter 6, Part 3, Division 2 – Collisions, Lights and Signals).	Inspection and maintenance for the navigational lights is undertaken in accordance with the CMMS.
	The Yolla-A PSZ (and 3-km radius cautionary zone) is actively monitored by the platform using AIS and radar to minimise the risk of vessel collision with the platform.	The communications diary, daily log and CMO records verify that contact was made with vessels breaching the cautionary zone and/or PSZ.
Vessels		
Third-party marine users are not disadvantaged by the physical presence of	Beach regularly liaises with fisheries and navigation agencies in accordance with the BassGas Offshore Operations SEP to ensure they are aware of	Consultation records verify that consultation is undertaken with marine stakeholders ahead of planned inspection and maintenance campaigns.

vessels working along the raw gas pipeline.	planned vessel-based inspection and maintenance activities.	
	The Australian Hydrographic Office and/or Maritime Safety Victoria will be notified of the vessel-based activity no less than four weeks prior to it commencing to enable the promulgation of Notice to Mariners and AusCoast navigational warnings.	Notice to Mariners includes vessel details, location and timing.
	Visual and radar watch is maintained on the bridge of the project vessel at all times. The Vessel Master and deck officers have valid SCTW certificates in accordance with AMSA Marine Order 70 (seafarer certification) (or equivalent) to operate radio equipment to warn of potential third-party spatial conflicts (e.g., International Convention on Standards of Training, Certification and Watchkeeping for Sea-farers [STCW95], GDMSS proficiency).	Appropriate qualifications are available to verify the competence of the Vessel Masters and deck officers.
	Project vessel lighting is managed in accordance with: • Marine Order 21 (Safety of Navigation and Emergency Procedures); and • Marine Order 30 (Prevention of Collisions).	Vessel PMS verifies that lighting is maintained in accordance with the Marine Orders.
	Project vessel navigation and radio systems comply with Marine Order 27 (Safety of Navigation and Radio Equipment).	Vessel PMS verifies that navigation and radio systems are maintained in accordance with Marine Order 27.
	The Vessel Master issues warnings (e.g., radio warning, flares, lights/horns) to third-party vessels approaching the vessel in order to prevent a collision.	Radio communications/bridge log verifies that warnings to third-party vessels are issued as necessary.
Infrastructure and vessels		
Marine user claims of interference are promptly investigated.	Upon notification of a claim of interference, Beach will enter the details into the CMO incident management system and follow its Investigations Procedure to investigate the complaint/incident and determine whether compensation is payable to the complainant.	The CMO contains complaint/incident details.
		Incident report verifies that the incident procedure was followed and the need for compensation was considered.
Impact Consequence (residual)		
Minor		
Demonstration of ALARP		
A ‘minor’ residual impact consequence is considered to be ALARP and a ‘lower order’ impact. An ALARP analysis is therefore not required.		
Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	

<table>
<tr><td>Stakeholder engagement</td><td colspan="2">The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues.
Stakeholders have not raised concerns about the physical presence of infrastructure or vessels.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The EPS outlined in this table align with the requirements of:
• OPGGS Act 2006 (Cth).
  ○ Section 280 – requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation or fishing (among others).
• OPGGS Act 2010 (Vic).
  ○ Section 276 – requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation or fishing (among others).
• Navigation Act 2012 (Cth).
  ○ Chapter 6 (Safety of navigation), particularly Part 3 (Prevention of collisions).
  ○ AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures).
  ○ AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment).
  ○ AMSA Marine Order Part 30 (Prevention of Collisions).
• Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).</td></tr>
<tr><td rowspan="5">Industry practice</td><td colspan="2">The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to:
• Physical presence – ensure facility is marked on navigation charts, exclusion zones are in place, navigation lighting is used.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>There are no guidelines specifically regarding physical presence for offshore activities.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>The EPS listed in this table meet these guidelines with regard to:
• Ship Collision (item 120). To avoid collisions with third-party and support-vessels, offshore facilities should be equipped with navigational aids that meet national and international requirements.
• Ship Collision (item 121). The relevant maritime, port, or shipping authority should be notified of all permanent offshore facilities, as well as safety zones.
• Ship Collision (item 122). A subsea pipeline corridor safety zone should be established to define anchoring exclusion zones and provide protection for fishing gear.
  ○ Note that offshore pipeline exclusion zones are not granted in Australia.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS listed in this table meet the following offshore development and production objectives:
• To reduce the impact on other marine resource users to ALARP and to an acceptable level.
• To reduce the impacts to benthic communities to acceptable levels and to ALARP.
• To reduce risks to public safety to ALARP and an acceptable level.</td></tr>
<tr><td>Environmental context</td><td colspan="2">MNES</td></tr>
</table>

	AMPs (Section 5.4.1)	This hazard does not intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	This hazard does not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	This hazard does not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	This hazard does not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	This hazard does not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	This hazard does not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
• Not applicable.		
Record Keeping		
• Maritime navigation charts. • PSZ gazettal. • BassGas stakeholder engagement register. • CMMS records for the Yolla-A platform (navigation lighting).	• Vessel PMS records. • Notices to Mariners. • Communications logs. • Incident register/reports. • Stakeholder flyers.	

7.2 IMPACT 2 - Infrastructure Inspection and Maintenance

7.2.1 Hazards

Inspection and maintenance activities undertaken on the platform and offshore RGP (described in Section 3.7) may result in small areas of direct or indirect disturbance to the seabed and marine fauna.

7.2.2 Known and potential environmental impacts

Inspection and maintenance activities impact on marine receptors due to:

- Physical removal or disturbance of seabed sediments through localised water jetting or mattressing;
- Temporary and localised reduction in water quality;
- Sound disturbance from sub-bottom profiling (to locate buried portions of pipeline) (addressed in Section 7.5);

- The dislodgement (and possible death) of marine growth (e.g., macro-algae and epifauna such as sponges, ascidians and molluscs) previously attached to the subsea infrastructure; and
- The generation of grit blasting material (generally sand) and dislodgement of scale and/or paint that settles on the seabed.

7.2.3 EMBA

The EMBA for infrastructure inspection and maintenance activities is limited in spatial extent to no greater than several metres radius from the activity.

Receptors in the EMBA include:

- Pelagic fauna (plankton, fish, cetaceans);
- Benthic invertebrates; and
- Benthic habitat (sandy seabed).

7.2.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
Inspection and maintenance activities occur on the platform topsides and jacket and the section of the RGP in Commonwealth waters.	Pipeline inspection and maintenance activities occur on the section of the RGP that occurs in Victorian waters.

7.2.5 Evaluation of environmental impact

Removal or disturbance of seabed sediments

Maintenance activities may result in small areas of direct or indirect disturbance to the seabed due to vessel anchoring (where DP is not possible), ROV propeller wash and disturbance to sediments around the infrastructure due to the works themselves (e.g., water jetting of sediments around the pipeline). This will result in highly localised and temporary turbidity and habitat disturbance.

Given the widespread nature of soft sediments throughout Bass Strait, the sporadic nature of these activities, and the localised and temporary nature of the disturbances, impacts to benthic habitat and benthic fauna will be minor. For example, anchor depressions act as traps for marine detritus and sand that eventually fill, meaning the effect is temporary and benthic organisms rapidly re-colonise these areas (Currie and Isaac, 2005).

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 platform and pipeline due to the short lengths over which marine growth removal will be conducted at any location.

Given the majority of the pipeline alignment is located 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. 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 minor.

Dislodgement 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 minor.

On the Yolla-A jacket, colonising organisms have been noted to quickly recolonise due to the new habitat presented by grit blasting.

Additional sand settlement on the seabed

The use of sand or garnet in sand-blasting activities (i.e., to remove rust and prepare steel surfaces for painting) will settle on the seabed. This will not have long-term impacts given that the seabed around the assets are predominantly sand. Discharged sand will settle on the seabed and become congruous with its surrounds.

Grit and paint chips/flakes generated as a resulted of blasting activities that dislodge and settle on the seabed are not expected to form a physical or chemical impediment to biota settling on or in the seabed sediments. The area of impact will be small (localised around the platform or pipeline) and the dynamic nature of the seabed environment (rapid shifting/mixing of sands) means the impacts are minor.

7.2.6 Impact Assessment

Table 7.3 presents the impact assessment for infrastructure inspection and maintenance activities.

Table 7.3. Impact assessment for infrastructure inspection and maintenance activities

Summary		
Summary of impacts	Localised and temporary disturbance of benthic habitat and fauna. Localised and temporary reduction in water quality. Death of encrusting marine growth. Discharge of paint chips/flakes.	
Extent of impacts	Localised – very small areas on and immediately around the infrastructure.	
Duration of impacts	Temporary – duration of activity. Encrusting biota recolonises rapidly.	
Level of certainty of impact	HIGH – the impacts of disturbance to benthic habitat from pipeline maintenance and colonising species on the platform jacket are easily observed and well documented.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Seabed disturbance is kept as local as possible during inspection and maintenance activities.	Inspection and maintenance activities are limited to the immediate works area as per the activity-specific plan (i.e., no indiscriminate sand or water blasting).	Documentation describing the planning undertaken for inspection and maintenance activities demonstrates that work is limited to the immediate work area.
		ROV footage is available and reviewed to ensure disturbance is limited to infrastructure footprint.

	Water blasting is given preference to grit blasting.	Maintenance activity reports verify that water blasting was considered.
	Grit blasting on the platform jacket and topsides uses containment and recovery to minimise losses to the ocean.	Maintenance activity reports verify that containment and recovery methods were used.
	Grit blasting material selection is undertaken in accordance with the chemical selection procedure (see Section 8.19).	Maintenance activity reports verify that the chemical selection procedure was used.
	Vessels used to undertake maintenance activities will preferentially use DP; they will only anchor where DP presents unacceptable safety risks.	Vessel contracts show that DP vessels are used (in preferred to vessels using anchors).
Impact Consequence (residual)		
Minor		
Demonstration of ALARP		
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.		
Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about inspection and maintenance activities.	
Legislative context	The EPS outlined in this EP align with the requirements of: • OPGGS Act 2006 (Cth): ○ Section 572 – specifies that a titleholder must maintain all structures in good condition and repair. • OPGGS Act 2010 (Vic): ○ Section 621 – specifies that a titleholder must maintain all structures in good condition and repair.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Physical disturbance – reducing footprint to the minimum required.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines specifically regarding inspection and maintenance activities for offshore activities.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	There is no specific guidance regarding this hazard.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives:

		• To reduce the impacts to benthic communities to ALARP and an acceptable level. • To reduce the risk of any unplanned release of material into the marine environment to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	This hazard does not intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	This hazard does not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	This hazard does not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	This hazard does not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	This hazard does not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	This hazard does not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
• Not applicable.		
Record Keeping		
• CMMS records. • Maintenance Activity Plans. • Maintenance activity reports.		• Vessel contracts. • ROV footage and/or logs.

7.3 IMPACT 3 – Routine Emissions - Light

7.3.1 Hazards

The following activities result in light emissions:

- Platform operations:
    - Navigational and vessel deck lighting is kept on 24 hours a day for maritime safety and crew safety purposes and CCTV monitoring by operators.

  - Flaring (including pilot light).
  - Emergency lighting (noting that evacuation lights [illuminating the water surface] is only activated as required via ESD or manually).

- PSV and other project vessel operations – navigational lighting is kept on 24 hours a day for maritime safety purposes, with deck lighting used as necessary; and
- ROV operations – underwater light is used in order to illuminate an area of interest (e.g., the pipeline) during subsea inspection and maintenance activities.

7.3.2 Known and potential environmental impacts

The known and potential impacts of lighting are:

- Light glow may act as an attractant to light-sensitive species (e.g., seabirds, squid, zooplankton), in turn affecting predator-prey dynamics (due to attraction to or disorientation from light).

7.3.3 EMBA

The EMBA for light glow is localised based on the intensity of the light source. For example:

- Platform navigation lights - are designed to be seen from about 10 nm (18.5 km) away, but light glow per se is limited to a few hundred metres radius given the small size of the lights. Deck lighting is maintained at levels that allow safe operations and has an equally small radius of light glow.
- Flaring – may be seen from many kilometres away, depending on the volume of gas being flared (e.g., process upsets will result in more gas being flared and therefore a larger flame than routine flaring or from the pilot light). Flaring is not a routine event – continuous flow of fuel gas provides flare purge and pilot gas.
- Vessel navigation lights - are designed to be seen from afar, but likely to result in light glow limited to tens of metres radius given the small size of the lights.
- ROV lights – forward facing lamps are designed to illuminate an area several metres ahead of the ROV, with the distance dependent on the types of lights used and water clarity.

The light-sensitive receptors that may occur within this EMBA, either as residents or migrants, are:

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

7.3.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
The platform (and associated navigation lights) are located in Commonwealth waters. Similarly, vessels engaged in inspection and maintenance activities may work alongside the platform or RGP in Commonwealth waters.	Vessels engaged in inspection and maintenance activities may work alongside the RGP in Victorian waters.

7.3.5 Evaluation of Environmental Impacts

Shipping and fishing activities in Bass Strait (including squid fishing, which uses bright lights directed onto the water surface) are common activities, and the lighting levels associated with the BassGas Development are not considered to be significantly different from these sources or make a significant additional contribution.

There are no turtle nesting beaches in Bass Strait, so impacts of light to turtles are not assessed here.

The long distance of the platform from the nearest shoreline (91 km) and nearest town (Venus Bay, 125 km) means the flare is not visible from land and therefore the impacts of light from offshore BassGas operations to the public do not occur. To date, there have been no complaints from stakeholders since operations began in 2006 regarding light from flaring.

Light glow at the surface

Seabirds

Seabirds may be attracted to light glow at night time. 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 in DSEWPC, 2011).This disorientation may also result in entrapment, stranding, grounding and interference with navigation (DoEE, 2020). The DoEE (2020) notes that seabird fledglings may be affected by lights up to 15 km away.

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.

Migrating seabirds may be attracted by the lights of the platform, which may result in drawing them off course from their usual migration path (DoEE, 2020). DoEE (2020) reports that petrel species in the Southern Ocean may be unable to take off from a deck. To date, personnel based on Yolla-A have not encountered any unusual bird behaviour, injuries or deaths around light sources.

There are no actions within the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-16 (DSEWPC, 2011a) that are compromised by light emissions associated with BassGas operations.

Due to the absence of bird breeding colonies near the Yolla-A platform (it is 140 km east of little penguin, short-tailed shearwaters and black-faced cormorants on King Island, 95 km northeast of IBAs on islands off the Tasmanian coastline and 80 km southwest of Curtis Island), light glow from small permanent light sources is unlikely to result in impacts at the species population level or ecosystem level. Temporary activities such as vessel operations would similarly have minor impacts.

Fish and plankton

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.

Light attraction from permanent light sources is highly localised and therefore is highly unlikely to have impacts at the species population level or ecosystem level. Temporary activities such as vessel operations would similarly have minor impacts.

Cetaceans

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.

Light glow in the water column

Underwater light from ROV activity 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.

7.3.6 Impact Assessment

Table 7.4 presents the impact assessment for light emissions.

Table 7.4. Impact assessment for light emissions

Summary		
Summary of impacts	Light glow may act as an attractant to light-sensitive species (e.g., seabirds, fish and zooplankton), in turn affecting predator-prey dynamics (due to attraction to or disorientation from light).	
Extent of impacts	Localised – small radius of light glow around the platform, vessels and ROV.	
Duration of impacts	Temporary – duration of vessel-based inspection and maintenance activities. Permanent – platform operations.	
Level of certainty of impacts	HIGH – the impacts of light glow on marine fauna are well known. Human perceptions of visual amenity are subjective and difficult to define.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
No injury or death to seabirds as a result of artificial light.	**Platform and vessels**	
	Lighting is managed, as appropriate, in accordance with: • AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures). • AMSA Marine Orders Part 30 (Prevention of Collisions). • AMSA Marine Orders Part 59 (Offshore Support Vessel Operations).	CMMS and PMS records and/or inspection/audit reports verify that navigational lights are maintained to schedule and in accordance with original equipment manufacturer (OEM) specifications. Platform Lighting Assessment Reports verify that platform lighting is installed and operated according to maritime standards.
	Process work lights are directed only onto work areas and are shielded.	Inspection/audit reports verify that lights are directed only onto work areas and are shielded.
	Platform only	

	Flaring equipment and navigation lighting is maintained in good operational order to ensure optimal efficiency.	CMMS records verify that flaring equipment and navigation lighting is maintained according to OEM specifications.
	There is no routine flaring; flaring duration is minimised to ALARP.	Flare volumes are recorded in the engineering technical reports.
	Platform navigation lighting complies with sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).	Visual inspections verify that platform navigation lights remain functional at all times.
	Platform-based personnel report wildlife interactions on/around the platform that have the potential to be light related (i.e., congregations of marine species in pools of light, collisions of birds with lights).	The CMO incident management system includes reporting of marine species congregation, with records of action taken to assesses if additional controls are required.
	BassGas environmental awareness training includes reporting requirements for wildlife incidents or injuries.	Platform HSE induction presentation verifies wildlife incident reporting details are included.
		Training matrix is populated with induction records.

Impact Consequence (residual)
Minor
Demonstration of ALARP
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about light emissions.	

Legislative context	The EPS outlined in this EP align with the requirements of:
	• *Navigation Act* 2012 (Cth):
	  ○ Part 3 (Prevention of Collisions).
	  ○ AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures).
	  ○ AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment).
	  ○ AMSA Marine Orders Part 30 (Prevention of Collisions).	

Industry practice	The consideration and adoption of the controls outlined in the below-listed guidelines and codes of practice demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Light emissions – minimise external lighting to that required for navigation and safety, limit the occurrence and duration of flaring (where possible).
	Best Available Techniques Guidance Document on Upstream Hydrocarbon	There are no guidelines specifically regarding lighting for offshore activities.

	Exploration and Production (European Commission, 2019)	
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	The EPS listed in this table meet these guidelines with regard to: • Ship collision (item 120). To avoid collisions with third-party and support vessels, offshore facilities should be equipped with navigational aids that meet national and international requirements, including navigational lights on support vessels.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the impact of light to ALARP and an acceptable level. • To reduce risks to public safety to ALARP and to an acceptable level.
	Light-specific guidance	
	The National Light Pollution Guidelines for Wildlife (DoEE, 2020)	An assessment of Yolla-A operations against these guidelines is included in **Appendix 1**. This assessment indicates that many of the measures relating to seabirds in these guidelines are not applicable or not achievable for Yolla-A based on its location being remote from seabird rookeries. Measures relating to turtles and shorebirds are not applicable.
Environmental context	MNES	
	AMPs (Section 5.4.1)	The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies light pollution associated with offshore mining operations and other offshore activities as a threat to the AMP network. The EPS listed in this table aimed at minimising light pollution emitted from the platform and support vessels do not conflict with the strategies outlined in the plan that aim to address this threat. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	Localised light glow does not have any impacts on Ramsar wetlands.
	TECs (Section 5.4.5)	Localised light glow does not have any impacts on TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Localised light glow does not have any impacts on NIWs.
	Nationally threatened and migratory species (Section 5.5)	Localised light glow does not have any impacts on threatened or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	Localised light glow does not have any impacts on state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The management actions listed for seabirds in The National Light Pollution Guidelines for Wildlife (DoEE, 2020) have been considered

		The National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC, 2011a) does not list artificial lighting as a key threat. The Recovery Plan for Marine Turtles in Australia (DoEE, 2017) is not relevant given the rare sightings of vagrant turtles and absence of turtle BIAs and nesting beaches in Bass Strait. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
• Fauna interactions with lighting.

Record Keeping	
• Platform CMMS records.	• Engineering technical reports (for flare volumes).
• Vessel PMS records.	• Personnel induction training records.
• Platform lighting assessment/inspection/audit reports.	• CMO wildlife incident reports.

7.4 IMPACT 4 – Routine Emissions - Atmospheric

7.4.1 Hazards

The following activities generate atmospheric emissions:

- Yolla-A;
  - Combustion of fuel gas in the main power generators, turbine and export compressor.
  - Flaring (volumes noted in Section 3.5.11).
  - Continuous vent purge of ~0.002 MMscfd of fuel gas to prevent air ingress to the vent and drain system.
  - Cold venting of non-combusted hydrocarbon gas (during routine maintenance and intermittently during wireline and workover activities), usually in the order of 100 SCM per routine. These gas discharges include methane, ethane, propane and carbon dioxide (CO_2).
  - Combustion of diesel for the crane (and standby generator, lifeboat winches, etc).
  - Painting and paint storage, resulting in the release of fugitive Volatile Organic Carbons (VOCs) as vapours.
- Support vessels;
  - Combustion of marine diesel oil (MDO) from engines, generators and fixed mobile deck equipment.
  - Painting and paint storage, resulting in the release of fugitive VOCs as vapours.
- Helicopters;
  - Combustion of aviation gas while in the PSZ.

Products of hydrocarbon combustion emitted to the atmosphere, in decreasing order of volume (based on NPI data from Yolla-A for 2018-19) include (but are not limited to):

- Water vapour;

- Carbon dioxide;
- Total VOCs (97,090 kg/yr);
- Carbon monoxide (49,000 kg/yr);
- Oxides of nitrogen (28,400 kg/yr);
- Particulate matter, 2.5 µm & 10 µm (2,520 kg/yr);
- Sulphur dioxide (28.5 kg/yr);
- BTEX (10.27 kg/yr); and
- Hydrogen sulphide (3.74 kg/yr).

The use of MDO to power engines, generators and mobile and fixed plant (e.g., crane) on the support vessels, and the use of aviation gas to power the helicopters, will also result in smaller volumes of GHG emissions, such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), along with non-GHG such as sulphur oxides (SO_x) and nitrous oxides (NO_x).

7.4.2 Known and potential environmental impacts

The known and potential environmental impacts of atmospheric emissions are:

- Localised and temporary decrease in air quality due to gaseous emissions and particulates from diesel combustion; and
- Addition of GHG to the atmosphere (influencing climate change).

7.4.3 EMBA

The EMBA for atmospheric emissions associated is the local air shed – likely to be within hundreds of metres of the support vessels and tens of kilometres for the platform, both horizontally and vertically.

7.4.1 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box below.

Airshed above Commonwealth waters	Airshed above Victorian waters
Yes	Yes
Yolla-A generates atmospheric emissions.	Vessels undertaking inspections and maintenance along the portion of the RGP within state waters combust fuel that generate atmospheric emissions.

7.4.2 Evaluation of Environmental Impacts

<u>Localised and temporary decrease in air quality</u>

Atmospheric emissions from the platform, vessels and helicopters will result in a minor deterioration in local air quality. The combustion of MDO fuel can create continuous or discontinuous plumes of particulate matter (soot or black smoke). Inhaling this particulate matter can cause or exacerbate health impacts to humans exposed to the particulate matter, such as offshore personnel or residents of nearby towns (e.g., respiratory illnesses such as asthma) depending on the volume of particles inhaled. Similarly, the inhalation of particulate matter may affect the respiratory systems of fauna. Around Yolla-A, this is limited to seabirds overflying the support vessels and platform and presents a negligible impact due to the strong winds that disperse emissions quickly.

Particulate matter released from the vessels is not likely to impact on the health or amenity of the nearest human coastal settlements (e.g., Venus Bay, Inverloch), as 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 and platform exhaust points.

Contribution to the GHG effect

Natural gas and MDO combustion, along with gas venting, will result in gaseous emissions of GHG such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). While these emissions add to the atmospheric GHG load, which adds to global warming potential, they are relatively small on a global scale, representing an insignificant contribution to overall GHG emissions. These emissions are not considered to have a determinable local-scale impact and therefore impacts are considered to be low.

7.4.3 Impact Assessment

Table 7.5 presents the impact assessment for atmospheric emissions.

Table 7.5. Impact assessment from atmospheric emissions

Summary		
Summary of Impacts	Decrease in air quality due to emissions of combustion and venting and contribution to the incremental build-up of GHG in the atmosphere (influencing climate change).	
Extent of impacts	Localised (local air shed for air quality), widespread (for GHG).	
Duration of impacts	Ongoing – duration of operations (though emissions are rapidly dispersed and diluted).	
Level of certainty of impact	HIGH – the impacts of atmospheric emissions are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Fuel-combusting equipment operates in accordance with MARPOL Annex VI (Prevention of Air Pollution from Ships) to keep emissions ALARP.	**Platform**	
	Combustion equipment is inspected and maintained in accordance with the CMMS to ensure efficient operations.	CMMS records verify that combustion and associated monitoring and protection equipment and systems are inspected and maintained to schedule in accordance with OEM specifications.
	Flare auto-ignition, flame-out monitoring and back-up purge protection systems are maintained in accordance with the CMMS to minimise cold venting.	
	No waste is incinerated.	The Garbage Record Book verifies that all waste is backloaded to support vessels for onshore disposal.
	Flaring volumes are monitored so that abnormalities are rapidly detected and addressed.	Flaring data is reported within Engineering Technical Reports.

	Only low-sulphur (<0.5% m/m) MDO is used for the crane and diesel generator in order to minimise SOx emissions.	Bunker receipts verify the use of low-sulphur MDO.
	Operations Forward Planning is undertaken for supply vessel and helicopter movements, thereby minimising unnecessary travel (and thus minimising fuel combustion).	Operations Forward Planning documents are current and verify that planning of vessel and helicopter movements is undertaken.
	Flaring and exhaust emissions from Yolla-A are calculated and reported to the Clean Energy Regulator under the National Greenhouse and Energy Reporting (NGER) Act reporting scheme on an annual basis.	Yolla-A NPI data is available on the NGER website (http://www.cleanenergyregulator.gov.au/NGER).
	Vessels	
	Only low-sulphur (<0.5% m/m) MDO is used in order to minimise SOx emissions.	Bunker receipts verify the use of low-sulphur MDO.
	All combustion equipment is maintained in accordance with the PMS (or equivalent).	PMS records verify that combustion equipment is maintained to schedule.
	Vessels >400 gross tonnes possess equipment, systems, fittings, arrangements and materials that comply with the applicable requirements of MARPOL Annex VI.	IAPP Certificate is current.
	Vessels >400 gross tonnes and involved in an international voyage implement their Ship Energy Efficiency Management Plan (SEEMP) to monitor and reduce air emissions.	SEEMP records verify energy efficiency records have been adopted.
	Vessels >400 gross tonnes manage firefighting and refrigeration systems to minimise ODS.	ODS record book is available and current.
	Only a MARPOL VI-approved incinerator is used to incinerate solid combustible waste (food waste, paper, cardboard, rags, plastics).	IMO incinerator certificate verifies the incinerator meets MARPOL requirements.
	Incineration is only conducted when vessels are in Commonwealth waters (>3 nm from the shore).	Garbage Record Book indicates no incineration within 3 nm of the shore.
	Oil and other noxious liquid substances are not incinerated.	The Oil Record Book and Garbage Record Book verify that waste oil and other noxious liquid substances are transferred to shore for disposal.

Impact Consequence (residual)
Minor
Demonstration of ALARP
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability	
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.

<table>
<tr><td>Management system compliance</td><td colspan="2">Chapter 8 describes the EP implementation strategy employed for this activity.</td></tr>
<tr><td>Stakeholder engagement</td><td colspan="2">The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues.
Stakeholders have not raised concerns about atmospheric emissions.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The performance standards outlined in this EP align with the requirements of:
• Navigation Act 2012 (Cth):
○ Chapter 4 (Prevention of Pollution).
○ AMSA Marine Order Part 79 (Marine pollution prevention – air pollution).
• Protection of the Sea (Prevention of Pollution by Ships) Act 1983 (Cth):
○ Part IIID (Prevention of Air Pollution).
○ AMSA Marine Orders Part 97 (Air Pollution), enacting MARPOL Annex VI (especially Regulations 6, 14, 16).
• National Greenhouse and Energy Reporting Act 2007 (Cth).</td></tr>
<tr><td rowspan="7">Industry practice</td><td colspan="2">The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to:
• Combustion emissions – selection of low sulphur fuel and undertaking regular equipment maintenance.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>The EPS listed in this table meet these guidelines for offshore activities with regard to:
• Flaring and venting (item 21). The Best Available Techniques (BAT) are met for Yolla-A operations.
• Management of fugitive emissions (item 22). The BAT are met for Yolla-A operations.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>Guidelines met with regard to:
• Air emissions (item 11). The overall objective to reduce air emissions.
• Air emissions (item 12). During equipment selection, air emission specifications should be considered, as should the use of very low sulphur content fuels and/or natural gas.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS listed in this table meet the following offshore development and production objectives:
• To reduce the impact of air emissions to ALARP and an acceptable level.
• To reduce GHG emissions to ALARP and an acceptable level.</td></tr>
<tr><td colspan="2">Atmospheric emissions-specific guidelines</td></tr>
<tr><td>Guidance on Upstream Flaring and Venting; Policy and regulation (Global Gas Flaring Reduction Partnership, 2009)</td><td>This guideline is directed at regulators, but Beach complies with the key issues to be regulated, which are focussed on monitoring and reporting of emissions.</td></tr>
<tr><td rowspan="2">Environmental context</td><td colspan="2">MNES</td></tr>
<tr><td>AMPs (Section 5.4.1)</td><td>Atmospheric emissions do not directly affect nearby AMPs.
See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.</td></tr>
</table>

	Wetlands of international importance (Section 5.4.4)	Atmospheric emissions do not directly affect any Ramsar wetlands.
	TECs (Section 5.4.5)	Atmospheric emissions do not directly affect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Atmospheric emissions do not directly affect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	Atmospheric emissions do not directly affect threated or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	Atmospheric emissions do not directly affect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC, 2011a) lists climate change as a key threat, though the most pervasive threat is accidental mortality and injury from interactions with fishing activities. The Recovery Plans and Conservation Advice for the Blue, Sei, Fin, Southern Right and Humpback Whales lists climate change as a key threat, though the most pervasive threats are whaling, vessel strike and entanglement. The Recovery Plan for Marine Turtles in Australia lists climate change as a key threat. The Recovery Plan for the Orange-bellied parrot lists climate change as a key threat, though the most pervasive threat is loss of habitat. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring

- Fuel use.

Record Keeping

Platform	Vessels
• MDO bunkering receipts. • CMMS records. • Garbage Record Book. • Operations Forward Planning documents. • NPI calculations.	• MDO bunkering receipts. • PMS records. • Garbage Record Book. • IAPP certificate. • SEEMP. • IMO incinerator certificate. • ODS register. • Oil Record Book.

7.5 IMPACT 5 – Routine Emissions - Noise and Vibration

7.5.1 Hazards

Noise and vibration is generated by the following activities associated with the operation of BassGas infrastructure and vessels:

- General production equipment, including power generation (required 24 hours per day), crane use and abnormal equipment operation on the platform;
- Flaring;
- High gas flow through the raw gas pipeline;
- Wireline activities;
- Inspection and maintenance activities;
    - Geophysical activities (primarily SBP), to locate buried portions of the raw gas pipeline.
    - Abrasive blasting to remove paint and marine growth from the platform structure or raw gas pipeline;
- Vessel operations within the PSZ and alongside the raw gas pipeline during inspection and maintenance activities (engine noise transmitted through hull, DP thrusters and/or propellers);
- Helicopter operation (within the PSZ). During normally manned operations there are approximately three return flights per week to and from Yolla-A.

Additional details about these activities, where available, is presented here.

Platform activities

The effects of noise generated by equipment on Yolla-A is low because the equipment is located above sea level. The frequency and level of noise received underwater from the topsides equipment depends on a range of factors, including the type of equipment, the size of engines and the local hydroacoustic and geoacoustic environment (Erbe, 2011).

An estimate of underwater noise from a platform's machinery has been drawn from a study by McCauley (1998) of noise from a drilling rig when it is working but not drilling, with the rig tender at anchor. The comparison is considered conservative, thus overestimating the sound being produced from a platform. The highest level encountered by McCauley (1998) was recorded as 117 dB re 1 µPa at 125 m. This noise was audible up to 1 to 2 km away.

Gas flow through the offshore RGP

Sound from the flow of gas through the offshore RGP is expected to be negligible. A study conducted by Glaholt et al (2011) found that sound measurements made over a 25.4 cm (10") diameter subsea high-pressure gas pipeline suggest that the pipeline was not producing any clearly resolvable noise. Methods for assessment of operational noise generated from the pipeline included a combination of field measurements, laboratory investigation and pipeline component analysis.

Given the low intensity of gas pipeline noise and the fact that species sensitive to underwater sound, primarily cetaceans, typically occupy ranges over many hundreds or thousands of square kilometres, impacts of sound through the pipeline on cetacean communication or foraging efficiency are unlikely to even be minor.

Wireline activities

Wireline operations may involve Vertical Seismic Profiling (VSP), which typically involves the use of several airguns located several metres below sea level, with a total sound source volume of several hundred to several thousand cubic inches. Wireline activities are infrequent activities that are undertaken for short periods of time (typically less than 24 hours).

Geophysical surveys

Single-beam echo sounder

A SBES typically has a frequency range between 120 and 710 kHz and a maximum sounding rate of 20 Hz. The beam width varies between 10° (120 kHz) and 2.8° (710 kHz). The single beam bathymetry received sound exposure level typically does not exceed 160 dB.

Multi-beam echo sounder

The frequency range of the MBES is typically 200–500 kHz (classified as high frequency) with a maximum angular coverage of 160°. The maximum source levels are about 236–242 dB re 1 µPa @ 1 m for the 1° and 2° beams (DoC, 2016).

Side scan sonar

A SSS typically operates in the 100–500 kHz frequency range (classified as high frequency). The maximum source levels are about 210-220 dB re 1µPa @ 1 m (DoC, 2016). The SSS towfish is typically towed 10–15 m above the seabed (depending on water depth and the exact frequency) at a distance of about 150- 200 m behind the vessel.

Sub-bottom profiler

Acoustic emissions from SBPs are typically in the frequency range of 0.05 to 12 kHz, with peak sound pressure level (SPL) of up to 220 dB re 1µPa @ 1 m. There are three different types of SBP, which exhibit a trade-off of in resolution versus depth of penetration based on the frequency of the acoustic signal:

1. CHIRP – uses an FM signal across a full range of frequencies, typically either 2-16 kHz or 4-24 kHz (low to high frequency). The maximum source levels of a CHIRP are about 200– 205 dB re 1 µPa @ 1 m (DoC, 2016).

2. High-frequency boomers – the typical frequency spectrum of boomer systems ranges between 0.2 and 10 kHz, with an effective bandwidth of 1 to 10 kHz (low to high frequency). The sound source level can vary from 100 to 220 dB re 1 µPa @ 1 m.

3. Medium-frequency sparkers – the generated frequencies are generally between 50 Hz (0.05 kHz) and 4 kHz (low to high frequency). The sound source level is typically between 215 and 225 dB re 1 µPa @ 1 m.

Vessel sound

There is generally one PSV return trip per week between Yolla-A and the supply base. Other vessels will be deployed to the platform and pipeline for inspection and maintenance activities as required. These vessels generate low levels of sound. This is generated from propeller cavitation (the dominant sound source), hydrodynamic flow around the hull and from onboard machinery (Popper *et al.*, 2014).

It is unlikely that engine sound levels will be greater than that of any other similarly sized vessel normally travelling through Bass Strait (such merchant vessels travelling in the nearby shipping fairway, see Section 5.7.7).

The sound levels and frequency characteristics of underwater sound produced by vessels are related to vessel size and speed. When idle or moving at slow speed (i.e., within the Yolla-A PSZ or alongside the pipeline), vessels generally emit low-level noise. The typical sound levels generated by vessels are:

- Tugboats, crew boats, supply ships and many research vessels in the 50-100 m size class – 165-180 dB re 1µPa range (Gotz *et al.*, 2009);
- Vessels up to 20 m size class – 151-156 dB re 1µPa (Richardson *et al.*, 1995);

- Trawlers – peak at around 175 dB re 1µPa (Gotz *et al.*, 2009); and
- Large ships – levels exceeding 190 dB re 1µPa (Gotz *et al.*, 2009).

Noise from vessels acts to increase the sound in the water column above ambient noise levels. For example, noise emissions from idling vessels are low, however noise from thrusters and strong thrusts from the main engines have been recorded at levels of up to 182 dB re 1µPa at 1 m (McCauley, 1998). Under this mode of operation, McCauley (1998) measured underwater broadband noise of approximately 137 dB re 1µPa at 405 m. Levels of 120 dB re 1 µPa extended for a distance of approximately 3-5 km from the source, depending on water depth, seabed composition and other factors.

Under normal operating conditions when the vessel is idling or moving between sites, vessel noise would be detectable over only a short distance. For example, Woodside (2003) found that vessel noise levels rarely (<1% of the time) exceeded a threshold of 120 dB re 1 µPa (i.e., generally less than ambient underwater sound intensity in the region) from an acoustic monitoring site 5.1 km from the source when a drilling support vessel was holding position using dynamic positioning bow thrusters.

Helicopter sound

Sound emitted from helicopter operations is typically below 500 Hz (Richardson *et al.*, 1985). Sound travelling from a source in the air (e.g., helicopter) to a receiver underwater is affected by both in-air and underwater propagation processes, which are further complicated by processes occurring at the air-seawater surface interface. The received sound level underwater depends on the altitude of the sound source and lateral distance from the receiver, receiver depth, water depth, and other variables.

The angle at which the line from the aircraft and receiver intersects the water surface is important. In calm conditions, at angles above 13° from the vertical much of the sound is reflected and does not penetrate into the water (Richardson *et al.*, 1995; NRC, 2003). Therefore, strong underwater sounds are detectable for a period roughly corresponding to the time the helicopter is within a 26° cone above the receiver. This 'zone of ensonification' can be enlarged in rough seas and can also be enlarged in shallow waters (Richardson *et al.*, 1995).

Most air traffic supporting offshore installations involves turbine helicopters flying along straight lines. Usually, a helicopter can be heard in air well before and after the brief period it passes overhead and is heard underwater. Sound pressure in the water directly below a helicopter is greatest at the surface and diminishes with increasing receiver depth. The peak received level diminishes with increasing helicopter altitude, but the duration of audibility often increases with increasing altitude. Richardson et al (1995) reports figures for a Bell 214 helicopter (considered to be one of the loudest) being audible in air for four minutes before it passed over underwater hydrophones but detectable underwater for only 38 seconds at 3 m depth and 11 seconds at 18 m depth.

7.5.2 Known and Potential Environmental Impacts

The impacts and risks resulting from underwater sound are generally well understood with regard to potential mortality and/or physiological injury for species in the water column, however, uncertainty lies in understanding the spatial and temporal extents of behavioural disturbances and the potential effects on populations and requires the application of context-specific information. The potential impacts to marine fauna from high levels of underwater sound are:

- Physical injury to auditory tissues or other air-filled organs;
- Hearing impairment:
  - Temporary threshold shift (TTS) – the temporary loss of hearing sensitivity caused by excessive noise exposure, in which the animal recovers usually within a day at most.
  - Permanent threshold shift (PTS) – a permanent loss of hearing sensitivity caused by excessive noise exposure, considered an auditory injury, from which the animal does not recover.
- Direct behavioural effects through disturbance or displacement, and consequent disruption of natural behaviours or processes (e.g., migration, resting, calving or spawning); and

- Indirect behavioural effects by impairing/masking the ability to navigate, find food or communicate, or by affecting the distribution or abundance of prey species.

7.5.3 EMBA

The EMBA for sound and vibration varies with the source and atmospheric and underwater conditions. In general, sound and vibration from operations activities are unlikely to cause impacts beyond tens to hundreds of metres from the source.

Sound-sensitive receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic species (plankton, fish, cetaceans, pinnipeds);
- Benthic species (e.g., rock lobsters); and
- Seabirds.

7.5.4 Jurisdiction of Hazard

The jurisdictions for this hazard are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
The platform is located in Commonwealth waters. Vessels engaged in maintenance activities will generate noise and vibration while working alongside the platform or RGP in Commonwealth waters.	Vessels engaged in maintenance activities will generate noise and vibration while working alongside the RGP in Victorian waters.

7.5.5 Evaluation of Environmental Impacts

The environmental effects will have a gradation of severity based mainly on distance from the noise or vibration source and sensitivity of the species.

In assessing the likely impacts on the key marine groups, it is necessary to consider that the level of behavioural response and stress induced by noise will also decrease with habituation. Consequently, fauna will often approach or remain near to a noise source, such as an operating facility, even though the level of noise exceeds that at which the behaviour changes have been observed to occur when there is no corresponding threat associated with it. Process equipment on the platform generates low levels of sound. Power is generated continuously on the platform, being supplied by gas turbine driven generators. Gas engines and generators on the platform are enclosed to reduce noise.

High quality data presented in Reiser et al (2011) regarding the SPL and SEL of geophysical equipment, based on measurements undertaken in the Alaskan Chukchi and Beaufort Seas in 2010, indicates that sound levels generated by this equipment rapidly attenuates within hundreds of metres of the sound source.

<u>Plankton</u>

Plankton and pelagic invertebrates drift with the water and wind currents past the Yolla-A facility and vessels. The effects of noise and vibration are unlikely to have any discernible impacts on plankton, and in the event that sound do exceed TTS or PTS threshold levels, this is only likely to occur within metres of the sound source.

The short-term nature of noise-generating activities, the continual mixing of Bass Strait waters and the nearby high productivity 'Upwelling East of Eden' KEF (located about 270 km east of Yolla-A) means there will be rapid replenishment of plankton around the operational area. As such, impacts of underwater sound to plankton are minor.

Fish

Underwater noise levels significantly higher than ambient levels can have a negative impact on fish, ranging from physical injury or mortality, to temporary effects on hearing and behavioural disturbance effects.

The effects of underwater sound on fish within the vicinity of a sound source will vary depending on the size, age, sex and condition of the receptor among other physiological aspects, and the topography of the benthos, water depth, sound intensity and sound duration. The effect of noise on a receptor may be either physiological (e.g., injury or mortality) or behavioural, as described in the following sub-sections.

The following provides a summary of research findings of the impacts of seismic sound (such as VSP) on fish and fish larvae (noting the relative paucity of research on non-seismic sound sources).

Physiological impacts

Direct physical damage may occur to fish if they approach within a few metres (<5 m) of a high-intensity sound source (Gausland, 2000; McCauley *et al.*, 2000a; Parvin *et al.*, 2007).

Lethal effects of seismic surveys on fish have not been reported, but those with a swim bladder closely connected to the inner ear are more susceptible than those without (McCauley, 1994). Fish with thin-walled, lightly damped and large swim bladders will be most susceptible to mechanical damage or trauma from seismic pulses. Other fish, including the elasmobranchs (sharks and rays), family Scombridae (mackerels and tuna) and many of the flatfish and flounder species do not possess a swim bladder and so are not susceptible to swim bladder-induced trauma (McCauley, 1994). Carroll et al (2017) provides a summary into the impacts of seismic airgun sound on fish, which indicates that lethal effects of seismic surveys on fish have not been observed.

Behavioural impacts

Gausland (2000) postulates that while seismic airgun operation causes little direct physical damage to fish at distances greater than 1-2 m from the source, it is evident that fish respond to sounds emitted from airguns, and that avoidance seems to be the primary response for all species.

Available evidence suggests that behavioural change for some fish species may occur, however this is thought to be localised and temporary, with displacement of pelagic or migratory fish populations having insignificant repercussions at a population level (McCauley, 1994). Behavioural changes such as startle or alarm responses are expected to be localised and temporary, with displacement of pelagic or migratory fish likely to have insignificant repercussions at a population level (McCauley, 1994; McCauley & Kent, 2012; Popper *et al.*, 2015; Popper *et al.*, 2007).

Limited research has been conducted on responses from elasmobranchs (sharks and rays, including juveniles) to underwater sound. This may be because sharks and rays differ from bony fish in that they have no accessory organs of hearing (i.e., a swim bladder) and therefore are unlikely to respond to acoustic pressure (Myrberg, 2001). Elasmobranchs sense sound via the inner ear and organs and as they lack a swim bladder it is thought that they are only capable of detecting the particle motion component of acoustic stimuli (Myrberg, 2001).

In addition to particle motion, elasmobranchs are also sensitive to low frequency sound between 40 and 800 Hz (Myrberg, 2001). This range overlaps with that of VSP. However, sharks do not appear to be attracted by continuous signals or higher frequency sounds that presumably they cannot hear (Popper & L.kkeborg, 2008).

Klimley and Myrberg (1979) established that an individual shark will suddenly turn and withdraw from a sound source of high intensity (more than 20 dB re 1 µPa above background ambient noise levels) when approaching within 10 m of the sound source. The available evidence indicates sharks will generally avoid sound sources, so the likely impacts on sharks are expected to be limited to short-term behavioural responses, such as avoidance of waters around the sound source.

Fish are highly mobile and congregate around the Yolla-A jacket due to the marine growth that has encrusted the submerged infrastructure, which provides hard substrate habitat that is otherwise absent in the deeper waters of Bass Strait. This suggests that fish are unconcerned by noise and vibration that travels through the jacket structure.

Based on VSP modelling undertaken in 2018 for a nearshore area of Bass Strait, wireline activities may result in the following impacts to fish (assuming the fish remain stationary for 24 hours):

- TTS – within a 922 m radius of the sound source;
- Recoverable injury – within a 78 m radius of the sound source (only fish with swim bladders); and
- Mortality or potential mortal injury - within a 25-43 m radius of the sound source (only fish with swim bladders).

With regards to geophysical activities, the data from Reiser et al (2011) indicates that the thresholds for mortality, recoverable injury and TTS for fish presented in Popper et al (2014) are not met by geophysical equipment.

The sound generated by operations and inspection and maintenance activities is therefore considered to be of a minor consequence for fish.

<u>Pinnipeds</u>

Richardson et al (1995) identifies for Californian sea lions (an Otariid similar to fur seals) the following behaviours to aviation sound:

- Jets above an altitude of 305 m produced no reaction and below that height caused limited movement but no major reaction;
- Light aircraft directly overhead at altitudes of <150-180 m elicited alert reactions; and
- Helicopters above 305 m usually caused no observable response while those below caused the pinnipeds to raise their heads, often causing some movement and occasionally caused rushes by some animals into the water.

Fur-seals are less sensitive to low frequency sounds (<1 kHz) than to higher frequencies (>1 kHz). McCauley (1994) suggests that the sound frequency of seismic air gun pulses is below the greatest hearing sensitivity of Otariid pinnipeds, but data is lacking for Australian species. Aerial sounds produced by the Australian fur-seal (*Arctocephalus pusillis*) have strong tonal components at frequencies that are less than 1 kHz, although they all range up to 6 kHz with most energy between 2-4 kHz. If the low frequency components of calls are used, then seals may also hear at low frequency and may be affected by seismic source pulses. However, Shaughnessy (1999) states that seismic activity (much higher intensity than wireline operations) will only be a threat to pinnipeds if it takes place close to critical habitats.

Gotz et al (2009) reports that controlled exposure experiments with small airguns (215 – 224 dB re 1 µPa) were carried out over 1 hour to individual harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), and in seven out of eight trials with harbour seals, the animals exhibited strong avoidance reactions. Two harbour seals equipped with heart rate tags showed immediate, but short-term, startle responses to the initial airgun pulses. The behaviour of all harbour seals seemed to return to normal soon after the end of each trial, even in areas where disturbance occurred on several consecutive days. Only one harbour seal showed no detectable response to the airguns and approached the airgun to within 300 m, and seals remaining in the water returned to pre-trial behaviours within two hours of the end of the experiment (Gotz *et al.*, 2009). General avoidance behaviour of other northern hemisphere seal species was exhibited at exposure levels above 170 dB re 1 µPa.

Based on VSP modelling undertaken in 2018 for a nearshore area of Bass Strait, wireline activities will not trigger PTS thresholds for Otariid pinnipeds (the group in which fur-seals belong) and may result in TTS within a 20 m radius of the sound source.

Fur-seals are regularly observed swimming under and around the Yolla-A jacket. They have also occasionally been observed on the back deck of PSVs. These observations indicate that seals are unconcerned by noise and vibration generated by the platform and PSVs.

Data from Reiser et al (2011) indicates that the thresholds for behaviour and injury for pinnipeds from geophysical activities presented in NMFS (2013; 2016) are not triggered by geophysical equipment.

The sound generated by operations and inspection and maintenance activities is therefore considered to be of a minor consequence for pinnipeds.

Seabirds

Birds appear little affected by operational noise and vibration as they are known to roost on the Yolla-A helideck.

At Beach's Thylacine platform in the Otway Basin (located 258 km west-northwest of Yolla-A), there have been numerous incidents where birds did not depart the platform during attempted helicopter landings, indicating a general lack of sensitivity to helicopter rotor noise, so this may in fact cause very little disturbance to roosting seabirds.

Seabirds will be attracted to the vessels as a part of their foraging strategy and may use vessels as a resting place while foraging or migrating.

In the event that individual birds or flocks are present in the activity area during geophysical surveys, the risk of underwater sound significantly impacting a population of any given species or even individuals (during plunge/dive feeding) is extremely low. An indirect impact may occur if sound pulses cause changes to the abundance or behaviour of prey species (fish). However, the extent to which temporary 'descending' or 'tightening' responses of schooling prey fish such as pilchards (if it occurs) affects availability to avifaunal predators either positively or negatively, is not known. As described previously, the effects to fish from geophysical sound is minor. This, combined with the localised and temporary nature of geophysical surveys means that impacts to avifauna will be minor.

Seabird species that forage in the operational area all have considerable foraging habitat present throughout Bass Strait. The small size of the operational area and short-term nature of sound-general maintenance activities is insignificant relative to their normal foraging environment. Any temporary dispersal of prey species (i.e., fish) due to geophysical activities would not result in any significant decrease in availability of prey species that is of biological significance for these populations. As such, impacts to seabirds are considered minor.

Cetaceans

Cetaceans are widely regarded as being the most sensitive marine animals to noise, given that they use sound to communicate between individuals and locate their prey. As described in Section 5.5.5, the key cetaceans identified as sensitive receptors in the operational area (i.e., those that are listed as 'threatened' under the EPBC Act and have BIAs in the region) are southern right whales, pygmy blue whales and humpback whales.

Marine mammal species share basic hearing anatomy and physiology with their terrestrial ancestors. Marine mammals, however, have broader hearing frequency ranges due to the much higher sound speed underwater compared to in air. Odontocetes (toothed whales and dolphins) hear best at higher frequencies, generally in the ultrasonic range (>20,000 Hz), with no responsive hearing below 500 Hz (0.5 kHz). Mysticetes (baleen whales, such as humpbacks and southern right whales) hear better at lower frequencies (Wartzok & Ketten, 1999; Mooney *et al.*, 2012), generally at infrasonic frequencies as low as 10-15 Hz (APPEA, 2004). The optimal hearing frequency range for baleen whales is between ~20 and 1,000 Hz (McCauley *et al.*, 1994).

Sound is very important to whales and dolphins for effective hunting, navigation and communication. Mysticetes communicate at low frequencies (20 Hz to approximately 5 kHz) using predominantly tonal type calls. Odontocetes communicate using both tonal signals (up to approximately 30 kHz) and echolocation clicks (peak frequencies range from approximately 40 – 130 kHz), which they also use for hunting and navigation (Au *et al.*, 2000).

The type and scale of the effect on cetaceans from underwater sound generated depends on a number of factors including the level of exposure, the physical environment, the location of the animal in relation to the sound source, how long the animal is exposed to the sound, the exposure history, how often the sound repeats (repetition period) and the ambient sound level. The context of the exposure plays a critical and complex role in the way an animal might respond (Gomez *et al.*, 2016; Southall *et al.*, 2016).

High levels of anthropogenic underwater noise can have potential effects on cetaceans ranging from changes in their acoustic communication, behavioural disturbances and in more severe cases physical injury or mortality (Richardson *et al.*, 1995), as described herein.

Physiological impacts

Physiological impacts such as physical damage to the auditory apparatus (e.g., loss of hair cells or permanently fatigued hair cell receptors), can occur in marine mammals when they are exposed to intense or moderately intense sound levels and could cause permanent or temporary loss of hearing sensitivity. While the loss of hearing sensitivity is usually strongest in the frequency range of the emitted noise, it is not limited to the frequency bands where the noise occurs but can affect a broader hearing range. This is because animals perceive sound structured by a set of auditory bandwidth filters that proportionately increase in width with frequency.

The severity of TTS is expressed as the duration of hearing impairment and the magnitude of the shift in hearing sensitivity relative to preexposure sensitivity, in dB. TTS occurs at lower exposure levels than PTS. The cumulative effects of repeated TTS, especially if the animal receives another sound exposure near or above the TTS threshold before recovering from the previous sensitivity shift, could cause PTS. If the sound is intense enough, an animal could succumb to PTS without first experiencing TTS (Weilgart, 2007). Though the relationship between the onset of TTS and the onset of PTS is not fully understood, a specific amount of TTS can be used to predict sound levels that are likely to result in PTS. For example, in establishing PTS thresholds, Southall et al (2007) assume that PTS occurs with 40 decibels of TTS. While there are results from TTS and PTS studies on odontocetes exposed to impulsive sounds (Finneran, 2016), there is no data for mysticetes. There is no conclusive evidence of a link between sounds of seismic surveys and mortality of cetaceans (Gotz *et al.*, 2009).

Behavioural impacts

A secondary concern arising from sound generation is the potential non-physiological effects on cetaceans including:

- Increased stress levels;
- Disruption to underwater acoustic cues;
- Masking;
- Behavioural changes; and
- Displacement.

Behavioural responses to underwater sound are difficult to determine because animals vary widely in their response type and strength, and the same species exposed to the same sound may react differently (Nowacek *et al.*, 2004; Gomez *et al.*, 2016; Southall *et al.*, 2016). An individual's response to a stimulus is influenced by the context in which the animal receives the stimulus and how relevant the individual perceives the stimulus to be. A number of biological and environmental factors can affect an animal's response—behavioural state (e.g., foraging, travelling or socialising), reproductive state (e.g., female with or without calf, or single male), age (juvenile, sub-adult, adult), and motivational state (e.g., hunger, fear of predation, courtship) at the time of exposure as well as perceived proximity, motion and biological meaning of the sound and nature of the sound source.

Animals might temporarily avoid anthropogenic sounds but could display other behaviours such as approaching novel sound sources, increasing vigilance, hiding and/or retreating, that might decrease their foraging time (Purser & Radford, 2011).

Some cetaceans might also respond acoustically to noise in a range of ways, including by increasing the amplitude of their calls (Lombard effect), changing their spectral (frequency content) or temporal vocalisation properties, and in some cases, cease vocalising (McDonald *et al.*, 1995; 2007; Parks *et al.*, 2007; Di Ioro & Clark, 2010; Castellote *et al.*, 2012; Hotchkin & Parks, 2013; Blackwell *et al.*, 2015). Masking can also occur (Erbe *et al.*, 2015).

The behavioural reaction of cetaceans to circling aircraft (fixed wing or helicopter) is sometimes conspicuous if the aircraft is below an altitude of 300 m, uncommon at 460 m and generally undetectable at 600 m (NMFS, 2001; Richardson *et al.*, 1995). Baleen whales sometimes dive or turn away during over-flights, but sensitivity seems to vary depending on the activity of the animals. The effect on whales seems transient, and occasional over-flights probably have no long-term consequences (NMFS, 2001).

There are shipping fairways to the north, south and southwest of Yolla-A. It is expected that cetaceans migrating through and foraging in this part of Bass Strait are habituated to the sound generated by the merchant ships and passenger ferries using these shipping fairways, so routine offshore BassGas operations are unlikely to represent a significant additional source of sound and vibration.

Data from Reiser et al (2011) indicates that the thresholds for behaviour and injury for cetaceans (specifically low-frequency cetaceans, such as those present in the EMBA) from geophysical activities presented in NMFS (2013; 2016) are not triggered by geophysical equipment. Cetaceans are highly mobile and if geophysical sound was to create a disturbance, they are likely to exhibit short-term avoidance around the sound source.

Humpback whales are regularly sighted milling around the platform during their seasonal migrations, indicating that physiological and behavioural effects are not likely. If operational sound from the platform was causing them a disturbance, it is unlikely they would approach the platform. The sound generated by operations and inspection and maintenance activities is therefore considered to be of a minor consequence for cetaceans.

<u>Benthic invertebrates</u>

Marine invertebrates (such as scallops and rock lobsters) detect sound by sensing either the 'particle motion' (Przeslawski *et al.*, 2016a;b; Carroll *et al.*, 2017), through other external and internal physiological structures such as hairs, statocysts and muscles; or 'pressure' component (or both) of a sound field in the marine environment. Because they lack gas-filled bladders, marine invertebrates are unable to detect the pressure changes associated with sound waves (Carroll *et al.*, 2017; Parry & Gason, 2006).

However, all cephalopods as well as some bivalves, echinoderms and crustaceans have a sac-like structure called a statocyst, which includes a mineralised mass (statolith) and associated sensory hairs (Carroll *et al.*, 2017). Cephalopods have epidermal hair cells that help them to detect particle motion in their immediate vicinity (Kaifu *et al.*, 2008). Decapods have similar sensory setae on their body (Popper *et al.*, 2001) and antennae that may be used to detect low-frequency vibrations (Montgomery *et al.*, 2006).

The statocyst organs, found in a wide range of invertebrates, are utilised by animals to maintain their equilibrium and orientation and to direct their movements through the water. Their functions include the detection of gravitational forces and linear accelerations. Although there is little information available on the functioning of these sensory organs, it has been suggested that marine invertebrates are sensitive to low-frequency sounds and that this sensitivity is not directly linked to sound pressure but to particle motion detection (André *et al.*, 2016; Edmonds *et al.*, 2016; Roberts and Breithaupt, 2016). The statocysts may play a key role in controlling the behaviour responses of invertebrates to a wide range of stimuli.

The EIA presented here focuses on underwater sound generated by geophysical activities, as previous discussions about platform, pipeline, vessel and other maintenance activities indicates these sound sources will have minor impacts to marine fauna.

Studies recently undertaken in Bass Strait and in southern Tasmania regarding the impacts of seismic sound on marine invertebrates have concluded that seismic surveys do not result in mass mortality or mortality at a greater rate than natural mortality (Przeslawski *et al.*, 2016, Day *et al.*, 2016). These studies support various studies conducted in the 2000s (e.g., Harrington *et al.*, 2010, Parry *et al.*, 2002, Aguilar de Soto, 2015) that detected no significant differences to marine invertebrates between sites exposed to seismic operations and those not exposed.

Given that the sound sources for MBES, SSS and SBP are lower than seismic sound (and seismic survey impacts on marine invertebrates are considered minor), that the duration of such surveys is far less than seismic surveys (i.e., generally a few days), that these surveys occur infrequently (once every few years at most), that the geographic range of these surveys is far less than seismic surveys (e.g., along the pipeline only) and that the scallop and lobster fisheries do not operate in close proximity to the BassGas infrastructure, the impacts of geophysical surveys on benthic invertebrates is minor.

7.5.6 Impact evaluation and assessment

Table 7.6 presents the impact assessment for sound and vibration.

Table 7.6. Impact assessment for sound and vibration

Summary		
Summary of impacts	Noise and vibration from offshore operations can result in hearing damage and behavioural changes to sound-sensitive fauna.	
Extent of impacts	Localised – around the platform and vessels.	
Duration of impacts	Ongoing – duration of operations.	
Level of certainty of impacts	HIGH – the effects of noise on marine fauna are well studied and documented.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Fauna use the waters around the BassGas Development without displacement or injury due to noise and vibration from offshore operations.	**Platform**	
	Gas engines, generators and compressor are enclosed on the Yolla-A topsides.	Visual inspection records verify the integrity of noise enclosures is maintained.
	Rotating and vibrating equipment is maintained in accordance with the platform CMMS and vessels' PMS to ensure it are operating efficiently (thereby minimising vibration and sound generation).	CMMS records verify that rotating and vibrating equipment is inspected and maintained to schedule in accordance with OEM requirements.
	During VSP activities, the wireline contractor implements the EPBC Act Policy Statement 2.1 (Part A) using personnel trained and experienced	VSP operations reports verifies that EPBC Act Policy 2.1 (Part A) was implemented.

in undertaking marine mammal observation (MMO) duties.	VSP contractor CVs verify their experience at implementing EPBC Act Policy 2.1 requirements.
Vessels	
Through constant bridge watch, vessels comply with the *Australian National Guidelines for Whale and Dolphin Watching for Vessels* (DoEE, 2017) when working within the operational area. This means: • Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone. • No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod/group.	Vessel operations reports note when cetaceans were sighted and what actions were taken to avoid disturbance.
Vessel engines and thrusters are maintained in accordance with the PMS to ensure efficient operation (thereby minimising sound output).	PMS records verify that engines and thrusters are maintained to schedule in accordance with OEM requirements.
For geophysical surveys undertaken during February or March, the contractor implements the EPBC Act Policy Statement 2.1 (Part A) using personnel trained and experienced in undertaking MMO duties in to minimise risks to migrating and foraging pygmy blue whales.	Geophysical survey operations reports verify that EPBC Act Policy 2.1 (Part A) was implemented. Contractor CVs verify their experience at implementing EPBC Act Policy 2.1 requirements.
Helicopters	
Helicopter pilots must comply with the *Australian National Guidelines for Whale and Dolphin Watching for Vessels* (DoEE, 2017) when flying in the PSZ. This means: • Not flying lower than 500 m within a 500-m radius of a whale or dolphin. • Not approaching a whale or dolphin from head on.	Helicopter operations logs note when cetaceans were sighted within 500 m of the helicopter and what actions were taken to avoid disturbance.

Impact Consequence (residual)	
Minor	
Demonstration of ALARP	
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.	
Demonstration of Acceptability	
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about sound and vibration.

<table>
<tr><td>Legislative context</td><td colspan="2">The performance standards outlined in this EP align with the requirements of:
• EPBC Act 1999 (Cth):
○ Section 229, 229A – all cetaceans protected in Australian waters, and it is an offence to kill, injure or interfere with a cetacean.
○ EPBC Regulations 2000 (Part 8) – minimum approach distances to cetaceans.
○ EPBC Act Policy Statement 2.1 (Interaction between offshore seismic exploration and whales) management procedures.
• Wildlife (Marine Mammal) Regulations 2009 (Vic):
○ Vessels within Victorian State waters adhere to the minimum approach distance of 300 m for whales and 30 m for seals.
○ Helicopters flying over Victorian State waters must not fly or hover lower than 500 vertical metres of a marine mammal.</td></tr>
<tr><td rowspan="5">Industry practice</td><td colspan="2">The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to:
• Acoustics (underwater noise and vibration) – offshore facilities consider engineering measures to minimise operational noise emissions, vessels ensure gradual start-up of engines and thrusters where possible to provide opportunity for species to take evasive action.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>The EPS listed in this table meet these guidelines for offshore activities with regard to:
• Flaring and venting (item 21). The Best Available Techniques (BAT) are met for Yolla-A operations.
• Management of fugitive emissions (item 22). The BAT are met for Yolla-A operations.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>The guidelines are met with regard to:
• Noise (item 74). Environmental parameters that determine sound propagation in the sea are site-specific, and different species of marine life have different hearing sensitivities as a function of frequency. An impact assessment should be conducted to:
(i) identify where and/or when anthropogenic sound has the potential to create significant impacts, and
(ii) determine what mitigation measures, if any, are appropriate.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS listed in this table meet the following offshore development and production objectives:
• To reduce the impact of planned noise emissions to ALARP and to an acceptable level.</td></tr>
<tr><td rowspan="3">Environmental context</td><td colspan="2">MNES</td></tr>
<tr><td>AMPs (Section 5.4.1)</td><td>Underwater sound from the activity will not reach levels above ambient sound at the Boags and Beagle AMPs, or coastal state marine reserves.
See Appendix 1 for additional detail regarding the impacts of routine activities on the management aims of these AMPs.</td></tr>
<tr><td>Wetlands of international importance (Section 5.4.4)</td><td>Underwater sound from the activity will not reach levels above ambient sound at any Ramsar wetlands.</td></tr>
</table>

	TECs (Section 5.4.5)	Underwater sound from the activity will not reach levels above ambient sound at any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Underwater sound from the activity will not reach levels above ambient sound at any NIWs.
	Nationally threatened and migratory species (Section 5.5)	Underwater sound from the activity will not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	This hazard does not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The Conservation Management Plan for the Blue Whale (DoE, 2015) and the Conservation Management Plan for the Southern Right Whale (DSEWPC, 2012) identify noise interference as a threat to both species. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring

- Cetacean observations during wireline operations.

Record Keeping

Platform	Vessels	Helicopters
• CMMS records. • Wireline operations reports. • Wireline contractor CVs. • Incident register.	• PMS records. • Operations reports. • Geophysical operations reports.	• Operations reports.

7.6 IMPACT 6 – Routine Discharge - PFW

7.6.1 Hazard

PFW is composed of the natural formation water produced from gas and condensate-bearing reservoirs, and it includes condensed water vapour from the gas phase during transport from the wellbore and processing stages on the surface. The PFW is often a complex mix containing dissolved inorganic salts, minerals and heavy metals, in addition to dissolved and dispersed hydrocarbon components and other organic compounds. Small volumes of low toxicity process chemicals such as methanol and TEG (see Section 3.5.4) that are used may also be discharged via the PFW system. Though complex, this mixture represents a typical composition of PFW for the petroleum industry though some variation exists between operations depending on the hydrocarbon and reservoir specifics. It is recognised that PFW from gas fields generally has a higher BTEX content than PFW from oil fields (OGP, 2002). The PFW is treated on Yolla-A to prevent corrosion in the export pipeline and to ensure impacts to the receiving environment are minimised. It is discharged offshore, 45 m below the sea surface via a 750 mm diameter dump caisson (refer to Section 3.5.6).

In order to determine the effects of the PFW on the receiving environment, Beach contracted AECOM to undertake an ALARP review (AECOM, 2020) of PFW discharge technologies and to determine a PFW mixing zone based on WET testing and plume modelling.

Methodology for Determining the Mixing Zone

The methodology to determine the extent of the PFW mixing zone was informed by the accepted approaches to assessing discharges of wastewater, in this case PFW, to the marine environment. The methodology looks to determine the likely impacts within a mixing zone, and the point at which there is 'no effect' by determining a suitable dilution factor.

The mixing zone is an area within which environmental impacts will occur but the impacts are considered acceptable.

The Australian & New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) define a mixing zone as "an explicitly defined area around an effluent discharge where some, or all, water quality objectives may not be met". They note that "As a consequence, some community values of the water body may not be protected". Hence, it is important to consider the environmental setting of a discharge around which a mixing zone is applied. For example, a discharge at a remote offshore location has different implications for community values than a discharge into an urban waterway that may provide a multitude of ecosystem services to local communities.

ANZG (2018) notes that "mixing zones are regulated at the state or territory level in Australia". While it is recognised that, given its location, the discharge of PFW from Yolla-A is not in waters that are regulated by the State of Victoria, it is considered relevant to adopt the approach to determining mixing zones that is espoused by the Environment Protection Authority Victoria (EPA, 2010); to which ANZG (2018) refers.

The EPA Victoria (2010) guidance includes the following:

> *The levels of chemical, physical and biological stressors determined for the mixing zone are used to assess impacts to water body values. This includes the level and spatial extent of impact to values from individual stressors (where they operate separately) or combined stressors (where they operate synergistically or have an additive effect on beneficial uses and values).*

To account for the potential synergistic or additive effects from the various chemical components within the PFW discharge from Yolla-A, it is necessary to consider the level of toxicity of the whole effluent (as determined from WET testing), rather than considering the level of toxicity of each component chemical in isolation. This is the approach that has been adopted by Beach to determine the PFW mixing zone around Yolla-A.

To inform the revision of the Australian & New Zealand Guidelines for Fresh and Marine Water Quality, van Dam and Chapman (2001) compiled a review of the use of Direct Toxicity Assessment (DTA), a synonym for WET testing. They considered the major benefit of DTA to be that it can be used to "assess the toxicity of waters, in which the number of unidentified components may number thousands, and their behaviour, or interactions cannot be predicted". Through this, it "enables a greater understanding of potential impacts to aquatic environments, which in turn aids in the development of environmental protection measures".

Van Dam and Chapman (2001) highlight that single-chemical toxicity testing is not representative of the situation in the natural environment as organisms are rarely exposed to just one toxicant. Rather, a particular chemical is typically present in combination with many other chemicals between which interactions may occur which may alter their toxicity. Subsequently, mixtures of chemicals can result in either additive toxicity, greater than additive toxicity (aka synergism), or less than additive toxicity (antagonism) (Rand, 1995 in van Dam & Chapman, 2001). They note that single-chemical toxicity tests do not account for such factors, and the extrapolation of these results to the assessment of potential environmental impacts therefore has a great deal of inherent uncertainty. Holdway (1992, in van Dam & Chapman, 2001) notes that the toxicity of individual compounds can change with time and are often not fully known.

To overcome the limitations attendant to single-chemical toxicity testing, van Dam and Chapman (2001) indicate that it is necessary to implement DTA to provide an integrative measure of the aggregate/additive toxicity of chemicals within a mixture that accounts for interactions between component compounds. This allows more reliable predictions to be made of the potential for adverse impacts within the receiving environment (as per Waller *et al.*, 1996; de Vlaming & Norberg-King, 1999 [both in van Dam & Chapman, 2001]; de Vlaming *et al.*, 2000).

Previously for Yolla-A, a mixing zone has been de facto recognised, described and approved through the 2014 accepted EP. The basis of the assessment was hydrocarbon concentrations in the discharge at the time and comparison to ANZECC guidelines, as default standards. It should be noted, however, that ANZECC guidelines (i.e., ANZG, 2018) are 'triggers', which if exceeded provide for further site-specific assessments (e.g., WET testing).

From the foregoing evidence, it is considered that it can be reasonably concluded that the application of WET/DTA testing results provides a more realistic means of defining a mixing zone boundary than does the consideration of dilutions of individual constituents of the PFW discharge from Yolla-A.

In order to address a level of uncertainty Beach have provided a mixing zone range that will account for the mixing zone determined from the ANZG 2018 methodology, and highest worst case single constituent from the ANZECC guidelines (see Table 7.7). Plume verification modelling to be undertaken in late 2020 will confirm the extent of the mixing zone.

The approach to assessing the impact from a discharge can be conducted as follows:

- Characterisation of the discharge in terms of constituents and their concentrations.
- Characterising the discharge regime.
- Characterisation of the receiving environment and potential sensitive receptors
- Assessment of potential impacts through comparison of discharge concentrations with ANZG (2018) as default standards.
- Should the characteristics be lower than ANZG (2018), the assessment generally concludes that the discharge is acceptable.
- Should the characteristics be greater than ANZG (2018), then further assessment of impacts can be undertaken (i.e., additional WET Testing)

This is the approach taken in this assessment. It should be noted that ANZECC guideline values are derived from single biological species tests and single chemical species, not necessarily Australian species, often with a safety factor. These are generally conservative criteria and as noted above are trigger for further assessment. Further discussion of this aspect is provided below.

ANZG (2018) notes that exceedance of the guidelines indicates that there is potential for an impact to occur (or to have occurred) but does not provide any certainty that an impact will occur (or has occurred). In areas where protection of aquatic ecosystems is a designated environmental value (as is the case for Yolla-A), ANZG (2018) recommend direct assessment of the biological community to assess whether ecosystem integrity is being maintained, threatened or compromised to a level that causes pollution. Biological indicators should therefore be used to complement the use of physical and chemical indicators for this value. These guidelines (ANZG, 2018) describe indicators for biological assessment and give guidance for determining an acceptable level of change so that the relative condition of the ecosystem can be estimated. This approach is also advocated in the *Risk Based Assessment of Offshore Produced Water Discharges* guidelines (IOGP, September 2020).

Decision frameworks provide guideline trigger values (equivalent to the old guideline default values) that refer to the concentration of the chemical available for uptake by organisms. Guideline trigger values are concentrations that, if exceeded, will indicate a potential environmental problem, and so 'trigger' further investigation. The investigation aims to both assess whether exceedance of a trigger value will result in environmental harm and refine a guideline value, by accounting for environmental factors that can modify the effect of the chemical.

Although in some cases this will require more work (in this case, the WET testing), it will result in much more realistic goals for PFW management.

Ultimately, it is biological measurement that will provide confirmation of the site-specific guideline, so the ANZG decision scheme directs users to the option of DTA if the guideline is exceeded or if there is low confidence in desktop assessments. WET testing is an acceptable form of DTA.

When no default trigger value is provided, where the trigger value is not applicable to a specific site, or if the chemical is one of a complex mixture, DTA is also useful. Further, DTA may provide the required link between chemical levels and biological effects or establish concentrations that are unlikely to cause adverse environmental effects. Field biological assessments can be undertaken also.

It is recommended that, if there is any degree of complexity in the mixture interactions, proceed to DTA on the ambient waters at the site. The PFW discharge is a complex mixture, as it has a large number of constituents at generally low concentrations.

The use of an appropriate suite of test species and chronic end-points to ascertain whether toxicity is being observed is recommended. This was undertaken to develop the WET testing protocol. It is also recommended that if adverse effects are observed, then management action is initiated and toxicity identification and evaluation is used to assist in identifying the compound(s) that are causing toxicity.

ANZG (2018) provides the following guidance:

- Where a chemical is to be used in an environment of particular socio-political or ecological importance, it is better to undertake toxicity testing with that chemical on species relevant to that environment.
- When using DTA to examine toxicity of a chemical to locally important species or for pre-release effluents, to determine chronic effects at a range of concentrations of the chemical or effluent. For dilution, use the local reference dilution waters.
- Determine No Effect Concentration (NOEC) values for the chemical or effluent and use them for calculating site-specific guidelines. The method used for these calculations will depend on the number of data points, but use the statistical distribution method if the data requirements have been met (at least five species from four different taxonomic groups).
- The DTA can comprise in situ field and/or laboratory ecotoxicity tests (Chapman, 1995), preferably chronic or sub-chronic tests on appropriate species using local dilution waters, satisfying all sampling, test and analysis conditions.
- To aid interpretation of results, analyse the chemicals concurrently with biological assessment, unless there is a biological marker of toxicity.
- For already existing discharges and for chemicals that have a high potential to disturb the environment, it will be necessary to measure and assess the biological health of potentially disturbed sites.

The WET testing results are listed in Table 7.7. These results indicate that levels of ammonia, BTEX, cobalt, phenol, naphthalene, TRH (C10-C36, total) in the PFW stream are higher than the ANZG (2018) 99% default guideline values (DGVs). The eight test species used for ecotoxicity testing are listed later in this chapter. These species have been determined to reflect the typical suite of species in the marine waters of Bass Strait, such as zooplankton, macroalgae, pelagic fin-fish and benthic invertebrates.

On this basis, the use of the WET testing to assess the toxicity of the PFW and its impacts is in line with ANZG (2018) methodology and the *Risk Based Assessment of Offshore Produced Water Discharges* guidelines (IOGP, September 2020).

To address the level of uncertainty around the potential for the PFW discharges from Yolla-A to impact upon the receiving environment, Beach has implemented a WET testing program. This program supports the assessment of potential additive or synergistic effects that may result from the chemical constituents interacting within the PFW discharge stream that may influence stream toxicity. The results of the WET testing program are used to inform an ALARP assessment of environmental risks associated with the current PFW discharge from Yolla-A.

Table 7.7. Chemical analytes of the samples used for WET testing

Analyte	WET testing samples chemical analyses (mg/L)							Dilutions to achieve ANZG 99% DGVs based on average	Dilutions to achieve ANZG 99% DGVs based on maximum
	25 Sept 19	2 Oct 19	10 Oct 19	ANZG 99% DGVs	Av	Max	Min		
Chloride	11,000	9,800	12,000	-	10,933	12,000	9,800	-	-
Conductivity (at 25°C)	29,000	29,000	31,000	-	29,667	31,000	29,000	-	-
Nitrate & nitrate (as N)	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	-
pH (at 25°C)	6.7	6.9	7.1	-	6.9	7.1	6.7	-	-
Phosphate total (as P)	-	-	0.03	-	0.03	0.03	0.03	-	-
Total Kjeldahl Nitrogen (as N)	27	51	34	-	37	51	27	-	-
Total Nitrogen (as N)	27	51	34	-	37	51	27	-	-
Total suspended solids (dried at 103°C)	2	4.7	5.1	-	4	5.1	2	-	-
Ammonia (non-NATA analysis)	32	32.6	31.4	0.5	32.3	32.6	32	64.6	65.2
Potassium	60	67	74	-	67	74	60	-	-
BTEX									
Benzene	14	17	15	0.5	15	17	14	30.7	34.0
Ethylbenzene	0.94	1.1	0.93	0.005[2]	0.99	1.1	0.93	198.0	220.0
M&p-Xylenes	10	12	10	0.275[2]	11	12	10	38.8	43.6
o-Xylene	2.7	3.2	2.7	0.35[2]	3	3.2	2.7	8.2	9.1
Toluene	25	30	27	0.11	27	30	25	248.5	272.7
Xylenese – total	13	15	13	-	14	15	13	-	-

Analyte	WET testing samples chemical analyses (mg/L)							Dilutions to achieve ANZG 99% DGVs based on average	Dilutions to achieve ANZG 99% DGVs based on maximum
	25 Sept 19	2 Oct 19	10 Oct 19	ANZG 99% DGVs	Av	Max	Min		
Total	**52.94**	**63.1**	**55.93**	-	-	-	-	-	-
Glycols									
Di-ethylene glycol	< 20	< 20	< 20	-	< 20	< 20	< 20	-	-
Ethylene glycol	< 20	< 20	< 20	-	< 20	< 20	< 20	-	-
Propylene glycol	< 20	< 20	< 20	-	< 20	< 20	< 20	-	-
Triethylene glycol	< 20	< 20	< 20	-	< 20	< 20	< 20	-	-
Heavy metals									
Aluminium	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	-
Antimony	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	-	-
Arsenic	0.003	0.002	0.003	-	0.0027	0.003	0.002	-	-
Barium	52	40	46	-	46	52	40	-	-
Beryllium	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Boron	13	11	13	-	12.3	13	11	-	-
Cadmium	< 0.0002	< 0.0002	< 0.0002	0.0007	< 0.0002	< 0.0002	< 0.0002	-	-
Chromium	< 0.001	0.001	< 0.001	0.0077 (Cr III)	0.001	0.001	0.001	-	-
Cobalt	< 0.001	< 0.001	< 0.001	0.000005	< 0.001	< 0.001	< 0.001	100.0	100.0
Copper	-	< 0.001	0.005	0.0003	0.005	0.005	0.005	16.7	16.7
Iron	1.2	1	0.86	-	1.02	1.2	0.86	-	-
Lead	< 0.001	< 0.001	< 0.001	0.0022	< 0.001	< 0.001	<0.001	-	-

Analyte	WET testing samples chemical analyses (mg/L)							Dilutions to achieve ANZG 99% DGVs based on average	Dilutions to achieve ANZG 99% DGVs based on maximum
	25 Sept 19	2 Oct 19	10 Oct 19	ANZG 99% DGVs	Av	Max	Min		
Manganese	0.029	0.028	0.028	-	0.028	0.029	0.028	-	-
Mercury	0.006	0.0059	0.0054	-	0.0058	0.006	0.0054	-	-
Molybdenum	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	-	-
Nickel	< 0.001	< 0.001	< 0.001	0.007	< 0.001	< 0.001	< 0.001	-	-
Selenium	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Silver	< 0.005	< 0.005	< 0.005	0.0008	< 0.005	< 0.005	< 0.005	3.1	3.1
Strontium	3.1	3.1	3.1	-	3.1	3.1	3.1	-	-
Thallium	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	-	-
Tin	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	-	-
Titanium	< 0.005	< 0.005	< 0.005	-	< 0.005	< 0.005	< 0.005	-	-
Vanadium	< 0.005	< 0.005	< 0.005	0.05	< 0.005	< 0.005	< 0.005	-	-
Zinc	0.017	0.011	0.019	0.007	0.0157	0.019	0.011	2.2	2.7
Phenols (halogenated)									
2.4.5-Trichlorophenol	< 0.01	< 0.01	< 0.01	-	< 0.01	< 0.01	< 0.01	-	-
2.4.6-Trichlorophenol	< 0.01	< 0.01	< 0.01	-	< 0.01	< 0.01	< 0.01	-	-
2.4-Dichlorophenol	< 0.003	< 0.003	< 0.003	-	< 0.003	< 0.003	< 0.003	-	-
2.6-Dichlorophenol	< 0.003	< 0.003	< 0.003	-	< 0.003	< 0.003	< 0.003	-	-
2-Chlorophenol	< 0.003	< 0.003	< 0.003	-	< 0.003	< 0.003	< 0.003	-	-
4-Chloro-3-methylphenol	< 0.01	< 0.01	< 0.01	-	< 0.01	< 0.01	< 0.01	-	-

Analyte	WET testing samples chemical analyses (mg/L)							Dilutions to achieve ANZG 99% DGVs based on average	Dilutions to achieve ANZG 99% DGVs based on maximum
	25 Sept 19	2 Oct 19	10 Oct 19	ANZG 99% DGVs	Av	Max	Min		
Pentachlorophenol	< 0.01	< 0.01	< 0.01	0.011	< 0.01	< 0.01	< 0.01	-	-
Tetrachlorophenols - total	< 0.03	< 0.03	< 0.03	-	< 0.03	< 0.03	< 0.03	-	-
Total halogenated phenol	< 0.01	< 0.01	< 0.01	-	< 0.01	< 0.01	< 0.01	-	-
Phenols (non-halogenated)									
2.4-Dimenthylphenol	0.049	5.3	4.3	-	3.22	5.3	0.049	-	-
2.4-Dinitrophenol	< 0.03	< 0.03	< 0.03	-	< 0.03	< 0.03	< 0.03	-	-
2-Cyclohexyl-4.6-dinitrophenol	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1	< 0.1	-	-
2-Methyl-4.6-dinitrophenol	< 0.03	< 0.03	< 0.03	-	< 0.03	< 0.03	< 0.03	-	-
2-Methylphenol (o-Cresol)	0.12	14	13	-	9.04	14	0.12	-	-
2-Nitrophenol	< 0.01	< 0.01	< 0.01	-	< 0.01	< 0.01	< 0.01	-	-
3&4-Methylphenol (m&p-Cresol)	0.1	10	12	-	7.37	12	0.1	-	-
4-Nitrophenol	< 0.03	< 0.03	< 0.03	-	< 0.03	< 0.03	< 0.03	-	-
Dinoseb	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1	< 0.1	-	-
Phenol	0.19	7.7	8.4	0.27	5.43	8.4	0.19	20.1	31.1
Total non-halogenated phenols	**0.459**	**37**	**37.7**	**-**	**25.053**	**37.7**	**0.459**	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)									
Acenaphthene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-

Analyte	WET testing samples chemical analyses (mg/L)							Dilutions to achieve ANZG 99% DGVs based on average	Dilutions to achieve ANZG 99% DGVs based on maximum
	25 Sept 19	2 Oct 19	10 Oct 19	ANZG 99% DGVs	Av	Max	Min		
Acenaphthylene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Anthracene	< 0.001	< 0.001	< 0.001	0.00001[2]	< 0.001	< 0.001	< 0.001	50.0	50.0
Benz(a)anthracene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Benzo(a)pyrene	< 0.001	< 0.001	< 0.001	0.0001[2]	< 0.001	< 0.001	< 0.001	5.0	5.0
Benzo(b&j)fluoranthene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Benzo(g.h.i)perylene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Benzo(k)fluoranthene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Chrysene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Dibenz(a.h)anthracene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Fluoranthene	< 0.001	< 0.001	< 0.001	0.001[2]	< 0.001	< 0.001	< 0.001	-	-
Fluorene	< 0.001	0.001	< 0.001	-	0.001	0.001	0.001	-	-
Indeno(1.2.3-cd)pyrene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Napthalene	0.002	0.36	0.14	0.05	0.167	0.36	0.002	3.3	7.2
Phenanthrene	< 0.001	< 0.001	< 0.001	0.0006[2]	< 0.001	< 0.001	< 0.001	0.8	0.8
Pyrene	< 0.001	< 0.001	< 0.001	-	< 0.001	< 0.001	< 0.001	-	-
Total PAH	**0.002**	**0.361**	**0.14**	**-**	**0.168**	**0.361**	**0.002**	-	-
Total Recoverable Hydrocarbons – 1999 NEPM fractions									
TRH C10-C14	0.33	32	32	-	21.44	32	0.33	-	-
TRH C10-C36 (total)	0.33	32.2	33	0.007[2]	21.84	33	0.33	3,120.5	4,714.3

Analyte	WET testing samples chemical analyses (mg/L)							Dilutions to achieve ANZG 99% DGVs based on average	Dilutions to achieve ANZG 99% DGVs based on maximum
	25 Sept 19	2 Oct 19	10 Oct 19	ANZG 99% DGVs	Av	Max	Min		
TRH C15-C28	< 0.1	0.2	1	-	0.6	1	0.2	-	-
TRH C29-C36	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1	< 0.1	-	-
TRH C6-C9	71	82	80	-	77.7	82	71	-	-
Total Recoverable Hydrocarbons – 2013 NEPM fractions									
Napthalene	0.63	< 5	< 5	-	1.88	< 5	0.63	-	-
TRH >C10-C16	0.33	35	37	-	24.11	37	0.33	-	-
TRH >C10-C16 less Napthalene (F2)	-	35	37	-	36	37	35	-	-
TRH >C10-C40 (total)	0.33	35	37.8	0.007[2]	24.4	37.8	0.33	3,482.4	5,400.0
TRH >C16-C34	< 0.1	< 0.1	0.8	-	0.8	0.8	0.8	-	-
TRH >C34-C40	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1	< 0.1	-	-
TRH C6-C10	80	92	90	-	87.3	92	80	-	-
TRH C6-C10 less BTEX (F1)	27	29	34	-	30	34	27	-	-

PFW Characterisation

The most recent characterisation of physical and chemical constituents of Yolla PFW discharge are presented in Table 7.8 (which compares the most recent testing with results presented in the 2014 EP), while the results from 2014 to 2018 for comparison are presented in Table 7.9.

The PFW samples were collected on the platform prior to discharge, so data in these tables present PFW characterisation at the point of discharge, prior to any dilution and mixing with seawater. The comprehensive analyses were assessed in order to address whether the analyses supported the conclusions from the non-NATA analyses whether the characteristics of PFW have changed over time.

Table 7.8. Composition of the Yolla PFW (2014, 2017-2019)

Analyte	2014 (mg/L)	2017 (mg/L)	2018 (mg/L)*	2019 (mg/L)**	Trend (2014-19)
Heavy metals					
Aluminium	3.2	-	-	<0.05	Decreasing
Arsenic	BD	0.002	<0.005	0.003	Stable
Boron	3.4	-	-	13	Increasing
Barium	13	-	-	52	Increasing
Cadmium	-	<0.0002	<0.001	<0.0002	Stable
Chromium	0.001	<0.001	<0.005	0.001	Stable
Copper	-	<0.001	<0.005	0.005	Stable
Iron	4.3	-	-	1.2	Decreasing
Lead	BD	<0.001	<0.005	<0.0001	Stable
Mercury	0.029	0.01	0.0055	0.006	Decreasing
Manganese	0.03	-	-	0.029	Stable
Molybdenum	0.001	-	-	<0.005	Stable
Nickel	0.01	<0.001	<0.005	<0.001	Stable
Potassium	-	-	66	74	Increasing
Selenium	0.001	-	-	<0.001	Stable
Strontium	0.81	-	-	3.1	Increasing
Zinc	0.09	0.016	<0.025	0.019	Decreasing
BTEX					
Benzene	12	10	17	17	Increasing
Toluene	14	13	25	30	Increasing
Ethylbenzene	0.45	0.52	0.9	1.1	Increasing
o-Xylene	1.6	1.7	3.1	3.2	Increasing

Analyte	2014 (mg/L)	2017 (mg/L)	2018 (mg/L)*	2019 (mg/L)**	Trend (2014-19)
m&p- Xylene	5.2	5.6	9.6	12	Increasing
Napthalene	1	-	-	0.36	Decreasing
Phenols					
Phenol	64	61	32	8.4	Decreasing
Cresols	75	-	-	26	Decreasing
2,4-Dimethyl Phenol	8.7	9.1	11	5.3	Decreasing
Other					
TPH (oil and petroleum hydrocarbons)	-	-	-	114.2 - 127.8	ID
Glycol	-	-	-	<20	ID

Note: the range for oil and petroleum ('Total Hydrocarbon') arises from two analyses: Total Recoverable Hydrocarbons 1999 NEPM fractions C6-C36 and Total Recoverable Hydrocarbons 2013 NEPM fractions C6-C40.
BD: below detection, ID: insufficient data to establish a trend.
** Represents the highest figure for the two samples taken in June & December.*
*** Represents the highest number from the three samples taken for WET testing in September & October.*

Table 7.9. PFW analysis for BTEX and hydrocarbon species (mg/L)

	Benzene	Ethyl benzene	Toluene	Xylene	Total BTEX	C6-C9 excluding BTEX	TPH*	
							C6-C9	C10-C40
ANZG DGV 99% (mg/L)	**0.5**	**0.005**	**0.18**	**0.625**	**NA**	**NA**	**NA**	**0.007**
ALS laboratory								
1-Jan-14	7.7	NA	NA	NA	NA	NA	NA	NA
2-May-15	5.91	NA	NA	NA	NA	NA	NA	NA
2-Feb-16	5.4	NA	NA	NA	NA	NA	NA	NA
19-Jul-16	7	0.19	6.7	3	17	4.8	22	57
10-Jan-17	7.1	0.17	7.2	2.9	17.37	6.2	25	80
16-Jun-17	12	0.45	14	6.8	33.25	11.75	45	87
10-Dec-17	10	0.52	13	7.3	30.82	9.1	39.92	51
Eurofins laboratory								
21-Jun-18	15	0.81	24	12	51.81	22	73.81	50.5
11-Dec-18	17	0.9	25	13	55.9	42	97.9	63.7
5-Aug-19	14	0.97	27	12	53.97	14	67.97	59.6
26-Sep-19	14	0.94	25	13	52.94	18.1	71.04	0.33
2-Oct-19	17	1.1	30	15	63.1	18.9	82	35

	Benzene	Ethyl benzene	Toluene	Xylene	Total BTEX	C6-C9 excluding BTEX	TPH*	
							C6-C9	C10-C40
10-Oct-19	15	0.93	27	13	55.93	24.1	80.03	37.8
Trend (2016-19)	↑	↑	↑	↑	↑	↑	↑	↓

↑ = increase, ↓ = decrease * TPH is the sum of C6-C9 and C10-C40.

Table 7.8 indicates that the concentrations of barium, boron, strontium and BTEX increased since 2014 but have been stable from 2018. It is noted that there was a change in the criteria included in the EP (2014) from 30/50 mg/L dispersed oil to 30/50 mg/L total hydrocarbons (noting that then Origin's intent was to address dispersed hydrocarbons only). The increases in BTEX (as a total) were due to increases in individual chemical species, in some cases an almost doubling (e.g., toluene, ethyl benzene and xylene), which is likely due to two new wells (Yolla-5 and Yolla-6) that were brought on line in mid-2015. This also saw a significant reduction in phenols.

Weekly BTEX data has been collected since mid-2018, and Figure 7.2 shows that BTEX levels have generally been in the 40-80 mg/L range since that time.

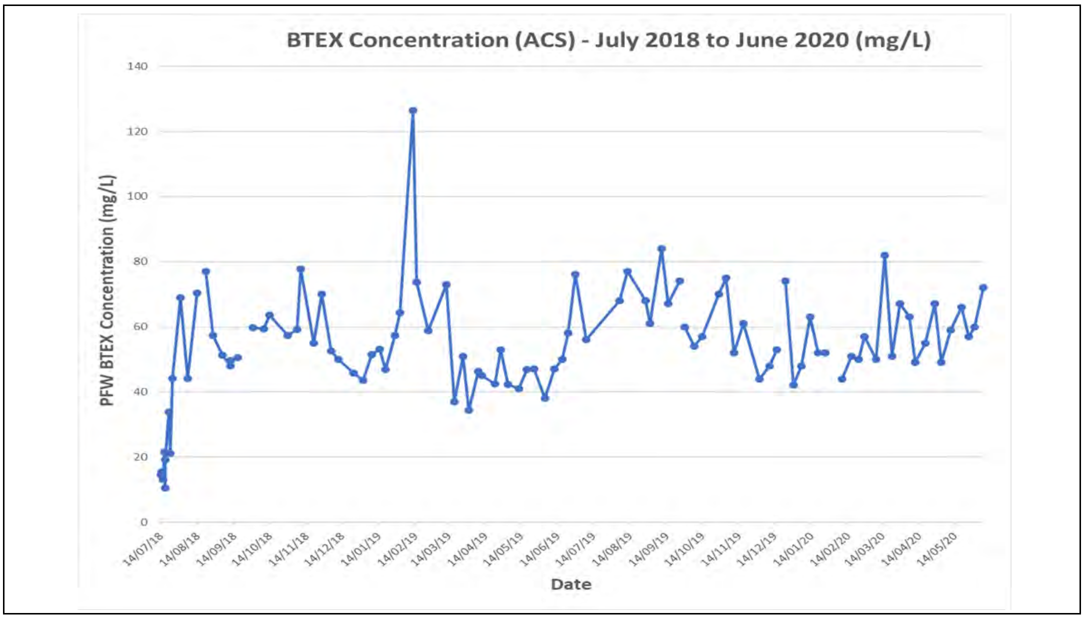


Figure 7.2. PFW BTEX analyses 2018-2020

Figure 7.3 illustrates the PFW TPH concentrations (the addition of OIW and BTEX, or the addition of the C6-C9 and C10-C40 chains) that have been recorded since mid-2018. This shows that TPH concentrations are generally in the range of 40 – 80 mg/L during normal operations, with occasional spikes due to non-routine operations (e.g., process upsets, shutdowns). As noted in Section 3.5.6, it is expected that TPH levels will gradually increase in coming years as the water cut of the Yolla wells increases, which means there will be less PFW residence time in the caisson prior to discharge.

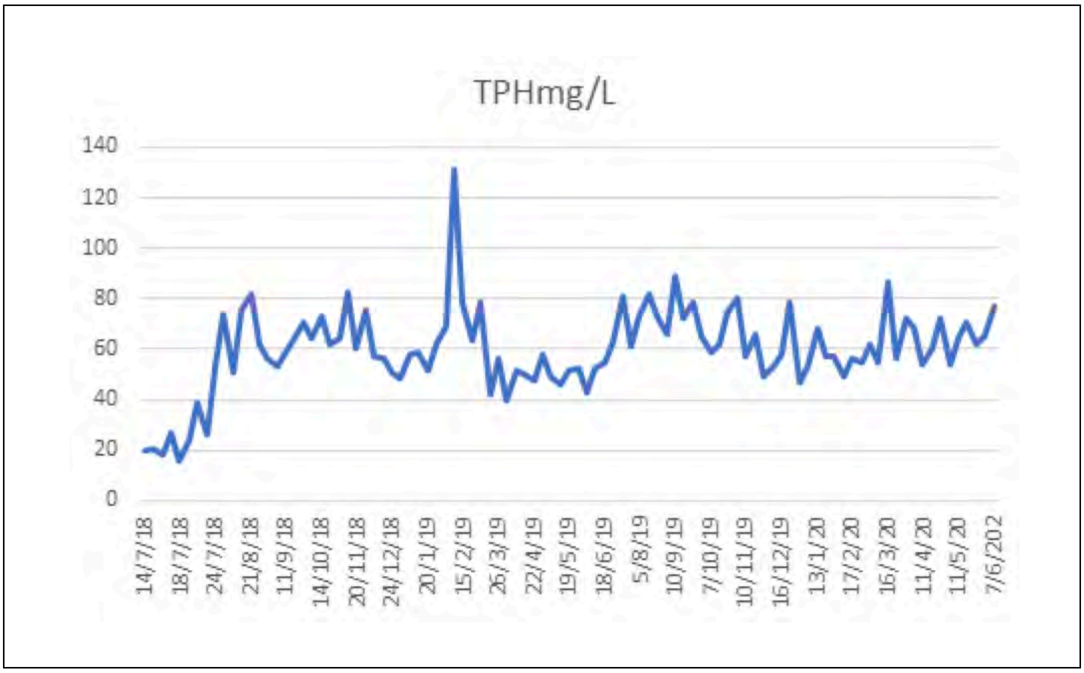


Figure 7.3. PFW TPH analyses 2018-2020

Table 7.10 presents a summary of the analytical data for PFW characterisation for the most recent full calendar year (12 months to December 2019). This demonstrates that the PFW comprises minimal amounts of dispersed OIW and confirms the main constituents are BTEX (dissolved hydrocarbons).

Table 7.10. Composition of the Yolla PFW (2019) calendar year

	BTEX (GCMS) (mg/L)*	OIW (dispersed oil C7-C40 aliphatic) (mg/L)	TPH (mixed) (mg/L)
Average	58	5	63
Maximum	126	7	133
Minimum	34.3	5	39.3

* *Indicative of dissolved hydrocarbons*

PFW Volume

The original design PFW flow rate was nominated as 100 m^3/day, however, an increase in flow rates was anticipated, and has occurred. Data provided in Table 7.11 and Figure 7.4 indicates that flow rates have increased over the initial design, with average daily flows above 220 m^3/day.

A wireline campaign was conducted in October and November 2019, which successfully increased gas production. The field was producing large flows of PFW in the order of 260 m^3/day before the campaign and with the Yolla-4 plug being sealed, this resulted in PFW production reducing to an average of about 150-170 m^3/day.

Table 7.11. PFW discharge flow rates

	Flow (m^3/day)		
Time period	Average	Minimum	Maximum
July-Dec 2018	238.8	215	260
Jan-Dec 2019	186.4	29	271

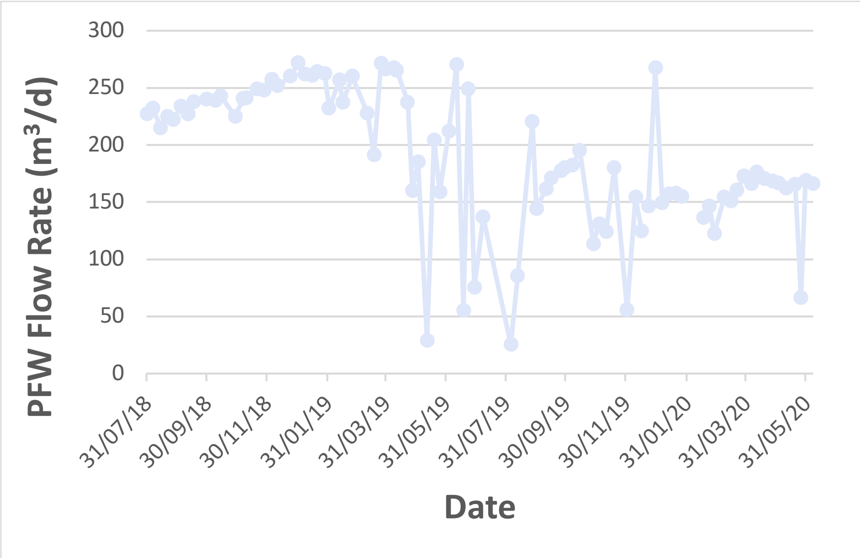


Figure 7.4. PFW discharge flow rates 2018-2020

Hydrocarbon Discharges

The total amount of hydrocarbon discharged in the PFW stream has been calculated since the start of 2019. For the 2019 calendar year, 3,833 kg (~3,335 litres) of hydrocarbon (i.e., the TPH component of the PFW) was discharged with the PFW stream (which is an average of 10.5 kg/day, or ~9.1 litres/day). The impacts of hydrocarbons discharged in the PFW stream are assessed in Section 7.6.5.

PFW Toxicity

To better understand the toxicity of the Yolla PFW stream, Beach commissioned AECOM to undertake WET testing of the PFW stream, with an objective to set risk-based limits for OIW and TPH concentrations in the PFW. The WET testing involved taking PFW samples and undertaking chemical analysis and toxicity tests on a range of species known to be reflective of the receiving environment in order to determine the safe operating limits for the PFW. The results are summarised in this section, with the full report provided in **Appendix 9**.

To determine the safe OIW and TPH concentrations, a range of Australian marine test species (fish, molluscs, crustaceans, echinoderms, algae and macroalgae) representative of Bass Strait and Australian waters were selected for the WET testing based on their ecological relevance and the availability of standard tests with known reproducibility. Test species that exhibited the most sensitive response to previous PFW testing were also included to permit comparison of results with these previous studies.

Sampling Program

The following program design was aligned with similar investigations of PFW discharges implemented elsewhere within the offshore petroleum industry. The WET testing was conducted by Ecotox Services Australia (Ecotox), who is NATA-certified for these tests, in its Sydney Laboratory. Chemical characterisation of the PFW samples was undertaken by Eurofins, NATA-certified for these analyses. The sampling and analysis program was as follows:

- Three single, representative samples of PFW were collected (up to 20 litres each), with one week between samples (25th September 2019, 2nd October 2019 and 10th October 2019). Samples were collected on Yolla-A where the PFW stream enters the caisson for discharge overboard.

Taking into consideration the location of the receiving environment, and advice provided by the analysing laboratory based on their prior experience undertaking WET testing programmes for offshore oil and gas operations around Australia, the following toxicity tests were undertaken:

- Acute tests (assess on the basis of mortality):
  - 96-hr acute amphipod survival using the amphipod (*Allorchestes compressa).*
  - 96-hr fish imbalance toxicity test using Australian bass (*Macqauria novemaculeata).*
- Chronic tests (non-lethal impacts related to growth and development):
  - 72-hr marine algal growth test using *Nitzschia closterium*.
  - 72-hr macroalgal germination success using Neptune's necklace (*Hormosira banksia)* or kelp (*Ecklonia radiata*).
  - 48-hr larval development test using the mussel *Mytilus galloprovincialis*.
  - 1-hr sea urchin fertilisation success test using *Heliocidaris tuberculata*.
  - 72-hr sea urchin larval development test using *Heliocidaris tuberculata*.
  - 7-day marine fish imbalance and growth using barramundi (*Lates calcarifer*).

The species were selected by Dr Rick Krassoi of Ecotox (NATA-registered), who is considered an expert in this field. The selection was based on the understanding of the marine environment in Bass Strait and as being representative of the marine environment into which the PFW is discharged.

The toxicity testing involves preparing water samples comprising various dilution of PFW with seawater (e.g., 1.6%, 3.1%, 6.3%, 12.5%, 25%, 50% and 100%) and subjecting the test species to these concentrations for the test period duration (1 hour, 48, 72 and 96 hours, 7 days). The test species are then assessed to determine impacts as per the tests above (e.g., larval development, fertilisation success, etc). The results are analysed statistically to provide the following data:

- Effect Concentration (EC)50 - dilution results in impact to 50% of the test species in a particular test;
- EC10 - dilution results in impact to 10% of the test species in a particular test;
- NOEC - no observable effect concentration (i.e., no observable impact, noting this is a higher level of protection than the 99% species protection level); and
- LOEC (Lowest Observable Effect Concentration) - dilution that results in an impact to the test species in a particular test.

WET Testing

The results of the chemical analyses of the samples are presented in Table 7.7, with the laboratory reports included as appendices to **Appendix 9**. A comparison of the historic data (2014 BassGas Offshore Operations EP) with that from the WET testing samples is presented in Table 7.8.

The analytical results from the three samples are compared to ANZG 99% species protection DGVs, and the number of dilutions required to achieve these criteria are presented in Table 7.7. ANZG 99% criteria can be used for defining the edge of an approved mixing zone. However, it should be noted that the DGVs are conservatively derived and take into account uncertainty in the data used to develop the guideline values. As such Beach will present a mixing zone range, from the low confidence single constituent mixing zone range to the higher confidence combined effluent mixing zone edges.

The derivation of dilution criteria from WET testing is an acceptable process in accordance with ANZG (2018) and OSPAR methodology (as noted in IOGP, 2020), and is more suitable for site-specific application than the adoption of the ANZG single species dilution values criteria. In other words, while the ANZECC Guideline values are exceeded in some circumstances with recommended dilution factors, when the WET is combined, the dilution factors change.

This is consistent with the accepted approach outlined in 'methodology', in which site-specific WET testing is undertaken if characterisation indicates exceedance of conservative ANZG (2018) guidelines as shown in Table 7.7. The retention time in the caisson is around two hours and this provides additional PFW quality improvement such as flotation of free hydrocarbon with associated skimming and potentially some volatilisation. These processes would decrease the final toxicity of the PFW when comparing results from the sample point on the platform (into the caisson) and final discharge to the receiving environment (out of the caisson). Therefore, the results are also considered to be conservative.

The samples taken are also conservatively based as there will be some improvement in PFW quality through the residence time in the caisson before discharge to the marine environment.

Toxicity Results

The WET testing results were reviewed by AECOM to develop conservative and scientifically-based conclusions.

Firstly, a NOEC was selected as the criteria to be used to define the higher confidence mixing zone. This is the dilution at which there is no impact on the marine environment because the species and test selected provide a representative assessment of the platform's marine environment and how the species could be impacted. This dilution level is the lowest number in Table 7.12 (as highlighted in the table), which represents that the species are subject to all the constituents simultaneously. This is different from the way ANZ 99% species protection is derived, which is based on testing of individual species (not necessarily Australian based) and application of a safety factor. The NOEC value is considered to give a higher than 99% species protection with a high confidence level as it is reflective of the actual discharge stream (see 'Methodology for Determining the Mixing Zone' earlier).

Secondly, the lowest NOEC value (maximum dilution) across all the species and all the samples was selected from the data in Table 7.12. The results in Table 7.12 show a range of NOEC values that range from 1.6 - 12.5%. The results of the testing demonstrate that:

- A minimum NOEC of 1.6% (a maximum dilution of 62.5:1) would not impact these species; and
- A minimum LOEC of 3.1% (a dilution of 32.3:1) could result in some impact (LOEC depends on the test type, so it could be mortality in the 96-hr fish imbalance test or it could be inhibition of development or fertilisation success).

The NOEC of 1.6% means that when the PFW is diluted at this ratio (1.6% dilution is 100 parts seawater to 1.6 parts PFW, with 100 divided by 1.6 being 62.5, hence the 62.5:1 dilution), it will have no impact on the marine environment (as represented by the eight test species subject to the PFW toxicity tests). By the same reasoning, the LOEC of 3.1% means that 3.1 parts of PFW with 100 parts seawater will have some impact on the marine environment.

The NOEC dilution criteria derived from the WET testing is adopted for assessment of potential impacts for the PFW discharge.

The results demonstrate that the PFW is much less toxic when evaluating whole toxicity rather than individual constituents. While some individual constituents have increased since 2014, others have decreased (see Table 7.8) and once combined, the individual constituents react with each other and in this case reduce the overall toxicity of the stream. Therefore, while the ANZG DGV for hydrocarbons of 0.007 mg/L is a low reliability indication that predicts the need for dilutions of worst case 5,400 (see TRH C10-C40 (total) in Table 7.7), compared to the high reliability 62.5 dilutions based on the WET testing, this is in line with the ANZG (2018) described in 'Methodology for Determining the Mixing Zone' earlier.

The difference between the two defines the range of the expected mixing zone.

Table 7.12. Summary of WET testing results (% dilution)

Test species	Chronic Toxicity			Chronic Toxicity			Chronic Toxicity			Acute Toxicity		
	1-hr sea urchin fertilisation success			72-hr sea urchin larval development test			48-hr larval development test			96-hr acute toxicity test using amphipod		
Date	25-Sep	2-Oct	10-Oct	25-Sep	2-Oct	10-Oct	25-Sep	2-Oct	10-Oct	25-Sep	2-Oct	10-Oct
EC10	1.6	2.5	3.9	3	3	8.8	2	2.3	7.4	3.4	7.9	11.1
EC50	2.4	3.8	5.7	4.8	4.1	13.9	3.4	3.9	12.3	6.6	9.2	13.9
NOEC	1.6	1.6	3.1	1.6	1.6	6.3	1.6	1.6	6.3	3.1	6.3	6.3
LOEC	3.1	3.1	6.3	3.1	3.1	12.5	3.1	3.1	12.5	6.3	12.5	12.5
Test Species	Chronic Toxicity			Chronic Toxicity			Acute Toxicity			Chronic Toxicity		
	72-hr marine algal growth test			72-hr macroalgal germination success test			96-hr fish imbalance toxicity test			7-day fish imbalance and biomass toxicity test		
Date	25-Sep	2-Oct	10-Oct	25-Sep	2-Oct	10-Oct	25-Sep	2-Oct	10-Oct	25-Sep	2-Oct	10-Oct
EC10	(IC10) 3.7	2	12.3	7.9	13.3	12.7	2.1	4.1	4.8	(unaffected) 2.7/ (biomass) 1.7	4.1/ 3.2	6.6/ 3.1
EC50	(IC50) 6	4	19	15.6	17.6	17.3	3.5	6.1	7.2	(unaffected) 3.2/ (biomass) 3.1	4.5/ 4.6	8.6/ 8.7
NOEC	3.1	1.6	12.5	6.3	12.5	6.3	1.6	6.3	3.1	1.6	3.1	6.3/3.1
LOEC	6.3	3.1	25	12.5	25	12	3.1	12.5	6.3	3.1	6.3	12.5/6.3

Note: *EC 10 - PFW proportion for 10% of test species impacted*
EC 50 - PFW proportion 50% of test species impacted
NOEC - PFW proportion for No Observable Effect Concentration
LOEC - PFW proportion for Lowest Observable Effect Concentration
Cells highlighted in green indicate the lowest NOEC dilution ratio

PFW Discharge Plume ('Mixing Zone') Modelling

The discharge of PFW at 45 m below sea level (and 35 m above the seabed) results in the PFW mixing in the water column. The degree of mixing depends on the sea currents (speed and direction of movement) at the time and relative densities and temperatures of the PFW and seawater. The mixture of PFW and seawater is known as a plume. A mixing zone is an accepted mechanism for delineating the area of impact to the marine environment from a point source of pollution.

In order to assess the extent of the plume and the dilution of PFW, hydrodynamic modelling is undertaken. A mixing zone is an accepted mechanism for describing the extent of a plume through its impact on the marine environment. The boundary of the 'mixing zone' is often defined by the use of ANZG DGV's at the species protection levels defined in the Victorian State Environment Protection Policy (Waters). For these marine waters, the SEPP requires a 99% protection level. For this study, a range will be provided by including the worst case ANZG DGV dilution results (TRH in Table 7.7) to the higher confidence NOEC dilution (Table 7.12), which is a more stringent criteria and a more relevant site-specific criteria because it is based on the WET testing rather than single constituents with the PFW stream.

Therefore, the purpose of the plume modelling is to define the impact and the plume through establishing locations and the associated dilutions of PFW that are occurring. Because modelling is a predictive tool, Beach also proposes to undertake an additional PFW plume monitoring program to verify and confirm the plume modelling results.

Origin (the then operator of the BassGas Development) commissioned RPS to undertaken PFW plume modelling in 2017. This modelling has been repeated in 2020 to account for up to 5,400 dilutions of TRH. The following description of the plume modelling methodology was extracted from the RPS plume modelling reports (2017; 2020).

Mixing Zone Modelling Methodology

The modelling study was carried out by firstly generating a high-resolution vertical current profile for the study area, which included the combined influence of ocean and tidal currents. Secondly, the vertical profiles for typical seasonal salinity and temperature profiles were obtained from the World Ocean Atlas.

Finally, a near-field discharge model (CORMIX) was used to assess the rate of dilution (defined as the ratio of the initial concentration (at the discharge port) to the concentration at a given location based on the centreline of the plume) of the plume under static low and high current speeds for each of the three model scenarios under summer and winter conditions.

To accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining deep ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with surface tidal currents developed by RPS.

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified by comparison to field measurements throughout the world over the past 32 years (Isaji & Spaulding, 1984; Isaji *et al.*, 2001; Zigic *et al.*, 2003). HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) pollutant spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA.

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of particular interest to a study. The numerical solution methodology follows that of Davies (1977a;b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji & Spaulding (1984) and Isaji et al (2001).

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 8.0) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K2, S2, M2, N2, K1, P1, O1 and Q1. Using the tidal data, time series surface heights were calculated along the open boundaries for the simulation period.

The Topex-Poseidon satellite data has a resolution of 0.25 degrees globally, with higher resolution in coastal regions, and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The data capturing satellites, equipped with two altimeters capable of taking sea level measurements accurate to less than ± 5 cm, measured oceanic surface elevations (and the resultant tides) for the period 1992–2005. In total, these satellites carried out 62,000 orbits of the planet. The Topex-Poseidon tidal data has been widely reported amongst the oceanographic community, being included in more than 2,100 research publications (e.g., Andersen, 1995; Ludicone *et al.*, 1998; Matsumoto *et al.*, 2000; Kostianoy *et al.*, 2003; Yaremchuk & Tangdong, 2004; Qiu & Chen, 2010). The Topex/Poseidon tidal data is considered suitably accurate for this study. To ensure that tidal predictions were accurate, predicted surface elevations were compared to data from five locations situated within the study area.

Data describing the flow of ocean currents was obtained from HYCOM, which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet *et al.*, 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of once per day. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain following coordinate in shallow coastal regions, and to level coordinates in the mixed layer and/or unstratified seas. For this study, the HYCOM hindcast currents were used.

The near-field mixing and dispersion of the operational discharge was simulated using the fully three-dimensional flow model in CORMIX. CORMIX is a mixing zone model and decision support system for EIA of regulatory mixing zones. CORMIX contains a series of elements for the analysis and design of conventional or toxic, single or multi-port, submerged or surface, buoyant or non-buoyant, pollutant discharges into stratified or unstratified watercourses, with emphasis on the geometry and dilution characteristics on the initial mixing zone (Doneker, 1990; Jirka & Doneker, 1991). CORMIX has been validated in many independent studies over the years. A list of some of these studies is provided on the CORMIX website (http://www.cormix.info/validations.php).

Yolla-A Mixing Zone Modelling Results

The current discharge rate for the Yolla-A is around 150-160 m^3/day, with a maximum discharge rate of 300 m^3/day due to equipment and design constraints.

In both the 2017 and 2020 PFW plume modelling reports, RPS modelled a range of flow rates (100 m^3/day [design case], 200 m^3/day [typical] and 300 m^3/day [maximum]) and a range of sea current conditions. The reports are included as **Appendix 9** and **Appendix 10**. The predicted dilutions of the PFW plume for each design case are summarised in Table 7.13.

The distances from the discharge point to achieve selected dilutions, based on the WET testing and PFW plume dispersion modelling, are presented in Table 7.14 and Table 7.15. These demonstrate that the mixing zone as defined by the NOEC (determined by the high reliability WET testing methodology) is in the range of 1.5 - 7.3 m from the discharge point across a range of flow rates and ocean currents, and ranges up to a distance of 490 – 693 m based on the worst case (low reliability) single DGV 99% species protection factor (see Table 7.7).

Table 7.13. Distance from discharge point (m) to achieve the required dilutions at a range of seawater current conditions (5th to 95th percentile)

		WET testing		Single constituent
PFW discharge rate	PFW (%)	NOEC (1.6%)	LOEC (3.1%)	DGV
	Required dilution	62.5:1	32.3:1	5,400*
Typical	200 m^3/day	1.5 – 6.5 m	0.9 – 4.0 m	490 m
Maximum (worst-case)	300 m^3/day	1.5 – 7.3 m	1.0 – 4.3 m	693 m

* *Worst-case DGV, see TRH results in Table 7.7.*

Table 7.14 summarises the 2017 modelling parameters to assess average plume dilution factors at various distances from the caisson outlet. Table 7.15 presents the 2020 plume dilution modelling results.

Combining the RPS (2017) PFW plume modelling results with those of the WET testing, Figure 7.5, Figure 7.6 and Figure 7.7 illustrate the high reliability mixing zone (using the highest discharge rate of 300 m^3/day), showing that it does not extend beyond the Yolla-A 'footprint' and that the plume does not interact with the seabed. These diagrams demonstrate that the NOEC dilution occurs within a few meters of the discharge point across all conditions. This is because the WET testing (at 62:1 dilution) together with a low discharge flow (limited to a maximum of 300 m^3/day, and currently around 150-160 m^3/day) results in a very small mixing zone (no greater than 7.3 m radius).

Combining the RPS (2020) PFW discharge plume modelling results with the single highest constituent DGV dilution of 5,400 from the WET testing results in a mixing zone (low reliability mixing zone) as illustrated in Figure 7.8 (using the highest PFW discharge rate of 300 m^3/day).

Table 7.14. Dilution of PFW with distance from the discharge point (2017 modelling)

Case	Season	Current speed (percentile)	Maximum distance from discharge point to centreline dilution X:1 (m)																		
			10	20	30	40	50	60	70	80	90	100	200	300	400	500	600	700	800	900	1,000
Case 1 - Design Operation (100 m³/ day)	Summer	5th	0.2	0.4	0.6	0.7	0.9	1.0	1.1	1.3	1.4	1.5	2.7	3.7	4.6	5.4	6.2	7.0	7.8	8.5	9.2
		95th	1.2	2.2	3.0	3.6	4.2	4.8	5.3	5.8	6.3	6.7	11.0	14.9	18.4	21.8	25.1	28.4	31.6	34.8	38.0
	Winter	5th	0.2	0.4	0.6	0.7	0.9	1.0	1.1	1.2	1.4	1.5	2.6	3.6	4.5	5.3	6.1	6.8	7.6	8.3	9.0
		95th	1.2	2.2	3.0	3.6	4.2	4.7	5.2	5.7	6.2	6.7	10.9	14.6	18.0	21.2	24.3	27.3	30.1	32.9	35.6
Case 2 - Typical Operation (200 m³/ day)	Summer	5th	0.3	0.5	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	3.8	5.3	6.6	7.9	9.1	10.2	11.2	12.3	13.3
		95th	1.4	2.6	3.6	4.5	5.4	6.2	6.9	7.7	8.4	9.1	15.4	21.1	26.5	31.8	37.1	42.5	48.1	53.9	59.9
	Winter	5th	0.3	0.5	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.1	3.7	5.2	6.5	7.7	8.9	10.0	11.1	12.2	13.2
		95th	1.4	2.6	3.6	4.5	5.3	6.1	6.8	7.6	8.3	9.0	15.1	20.5	25.5	30.2	34.7	39.0	43.2	47.2	51.2
Case 3 - Worst Case Operation (300 m³/ day)	Summer	5th	0.3	0.6	0.9	1.1	1.4	1.6	1.8	2.1	2.3	2.5	4.4	6.1	7.6	9.0	10.4	11.6	12.9	14.0	15.1
		95th	1.5	2.9	4.0	5.0	6.0	6.9	7.7	8.6	9.4	10.2	17.5	24.1	30.5	36.8	43.3	49.9	56.7	63.5	70.3
	Winter	5th	0.3	0.6	0.9	1.1	1.4	1.6	1.8	2.0	2.2	2.4	4.3	5.9	7.4	8.9	10.2	11.5	12.8	14.1	15.4
		95th	1.5	2.8	3.9	4.9	5.9	6.8	7.6	8.5	9.3	10.1	17.1	23.2	28.9	34.4	39.5	44.5	49.3	54.0	58.6

Table 7.15. Maximum horizontal distance from the discharge point (metres) to varying PFW dilutions (1:x) for each case (2020 modelling)

Dilution	Case 1 - Design Operation (100 m^3/ day)	Case 2 - Typical Operation (200 m^3/ day)	Case 3 - Worst Case Operation (300 m^3/ day)
60	<5 m	<5 m	<5 m
62.5^	<5 m	<5 m	<5 m
70	<5 m	<5 m	26
80	<5 m	<5 m	26
90	<5 m	<5 m	26
100	<5 m	26	26
200	39	64	64
300	39	64	64
400	64	64	64
500	69	64	64
600	69	64	64
700	69	64	114
800	69	64	114
900	69	64	118
1,000	69	73	121
3,482.4*	133	295	485
5,400*	292	490	693

^ Represents the NOEC of 1.6% (see WET testing results in Table 7.12).

* *See TRH >C10-C40 (total) results in Table 7.7.*

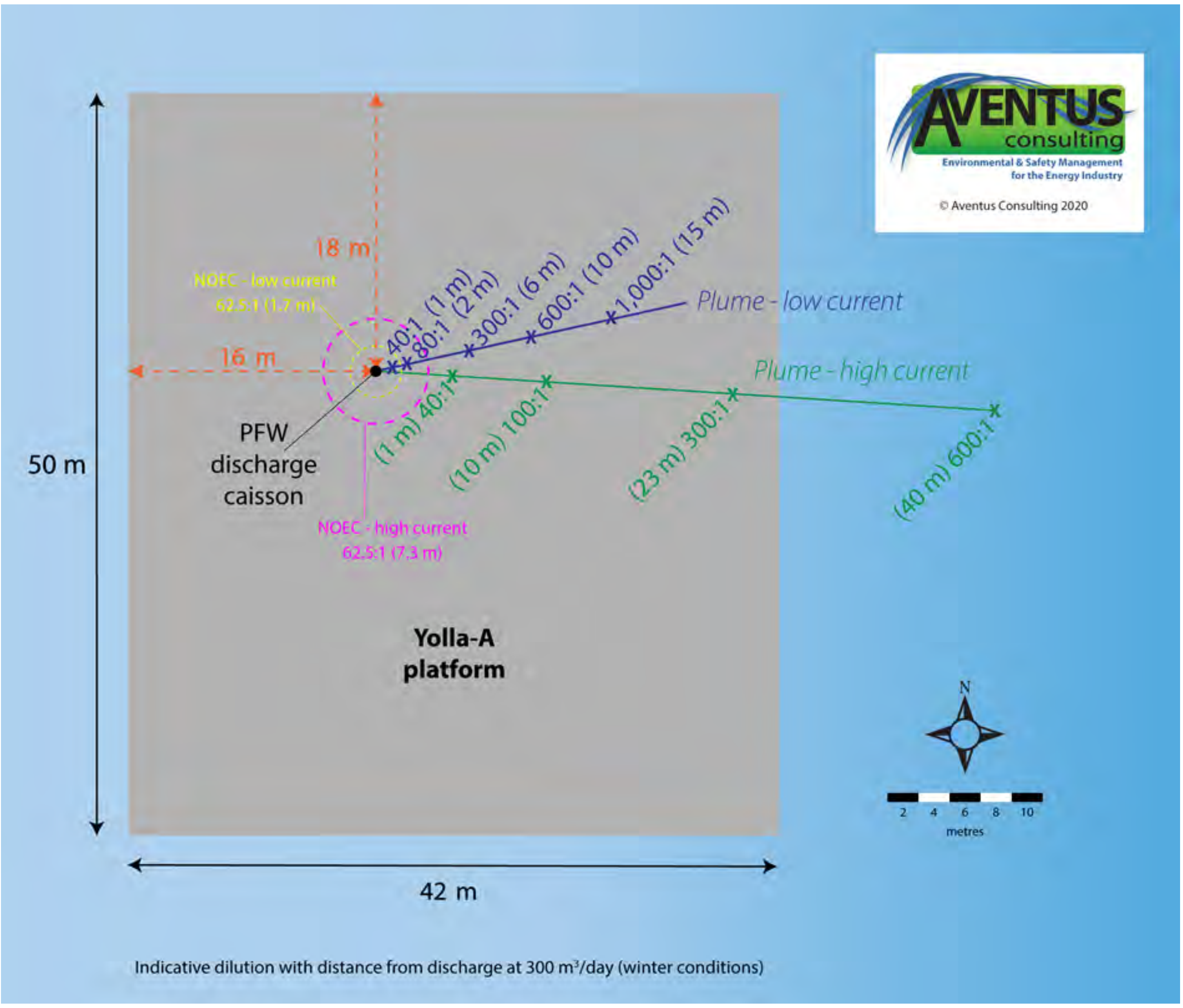


Figure 7.5. Plan view of Yolla-A showing plume direction, extent and dilutions for the maximum PFW discharge rate of 300 m^3/day under winter conditions

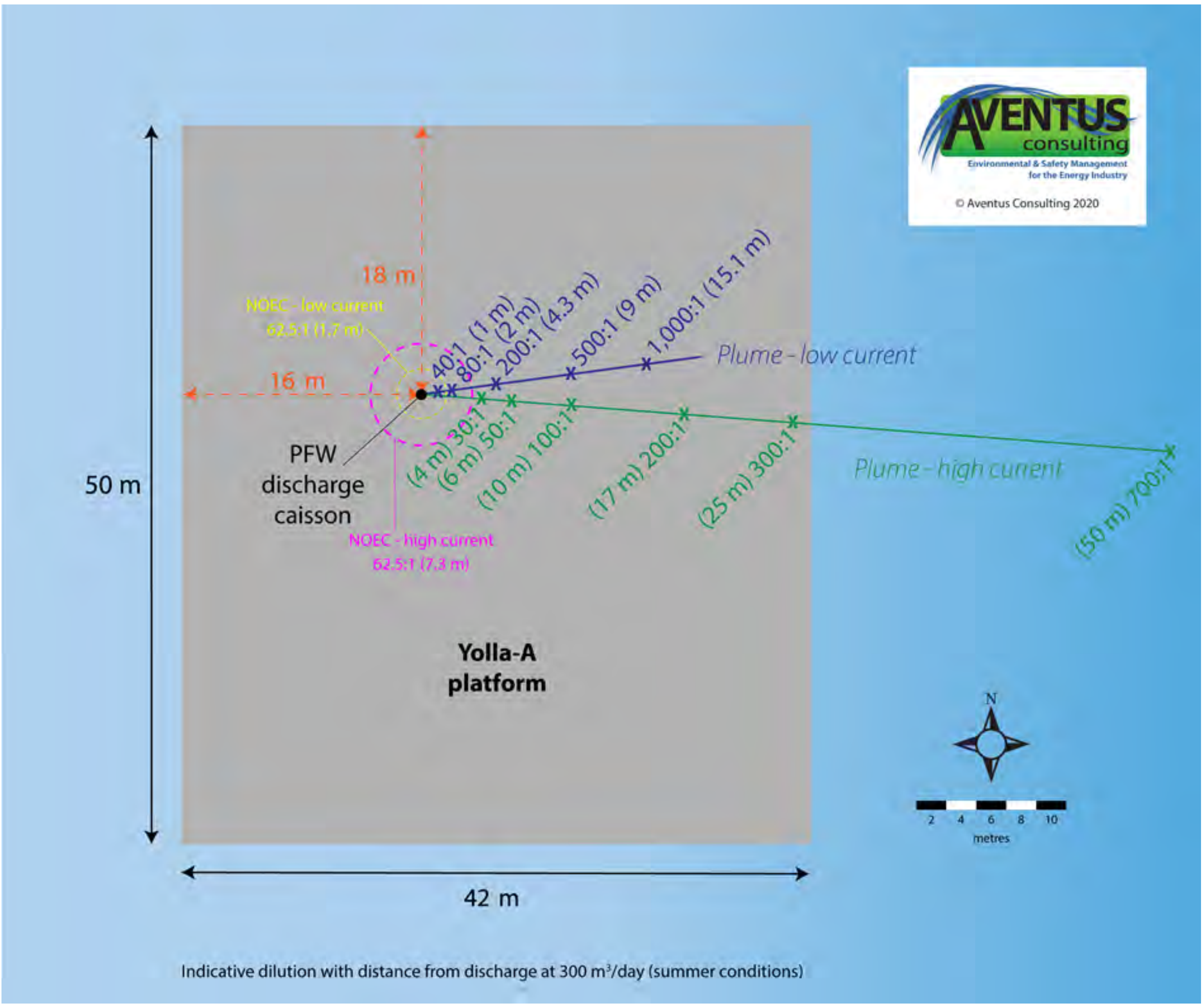


Figure 7.6. Plan view of Yolla-A showing plume direction, extent and dilutions for the maximum PFW discharge rate of 300 m^3/day under summer conditions

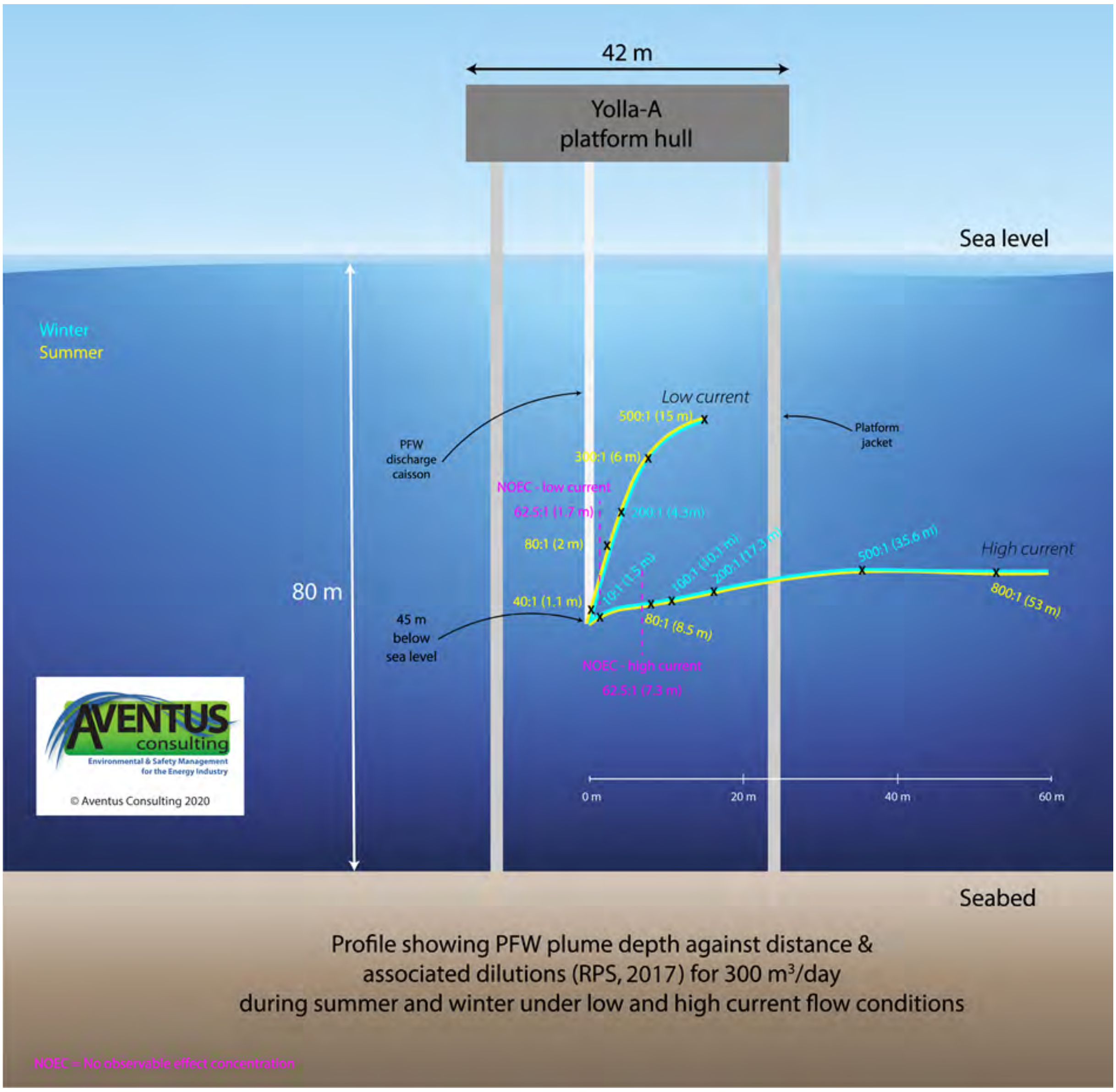


Figure 7.7. Profile view (from south) of Yolla-A showing plume direction, extent and dilutions for the maximum discharge rate of 300 m^3/day (summer and winter conditions) with high (95 percentile) and low (5 percentile) current flows

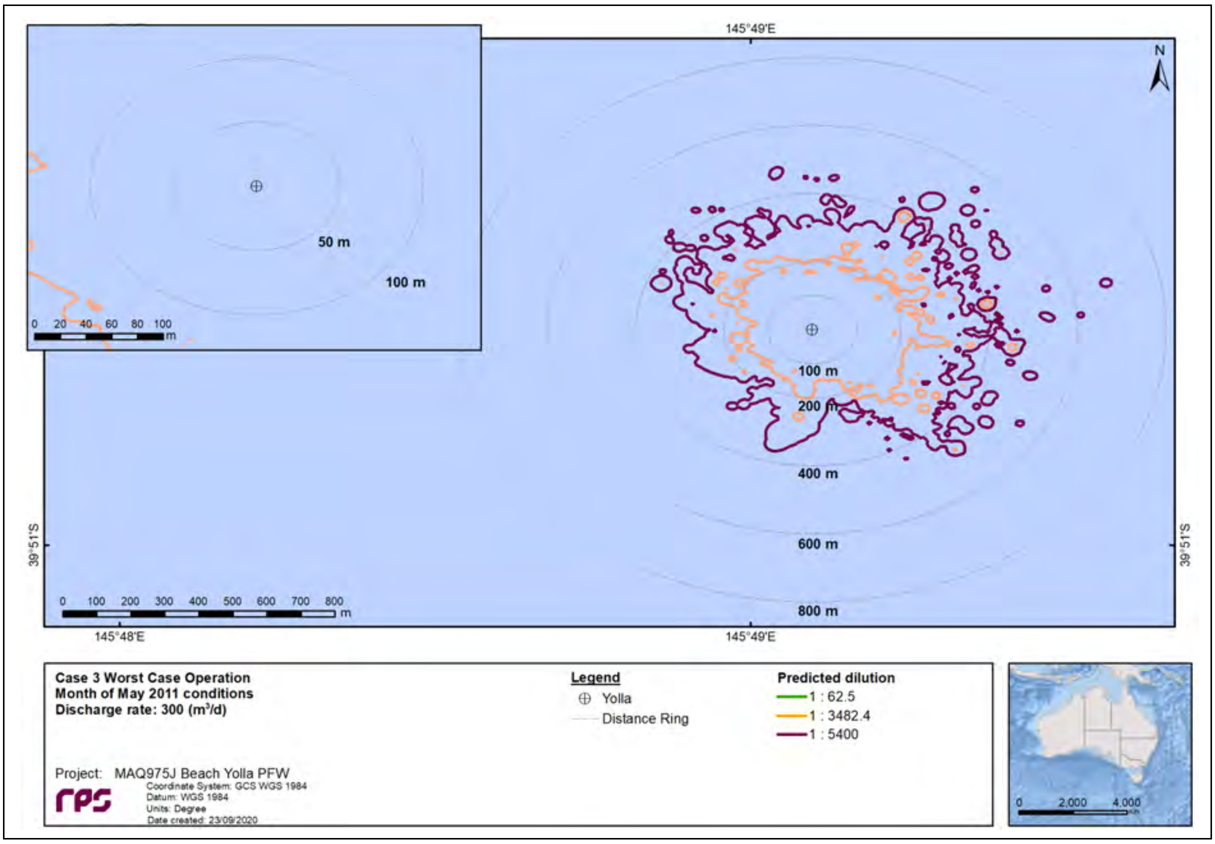


Figure 7.8. Predicted zones of dilution for the whole PFW stream up to a 1:5,400 dilution based on a flow rate of 300 m^3/day over 31 days during May conditions (representing least energetic month for water currents)

The PFW dispersion modelling is based on an assessment of ocean current speed and direction. The RPS reports (2017 & 2020) indicates that the predominant current direction is easterly throughout the year. RPS modelled a low current flow and a high current flow condition for summer and winter conditions. In order to take a conservative approach, the maximum discharge of 300 m^3/day was assessed. The discharge rate is around 150-160 m^3/day (as at mid-2020), so the extent of the modelled plume is very conservative.

The RPS modelling found that for low currents in summer and winter, the plume rises within 20-30 m of the discharge point, whereas for high currents in summer and winter, the plume does not rise significantly. These patterns are due to the relative temperatures of the plume together with the speed of the current (e.g., at low summer flows the plume is relatively warmer than the seawater and hence rises).

Figures 7.5 to 7.7 (and Table 7.14 and Table 7.15) illustrate that the high reliability NOEC dilution occurs within a few meters of the discharge point across all conditions. This is because the WET testing (at 62:1 dilution) together with a low discharge flow (limited to a maximum of 300 m^3/day, and currently around 150-160 m^3/day) results in a very small mixing zone (no greater than 7.3 m radius). The low reliability single constituent dilution modelling indicates a worst-case mixing zone extending to 693 m from the discharge point (Figure 7.8) using the same discharge rate of 300 m^3/day.

The extent of the PFW plume will be confirmed through a plume verification sampling program scheduled to take place in late 2020.

Overall, the results of the 2019 WET testing, combined with the 2017 and 2020 plume dispersion modelling results, show that:

- At TPH levels up to 127 mg/L, the NOEC is predicted to range between a high reliability distance of 1.5 m to 7.3 m out to a low reliability distance of 693 m from the discharge point;

- The sample point is conservative in that the PFW is discharged via a caisson in which there should be some improvement on PFW quality prior to its entry to the receiving environment;
- The use of ANZG 99% DGVs over-predicts the potential impacts from the PFW when looking at single constituents (low reliability) and the actual WET testing results (high reliability) require a much smaller dilution to confirm the NOEC; and
- The discharge mixing zone can be conservatively defined with high confidence by the NOEC of 1.6% (i.e., a dilution of 62.5 to one) and with a lower and extremely conservative worst-case single constituent ANZ DGV dilution of 5,400 (for TRH, see Table 7.8).

7.6.2 Known and potential environmental impacts

The known and potential environmental impacts of Yolla-A PFW discharges are:

- Temporary and highly localised decrease in water quality around the discharge point;
- Potential toxicity to sensitive biota within the mixing zone; and
- Potential changes to seabed sediment quality around the facility.

7.6.3 EMBA

The EMBA (or mixing zone) for this impact is modelled to be a range of 7.3 m (high reliability based on WET testing) to 693 m (low reliability based on single constituent worst case ANZG DGVs) from the discharge location. From here on in, this mixing zone range is referred to simply as the mixing zone.

7.6.4 Jurisdiction of hazard

The jurisdiction for this hazard is outlined in the box below.

Commonwealth waters	Victorian waters
Yes	No
PFW discharge only occurs from the platform, which is located in Commonwealth waters. The PFW EMBA does not extend into Victoria waters.	

7.6.5 Evaluation of Environmental Impacts

PFW is a chemically complex mixture, and the potential toxicants that it contains (e.g., PAHs) have been the subject of significant scientific study. The need for the assessment of potential environmental impacts from PFW is summarised by Lee et al (2005). Where marine species have been exposed to low concentrations of PFW, chronic and acute toxicity responses and sub-lethal deleterious effects have been observed, including:

- Evidence of bioaccumulation showed that PAHs, trace metals and radium were taken up by oysters (*Crassostrea virginiea*) near PFW discharge points (Neff *et al.*, 1992);
- Chronic toxic responses have been observed in clams (*Donax faba*) exposed to PFW concentrations as low as 0.08 ppm (Din & Abu, 1992);
- Detrimental effects from exposure to PFW on the reproductive success and development of early life stages has been observed in sea urchins (Krause *et al.*, 1992; Krause, 1994) and fish larvae/juvenile stages (Brown *et al.*, 1998; Hinkle-Conn *et al.*, 1998); and
- The distribution and abundance of benthic infauna communities has also been observed to change with distance from the release point of PFW discharges (Rabalais *et al.*, 1992; Osenberg *et al.*, 1992).

The potential for these effects varies according to multiple factors, including PFW composition, discharge volume, plume dilution/dispersion rate, bioavailability of constituents, duration of exposure to biota and marine species physiology and behaviour.

Therefore for the Yolla PFW discharge stream, such impacts are likely to be observed to fauna contained within the mixing zone. It requires that marine species remain in that area for an extended amount of time (at least 96 hours for acute impacts and up to 7 days for chronic effects, depending on species) to be realised.

<u>Impacts to Water Quality</u>

Impacts to ocean water quality from PFW discharges are generally limited because PFW weathers rapidly upon discharge into well-mixed oceanic waters (OGP, 2002; 2005). The most important weathering changes that affect the fate and therefore the effects of the elements within PFW are dilution, evaporation/volatilisation, adsorption/ precipitation, biodegradation and photooxidation (OGP, 2005). These processes reduce the concentrations of PFW compounds in the ocean and thereby reduce their toxicity to marine organisms (OGP, 2005). Oxygen demand of PFW is generally not a concern (OGP, 2005), and the salt concentration of PFW is generally within the same range as seawater (Neff *et al*., 2011).

The six-monthly Yolla PFW characterisation testing (undertaken since mid-2018) provides the following results for physical indicators:

- Conductivity (at 25°C) - ranges between 21,000 and 31,000 mS/cm.
    - This compares with a global ocean average of 33,100 ± 2,300 mS/cm. This means that the conductivity (salinity) of the PFW discharge varies between brackish and the same as the ocean; indicating a negligible potential for impacts on marine species within the mixing zone.
- pH (at 25°C) - ranges between 6.2 and 7.1 (with 7 being a neutral pH).
    - This compares to typical seawater pH of 8.2, meaning the PFW discharge is slightly more acidic than the surrounding seawater. Ocean acidification may impact on marine species such as molluscs that make hard shells and skeletons by combining calcium and carbonate from seawater (the increased pH reduces the ability of carbonate in the water to combine with hydrogen in the water to form calcium carbonate structures, such as shells) (NOAA, 2020). Some fish species may have a reduced ability to detect predators or find habitat in waters with a low pH, which may in turn affect the rest of the food web (NOAA, 2020). The pH of the seawater around Yolla-A is likely to rapidly return to background levels given the well mixed nature of the receiving waters.
- Total phosphate - averages 0.03 mg/L.
    - This compares with an average of 0.01 mg/L in seawater. This means that the nutrient level in the PFW discharge plume is up to three times higher than the surrounding seawater. In still, unmixed waters, this can result in eutrophication (reduction of dissolved oxygen through the promotion of growth of oxygen-consuming algae) and the death of marine life trapped in the low oxygen plume. In the well mixed waters around Yolla-A, such impacts do not occur, with turbulent mixing within the discharge caisson, and water currents in the receiving waters rapidly oxygenating the discharge.
- Total nitrogen - ranges between 27 and 51 mg/L. This compares with approximately 0.5 mg/L in seawater.
    - This means that the nutrient level in the PFW discharge plume is substantially higher than the surrounding seawater, with the potential effects of this similar to that of elevated phosphate. Turbulent mixing and water currents will rapidly oxygenate the discharge and prevent eutrophication from occurring.
- Total suspended solids (TSS) - range between 2 and 29 mg/L. This compares with TSS concentrations ranging from 0.8 to 13 mg/L in Australian waters.

- The TSS concentrations of the PFW discharge are within, and sometimes higher than the general range of natural oceanic TSS concentrations. TSS concentrations between 10 and 1,830 mg/L are considered a 'low exposure' level (sub-lethal effects on pelagic fauna) for the purposes of modelling the dispersion and fate of drill cuttings and muds (Nelson *et al.*., 2016). Concentrations above 1,830 mg/L are used to define high exposure that would result in mortality of pelagic fauna (IOGP, 2016).

- Such increases in suspended solids could potentially impair the ability of marine fauna to find prey or detect predators, and clog fish gills, but is in the lower range of the low exposure level (noted above). In the well mixed waters around Yolla-A, suspended solids are rapidly dispersed and diluted into the water column, meaning such impacts are highly unlikely to occur.

This data indicates that the quality of the Yolla PFW discharge, as expected, differs from that of typical seawater. The PFW rapidly dilutes and disperses upon discharge, and it is expected that changes to water quality within the mixing zone would have negligible potential to affect fauna moving in and out of the PFW plume.

<u>Impacts to Marine Life</u>

Neff et al (2011) states the following with regard to the effects of PFW discharges in the water column:

- Harmful biological effects to biological communities in the water-column in the open ocean are expected to be minimal and localised because of the rapid dilution, dispersion, and transformation rates of most chemicals in the PFW.
- Some produced waters contain chemicals that are highly toxic to sensitive marine species, even at low concentrations.
- When the PFW discharge is of a low-density in an area with low water turbulence and current speeds, concentrations of PFW chemicals may remain high for long enough to cause ecological harm (noting this is not the case for the Yolla-A location).
- The chemicals of greatest environmental concern in produced water, because their concentrations may be high enough to cause bioaccumulation and toxicity include aromatic hydrocarbons (including BTEX), some alkylphenols, and a few metals.
- Most metals and naturally occurring radionuclides are present in PFW in chemically reactive dissolved forms at concentrations similar to or only slightly higher than concentrations in seawater and, therefore, are unlikely to cause adverse effects in the receiving water environment.
- Inorganic ions (e.g., sodium, potassium, calcium, and chloride) are not of concern in PFW discharges to the ocean.
- There is a limited potential for acute toxicity to marine life beyond the immediate vicinity of PFW discharges, though continual chronic exposure may cause sub-lethal changes in populations and communities.

Most concern about impacts to marine life from PFW discharges are related to the impacts of petroleum hydrocarbons (monoaromatic hydrocarbons [BTEX] and PAH) and trace metals, which are discussed in general here.

Monoaromatic Hydrocarbons - BTEX

The most abundant hydrocarbons in PFW are the low molecular weight mono-aromatic hydrocarbons (MAH) benzene, toluene, ethylbenzene, and xylenes (collectively referred to as BTEX) and low molecular weight saturated hydrocarbons (Neff *et al.*, 2011). BTEX are extremely volatile and are lost rapidly during initial mixing of the plume in the ocean (Terrens & Tait, 1996). OGP (2005) states that BTEX do not persist in the seawater and are not accumulated to any degree by marine organisms. AECOM (2019) report the following impacts for the individual BTEX constituents:

- Benzene – The potential for benzene to bioconcentrate in aquatic organisms (intake and retention of a substance in an organism entirely by respiration from water) is considered to be low. It also has a low tendency to bioaccumulate, so it is not considered likely to biomagnify though food chains. It has high volatility and relatively low water solubility and is rapidly lost to the atmosphere from water. Biodegradation varies with season but is considered by ANZG (2018) to be rapid.
- Ethylbenzene – the acute toxicity of ethylbenzene to marine algae, invertebrates and fish is rated as 'moderate' by Toxnet (2017); there are no data reported for chronic toxicity. The potential for bioconcentration in aquatic organisms is considered low and ethylbenzene is considered to be volatile and inherently biodegradable in water under aerobic conditions.
- Toluene – algae seem to be more resistant to the acute effects of toluene than fish and crustaceans. Bioaccumulation in marine organisms has been found to be low, and depuration rates high. Bioconcentration in aquatic organisms is considered to be low to moderate. Toluene has high volatility and relatively low water solubility and is rapidly lost to the atmosphere from water (ANZG, 2018). Complete degradation has been observed over periods of four days (summer) and 22 days (spring) in a marine mesocosm (outdoor controlled experiment).
- Xylenes – meta-, para- and ortho-xylenes are chemical isomers, with similar physicochemical properties and moderate to low toxicity. They are inherently biodegradable under aerobic conditions and their bioaccumulation and bioconcentration potentials are considered to be relatively low (OECD, 2003; Ogata *et al*., 1984).

Within the mixing zone, the points noted above indicate that BTEX will biodegrade rapidly and therefore present a negligible risk of toxic impacts to marine life, especially because there is limited resident/site-attached fauna in the mixing zone, with species such as fish and seals typically moving in and out of the plume and an absence of specialised habitat (such as canyons, rocky reefs, volcanic mounts, kelp forests, etc) that would act as specialised habitat for marine fauna. Impacts to various fauna groups are discussed in more detail in the following sections.

Polycyclic Aromatic Hydrocarbons

PAHs comprise a large group of compounds (with two or more fused aromatic rings) that are relatively insoluble, with the potential for bioaccumulation increasing with molecular weight (OGP, 2005). Naphthalene and phenanthrene are generally the key PAH compounds (with naphthalene being the key component of the Yolla PFW stream, see Table 7.7). Naphthalenes are characterised by moderate aqueous solubility and lower bioaccumulation potential than PAHs with three rings or more. As such, they represent a low risk of effects in the environment (OGP, 2005). Fish can metabolise PAH rapidly (OGP, 2005), further reducing the potential for impacts to marine life.

Marine biota can take up PAH via a number of routes, including dermal absorption, inhalation and consumption of contaminated prey or sediment. However, the persistence of these compounds in tissues and body fluids of exposed marine organisms varies depending upon the rates of uptake, metabolism and elimination (AECOM, 2020). Fish exposed to PAHs may exhibit an array of toxic effects including genetic damage, morphological deformities, altered growth and development, decreased body size, inhibited swimming abilities and mortality (AECOM, 2020). Vertebrates, such as fish and marine mammals, quickly metabolise PAH into more polar forms that are then excreted into urine or secreted into bile for rapid elimination via faeces (AECOM, 2020).

OGP (2002) reports that a number of toxicity mechanisms have been linked to PAH, including non-polar narcosis, phototoxicity, biochemical activation that, in turn, may result in mutagenicity, carcinogenicity and teratogenicity. Some PAHs may also have influence on hormone regulation (endocrine disruption). OGP (2002) states that the extent of exposure to PAH and potential toxicity resulting from this exposure is considered low based on studies of fish and shellfish living in their natural environment near PFW discharges that did not accumulate PAH to an environmentally significant extent.

Metals

The Yolla reservoir fluids contain mercury and some of this is entrained within the PFW. A filter removes suspended mercury compounds from the water discharged to the ocean. The filter substrate is periodically changed and the waste material collected is brought onshore for disposal by a licensed waste management contractor. No particulate mercury is discharged to sea.

Mercury preferentially remains in either the gas or condensate streams. Dissolved mercury may however also be present in the PFW at levels up to saturation (i.e., 50 µg/L) at process operating conditions. Saturation levels of mercury increase with increasing temperature. Actual recorded mercury levels in 2008 were between 3 µg/L and 8 µg/L (Intertek produced water analysis, October 2008), while another six test results from 2014-2017 show mercury concentrations in the range of 1.2 µg/L to 29 µg/L. This level of mercury will remain in the PFW discharged into the dump caisson. Since mid-2018, the six monthly PFW characterisation tests show mercury concentrations to be under 0.006 mg/L (6 µg/L) (see Table 7.7), which is lower than the ANZG (2018) 99% species protection level if there are no data to allow for adjustment for bioaccumulation at the specific site. OGP (2005) reports that although trace metal concentrations in PFW are significantly higher than concentrations in seawater, these concentrations rapidly attenuate in the ocean by dilution and other physiochemical reactions such that they pose little risk to the receiving environment. ANZG (2018) notes that mercury in marine waters is not as toxic as some other metals and that mercury concentrations in most surface waters are too low to cause any direct toxic effects to adult fish or sensitive juvenile fish.

Sediment sampling planned to take place in late 2020 within the PFW mixing zone will provide details on the level of mercury in the seabed sediments. Results from the sampling program will feed into the AMF (see later discussion).

Acknowledging Uncertainties in Modelling Thresholds for Impacts to Marine Life

When discussing toxicity impacts to marine fauna, it is important to note the difference in modelling thresholds used for predicting effects between hydrocarbons in the PFW stream and hydrocarbons from a release of gas condensate or MDO.

In Sections 7.15, 7.16 and 7.17 of this EP, the impacts of a hydrocarbon release from a LoWC, LoC from the RGP and an MDO spill are assessed. The modelling threshold used for hydrocarbons dissolved in the water column that impart potentially toxic effects or sub-lethal effects to marine life is 500 ppb (0.05 ppm) (the 'moderate' threshold). The modelling threshold used for hydrocarbons dissolved in the water column that impart toxic effects, including lethal effects, is 400 ppb (0.4 ppm) (the 'high' threshold). These are generally based on exposure tests to invertebrates, fish and their larvae over four days (the 96-hour LC50 test).

These modelling thresholds obviously vary from that used for the PFW assessment (which uses TPH of 127 mg/L, equivalent to 127 ppm or 127,000 ppb or 0.0127%). That is, the modelling thresholds used for predicting the effects to marine life from an oil spill are significantly less than those that may be used for modelling the predicted effects from PFW discharge. This is due to several factors:

- PFW is treated via the production separator, produced water degasser and filter to remove the hydrocarbon content prior to discharge;
- Hydrocarbons in the PFW stream are already substantially diluted at the time of discharge; and
- Each gas and oil field is unique in terms of hydrocarbon composition, so toxicity testing must be undertaken to determine the impacts of its discharge within a PFW stream, as opposed to thresholds used for modelling the fate of oil spills, which use generic global averages that build in a level of conservativeness (especially for light condensates such as at Yolla).

Additionally, OSPAR has published a predicted no effect concentration (PNEC) for PFW, which accounts for the dispersed fractions of oil (representative of entrained oil droplets). The OSPAR PNEC is 70 ppb (and is based on biomarker and whole organism testing to total hydrocarbons (effectively the same as TPH) by Smit et al (2009)).

This PNEC represents a long-term chronic exposure level from continuous point source discharges in the North Sea. The chronic effect concentrations examined in Smit et al (2009) are based on effects ranging from oxidative stress and DNA damage to impacts on growth, reproduction and survival. An acute toxicity threshold of 700 ppb was extrapolated from the effect concentrations examined in Smit et al. (2009).

Both of these thresholds are significantly lower than the 127,000 ppb (0.0127%) TPH as determined from the WET testing undertaken for this study. This is likely to be because the OSPAR PNEC is based on organisms living in the North Sea (rather than southern Australian waters, as is appropriate for this study), and because the nature of the hydrocarbons used for the OSPAR study may vary from the Yolla field, which has a high component of dissolved hydrocarbons (BTEX) compared to dispersed hydrocarbons (OIW).

The values for PNEC have been developed using toxicity results together with a factor of safety (10-1,000) (e.g., see Table 6 of *Aromatics in produced water: occurrence, fate & effects, and treatment*, OGP 324-2002). They are chemical species-specific and do not take into account antagonistic or synergistic effects.

The approach in assessing the impacts of the PFW discharge is in line with the approach recommended in the *Risk Based approach to Assessment of Offshore Produced Water Discharges* (IOGP Report 633, September 2020). In particular, it states that in some specific cases, if there is confidence that the tested species is a representative sensitive species and that the executed test represents conservative exposure (e.g., 7-day chronic protocol), the NOEC from a WET test can be directly applied as the toxicity threshold. In this case, representative species have been used in the WET testing and tests included a 7-day protocol, thereby validating the approach taken.

Six-monthly WET testing (in 2021) and plume verification monitoring will be conducted to validate the results.

Potential toxicity to fish

Impacts of hydrocarbons to fish are principally via movement of water across the gills and ingestion of prey species who have been similarly exposed.

Research. Meier et al (2010) exposed Atlantic cod (*Gadus morhua*) to PFW in in the North Sea during the embryonic, early larval or early juvenile stage (embryonic to 6 months of age). The study found that alkylphenols bioconcentrated in fish tissue based on dose and developmental stage during PFW exposure. PFW exposure had no effect on embryo survival or hatching process. However, a 1% PFW concentration (but not 0.1% or 0.01%) interfered with development of normal larval pigmentation. Post-hatching, most larvae exposed to 1% PFW developed jaw deformities and failed to begin feeding and subsequently died of starvation. Cod exposed to 1% PFW concentrations had significantly higher levels of the biomarkers vitellagenin and CYP1A in plasma and liver respectively.

Although the Meier et al (2010) study exposed early life stage fish to PFW from a North Sea oil platform (as opposed to an Australian gas/condensate platform), it does demonstrate the potentially deleterious impact of the complex mixture on the early life stages of fish. More recently, using the same fish species, observations by Hansen et al (2019) on the exposure of Atlantic cod embryos to PFW are similar to those described above. After conducting a four-day exposure to PFW extracts equivalent to 1:50, 1:500 and 1:5,000 times dilution, no significant reduction in survival or hatching success was observed, however hatching was initiated earlier for exposed embryos in a concentration-dependent manner. During recovery, cod embryos were observed with significantly reduced heart rates (a sign of cardiotoxicity). The exposed embryos were smaller and displayed signs of craniofacial and jaw deformations. The developing heart is considered a primary target for toxicity of crude oil compounds to early life stages of fish, whereas most other aspects are likely secondary effects caused by loss of circulation (Incardona, 2016; Grøsvik 2010).

Across controlled laboratory studies, the groups of fish exposed to the highest concentration of PFW generally exhibit the most deleterious responses in comparison to groups treated against lower concentrations in the same study. The exposed fish are typically exposed for a much longer time than would be expected in the field (e.g., four-day exposure, 76-day exposure, etc.).

Studying the effects of PFW exposure on fish species on the Australian North West Shelf, Gagnon (2011) detected elevated levels of stress proteins (HSP70) in fish species at all study locations as a proxy for exposure to PFW. However, Gagnon concluded that while the chemical characteristics of PFW are important in determining potential impacts to biota, consideration of the loading of PFW (e.g., concentration x volume) exposure is crucial in assessing environmental effects and risks of PFW discharge.

Implications for Yolla-A. Based on the WET testing toxicity laboratory analysis, any fish swimming through the PFW mixing zone for extended periods (e.g., 96 hours) would be expected to experience acute toxicity (mortality) through uptake of hydrocarbons across their gills (dissolved components) or through ingestion of hydrocarbon droplets (dispersed components). Chronic toxicity (e.g., impaired growth, imbalance) may be experienced for fish exposed to the mixing zone for a continuous period of 7 days.

Fish may experience mortality or sub-lethal effects, but only if there are no physico-chemical (as opposed to toxicant) properties of the PFW plume (such as temperature, salinity or TSS) that may discourage fish from spending prolonged periods within it. It is reasonable to assume that the proportion of the regional population of any fish species that may be adversely affected by the PFW plume will be sufficiently low as to not pose a risk of significant impacts to overall regional productivity or ecosystem function.

As seen in Photo 3.2, there is minimal fouling on the platform jacket legs in the vicinity of the caisson discharge point to attract a resident fish population (by providing a source of food and shelter). This means that fish present in the mixing zone are more likely to be wide ranging pelagic species rather than site-attached fish, meaning they are more likely to swim through the mixing zone than reside within it or spend substantial time feeding within it. Given the highly mobile nature of pelagic fish species in central Bass Strait and the very small PFW mixing zone, it is therefore expected that exposure to the mixing zone is limited to brief periods where fish move in and out of the plume. Acute and chronic toxicity impacts are not likely to arise in species whose presence in the plume is of a transitory nature and not related to foraging.

Section 5.5.7 of the EP lists and describes the threatened fish species that are known to be or may be present in the operational area and spill EMBA. Based on habitat preferences, the species likely to occur in the EMBA by PFW are the following oceanic species; great white shark (vulnerable), shortfin mako shark (migratory) and the porbeagle (migratory). Based on the impact assessment presented, the probability of PFW discharges having significant impacts to the fish species listed as MNES under the *MNES Significant Impact Guidelines 1.1* (DoE, 2013) are presented in Table 7.16.

Table 7.16. Assessment of the likelihood of significant impact to EPBC-listed fish species using the EPBC Act Significant Impact Guidelines 1.1

Is there a real chance or possibility that the PFW discharge will…*	
Vulnerable species (great white shark)	
Lead to a long-term decrease in the size of an important population of a species?	No
Reduce the area of occupancy of an important population?	No
Fragment an existing important population into two or more populations?	No
Adversely affect habitat critical to the survival of a species?	No
Disrupt the breeding cycle of an important population?	No
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	No

Is there a real chance or possibility that the PFW discharge will…*	
Introduce disease that may cause the species to decline?	No
Migratory species (shortfin mako and porbeagle sharks)	
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species?	No
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species?	No
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species?	No
Commonwealth marine environment	
Result in a known or potential pest species becoming established in the Commonwealth marine area?	No
Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results?	No
Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution?	No
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity; social amenity or human health?	No
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected?	No

* *Note – only those items under each heading relevant to the marine environment are included.*

The probability of PFW discharges having significant impacts to the fish species listed as MNES under the *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies Significant Impact Guidelines 1.2* (DSEWPC, 2013) are presented in Table 7.17 (noting that the name of this document is misleading given that it does address impacts to the ocean).

Table 7.17. The real chance or possibility of PFW discharges having impacts on EPBC-listed fish species using the EPBC Act Significant Impact Guidelines 1.2

Is there a real chance or possibility that the PFW discharge will…*	
Impacts on ocean forms, ocean processes and ocean life	
Reduce biological diversity or change species composition on reefs, seamounts or in other sensitive marine environments?	No
Alter water circulation patterns by modification of existing landforms or the addition of artificial reefs or other large structures?	No
Substantially damage or modify large areas of the seafloor or ocean habitat, such as seagrass?	No
Release oil, fuel or other toxic substances into the marine environment in sufficient quantity to kill larger marine animals or alter ecosystem processes?	No
Release large quantities of sewage or other waste into the marine environment?	No
Pollutants, chemicals and toxic substances	
Generate smoke, fumes, chemicals, nutrients, or other pollutants that will substantially reduce local air quality or water quality?	No

Is there a real chance or possibility that the PFW discharge will…*	
Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal?	No
Impacts on animals	
Cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals?	No
Displace or substantially limit the movement or dispersal of native animal populations?	No
Substantially reduce or fragment available habitat for native species?	No
Reduce or fragment available habitat for listed threatened species that is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species?	No
Introduce exotic species that will substantially reduce habitat or resources for native species?	No

* *Note – only those items under each heading relevant to the marine environment are included. These guidelines are more relevant to the terrestrial environment than marine environment.*

Fish that are commercial fisheries targets may have the potential to be impacted by the PFW discharge. Noting that no commercial fishing can take place within the PSZ (500-m radius) of the Yolla-A platform (which covers the majority of the PFW mixing zone), the commercial fisheries known to operate in the region (see Section 5.7.6 of the EP) that may target species that move through the PFW mixing zone are:

- Commonwealth-managed;
    - SESS (Shark Gillnet and Shark Hook sector) - targets mostly gummy shark, school shark, sawshark and elephant fish.
    - Southern squid jig – targets arrow squid (noting this is a cephalopod rather than a fish species).
- Victorian-managed;
    - Ocean purse seine – targets Australian salmon, sandy sprat and anchovy in nearshore waters.
- Tasmanian-managed;
    - Scalefish – targets banded morwong, tiger flathead and southern school whiting.
    - Octopus – targets pale octopus (noting this is a cephalopod rather than a fish species).

The target species in these fisheries have wide oceanic habitat ranges and are not restricted to waters occupied by the PFW plume. While these species may briefly move through the plume, they do not permanently reside within it, meaning that they will not be subject to acute or chronic toxicity impacts from exposure to the PFW. As noted previously, PAH are likely to be quickly metabolised and excreted, meaning that bioaccumulation is not likely to occur (which also means these species are safe for human consumption).

Similarly, prey species for these commercial fishing targets are diverse (benthic, demersal and pelagic) and wide-ranging and not restricted to the area occupied by the PFW plume, so it is not likely that the target fisheries species would consume enough PFW-affected prey to result in bioaccumulation impacts.

Based on this information, the impacts to fish from the PFW discharge are assessed as having a minor consequence.

Potential toxicity to fouling species

Marine biota living within a PFW plume may accumulate metals, phenols and hydrocarbons from the water or their prey living within the plume (or from seabed sediments if the plume extends to the seabed) (a process known as bioaccumulation – the uptake and retention of bioavailable chemicals in animal tissues).

Research. Indicators of bioaccumulation were studied by Neff et al (2011) by measuring four metals (arsenic, barium, cadmium, and mercury), BTEX, phenol and PAH in two species of bivalve molluscs from platform legs and five species of fish collected within 100 m of PFW-discharging and non-discharging platforms in the Gulf of Mexico. The study found that there was no difference in concentrations of any of the metals, phenols or BTEX in tissues of bivalves and fish from discharging and non-discharging platforms. However, total PAH concentrations were significantly higher in tissues of one or both species of bivalve tissues than in fish tissues (likely because of the high activity of PAH-metabolising enzymes in fish). PAH concentrations were significantly higher in one or both species of bivalve compared to the reference (non-discharging) platforms. This study demonstrates the ability of some bivalve species associated with the biofouling community of submerged structures on PFW-discharging platforms to bioaccumulate PAHs but not metals, phenol or BTEX following exposure to PFW. OGP (2002) reports that due to the rapid time (i.e., a few minutes) required for PFW discharges to dilute 1,000;1, the exposure time to aromatic hydrocarbons (BTEX) is short. This limited time for exposure to acute or chronic toxicity levels of aromatic hydrocarbons limits the potential for exposure of organisms living near the discharge (e.g., fouling species). This is supported by observations that shellfish (and fish) living near PFW discharges have not been found to accumulate aromatic compounds (OGP, 2002).

Implications for Yolla-A. Based on the WET testing toxicity laboratory analysis, fouling species such as algae and mussels may experience chronic toxicity (e.g., impaired germination or development) if exposed to the PFW plume for a continuous period of 48-72 hours (2-3 days). However, it is noted that the plume is dynamic in nature and its distribution varies in response to oceanographic conditions (swells, wind and/or tidally-driven currents, etc). Hence the only fouling biota that could potentially be exposed to the plume for a continuous period of 2-3 days would be those on the caisson itself, where other conditions (e.g., the velocity of brine flow across the surface of the caisson) may prevent their establishment.

Fouling species living in the Yolla-A PFW plume may accumulate PAHs. Photo 3.2 indicates there is a sparse fouling community (e.g., bryozoans, hydrozoans, limpets, barnacles) that has grown on the platform jacket's cross-beams near the caisson discharge point, and these may periodically be within the Yolla-A PFW plume. Given the sparse abundance of such fouling species on the jacket cross beams, it is unlikely that higher order predators (e.g., pelagic fish) consuming this food source would consume enough to induce any toxicity impacts at their own trophic level or those higher (e.g., seals, sharks).

Based on this information, the impacts to fouling species (or to higher trophic species that may prey upon them) from the PFW discharge are assessed as having a minor consequence.

Potential toxicity to plankton

Section 5.5.2 describes the planktonic assemblages known for Bass Strait.

Based on the WET testing toxicity laboratory analysis, and using the amphipod *Allorchestes compressa* as a proxy for zooplankton, plankton may experience acute toxicity if they remain exposed to the PFW plume for a continuous period of 96 hours (4 days). Using urchin larvae as a proxy for zooplankton, plankton may experience chronic toxicity (e.g., impaired development) if exposed to the PFW plume for a continuous period of 72 hours (3 days).

Plankton is generally most abundant in the upper layers of the water column (Volkman *et al.*, 2004). Plankton floating through the PFW plume with the currents are exposed to OIW and TPH concentrations that may result in lethal and sub-lethal effects. At Yolla-A, this potential is very low, given the small size of the mixing zone, the fact that the discharge and the plume is largely confined to the mid-water column (where plankton is less abundant), the open ocean environment, and that currents are constantly moving through the region (current speed around Yolla-A is predicted to range between 0.16 and 0.22 m/s, as described in Section 5.3.1). Based on the lowest predicted current (0.16 m/s) and the size of the mixing zone, individual plankton would be exposed to the plume for less than one minute. Such brief exposure to the PFW plume will therefore pose a negligible risk of acute or chronic toxicity impacts to plankton.

In this highly dispersive open ocean environment, the relative size of the potential impact area is insignificant compared to surrounding waters and any impacts to plankton on a population level are expected to have a minor consequence.

Potential toxicity to seals

As noted in Section 5.5.6, fur-seals are frequent visitors to Yolla-A, often observed resting and playing at the sea surface around the platform jacket (there is no sea deck for the seals to haul on to). They often number up to a dozen, but may sometimes be several dozen individuals. This indicates that the infrastructure may support suitable foraging habitat or may provide perceived safety from predators.

Research. This Bass Strait region is considered to be of low primary productivity (Gibbs, 1992), therefore the presence of subsea infrastructure can potentially provide valuable foraging habitat. A study conducted by Arnould et al (2015) concluded that offshore infrastructure in the Bass Strait was potentially important foraging habitat for Australian fur-seals, due to creation of fish habitat, however the study indicated that pipelines and cable routes appeared to be the most influential structures (over wells and shipwrecks), potentially providing habitat connectivity for prey species.

Stimmelmayr et al (2018) note that PAHs are metabolised efficiently by vertebrates and usually found at low concentrations in the tissues of these animals. In experiments undertaken on visibly oiled seals in Alaska (*Phoca hispida* and *P. largha*), low levels of PAHs (<50 ng/g, wet weight) were measured in the tissues of oiled seals, validating other studies indicating the same finding in fish (the PAHs are rapidly metabolised, transferred to bile and then eliminated). This study found that tissues of oiled seals with higher percentages of lipids (e.g., blubber, skin) had higher concentrations of PAHs compared to tissues with low lipid content (e.g., muscles, kidney, liver with ≤10% lipid content). By extension, there is, theoretically, the potential for transfer of PAHs to nursing seal pups through their mothers' lipid-rich milk, though a study by Frost and Lowry (1994) of seals impacted by the *Exxon Valdez* spill found only low concentrations of PAHs in mammary tissue and mother's milk.

Lactational transfer of other fat-soluble persistent organic pollutants (e.g., PCBs) from mother seals to pups has been recorded in numerous northern hemisphere studies (e.g., Wolkers *et al.*, 2004; Hickie *et al.*, 2005; Frouin *et al.*, 2012; Vanden Berghe *et al.*, 2012; Shaw *et al.*, 2014) and in the southern hemisphere (e.g., Filho *et al.*, 2009). The transfer of organic halogenated contaminants (e.g., organochlorine pesticides, PCBs) from mother seals to foetuses has also been recorded (Wang *et al.*, 2012; Brown *et al.*, 2015). However, no research has been identified into lactational transfer, or mother-to-foetus transfer of PAHs. This may be due to the limited bioaccumulation potential of PAHs relative to PCBs (Noël, 2013), which is likely to be a result of the rapid metabolism and renal elimination of PAHs by seals (Engelhart, 1983; Stimmelmayr *et al.*, 2018).

Stimmelmayr et al (2018) also report that lung lesions were observed in one of the three seals, which may have been the result of inhalation-related damage (inhaling volatile oil components at the air/water interface). However, this is related to crude oil on the water rather than, as in the case with PFW discharges, highly diluted OIW.

Implications for Yolla-A. The WET testing did not involve toxicity tests on marine mammals (such a testing regime does not exist), so the exact dilution factor required to meet the NOEC for seals is unknown. There is a potential for seals, specifically the Australian fur-seal (which feeds on pelagic species, as opposed to New Zealand fur-seals that forage on benthic fauna), to forage on fish species that have had a direct association with habitat within the

PFW mixing zone (e.g., seals eat fish that may have eaten algae, crustaceans or molluscs that inhabit the PFW mixing zone). Therefore, there is a potential that bioaccumulation or bioconcentration of toxicants within fur seals may occur if enough of their prey has bioaccumulated the toxicants from the PFW discharge. The principal diet of most seals consists of cephalopod molluscs and fish. Unlike bivalves and suspension feeders (that may attach to the jacket or be present in sediments around the platform), these prey are not likely to accumulate petroleum hydrocarbons. Seals have been found to possess the necessary enzymes to metabolise some petroleum fractions, while others (e.g., anthracene, phenanthrene and naphthalene) may be deposited into fat stores (Engelhardt, 1982; Addison & Brodie, 1984; Addison *et al.*, 1986, Hoseini *et al.*, 2020). Geraci & St Aubin (1988) suggest that a small seal (weighing 50 kg) might need to ingest 1 litre of oil to be at risk. Given that the quantity of oil discharged in the PFW stream is about 9 litres/day (or 375 ml/hr), this would suggest that a seal (of similar weight, noting adults are expected to be much heavier than this) would need to remain around the discharge caisson exit point (mid-water column) and ingest all the discharge for three hours to be at risk. This is not a credible scenario given that they rest on the water surface or onshore (not mid-water column). Geraci & St Aubin (1988) note that seals have a good olfactory sense, and one that is keen enough to detect hydrocarbon vapours (and by extension, avoid it if it causes discomfort or injury). Given that seals are regularly sighted milling under and around the platform, this suggests that hydrocarbon vapours at the water surface are not of a sufficiently high concentration to cause discomfort, let alone inhalation-related damage. This is to be expected given the depth of the PFW discharge and the fact that by the time the PFW plume reaches the sea surface, it will be highly diluted and some distance away from the platform (rather than directly beneath it) due to the effect of water currents.

No evidence of deleterious effects related to bioaccumulation of petroleum hydrocarbons has been documented for seals (NOAA, 1992). It is therefore not likely that important biological activities such as breeding and feeding (which impact on life expectancy) will be affected by seals' occasional presence within the PFW mixing zone.

IOGP (2002) reports that the most abundant aromatic compounds in PFW, the BTEX compounds, are volatile and evaporate rapidly from PFW discharged close to the sea surface or from PFW discharge plumes reaching the surface due to density gradients. These losses, allied to dispersive mixing, result in 50,000 to 150,000-fold reduction of the benzene concentration in seawater 20 m away from the PFW discharge point (Brook *et al.*, 1980; Rabalais *et al.*, 1991; Terrens and Tait, 1996). The PFW discharge plume modelling used for this case (RPS, 2017; 2020) assumed no volatilisation and is therefore conservative (over predicting). The reported results support the findings of the WET testing and modelling in that the concentrations of aromatics (e.g., BTEX) will be at no effect levels in less that 7.3 m from the discharge point.

Oil on the sea surface has the potential to coat the fur of seals, which can affect vital physiological functions such as body temperature regulation (i.e., the matting of fur can lead to hypothermia and death) and coating of mucous membranes (such as eyes and ears, which would make functions such as locating prey difficult). The PFW discharge does not result in slicks of oil at the sea surface (either directly under and around Yolla-A where seals spend time resting, or further afield), so there is no risk of coating of fur by hydrocarbons within the PFW discharge. In the water column, the hydrocarbons within the PFW are diluted to such a low concentration in such a short distance from the discharge point that the coating of fur is not a credible risk.

The dozen or several dozen individual seals that are regularly sighted milling around the platform are likely to come from the nearby breeding colonies of Rag Island, Kanowna Island, the Answer Group of Islands and the Kent Island Group. These breeding populations are known to be in the thousands (see Section 5.5.6). While toxicity impacts to seals are not likely to eventuate (from direct exposure to the PFW plume, ingestion of contaminated prey or coating of fur), if impacts did occur, the small number of seals that may be impacted does not represent a significant impact at the population level. The same applies to New Zealand fur-seals, noting that the majority of their breeding colonies are in SA and WA, but that populations at the nearest haul-out sites to Yolla-A are also in the thousands.

Section 5.5.6 of the EP lists and describes the threatened pinniped species that are known to be present in the operational area and spill EMBA. Based on observations from Yolla-A and habitat preferences, the species known to and considered likely to occur in the PFW mixing zone are the Australian and New Zealand fur-seals (both listed as marine species under the EPBC Act). Based on the impact assessment presented, there is no probability of PFW discharges having significant impacts to pinnipeds as assessed against the significant impact criteria in the *MNES Significant Impact Guidelines 1.1* (DoE, 2013) (Table 7.18).

Table 7.18. Assessment of the likelihood of significant impact to EPBC-listed pinniped species using the EPBC Act Significant Impact Guidelines 1.1

Is there a real chance or possibility that the PFW discharge will...*	
Vulnerable species (both seal species)	
Lead to a long-term decrease in the size of an important population of a species?	No
Reduce the area of occupancy of an important population?	No
Fragment an existing important population into two or more populations?	No
Adversely affect habitat critical to the survival of a species?	No
Disrupt the breeding cycle of an important population?	No
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?	No
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat?	No
Introduce disease that may cause the species to decline?	No
Commonwealth marine environment	
Result in a known or potential pest species becoming established in the Commonwealth marine area?	No
Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results?	No
Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (for example, breeding, feeding, migration behaviour, life expectancy) and spatial distribution?	No
Result in a substantial change in air quality or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health?	No
Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected?	No

* *Note – only those items under each heading relevant to the marine environment are included.*

Listed marine species are not subject to the *Actions on, or impacting upon, Commonwealth land, and actions by Commonwealth agencies Significant Impact Guidelines 1.2* (DSEWPC, 2013); nevertheless, an assessment against these is presented in Table 7.19 for completeness (using the 'vulnerable' category, as the most suitable proxy for listed marine species).

In summary, the low susceptibility of seals to high concentrations of TPH (e.g., 127 mg/L) and the small number of seals around Yolla-A relative to nearby breeding populations (of which they are assumed to be a part) means the toxicological consequences of PFW discharges to individual seals or seal populations can be reasonably assessed as minor.

Table 7.19. The real chance or possibility of PFW discharges having impacts on EPBC-listed pinniped species using the EPBC Act Significant Impact Guidelines 1.2

Is there a real chance or possibility that the PFW discharge will…*	
Impacts on ocean forms, ocean processes and ocean life	
Reduce biological diversity or change species composition on reefs, seamounts or in other sensitive marine environments?	No
Alter water circulation patterns by modification of existing landforms or the addition of artificial reefs or other large structures?	No
Substantially damage or modify large areas of the seafloor or ocean habitat, such as seagrass?	No
Release oil, fuel or other toxic substances into the marine environment in sufficient quantity to kill larger marine animals or alter ecosystem processes?	No
Release large quantities of sewage or other waste into the marine environment?	No
Pollutants, chemicals and toxic substances	
Generate smoke, fumes, chemicals, nutrients, or other pollutants that will substantially reduce local air quality or water quality?	No
Result in the release, leakage, spillage, or explosion of flammable, explosive, toxic, radioactive, carcinogenic, or mutagenic substances, through use, storage, transport, or disposal?	No
Impacts on animals	
Cause a long-term decrease in, or threaten the viability of, a native animal population or populations, through death, injury or other harm to individuals?	No
Displace or substantially limit the movement or dispersal of native animal populations?	No
Substantially reduce or fragment available habitat for native species?	No
Reduce or fragment available habitat for listed threatened species that is likely to displace a population, result in a long-term decline in a population, or threaten the viability of the species?	No
Introduce exotic species that will substantially reduce habitat or resources for native species?	No

* *Note – only those items under each heading relevant to the marine environment are included.*

Potential toxicity to cetaceans

As noted in Section 5.5.5, humpback whales are observed migrating past Yolla-A and dolphin pods are regularly sighted.

Observations from operators on Yolla-A indicate that individual humpback whales mill around the platform for a number of hours during their annual migration seasons, appearing inquisitive about the structure. This milling and continuous movement means they do not remain in the PFW plume for extended periods (even though they have been sighted swimming under the platform hull). As such, the duration of potential exposure to PFW means that acute or chronic toxicity effects are not likely. This applies to other large cetaceans also.

For smaller cetaceans such as dolphins, their high mobility means they are not constantly exposed to the PFW discharge. They are not observed milling under the platform hull or around the platform, which means they would not be subject to any risks of acute or chronic toxicity.

Impacts to individual cetaceans or populations (e.g., PAH bioaccumulation) are therefore not anticipated given their transient (if at all) presence around the PFW plume.

PFW plume verification monitoring

To address the uncertainties with the extent of the PFW mixing zone, Beach commits to undertaking a PFW plume verification monitoring program starting in late 2020 (or early 2021 at the latest) using a reputable and experienced consultancy to determine the extent of the PFW mixing zone.

An initial review of PFW discharge data will be undertaken to ascertain the most appropriate parameters to use for monitoring, and to provide an understanding of the likely plume character. This review will include data from the previous month for:

- PFW flow rates;
- Temperature, salinity and any other physico-chemical parameters routinely measured; and
- Hydrocarbon concentrations.

A review of these data will provide insight to the possible plume character and the best parameters to measure.

Objective. The objective of the plume verification monitoring program is to verify to extent of the PFW mixing zone.

Sampling methodology. A range of methods are available to undertake PFW plume sampling and model verification, varying in technical complexity. A staged approach is considered best in the case of Yolla-A, with the stages being:

- Step 1 - Sampling from Yolla-A (to test the mixing zone based on NOEC).
- Step 2 - If PFW-related toxicants are detected at the edge of the platform at concentrations that exceed ANZG (2018) DGVs, then sampling will be undertaken from a vessel adjacent the platform.

Given the expected small scale of the PFW plume and rapid dilution to below levels predicted to impact the receiving environment, an initial sampling event from the platform will take place. This will allow the collection of data without the added safety risk of vessel operations. Pending the outcomes from the initial platform-based sampling, a methodology for further investigations utilising a vessel will be developed (if deemed necessary, pending the results of Step 1).

The following sampling methods will be undertaken from Yolla-A as part of Step 1:

- Water column profiles using a multiparameter probe to measure physico-chemical indicators of the PFW plume through the water column, such as electrical conductivity (EC), temperature and pH.
- Use of a tracer dye (such as Rhodamine WT, RWT) to assist with identifying the PFW plume during sampling or to help estimate dilution with distance from the platform.
- Collection of water samples for laboratory analysis and detection of PFW constituents. When a tracer dye (such as RWT) is used, laboratory analysis of water samples will also be undertaken to determine the concentration of dye before and after release and to estimate dilution where possible.

Proposed sampling locations for these methods include:

- Water column physico-chemical profiles:
    - A location up-current from the discharge point to be used as a reference reading (once at the beginning and once on conclusion of each sampling event).

    - Within samples taken from the PFW stream prior to discharge into the caisson (once at the beginning and once on conclusion of each sampling event. Technically not a profile but a measurement taken using the same profiling instrument).
    - Within the discharge caisson (surface and sub-surface intervals). It is assumed that the caisson is of a size, and that turbulence within the caisson is sufficiently low, that will allow the deployment of a multi-parameter probe into the water safely and without the risk of damage to the instrument.
    - In the receiving environment as close to the discharge location as possible.
    - Incremental distances (approximately 5 m distances or wherever possible) moving away from the point of discharge in the direction of the prevailing current for as far as possible.
- Water samples for laboratory analysis collected (using a Niskin bottle sampler where sampling overboard) from:
    - A point up-current from the discharge point to be used as a reference reading (nominally at surface, 2 m and 5 m depth), once at the beginning and once on conclusion of each sampling event;
    - The PFW stream prior to discharge into the caisson (once at the beginning and once on conclusion of each sampling event);
    - Within the discharge caisson (surface and sub-surface intervals);
    - As close to the discharge location as possible (top of plume, mid plume and below plume as determined from profile data); and
    - Incremental distances (approximately 5 m distances) moving away from the point of discharge in the direction of the prevailing current for as far as possible from the platform (surface, mid and lower plume as detected by profile data).

It is acknowledged that the plume behaviour will likely vary depending on the prevailing metocean conditions and the buoyant plume may surface quickly or remain submerged for a period after discharge. Sample locations and depths will be reassessed in the field in response to the plume behaviour at the time of sampling to best target the plume.

Two sampling events will take place, the timing of which should cover both a slack tide and a period of higher tidal flow. Across the two sampling events, it is expected that the approximately 50 water samples will be collected for laboratory analysis, though this will be dependent on the conditions encountered in the field and the number of access points for sampling. Collection of QA/QC samples (including 5% duplicate samples and 10 % triplicate samples) will increase the total number of samples to approximately 60 samples.

Additional measurements will also be taken at a point in time where a higher current speed is present to provide an indication of the plume behaviour during that period. This plume will be more difficult to measure as the plume will generally be smaller in diameter and will be carried further away from the platform.

Observations and measurements of the plume, including any plume surface expression, will be made over a longer period as tide changes occur. These should include:

- Photographs of any visible plume from the platform;
- Records of the direction in which the plume is dispersing from the platform;
- Records of wind speed and direction;
- Water current speed and direction measurements, where possible through the water column; and

- Physico-chemical water column profiles to detect any stratification that may be present, and plume location within the water column.

Use of tracer dye. Tracer dyes such as RWT can provide a means by which a discharge stream can be more readily identified to help with describing its character and dispersion pattern. It also allows, through the use of fluorometer instrumentation, another means by which the plume dilution can be estimated. It has been confirmed that tracer dye can be injected into the PFW stream and that it is chemically compatible with platform systems and processes. The plume verification monitoring program is proposed to be used subject to the following:

- Identification of an injection point at which RWT can be added to the PFW stream;
- Provision of a tank of greater than 500 litre capacity with re-circulation capability to keep the dye mixed prior to pumping into the PFW stream, and hoses to add RWT to the PFW stream; and
- Provision of a person on the platform to operate and monitor the pumping/injection process.

If a multiparameter probe can be deployed within the caisson, the measurement of dye within the caisson, compared to that in the open ocean may be used to estimate the PFW dilution. This is dependent on access to sampling the plume from the platform.

Where the sampling at stage one, undertaken from Yolla-A, indicates that the dilutions achieved at the edge of the platform do not meet the required dilutions to meet the NOEC concentrations derived from WET testing, the second stage sampling program from a vessel will be implemented within 3 months to assess the extent of the mixing zone and to verify plume the modelling.

Impacts to Seabed Sediment Quality

The Yolla-A PFW discharge caisson is located 35 m above the seabed and the PFW plume is buoyant. As illustrated in Figure 7.5, the PFW plume does not interact with the seabed, so there are likely to be few impacts to the seabed immediately around the PFW plume. Neff et al (2011) state that although PFW plumes occur mainly within surface waters, there is the potential for particles within the plume, which may comprise metal oxides and low solubility hydrocarbon droplets (such as higher molecular weight PAHs), to drop out of the plume in the far-field mixing zone.

In well-mixed offshore waters (such as Bass Strait), elevated concentrations of saturated hydrocarbons and PAH in surficial sediments are sometimes observed out to a few hundred meters from a high-volume PFW discharge. The concentration of PAH in sediments near offshore PFW discharge points is related to the volume and density of produced water discharges (Neff *et al.*, 2011). Particulates settling onto the seabed are subject to re-suspension, bioturbation and microbial decay.

Yeung et al (2011) analysed bacterial communities within PFW and seawater from the Baud platform on the Scotian Shelf off eastern Canada. Yeung et al (2011) found that the bacterial communities in the PFW and the seawater were different and that the PFW discharge had no detectable effects on the bacterial communities in the seawater.

However, genomic analysis of the seabed revealed that the bacterial communities within the sediments varied based on distance away from the PFW discharge location. The near-field sediments contained elevated concentrations of manganese and iron, which were associated with the PFW discharge stream. The study observed that the bacterial assemblages in sediments more than 250 m away from the discharge location were different to those closer to the platform (<250 m), suggesting that PFW discharge has a detectable effect on the bacterial communities in sediments closest to the discharge point and thus potentially the higher order communities among the food web.

Precipitation of barium and dilution of the resulting barite in the PFW plume are rapid enough that dissolved barium concentrations rarely exceed acutely toxic concentrations. Results from monitoring programs generally show the natural dispersion processes appear to control the concentrations of toxic metals in the water column and sediments just slightly above natural background concentrations (Neff *et al.*, 2011).

Prior to and at the time of installation of the Yolla platform, Origin (as the then titleholder) did not take sediment samples to determine the baseline physico-chemical nature of the sediments around the platform. The data from such samples would serve as a basis of comparison for future sampling to determine what impacts PFW may have on seabed sediment quality. Based on the conclusions of Neff et al (2011) above, the results of other studies into the impacts of PFW on seabed sediments in the Gippsland region (see following section) and the high proportion of dissolved hydrocarbons in the Yolla PFW (rather than OIW), toxicity effects of the PFW discharge on benthic communities are expected to be minor.

Sediment sampling study

To address the absence of pre-development baseline sediment quality data, Beach commits to undertaking a sediment sampling study in 2020 using a reputable and experienced consultancy.

Objective. The objective of the sediment sampling study is to characterise the sediment quality in the vicinity of Yolla-A and to determine whether the Yolla PFW discharge is having a detectable (or acceptably low) impact on sediment quality, as determined through comparisons against the ANZG (2018) Default Guideline Values (DGVs) and National Assessment Guidelines for Dredging (NAGD) (2009) Screening Levels.

Sampling methodology. The principles outlined in the Sediment Quality Guidelines (SQG) (CSIRO, 2013) will be used to guide the sediment sampling and analysis. In the absence of baseline sediment quality data in the area of interest, reference sites will be sampled to establish a local benchmark for comparison of results in addition to the ANZG (2018) DGVs and NAGD Screening Levels. Comparison of the median concentration of toxicants detected in sediments at sites surrounding Yolla-A will be compared to the 80th percentile values of the reference site data. The reference site data will provide a point of reference to ascertain whether any detections above the assessment criteria are within levels that may be expected across the region.

The sediment quality assessment will follow the process set out in NAGD (2009) for a Phase I (evaluation of existing information) and Phase II assessment (comparison of results against screening levels). Should the results of these assessment phases suggest it is warranted, a Phase III (elutriate and bioavailability) and Phase IV (toxicity and bioaccumulation) assessment as defined in NAGD (2009), will be considered.

A detailed sampling plan will be developed by specialist consultants, which will include the sample location coordinates and instructions for the collection of the sediment samples using grab samplers. The specialist consultants will provide a training session for the personnel undertaking the sampling to communicate the requirement for strict measures to prevent sample contamination. Key aspects of the sampling study are:

- Sediment sampling will be undertaken from a vessel (rather than from the platform) using a Van Veen grab sampler.
- Samples will be collected along two transects aligned with, and perpendicular to, the axis of the predominant current direction. This will provide the highest likelihood of sampling sediments that have been exposed to PFW discharges. Samples will be collected at intervals along each transect out to a distance of the edge of the modelled PFW mixing zone (693 m). Three reference sites will also be sampled.
- With sampling occurring along two transects, and a suitable amount of QA/QC replication (sample splits at 5% of locations and triplicate samples at 10% of locations and three reference sites), a total of 26 samples will be undertaken (to be reviewed closer to the time of sampling, but comprising 14 primary sites around the platform, three QA/QC samples and nine reference samples [three at each of the three reference sites]). The number of sampling sites is based on coverage of the modelled mixing zone across two gradients to allow for

increased sampling density in closer proximity to Yolla-A where an increased risk of sediment contaminants exists. A gradient sampling design increases the chances of sampling areas that may have been impacted by PFW discharges over time.

On completion of the sampling design, a peer review will be undertaken by a suitably qualified person with an understanding of the requirements of the data collection techniques and end use of data for the purpose of sediment sampling. The peer review will aim to confirm that the sampling design comprises suitable sampling times, locations and methods of sampling, and an appropriate number of replicates. The review will include undertaking a power analysis to determine if the sampling is sufficient to detect a difference between platform and reference sites to a 5% significance level (p=0.05) with a power of 0.80. Should this criterion not be met, additional sample sites will be added to subsequent surveys to meet the statistical power target.

Analysis will be undertaken to a Practical Quantitation Limit (PQL) sufficiently low so as to allow assessment of results against the SQG contained within ANZG (2018) and NAGD (2009). The contaminants of potential concern would be determined prior to the assessment taking place based on previously collected data and operational information. Indicatively, the following analysis will be undertaken:

- Total metals (aluminium, arsenic, antimony, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc).
- Total Recoverable Hydrocarbons (TRH).
- PAHs (where TRHs are detected).
- BTEX and naphthalene.
- Particle size distribution.
- Nutrients (Total Nitrogen [TN], Total Kjeldahl Nitrogen [TKN] and Total Phosphorus [TP]).

Samples will be frozen as soon as possible after collection and transferred to the analysing laboratory on completion of the survey, to allow sample analysis within the holding times for the analyses.

Sufficient sample material (including elutriate water) will be collected to undertake additional analyses for a Phase III and IV assessment in accordance with NAGD if required.

Laboratory results will be reviewed and statistical analyses undertaken to describe the concentration of contaminants in sediments surrounding Yolla-A, trends in contaminant concentrations with distance from the platform, and contaminant concentrations at the reference site(s).

Contaminant concentrations will be compared to ANZG (2018) DGVs where they exist, or to reference site concentrations where no DGV is provided. If any contaminants are detected above ANZG (2018) DGV in any sample collected from sites surrounding Yolla-A (i.e., not reference sites), bioavailability testing will be undertaken for that sample. Where bioavailability is found to exceed ANZG (2018) criteria, additional sampling will be undertaken to identify the extent of elevated toxicant(s) above ANZG (2018) DGV(s) in the vicinity of that sample location.

Survey designs for future sampling (i.e., 5-yearly sampling) will include sampling to monitor the distribution of sediments in which there are toxicant concentrations that exceed DGVs.

Comparison of laboratory results will also be made to the Screening Levels presented in the NAGD (2009), in accordance with the process for a Phase II assessment under those guidelines. Based on these results, any follow-up analysis required for a Phase III assessment as outlined in NAGD (2009) will be identified. Phase IV toxicity and bioaccumulation testing in accordance with NAGD (2009) will be considered upon the completion of the Phase III assessment if required.

A report will be provided once the laboratory tests are produced that describes the sampling undertaken and the conditions encountered in the field. A summary of the laboratory data and comparison to ANZG (2018) DGVs will be provided in the report. The report will also outline the results of the comparison of laboratory results against NAGD (2009) Screening levels will also be provided. Where the comparison with these Screening levels meet the criteria for a Phase III assessment, this will be communicated to Beach and the assessment process will begin. A description of the analytical results will include discussion of the comparison between samples taken around the platform against reference site samples.

If the report indicates that the 95% Upper Confidence Limit (UCL) concentrations of any contaminants exceed their ANZG (2018) DGVs or NAGD Screening Levels, Beach will engage the appropriate expertise to determine follow up actions to be taken (such as additional studies), in accordance with the PFW AMF (see later section).

Studies of PFW Discharges from Comparable Facilities in Gippsland

The eastern part of the offshore Gippsland Basin has been subject to PFW discharges from oil and gas platforms since 1978. EARPL operates nine facilities in eastern Bass Strait located 30 – 70 km offshore in waters ranging from 55 – 93 m, which combined, average 33 ML/day (or 33,000 m^3/day) of PFW discharges to the ocean (127 times that of Yolla-A's PFW average daily discharge volume). The PFW is treated prior to discharge to ensure an OIW concentration <30 mg/L.

Given the combined discharge of 33 ML/day across nine facilities, EARPL may be discharging about 3,600 m^3/day from a single platform (assuming equal discharge between the nine facilities). This is nearly 14 times the discharge volume for Yolla-A.

In the 1990s, hydrocarbon production from EARPL's facilities in the Gippsland Basin was higher than it is today, and PFW discharge rates from the combined EARPL facilities were ~90 ML/day (or 90,000 m^3/day). A study during this time by Terrens and Tait (1994) found that PFW discharged into the Bass Strait presented a very low risk to marine organisms. Terrens and Tait (1996) completed a second study using field measurements of aromatic hydrocarbon concentrations to calculate dispersion of PFW in the Bass Strait. They found that at 20 m from the discharge point, PFW concentrations were reduced 20,000-fold compared with initial concentrations. Despite these significant rates of dilution between PFW constituents and seawater from the receiving environment, it was determined that marine biota may be exposed to some toxic constituents from PFW discharges in the water column and on/in sediments, resulting from deposition and accumulation of various constituents over time (Neff, 2002; Phillips, 2004).

In order to quantify the impacts of PFW discharges on the marine environment of Bass Strait and update the Terrens and Tait (1996) results, EARPL commissioned Cardno to undertake a detailed study to investigate the potential effects of PFW discharges from two platforms (Tuna and West Kingfish) on the receiving environment (Barnes *et al*., 2019). These platforms were selected because they were assessed as presenting the highest risk to marine biota based on PFW concentrations relative to the Australian and New Zealand Environment Conservation Council (ANZECC) guidelines (ANZECC, 2000, now superseded by ANZG, 2018). The study aimed to characterise PFW dilution in comparison to existing models, measure PFW analyte concentrations in the receiving marine environment, measure PFW analyte concentrations in sediments and to describe and compare the benthic infauna assemblages adjacent to the platforms against suitable reference locations.

The similarity of oceanographic and ecological conditions between Yolla-A and the EARPL facilities in this study (water currents, water temperature, seabed composition and fish and benthic species composition) make the Barnes et al (2019) study a highly suitable proxy for the impacts of PFW discharges from the Yolla-A facility. It is noted, however, that PFW produced from treating crude oil and gas do differ; PFW from gas production has a higher content of BTEX compared to PFW resulting from oil production and therefore becomes more readily bioavailable to fauna (as noted in Section 3.5.6), though the total amount of PFW produced from gas fields is generally much smaller than from oil fields (OGP, 2002). Table 7.20 provides a comparison between the Yolla-A facility and the Tuna (producing gas) and West Kingfish (producing oil) platforms for the purpose of comparisons between the assets.

Table 7.20. Comparison between the Beach and EARPL PFW-discharging facilities

Parameter	Beach – Yolla-A	Esso – Tuna	Esso – West Kingfish
Primary hydrocarbon production target	Gas	Gas	Oil
Average OIW discharge concentration	<5 mg/L (dispersed oil)	5 – 15 mg/L	
Average PFW volume discharged per day	160 m^3/day (current) 300 m^3/day (maximum)	3,600 m^3/day (average of nine platforms discharging 33ML/day combined)	
Water depth at platform	80 m	59 m	76 m
Distance from Yolla-A	N/A	292 km NW	240 km NW
Discharge depth of PFW	45 m below sea surface	30 m below sea surface	
Local seabed substrate type	Soft sediments	Soft sediments	

Water Column Toxicity

Using a dye solution injected into the PFW stream prior to discharge at the Tuna platform, the study successfully tracked the discharge plume and estimated the rate of dilution within the receiving environment. The study found that the modelled dispersion of the PFW plume and the actual dye-assisted plume tracking differed. The modelled dilutions by RPS-APASA (2018) predicted that average dilution of PFW constituents at ~100 m and 1,000 m from the outlet would be 1,000-fold and 2,500-fold respectively, whereas plume tracking at Tuna indicated average dilutions at the same distances were 3,000-fold and 10,500-fold, respectively. In the receiving waters around the Tuna platform (>59 m away), most of the analytes in the discharged PFW were not detected above background concentrations or the limit of reporting (LOR) in the plume measurements. For the analytes that were detected above the LOR, the concentrations satisfied the respective 80% species protection trigger values (in ANZECC, 2000) regardless of source, thus ensuring the protection of 80% of species.

Seabed Sediment Toxicity

Sediment accumulation of toxic chemical constituents has been noted as an impact of regular PFW discharges to the marine environment. Barnes et al (2019) found that in the majority of sediment samples collected around the Tuna and West Kingfish platforms, the concentrations of PFW analytes were below the ANZECC (2000) SQG and the 2013 revision to the SQG. When compared to concentrations reported in close proximity to other oil and gas facilities around the world, the concentrations encountered by this study are substantially lower (Schifter *et al.*, 2015; Kennicutt, 2017).

A diverse assemblage of benthic infauna was collected during the study via sediment sampling at locations adjacent Tuna and West Kingfish and at reference locations. As is consistent with previous works, this study observed decreased infauna abundance and species richness closer to the platforms for some taxa while also observing enhanced species richness, abundance and biomass of other certain species close to the platforms. Where a significant relationship exists between species abundance and distance from the platform (whether it be decreasing to or increasing from), the maximum distance modelled to reach reference location levels was 1,250 m. This suggests that the impacts of PFW discharge on benthic infauna assemblage is localised to areas of approximately 1-1.25 km immediately surrounding the platform and is highly unlikely to impact species composition at a bioregional level. Given that soft sediments dominate the seabed of Bass Strait, this disruption is not likely to impact benthic infauna species at a population level.

Barnes et al (2019) conclude that because of the rapid dilution of PFW discharges, evidence of analyte concentrations below deleterious levels and the presence of benthic infauna assemblages similar to other areas within Bass Strait, it is likely that the PFW discharges from Tuna and West Kingfish represent a low risk to the receiving environment.

Given that this study has been conducted within relative proximity to the Yolla operations (see Table 7.20), occupies a highly similar bioregion (i.e., seabed composition, benthic infauna assemblages, oceanographic condition) and is operationally similar to Yolla-A (e.g., water depth and PFW discharge depth), it is reasonable to suggest that the results of this study also apply to the BassGas operations. However, due principally to the far lower PFW discharge volumes from Yolla-A, any impacts to seabed sediments are expected to be over a much smaller area and result in lower concentrations of analytes in sediments than those in this study, meaning the potential for overall toxicity impacts to benthic epifauna and infauna is considered minor (i.e., the distance to achieve marine assemblages typical of reference locations is likely to be very short).

Adaptive Management Framework (AMF)

The PFW AMF comprises routine monitoring and non-routine monitoring that may be triggered as a result of PFW monitoring results.

The AMF is in place to ensure that procedures are in place and implemented to ensure that verification, assessment or monitoring actions can be undertaken to prevent breaching the PFW TPH discharge limit and the discharge compliance regime.

The AMF provides a clearly defined process for management of the PFW discharges in accordance with the EPOs relevant to PFW in this EP. The AMF also takes into consideration:

- Cause-effect pathways for the discharge;
- State of knowledge on the impacts of the discharge;
- Scope of routine and non-routine monitoring/verification studies and risk re-assessment; and
- Trigger values for non-routine monitoring/verification or discharge re-risk assessment.

The AMF is based on a decision-making process to determine whether additional non-routine monitoring or verification is required, either due to planned or unplanned changes to the PFW discharge characteristics, as a result of abnormal results or an alarm being triggered from the routine monitoring.

Figure 7.9 demonstrates what actions are taken if any of the routine monitoring limits are exceeded and who has monitoring responsibilities.

Threshold Definition

The following threshold concentrations are defined for the Yolla PFW stream:

- OIW (dispersed oil) – average of <30 mg/L over any 24-hr period and an instantaneous limit of 50 mg/L.
    - This is aligned with long-accepted industry threshold for dispersed oil.
    - Yolla OIW levels are consistently <10 mg/L, so this threshold is expected to be easily met into the future.
- TPH (OIW + BTEX) – a limit of 127 mg/L.

- This is based on the highest TPH concentration from the three PFW samples used in the 2019 WET testing, as well as a review of the TPH data collected over the last 3 years.
- Since recording of TPH commenced in mid-2018, concentrations have generally ranged between 40 to 80 mg/L (see Figure 7.3), so this limit is expected to be achievable for the immediate future. Longer-term, there is potential for the concentrations to rise as the field matures and water volumes from the wells increase. The platform's PFW system is only operating at roughly half its capacity, and gas rates are also roughly half the platform's production capacity. The wells will water out as they continue to deplete, and will increase the PFW production rate closer to the maximum 300 m^3/day. This has the potential to increase the TPH levels due to the reduction in the PFW residence time in the treatment process (i.e., there will be less time for free hydrocarbons in the water to volatize in the caisson). As such, it is appropriate to maintain the 127 mg/L TPH limit. The AMF will continuously monitor for changes in TPH levels and allow for appropriate action to be taken to prevent limits being breached.
- A trigger level of 90 mg/L TPH has been set at the point at which operational conditions are reviewed (and actions taken as necessary) to ensure that TPH concentrations do not exceed the threshold. This is based on normal operating processes; it is expected that there may be fluctuations in the TPH concentrations due to routine operations such as pumping of water from the flare drum for processing and disposal. During this operation, there is usually a temporary fluctuation of OIW/TPH readings. The higher TPH trigger allows for these temporary increased concentrations to ensure safe operation of the platform, while also maintaining production. These fluctuations shall be reviewed and managed in accordance with the AMF and will be managed to keep short-term fluctuations between 90 and 127 mg/L.

The assurance activities shown in Tables 7.21, 7.22, 7.23, 7.24 and 7.25 describe the routine and non-routine monitoring program that is in place as part of the AMF that ensure the limits are not breached.

Training and Competency

All new crew joining Yolla-A are assessed as competent to perform their role through the Beach training and competency framework for their role prior to joining the platform. This is followed up through regular performance reviews.

All new crew joining Yolla-A attend an EP awareness induction, which provides an overview of the environmental impacts and risks associated with the facility, including routine discharges such as PFW. The presentation points to specific procedures for crew to become familiar with. Refresher inductions are not required unless new impacts or risks are identified. Upon acceptance of this EP, all platform crew will be provided with a refresher induction to ensure that the EPS outlined in this section are communicated and understood by all. Beach will also consolidate the various PFW procedures currently in place into one document to act as a 'go-to' reference for all PFW management and monitoring issues.

There is formal and informal on-the-job training undertaken with all personnel. As outlined in Section 8.6.1, there is a BassGas Workforce Capability Requirements Matrix in place that details technical competency requirements that is updated on a monthly basis to identify training gaps and schedule training. The Beach Learning Management System (LMS) also records and tracks technical compliance training. For example, a new Production Technician joining the platform will be shown how various equipment works and the procedures associated with these by the PIC or an experienced Production Technician. With regard to PFW management, this involves demonstrating how the various PFW procedures are implemented (e.g., explaining how the Sigrist analysers work, how they are calibrated and maintained, how to enter the data, where the manual sampling points are and so forth). Once the individual is assessed as competent in performing the required tasks, as determined by senior personnel, this is noted in the capability requirements matrix.

Table 7.21. PFW OIW routine monitoring and management assurance

Program element	Explanation	Frequency	Responsibilities
OIW monitoring	From the existing two (2) Sigrist analysers continuously monitoring OIW – alarms triggered at 20 mg/L and 30 mg/L and 50 mg/L instantaneous.	Continuous	Production Technicians, PIC
TPH monitoring	From the existing two (2) Sigrist analysers continuously monitoring TPH – alarms triggered at 90 mg/L and 127 mg/L. Levels over 127 mg/L for 60 minutes will trigger automatic shut in of the PFW stream.	Continuous	Production Technicians, PIC
Total PFW volume discharge monitoring	Total discharge rate monitored and alarmed not to exceed 300 m^3/day. PFW shut in if a volume of 300 m^3/day is exceeded.	Daily	• Data entry and trend monitoring – Senior Process/Production Optimisation Engineer • Compliance review – Senior Environmental Advisor (SEA)
TPH verification (OIW plus BTEX)	Weekly third-party laboratory samples added to the LIMS spreadsheet to validate Sigrist TPH data.	Weekly	• Sampling & freight – Production Technician • Data entry and trend monitoring – Senior Process/Production Optimisation Engineer • Compliance review – SEA
Online OIW/TPH analyser maintenance	Calibration and routine maintenance performed weekly in accordance with the CMMS.	Weekly	• Maintenance – Production Technician
OSPAR validation testing	PFW testing is conducted weekly in accordance with the CMMS. Water samples are sent to the third-party laboratory for testing to the OSPAR 2005-15 method for determination of dispersed oil (OIW). Depending on results, the following actions will be taken on the Sigrist analysers: <u><20 mg/L</u> 1 x spot check PFW sample tested weekly for dispersed oil content as per OSPAR 2005-15 test method. <u>20-30 mg/L</u> Analyser calibration checked and if confirmed accurate, PFW samples to be taken daily during this condition and tested weekly. <u>>30 mg/L</u> Analyser calibration checked and if confirmed accurate, PFW production rate reduced to bring OIW content below 30 mg/L.	Weekly	• Sampling & freight – Production Technician • Data entry and trend analysis – Senior Process/Production Optimisation Engineer • Compliance review – SEA

Program element	Explanation	Frequency	Responsibilities
Online OIW/TPH analyser correlation check	Monthly Technical Monitoring Report includes review of the past month's OSPAR test results against analyser output. The review assesses the trends in OIW, BTEX, TPH and total PFW discharge volume. If there is any increasing trend, further action will be undertaken to investigate the reason. This will consist of process intervention, consideration of further PFW characterisation and WET testing. 3M Preventative Maintenance task scheduled for engineering team to review accuracy of the fluorescent units to OIW correlation.	Monthly	• Input to report - Senior Process/Production Optimisation Engineer • Review of results - SEA • Response to trend increase - PIC

PFW chemical characterisation	The chemical characterisation study of the PFW stream commenced in 2014 as an annual activity and was increased to a frequency of six-monthly in mid-2018. The sample is taken from the treatment system, immediately prior to its discharge to ocean. Characterisation includes physical and chemical parameters (as outlined in Table 7.8 and Table 7.9). Routine chemical characterisation allows a detailed database of information to be collected over the years. It enables more regular monitoring for potential contaminants of concern that may be known to contribute to toxicity. This knowledge continues to be developed through ecotoxicity analysis of PFW, and in particular expanding these tests to identify contaminants causing or contributing to levels of toxicity. The process to be followed to assess the biannual chemical characterisation data and any potential change in risk is as follows: • Compare results to previous chemical composition data and assess the results for any significant changes (to be determined by the SEA and/or Production Chemist reviewing the data) that may be a potential indicator of change in overall toxicity and compliance with the relevant EPO. • Beach will engage experts to review the data in light of their knowledge of components contributing to PFW toxicity and toxicity more broadly. If such components have changed to a degree where there is uncertainty as to known toxicity from that defined from the last round of ecotoxicity testing, the PFW AMF will be followed and potential additional WET testing trigged if required. • The trigger for the allowable degree of effluent quality reduction in the six-monthly characterisation tests will be based on the concentrations of constituents in the PFW observed with the dilution factor (from the PFW modelling) applied to estimate the concentration of each PFW constituent at the edge of the mixing zone. The trigger for management measures will then be based on whether the trigger level (e.g., ANZG, 2018) is exceeded at the edge of the mixing zone. • Depending on which (if any) constituent is predicted to exceed a trigger at the edge of the mixing zone, further sampling/characterisation will be undertaken to test if the result was an anomaly or a WET testing event triggered to see if the constituent exceeding a trigger is resulting in an increase to toxicity of the PFW stream.	6-monthly	• Sampling & freight – Production Technician • Review of results - SEA, Production Chemist • Specialist consultants contracted as required

Program element	Explanation	Frequency	Responsibilities
WET testing	See discussion under 'PFW WET testing' for the methodology involved in undertaking WET testing. If WET testing is triggered through this AMF, then this testing may occur more or less frequently. The WET testing results will be analysed by a suitability qualified marine ecotoxicologist (or similar) to determine the sampling frequency (i.e., remain as is, increase or decrease). If results vary significantly between WET tests, see Table 7.22 to determine appropriate management actions.	6 monthly in the first year (2021)*^. After the first year, frequency to be determined in consultation with the marine ecotoxicologist (no less frequent than annually)	• Scoping, contracting, logistics and report review - SEA • PFW sampling, preservation and laboratory management – Production Technician
PFW plume dispersion verification monitoring	To be undertaken in late 2020 to validate the 2017 & 2020 plume modelling results, and undertaken five-early thereafter (or as otherwise triggered via the AMF). A specialist consultancy has been awarded a contract to undertake this work, with a monitoring design underway. Based on the monitoring results, appropriate management actions will be taken (see Table 7.23).	5-yearly, or more frequently if triggered by modelling results or AMF	• Scoping, contracting, logistics and report review – SEA • Program design and implementation – specialist consultant
Seabed sediment sampling	To be undertaken in late 2020 in accordance with the SQG to begin a baseline assessment against ANZG (2018) DGVs and NAGD Screening Levels. Depending on results, assessment will be made on requirements to undertake more routine sediment sampling, or if changes to PFW process are required (see Table 7.24).	5-yearly, or more frequently if triggered by sampling results or AMF	• Scoping, contracting, logistics and report review - SEA • Program design and implementation - specialist consultant

** Six-monthly WET testing is deemed to be a suitable frequency because it has increased from the previous frequency of three years to substantially more frequent due to the higher BTEX levels. A higher frequency than this is not appropriate as continuous TPH monitoring will trigger WET testing if there are any significant changes (i.e., increasing trend in TPH concentration).*

^ WET testing is due to occur in mid-December 2020 (or at the latest, in January 2021 if there are continued delays due to the COVID-19 pandemic travel restrictions).

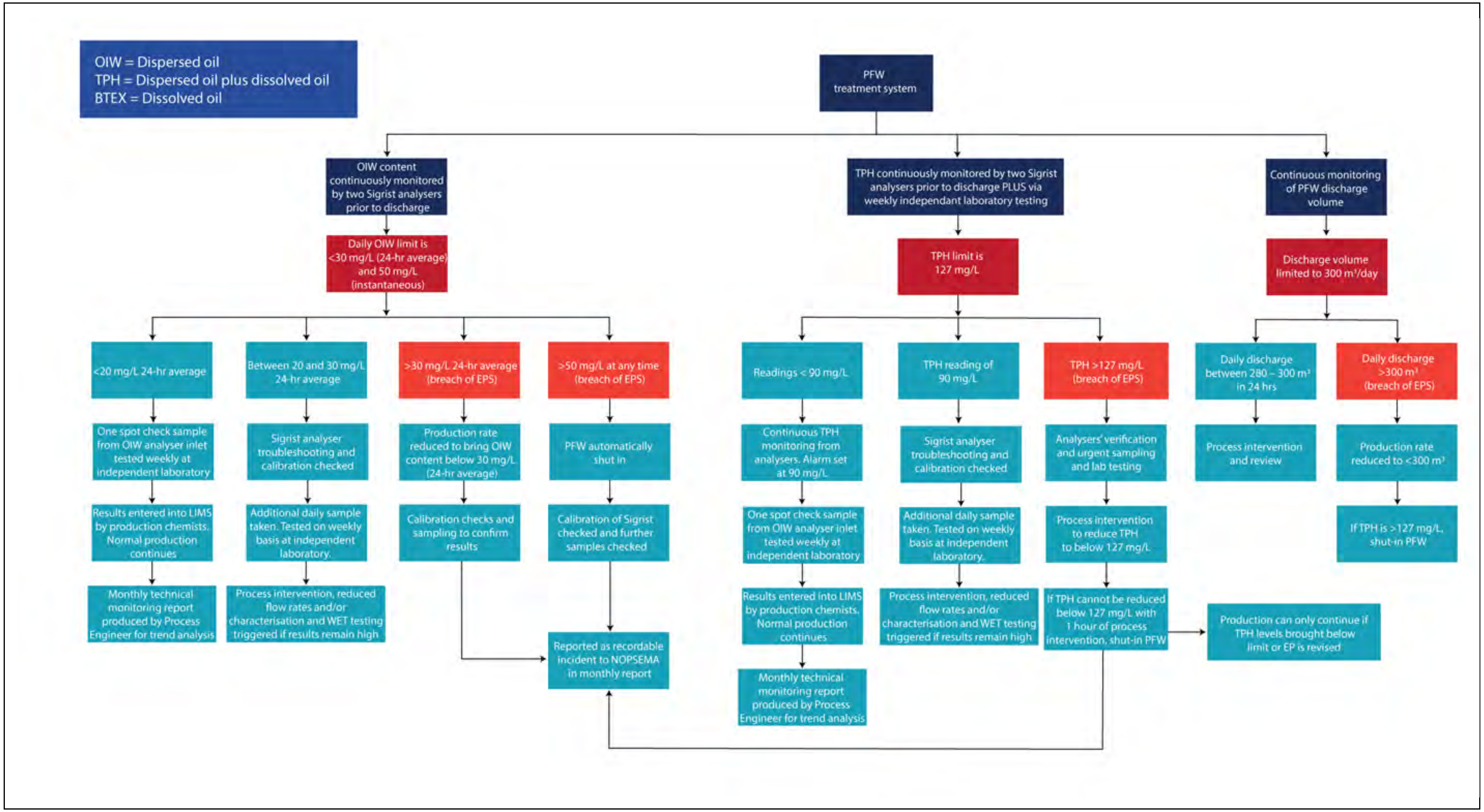


Figure 7.9. PFW adaptive management framework

Table 7.22. AMF Decision Tree – TPH

TPH limit (90 mg/L) triggered	Detailed steps	By who	Result	Consequence*
Review of operational conditions	Undertake investigation into operating conditions for TPH readings >90 mg/L or >127 mg/L If it is a slow, gradual increase in TPH concentrations and the process is steady with weekly OIW analyser calibration checks completed, change out the PWF elements. The Control Room Operator (CRO) requests the elements to be changed out when the alarm is active. If there is a spike in OIW analyser readings, check the following: - Is the flare KO drum pump online? - Is there excess water entering the production separator and not allowing sufficient residence time in separator or degasser? - Shut down the flare KO drum pump and monitor OIW analysers. - Is a new well being brought online? - Excess water into production separator not allowing residence time in separator or degasser? - Close in on choke and monitor OIW analysers. Obtain PFW sample for laboratory testing. The investigation and actions will be dependent on the rate of increase in TPH. Whether or not the increase in TPH is slow or rapid, the controls will be the same in that the asset will do everything it can to ensure the TPH limit of 127 mg/L is not exceeded, and the implementation of new trips will ensure this. If the benchmark of 90 mg/L is consistently exceeded, additional measures to control include: - Check process operations for abnormal operating conditions and rectify as appropriate. - Check that the PFW system is operating as normal and as expected, if not rectify as appropriate. - Check Sigrist analysers to ensure correct readings and rectify/calibrate as necessary. - Obtain additional PFW water samples for testing and verification to validate higher readings. - If caused by pumping from flare KO drum, reduce or cease pumping rate to ensure TPH will not exceed 127 mg/L. - Reduce PFW flowrates to control TPH and keep below 127 mg/L. - Reduce production rates to control TPH and keep below 127 mg/L.	PIC/CRO	Investigation completed – process condition known, with causes understood and readings have returned to between normal operating limits (40 to 80 mg/L TPH)	Note on LIMS spreadsheet reason for lower limit breach. Notify SEA. No further action. Continue normal operations.
			Investigation incomplete or causes are not known. TPH readings continue to be between 90 and 127 mg/L.	Continue investigation until completed with causes known (as per 'detailed steps' column). Reduce flowrates/ production rates if results remain high.
			Investigation complete with cause unknown or cause known but requires technical long lead intervention, and TPH readings over 127 mg/L.	Reduce PFW flowrates to control TPH and keep below 127 mg/L. Reduce production rates to control TPH and keep below 127 mg/L. PFW will be automatically shut in if TPH exceeds 127 mg/L AND PFW flow rate reaches 300 m^3/day. PFW will be automatically shut in if TPH exceeds 127 mg/L for a period of 60 minutes. Normal production cannot commence until causes known and resolved or alternative treatment technologies introduced to reduced TPH levels. EP revision may be required if issue cannot be resolved. WET testing will be triggered (see below).

TPH limit (90 mg/L) triggered	Detailed steps	By who	Result	Consequence*
WET testing and/or characteris-ation to be undertaken	Testing undertaken by suitably qualified environmental science consultancy: • Scoping, contracting, logistics and report review – SEA. • PFW sampling, preservation and laboratory management – Production Technician. Should triggers associated with PFW toxicity be detected through WET testing, sampling of biological indicators will be undertaken to ascertain whether contaminants are bioaccumulating within the tissues of biota growing on or occurring in the vicinity of Yolla-A. The objective of this component of the assessment will be to determine the likelihood of contaminants being passed from biota in the lower trophic levels to higher order predators (such as seals) at levels that may impact the health of the latter. The assessment will comprise two potential stages: • Stage 1 - Baseline assessment; and • Stage 2 - Triggered assessment. The baseline assessment will be implemented to provide a baseline against which results of any subsequent surveys may be compared. A triggered sampling event would take place when a trigger is exceeded in the results of WET testing of the PFW stream. The results of the triggered assessment would be compared to the baseline results to ascertain if the levels of toxicants taken up by biota have increased. The target indicator species comprise two sessile invertebrate filter feeder species and at least one fish species. A bivalve mollusc will be selected as an indicator species (likely *Mytilus edulis*) to be deployed in a caged rack at the platform. The second filter feeder species will be selected and sampled opportunistically from the platform structure itself. The species to be sampled will be determined during ROV inspection at the time of sampling. The fish species targeted will also be identified at the time of sampling depending on the species present and thought to be likely prey species for seals. Where contaminants in fish are found to be bioaccumulating, the following measures will be implemented and results reported within 3-6 months: 1. Undertake a risk assessment to assess potential implications to fisheries and to determine whether risks are ALARP (and therefore, that the EPO has been	SEA	Results are commensurate with existing WET testing results and indicate no increase in toxicity levels. TPH readings have returned to <90 mg/L.	No further action. If process investigation is complete, normal operations continue.
			Results indicate slight elevation of TPH levels but <127 mg/L. TPH concentrations either <90 mg/L or between 90 and 127 mg/L.	Continue to monitor. May commence further WET testing. With consideration of scope of testing to include biological monitoring as per the 'detailed steps' column. Continue investigation in alignment with above process intervention. Consider and prepare to cease production if required.
			TPH concentrations > 127 mg/L.	Reduce flow rates to keep TPH <127 mg/L or cease production if TPH cannot be reduced below this limit. EP revision or MoC may be required. Normal production cannot commence until causes known and resolved or alternative treatment technologies introduced to reduced TPH levels.

TPH limit (90 mg/L) triggered	Detailed steps	By who	Result	Consequence*
	achieved). This risk assessment would consider factors such as: a. Active fisheries present in the region and the proximity to Yolla-A in which they operate. b. Contaminant levels in the fish and biota tested. c. Likelihood of fish occurring within the immediate vicinity of Yolla-A, or higher order predator species in this area, being potential target species for fisheries. 2. Undertake study to assess risk to higher order predators (e.g., seals) that considers the contaminant concentrations detected within the biota tested and the likely consumption required to pose a risk to their health. If it can be demonstrated that the risk is ALARP, then it is considered that the EPO will have been achieved.			

* *Colour coding follows the 'traffic light' system (green = proceed as normal, amber = caution/take action, red = stop/take action).*

Table 7.23. AMF – plume verification study

Steps	By who	Result	Consequence*
Undertake plume verification study utilising suitably qualified environmental consultancy: • Scoping, contracting, logistics and report review – SEA. • Program design and implementation - specialist consultant.	SEA	Plume verification study completed with results showing plume dispersion modelling is accurate and in line with modelled mixing zone range.	No further action. Continue to continuously monitor and apply AMF. Continue to re-check plume monitoring on 5-yearly basis. Normal operations continue.
		Plume verification study completed with results showing modelling is inaccurate (i.e., under predicting the extent of the low confidence single constituent mixing zone).	Reduce PFW flow rates to 50% of current production to reduce plume extent to within the modelled range (less than the 693 m extent of the low confidence single constituent mixing zone), or cease production. Undertake plume verification modelling based on most recent WET testing results to determine the new mixing zone range. Undertake additional vessel-based plume monitoring to verify that the conditions at the boundary of the mixing zone are being met. EP revision or MoC required.

* *Colour coding follows the 'traffic light' system (green = proceed as normal, amber = caution/take action, red = stop/take action).*

Table 7.24. AMF – seabed sediment sampling study

Steps	By Who	Result	Consequence*
Undertake seabed sediment sampling utilising suitably qualified environmental science consultancy: • Scoping, contracting, logistics and report review – SEA. • Program design and implementation - specialist consultant. • Results to be compared to ANZG (2018) DGVs and NAGD Screening Levels • Undertake an attributability assessment considering any unplanned releases and/or in-field operations that have the potential to affect sediment quality. • Sediment sampling points will be based on PFW plume modelling.	SEA	Study completed with results showing sediment quality is in line with ANZG (2018) DGVs and NAGD Screening Levels.	No further action. Continuously monitor and apply AMF. Continue to undertake 5-yearly sediment sampling. Normal operations continue.
		Study completed with results showing sediment quality is outside ANZG (2018) DGVs and NAGD Screening Levels. Assessment determines exceedances in criteria are attributable to a non-PFW discharge source.	Undertake sediment remediation study as part of future Yolla decommissioning program.
		Study completed with results showing sediment quality is outside ANZG (2018) DGVs and NAGD Screening Levels with impacts linked to PFW discharge.	Within 2 months of detecting a trigger being exceeded, undertake bioavailability assessment and, where results suggest bioavailability exceeds ANZG (2018) or NAGD criteria, implement additional targeted seabed sediment sampling (within 3-6 months of bioavailability results) to ascertain the extent of elevated toxicant concentrations to inform future sediment quality monitoring events. Undertake sediment remediation study.

** Colour coding follows the 'traffic light' system (green = proceed as normal, amber = caution/take action, red = stop/take action).*

Table 7.25. Triggers for non-routine PFW monitoring

Trigger	Indicative verification monitoring
Change in process chemicals in PFW stream	• A change in process chemicals will be planned in advance and approved according to the Chemical Selection and Management Procedure and MoC procedure. • If the chemical approval process identifies the potential for increased risk, further desktop studies will be undertaken to ensure the NOEC for that chemical can be achieved within the approved mixing zone prior to any change being implemented. • Increased risk would be associated with factors such as the addition of large batch volumes of chemicals (>100 litres/day) for high toxicity chemicals (e.g., non-OCNS 'Gold'/'Silver' or 'D'/'E' rated).
Increase in process chemical concentration in PFW stream discharge	• Increases in process chemical concentration will be planned in advance. • Prior to approval, a desktop study will be undertaken (e.g., dilution assessment) to assess changes in risk, and impact to existing compliance. • If desktop analyses indicate potential for a compliance breach, further toxicity assessments will be undertaken to determine whether compliance is achievable.
Increase in average OIW concentration output	• This is monitored via the monthly technical monitoring report. If there is a significant increasing trend, further action will be undertaken to investigate the reason. This will consist of process intervention, consideration of characterisation and potential further WET testing. • A significant increase would be considered to be a large change (e.g., 10 mg/L) over a short period (e.g., three months) or a moderate change (e.g., 5 mg/L) over a longer period (e.g., six months).
Increase in TPH (OIW plus BTEX)	• This is monitored continuously through the Sigrist analysers. • Trends are also monitored through weekly laboratory verification tests and via the Monthly Technical Monitoring Report. If there is any t increasing trend, further action will be undertaken to investigate the reason. This will consist of process intervention, consideration of characterisation and potential further WET testing. • The benchmark trigger for process intervention is 90 mg/L given that normal operating conditions are between 40-80 mg/L.
Change to process assumptions such as new wells	• Any change such as bringing on new wells will trigger a requirement for revising modelling assumptions, flowrates, concentrations etc. If it is concluded that current limits may be exceeded, this may result in an EP revision. This will be evaluated prior to any changes as part of the MoC Process.

The EPO was developed based on the 2019 WET testing and 2017 & 2020 PFW dispersion modelling. The following interpretations apply:

- NOEC – dilution is sufficient to ensure effluent at the boundary of the protection zone protects 100% of species, as calculated using the ANZG (2018). The protection of 100% of species maintains the highest level of ecological protection and represents no detectable change from natural variation and no impact to the receiving environment outside the mixing zone, with negligible and acceptable impact within the mixing zone.
- Within an accepted mixing zone – based on PFW WET testing and plume dispersion modelling, Beach defines the accepted PFW mixing zone for Yolla-A as the marine waters within a high reliability distance of 7.3 m to a low reliability distance of 693 m from the PFW discharge point.
- Note the upper end range is based on worst-case single constituent ANZECC 99% species protection value (which is superseded by the ANZG (2018) methodology).

Meeting this EPO provides a high level of ecological protection from PFW discharges to achieve no detectable change from natural variation.

7.6.6 Impact assessment

Table 7. 26 presents the impact assessment for PFW discharges.

Table 7. 26. Impact assessment for PFW discharges

Summary		
Summary of impacts	Reduction in water quality. Toxicity impacts to fauna within the mixing zone.	
Extent of impact	Mixing zone ranging from 7.3 m (high reliability) to 693 m (low reliability) from the discharge point.	
Duration of impact	Ongoing for the life of operations.	
Level of certainty of impact	HIGH – the impacts of PFW discharges are well studied and understood. Studies on the North West Shelf and recent studies in the Gippsland Basin, together with WET testing and plume modelling undertaken for Yolla-A contribute to this level of certainty.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Moderate		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
No impact to the marine environment outside the mixing zone boundary. Impacts within the mixing zone are kept to acceptable levels.	Implement the Yolla PFW Sampling and Testing Maintenance Procedure (CDN/ID 10020479), which involves: • Continuous automatic analysis of dispersed OIW concentrations using two analysers working in parallel to ensure:	PFW log (stored in DCS Bablefish) verifies continuous OIW concentration monitoring is in place.

No significant impact to MNES within the mixing zone.	○ No discharge >50 mg/L at any time. ○ Discharges average <30 mg/L over any 24-hr period.	CMMS contains records of alarm trips for any recordings >50 mg/L.
	• PFW with dispersed OIW concentration >50 mg/L results in automatic PFW shut-in to prevent overboard discharge of over-specification PFW.	CMMS records verify that over-specification water results in cessation of PFW discharge.
		Incidents of OIW concentration >50 mg/L are captured in the OMS incident register.
	• Twice daily manual logging of the PFW OIW concentrations are undertaken by the Control Room Operator to validate analyser readings.	PFW sample log verifies continuous OIW concentration monitoring is in place.
	• Continuous automatic analysis of TPH concentrations using the existing two Sigrist analysers working in parallel to ensure TPH concentrations are not >127 mg/L at any time.	Live data is recorded in Historian.
	• PFW with TPH concentration >127 mg/L for a period of one hour results in automatic PFW shut-in to prevent overboard discharge of over-specification PFW.	CMMS records verify that over-specification water results in cessation of PFW discharge.
		Incidents of TPH concentration >127 mg/L are captured in the OMS incident register.
	• TPH concentration is verified weekly via sampling and independent laboratory testing to confirm accuracy of the Sigrist data.	Laboratory PFW test results are logged in LIMS spreadsheet and verify weekly sampling frequency and results are within limits.
	• Testing for benzene and mercury concentrations takes place (as part of the PFW characterisation testing) to confirm concentrations are <30 ppm and <50 ppb, respectively.	LIMS spreadsheet records data. Characterisation report review by environmental specialist is on file.
	Only low toxicity process chemicals (i.e., PLONOR, 'D'/'E' (non-CHARM) or 'Gold'/'Silver' (CHARM) OCNS-rated) are discharged with the PFW stream.	Chemical inventory verifies low toxicity nature of process chemicals discharged with the PFW stream.
	The two IMO-approved OIW Sigrist analysers are cleaned and calibrated weekly in line with the Yolla OIW Analyser Weekly Maintenance Procedure (CDN/ID 3972825).	CMMS records verify cleaning and calibration occurs in line with the procedure.
	Total PFW volume is monitored daily and recorded in LIMS spreadsheet to ensure the worst-case volume (300 m^3/day) used for plume modelling is not exceeded (with alarm set at 300 m^3/day). A discharge rate >300 m^3/day results in PFW shut-in.	BableFish database records daily PFW discharge total volume and confirm volume does not exceed 300 m^3/day.
		CMMS records verify that cessation of PFW discharge takes place if discharge rate is >300 m^3/day.
		Incidents of a PFW discharge rate >300 m^3/day are captured in the OMS incident register.

	PFW characterisation is undertaken six-monthly to confirm the constituents of the PFW have not significantly changed year-on-year.	LIMS spreadsheet records characterisation data frequency to ensure no significant change. Characterisation report review by environmental specialist is on file.
	Trained and experienced operators manage the PFW system in accordance with Yolla-specific requirements.	CBTA training records verify operators' competency to manage the PFW system.
		All operators are inducted into the PFW training module.
	Sampling and verification monitoring	
	PFW WET testing is undertaken six-monthly (starting late 2020 or early 2021 at the latest) or annually based on the AMF (see Table 7.22 & Table 7.25).	WET test reports are available and confirm results still within the set limits and appropriate actions taken in line with the AMF.
	PFW plume dispersion verification monitoring is undertaken every 5 years or as triggered via AMF, to ensure that data used to calculate the mixing zone remains current (see Table 7.23).	PFW plume dispersion modelling reports (prepared to schedule – 2020 & 2025) are available and confirm mixing zone is still within the predicted range.
	Sediment sampling is undertaken in 2020 to characterise sediment quality and impacts that may be attributable to the PFW discharge (see Table 7.24).	Sediment sampling report is available and appropriate actions taken in line with the AMF.
	Sediment sampling is undertaken every 5 years, or as triggered via AMF (see Table 7.24), to ensure that sediment quality data remains current.	Sediment sampling reports are available.
	Reporting	
	Instances where instant dispersed OIW concentration are >30 mg/L, TPH over 127 mg/L or total PFW discharge volume is over 300 m^3/day are reported to NOPSEMA in the monthly recordable incident report.	Monthly recordable incident reports.
Impact Consequence (residual)		
Minor		
Demonstration of ALARP		
A 'minor' residual consequence rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required. However, because PFW discharge is one of the largest continuous discharges from the platform, an ALARP analysis is presented below.		
Good practice		
Avoid/Eliminate	Eliminating PFW generation, and therefore discharge, is not possible. Alternatives to overboard PFW have been identified and analysed and are not feasible due to their prohibitively high costs (see 'engineering risk assessment' over page).	
Change the likelihood	No options identified.	
Change the consequence	Continuous platform-based TPH monitoring has been implemented as a result of this EP revision so as to have the ability to detect exceedances of the TPH sooner than was previously available (i.e., weekly laboratory testing) so that adaptive management is triggered sooner.	

Reduce the risk	The EPS listed in this table reduce the risk associated with PFW discharges.
Engineering risk assessment	

Beach commissioned AECOM to undertake an ALARP assessment of Yolla PFW management. The results of this assessment are summarised here. The AECOM (2020) report is presented in **Appendix 9**.

PFW treatment options

There are various methods of PFW treatment used in offshore production systems in Australia, with the system used on Yolla-A being similar to most of the other platforms in Australian waters. The monitoring results demonstrate that the treatment system used at Yolla-A is effective in removing dispersed oil to keep it below the acceptable limits, and that all contaminants in the PFW stream, including TPHs, do not result in significant environmental impacts within the mixing zone due to its rapid dilution, dispersion and the mobility of species that move through the mixing zone.

After assessing more than 70 PFW treatment technologies, consideration for treatment options most relevant to BassGas operations was narrowed down to the following four treatment options:

- PFW reinjection wells – all four wells on Yolla are required for production. Therefore, a new well would need to be drilled once a sub-surface structure that could accept the PFW was evaluated and identified. A new well would cost roughly $40 million, excluding rig mobilisation/demobilisation cost, injection pumps and xmas tree). A reinjection well would mean additional space is required on the platform, another conductor, hydraulic control system and so forth. While PFW discharges to sea would be avoided, this option requires additional energy to construct and install the well and operate the reinjection pump/s and the use of additional chemicals.
- Discharge to shore via pipeline – this option involves no separation of PFW on the platform, but discharge to the LLGP. There would be the need for substantial chemical injection (MEG) and corrosion inhibitors through the pipeline. The supply of MEG to the platform would require either a pipeline or regular delivery by vessel. The PFW would be separated at the LLGP and would require the construction of evaporation ponds. It would be necessary to obtain an EPA works approval as well as other approvals. While PFW discharges to sea would be avoided, this option moves treatment to an onshore solution (with associated impacts), additional energy to construct and install the pipeline and operate the pumps, and the saline nature of the PFW means that it cannot be reused or recycled (e.g., land irrigation) without substantial treatment facilities. This option was rejected in a 2009 study due to the high capital and operating cost (noting the dollar values here are for 2009):
  - MEG pipeline - $116 million capital cost and $0.2 million annual operating cost.
  - MEG vessel delivery - $55 million capital cost and $9.5 million annual operating cost.
- PFW stripping – two stripping options have been identified and considered, as described below. These options do not avoid discharges but do recover some hydrocarbons.
  - The gas stripper utilises the fuel gas produced in the platform to strip volatiles from the PFW. This system was used on Yolla-A from 2006-2009 but was removed due to its inefficiency at removing BTEX. This option was therefore not considered further in this assessment, but the installed cost would be about $7.9 million.
  - The steam stripper comprises of a demineralised water package, a steam stripper and associated pumps, tie-ins and demolition of some elements on the platform. The screening level estimated capital cost is $18.2 million, and the operating cost has not been estimated. The power consumption estimate is equivalent to 400 kW using fuel gas. This option requires additional energy to produce and pump steam.
- Macro Porous Polymer Extraction (MPPE) – this comprises of a demineralised water package and ion exchange beds, pumps, the MPPE unit, tie ins and demolition. The screening level estimated capital cost is $15.4 million and the operating cost has not been estimated. The power consumption estimate is 75 kW. These options do not avoid discharges but do recover some hydrocarbons, albeit requiring additional energy for steam production and pumping.

The two following options were ruled out as they are most relevant to treating dispersed oil rather than dissolved oil:

- Dissolved gas/induced gas flotation – this technology is used to remove dispersed hydrocarbons through flotation. The floated hydrocarbons are a waste stream to be managed. The systems are not useful in removing dissolved hydrocarbons (i.e., BTEX). The flotation unit would be in an enclosed vessel about 2 m in diameter and 1-2 m high and require integration (including compression) into the existing production system. Given this system is not useful at removing BTEX and that dispersed hydrocarbons in the PFW stream are already very low, this treatment system is not suitable for use on Yolla-A.
- Adsorption filters – these remove dispersed hydrocarbons through filtration and are not useful in removing dissolved hydrocarbons (i.e., BTEX). This system generates a contaminated filter waste stream that requires

management and disposal. The size of the unit could be in the order of 1-2 m high and 1-2 m width depending on the configuration of the filters. Given this system is not useful at removing BTEX and that dispersed hydrocarbons in the PFW stream are already very low, this treatment system is not suitable for use on Yolla-A.

It is concluded that the cost of implementing any of the six options described above is grossly disproportionate to the environmental benefit of implementing any of the options. This is because:

- The PFW flow and total volume discharged is low (especially when compared to other platforms in Australia);
- The toxicity (as measured by the WET testing) demonstrates that there are minor effects within the mixing zone;
- The extent of the mixing zone range is small; and
- The AMF and monitoring program are effective controls, with adequate triggers in place to ensure limits are not breached.

Therefore, it is concluded that the current PFW treatment system represents a solution that is ALARP.

Additional TPH monitoring options

- Daily TPH sampling and laboratory analysis - the cost of sending PFW samples to shore daily for TPH analysis using the helicopter service would add over $60,000 a week (or over $3 million/yr) to the current monitoring regime. While this would allow Beach to more accurately monitor TPH concentrations (than the Sigrist analysers), the costs associated with undertaking this sampling regime are grossly disproportionate to the environmental impacts given the 'minor' residual consequence of PFW discharges.
- Using a laboratory on the platform for TPH monitoring - the cost of installing and maintaining a laboratory on the platform has been investigated. This is not a feasible option because it would require a dedicated room on the platform for the laboratory and to accommodate a full-time laboratory technician, which is not available (the platform was initially designed as an unmanned facility prior to the MLE upgrade). If this additional space needs to be installed, this would cost in the tens of millions of dollars. If theoretically there was the room currently available for a laboratory and associated personnel on the platform, the cost of buying, installing and commissioning the equipment would be in the order of several hundred thousand dollars, plus the associated cost of equipment servicing, calibrations and so forth. Such a laboratory would be unlikely to be NATA-accredited, meaning that samples would still need to be sent ashore for correlation with the laboratory test results. These costs are grossly disproportionate to the 'minor' residual consequence of PFW discharge.

Cost benefit analysis
A cost benefit analysis is covered in the engineering risk assessment detailed above.

Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Non-regulatory stakeholders have not raised concerns about PFW discharges. NOPSEMA has conducted several audits of the Yolla-A PFW management arrangements since the last EP submission in 2014. The EPS presented in this table reflect changes made to PFW management as a result of these audits.	
Legislative context	The performance standards outlined in this EP align with the requirements of: • *Protection of the Sea (Prevention of Pollution by Ships) Act* 1983 (Cth): ○ Part II (Prevention of Pollution by Oil). • AMSA Marine Orders Part 91 (Oil Pollution), enacting MARPOL Annex I.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Produced water – minimise the amount of PFW that is produced, evaluate options for treatment and disposal, where offshore discharge is the selected disposal

		option, establish mitigation targets, design the discharge outfall to maximise dispersion.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: • Produced water handling and management (item 23). The BAT are met for Yolla-A operations. The option of reinjecting PFW downhole is not available at Yolla-A.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines with regard to PFW management (items 30, 32, 33, 34, 35 and 36) were met in the planning phase of the development.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the impact of PFW on the marine environment to ALARP and to an acceptable level; and • To reduce the impact of routine waste discharges on the marine environment to ALARP and to an acceptable level.
	Environmental management in oil and gas exploration and production (UNEP IE, 1997)	The EPS listed in this table meet the environmental protection measures listed for offshore development and production activities, which specify that PFW must meet local regulations or company specified standards prior to discharge.
	PFW-specific guidelines	
	Risk Based Assessment of Offshore Produced Water Discharges (IOGP, 2020)	This provides guidance on the assessment and management of potential toxic risks to the marine environment caused by PFW. The guidelines aim to improve consistency in the application of assumptions, levels of conservatism and selection of risk endpoints. The risk-based assessment framework described in Section 2.3 of the guidelines is applied to the management of Yolla PFW discharges (e.g., ANZG (2018) guidelines followed for WET testing). Distinctions between dispersed and dissolved hydrocarbons are not made in this guidance document, with the term OIW applied throughout.
	ANZG (2018)	Beach commissioned AECOM to undertake WET testing on the Yolla PFW, which used these guidelines to determine whether the impacts to various test species are ALARP.
	OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore dispersed	The purpose of this Recommendation is to eliminate pollution by oil and other substances caused by discharges of PFW into the sea. The main EPS for this OSPAR Recommendation is that individual offshore installations should not exceed 30 mg/L dispersed oil in PFW and that the method used to determine this is as per OSPAR Agreement 2005/15.
	OSPAR Reference Method for Analysis for the Determination of the Dispersed Oil Content in Produced Water (Agreement 2005/15)	This agreement provides guidance on the methodology for determining dispersed OIW concentrations. The laboratory PFW testing uses this methodology.

	OSPAR Recommendation 2012/5 for the Risk-based Approach to the Management of Produced Water Discharges from Offshore Installations	The purpose of this Recommendation is to provide general guidance for undertaking PFW environmental risk assessments, based on the determination of NOEC.
Environmental context	MNES	
	AMPs (Section 5.4.1)	The PFW mixing zone does not intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	The PFW mixing zone does not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	The PFW mixing zone does not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	The PFW mixing zone does not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	The PFW mixing zone is so small that the localised reduction in water quality does not result in significant effects to populations of threatened or migratory fauna.
	Other matters	
	State marine parks (Section 5.4.9)	The PFW mixing zone does not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The following threatened species management plans for species that may migrate past Yolla-A list habitat degradation (including pollution from toxic pollutants) as a threat: • Blue whale (DoE, 2015); • Southern right whale (DSEWPC, 2012); • Humpback whale (TSSC, 2015); • Sei whale (TSSC, 2015); • Fin whale (TSSC, 2015); and • Grey nurse shark (DoE, 2014). The controls listed in this table, combined with the fact that these species are mobile and transitory in the area (i.e., they do not reside in the PFW mixing zone or do not spend extended periods of time in it), means that the threat of toxicity listed in these plans is not likely to materialise for these species. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
• PFW sampling and testing (as per CDN/ID 10020479).		

- Yolla PFW OIW Testing Philosophy (as per technical note).
- Yolla OIW analyser changes (Rev 4) (CRB-BASSGAS-1743).
- PFW plume verification monitoring.
- Seabed sampling program.

Record Keeping
• PFW OIW test results (Sigrist analysers, manual and laboratory). • PFW OIW calibration records. • PFW LIMS spreadsheet. • BabelFish database. • Historian database. • Monthly Technical Monitoring report. • Laboratory test results. • Characterisation reports. • WET testing data and reports. • Plume modelling and verification data and reports. • Sediment sampling data and reports.

7.7 IMPACT 7 – Routine Discharges - Putrescible Waste

7.7.1 Hazards

The generation of food waste (putrescible waste) from the platform and vessel galleys will result in the overboard discharge of this waste. On Yolla-A, the macerator discharges food scraps via the sewage caisson 7 m below sea level.

The average volume of putrescible waste discharged overboard depends on the number of POB at any time, and the types of meals prepared. However, some anecdotal reports estimate this volume to be in the order of 1-2 kg per person per day (NERA, 2018). On Yolla, approximately 10-15 litres of putrescible waste are generated daily.

7.7.2 Known and potential environmental impacts

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

- Temporary and localised increase in the nutrient content of waters surrounding the discharge point; and
- An associated increase in scavenging behaviour of marine fauna and seabirds (at the sea surface or within the water column).

7.7.3 EMBA

The EMBA for putrescible waste discharges is likely to be the top 10 m of the water column and a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex, Western Australia).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans, pinnipeds); and
- Avifauna.

7.7.4 Jurisdiction of hazard

The jurisdictions in which this hazard occur are outlined in the box overpage.

Commonwealth waters	Victorian waters
Yes	No
The platform is located in Commonwealth waters and discharges putrescible waste. Vessels engaged in maintenance activities working alongside the platform or RGP in Commonwealth waters may also discharge putrescible waste.	Vessels engaged in maintenance activities along the RGP are not permitted to discharge putrescible waste in Victorian waters.

7.7.5 Evaluation of Environmental Impacts

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

The impacts of putrescible waste discharges to the physical and biological environment are expected to have insignificant consequences because of the:

- Small discharge volumes;
- Intermittent nature of the discharge;
- Maceration of the waste prior to discharge;
- High dilution and dispersal factor in open waters;
- Long distance from shore;
- Rapid consumption by fauna;
- High biodegradability and low persistence of the waste; and
- The absence of sensitive habitats in the activity area.

7.7.6 Impact Assessment

Table 7.27 presents the impact assessment for putrescible waste discharges.

Table 7.27. Impact assessment for putrescible waste discharges

Summary		
Summary of impacts	Increase in nutrient content of near-surface waters around the discharge point, which may lead to an increase of scavenging behaviour of pelagic fish and seabirds.	
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Intermittent and temporary – until the discharge is completely diluted (likely to be several hours).	
Level of certainty of impacts	HIGH – the impacts of putrescible waste discharges on marine fauna are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria

Putrescible waste discharges comply with AMSA Marine Order 95 (Marine pollution prevention – garbage), which enacts MARPOL Annex V.	**Platform**	
	A MARPOL Annex V-compliant Garbage Management Plan (GMP) is in place for the platform (and for vessels >100 GRT tonnes or certified to carry 15 persons or more) that sets out the procedures for minimising, collecting, storing, processing and discharging garbage.	**Platform:** A Waste Management Plan (CDN/ID 3974553) is in place and kept current. **Vessels (>100 t):** A GMP is in place, readily available and kept current.
	A MARPOL Annex V-compliant macerator is on board the platform and vessels, functional, in use and set to macerate putrescible waste to a particle size ≤25 mm using to ensure rapid breakdown upon discharge.	**Platform**: CMMS records verify that the macerator is functional and regularly maintained and/or replaced. **Vessels:** PMS records verify that the macerator is functional and regularly maintained or replaced.
	Waste management and housekeeping requirements are communicated to all personnel boarding the platform and vessels to ensure discharges are in accordance with MARPOL Annex V.	**Platform:** Training matrix with populated induction records verifies the training is undertaken by all crew members. **Vessels:** Vessel induction includes waste management requirements.
	Records of food waste disposal to be maintained in a Garbage Record Book.	A Garbage Record Book is in place and verifies waste discharge locations and volumes.
	Vessels	
	Macerated putrescible waste (≤25 mm) is only discharged overboard when the vessel is >3 nm from the shoreline.	A Garbage Record Book is in place and verifies waste discharge locations and volumes.
	Un-macerated putrescible waste is only discharged overboard when the vessel is >12 nm from the shoreline and outside Yolla-A's PSZ.	
	For vessels without a macerator and for non-putrescible galley waste, waste is returned to shore for disposal.	

Impact Consequence (residual)

Minor

Demonstration of ALARP

A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability

Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about putrescible waste discharges.

Legislative context	The performance standards outlined in this EP align with the requirements of:
	• *Navigation Act* 2012 (Cth):
	  o Chapter 4 (Prevention of Pollution).
	  o AMSA Marine Order 95 (Marine Pollution Prevention - garbage).
	• *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth):

	○ Section 26F (which implements MARPOL Annex V). • *POWBONS Act* 1986 (Vic): ○ Section 23B (Prevention of pollution by garbage).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Food waste – ensure food waste is macerated to MARPOL standards prior to overboard discharge.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: • Environmental monitoring (item 26). The BAT are met for Yolla-A operations with regard to monitoring waste streams.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Other waste waters (item 44). Food waste from the kitchen should, at a minimum, be macerated to acceptable levels and discharged to sea, in compliance with MARPOL requirements.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	Putrescible waste discharges do not intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	Putrescible waste discharges do not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	Putrescible waste discharges do not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Putrescible waste discharges do not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	Putrescible waste discharges do not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	This hazard does not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The discharge of putrescible waste does not compromise the specific objectives or actions (regarding marine pollution) of the Albatross and Giant Petrels Recovery Plan (DSEWPC, 2011) or any of the other species Recovery Plans, Conservation Management Plans or Conservation Advice referenced in this EP. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.

ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).
Environmental Monitoring	
• Volume/weight of non-macerated waste sent ashore.	
Record Keeping	
• GMP. • CMMS (platform)/PMS (vessel) records. • Garbage Record Books (platform and vessels).	• Training matrix. • Induction records.

7.8 IMPACT 8 – Routine Discharges - Sewage and Grey Water

7.8.1 Hazards

On the platform and vessels, the use of ablution facilities results in the discharge of treated sewage and the use of laundries, showers, kitchens and hand basins results in the discharge of 'grey water' to the ocean. The composition of sewage and grey water (particularly when untreated) may include:

- Particulate matter – such as solids composed of floating, settleable, colloidal and dissolved matter, substances that affect aspects of aesthetics such as ambient water colour, the presence of surface slicks/sheens and odour.
- Chemicals – including:
  - Nutrients (e.g., ammonia, nitrite, nitrate and orthophosphate);
  - Organics (e.g., volatile and semi-volatile organic compounds, oil and grease, phenols, endocrine disrupting compounds); and
  - Inorganics (e.g., hydrogen sulphide, metals and metalloids, surfactants, phthalates, residual chlorine);
- Biological pathogens – including bacteria, viruses, protozoa and parasites.

Yolla-A usually accommodates between five to eight (5-8) POB, and both grey water and sewage are managed through a sewage treatment plant (STP) sized for a maximum of 44 POB. On Yolla-A, sewage and grey water is discharged via the sewage caisson 7 m below sea level.

7.8.2 Known and potential environmental impacts

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

- Temporary and localised increase in the nutrient content of surface waters around the discharge point.

7.8.3 EMBA

Given the buoyant nature of sewage and grey water discharges, the EMBA 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, Western Australia), 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).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Pelagic fauna (plankton, fish, cetaceans and pinnipeds); and
- Seabirds.

7.8.4 Jurisdiction of hazard

The jurisdictions in which this hazard occurs are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	No
The platform is located in Commonwealth waters and discharges treated sewage and grey water. Vessels engaged in maintenance activities working alongside the platform or RGP in Commonwealth waters may also discharge sewage and grey water.	Vessels engaged in maintenance activities along the RGP are not permitted to discharge treated or untreated sewage and grey water in Victorian waters.

7.8.5 Evaluation of Environmental Impacts

Water quality

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. Given the tidal movements and currents in open oceanic waters, eutrophication of receiving waters will not occur. Sewage will be treated through STPs to a tertiary level, so there are no impacts relating to the release of chemicals and pathogens in untreated sewage.

Grey water 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 treated through the STP, so pollutants will be largely removed from the discharge stream.

The effects of 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 m, 100 m 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 onboard a drill rig (typically 100-120) compared with the 5-8 POB Yolla-A and up to several dozen POB the PSV and other vessels, and because vessels are mobile (compared with a drill rig anchored on location).

Treated sewage and grey water discharges will be rapidly diluted in the surface layers of the water column and dispersed by currents. The biological oxygen demand 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.

Biological receptors

Plankton forms the basis of all marine ecosystems, and plankton communities have a naturally patchy distribution in both space and time (ITOPF, 2011a). They are known to have naturally high mortality rates (primarily through predation), however in favourable conditions (e.g., supply of nutrients), plankton populations can rapidly increase. Once the favourable conditions cease, plankton populations will collapse and/or return to previous conditions.

Plankton populations have evolved to respond to these environmental perturbations by copious production within short generation times (ITOPF, 2011a).

Any potential change in plankton diversity, abundance and composition as a result of treated sewage and grey water discharges is expected to be very low (given the waste stream is treated) and localised (as outlined in the EMBA), and is likely to return to background conditions within tens to a few hundred metres of the discharge location (NERA, 2017). Accordingly, impacts higher up the food chain (e.g., fish, reptiles, birds and cetaceans) are expected to be negligible.

Social impacts

Treated sewage and grey water discharges will not have any impacts social activities in or around the activity area because of the long distance between recreational beaches (swimming and fishing) and Yolla-A (and most vessel-related activities) and because there are no recognised dive sites (e.g., shipwrecks, reefs) around the platform and pipeline.

The impacts of treated sewage and grey water discharges to the physical, biological and social environment are expected to have negligible consequences because of the:

- Low discharge volumes;
- Intermittent nature of the discharge;
- Treatment of the waste stream prior to discharge;
- High dilution and dispersal factor in open waters;
- Distance from shore;
- High biodegradability and low persistence of the waste; and
- Absence of sensitive habitats in the activity area.

7.8.6 Impact Assessment

Table 7.28 presents the impact assessment for the discharge of treated sewage and grey water.

Table 7.28. Impact assessment for the discharge of treated sewage and grey water

Summary	
Summary of impacts	Reduction in water quality around the discharge point, increase in nutrients.
Extent of impacts	Localised – up to 50 m horizontally and 10 m vertically from the discharge point.
Duration of impacts	Temporary – until the discharge is completely diluted (likely to be minutes to hours).
Level of certainty of impact	HIGH – the impacts of sewage and grey water discharges water quality are well known.
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.
Impact Consequence (inherent)	
Minor	
Environmental Controls and Performance Measurement	

<table>
<tr><th>EPO</th><th>EPS</th><th>Measurement criteria</th></tr>
<tr><td rowspan="3">Comply with MARPOL Annex IV by treating sewage and grey water prior to overboard discharge.</td><td colspan="2">Platform</td></tr>
<tr><td>Sewage and grey water are treated in a MARPOL-compliant STP prior to overboard discharge.</td><td>ISPP certificate is available and current for the platform and vessels.</td></tr>
<tr><td>The STP is maintained in good working order in accordance with the Yolla-A CMMS and vessels' PMS.</td><td>CMMS records (platform) and PMS records (vessels) verify that the STP is maintained in accordance with OEM requirements.</td></tr>
<tr><td rowspan="3">There is no discharge of treated or untreated sewage and grey water in state waters (<3 nm from shore).</td><td colspan="2">Vessels</td></tr>
<tr><td>In accordance with Regulation 11 of MARPOL Annex IV (as enacted by Marine Order 96), sewage is comminuted, disinfected and only discharged when:
• Vessel is >3 nm from nearest land.
• Sewage originating in holding tanks is discharged at a moderate rate while the vessel is proceeding en route at a speed not less than 4 knots.</td><td>Records verify that treated sewage is only discharged when the vessel is >3 nm from shore.</td></tr>
<tr><td>In accordance with Regulation 11 of MARPOL Annex IV (as enacted by AMSA Marine Orders Part 96), <u>untreated</u> sewage and grey water is only discharged when the vessel is >12 nm from shore (e.g., in the event of STP malfunction) and outside the Yolla-A PSZ.</td><td>Records verify that untreated sewage is only discharged when the vessel is >12 nm from shore and outside the Yolla-A PSZ.</td></tr>
<tr><td colspan="3">Impact Consequence (residual)</td></tr>
<tr><td colspan="3">Minor</td></tr>
<tr><td colspan="3">Demonstration of ALARP</td></tr>
<tr><td colspan="3">A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.</td></tr>
<tr><td colspan="3">Demonstration of Acceptability</td></tr>
<tr><td>Policy compliance</td><td colspan="2">Beach Environmental Policy objectives are met through implementation of this EP.</td></tr>
<tr><td>Management system compliance</td><td colspan="2">Chapter 8 describes the EP implementation strategy employed for this activity.</td></tr>
<tr><td>Stakeholder engagement</td><td colspan="2">The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues.
Stakeholders have not raised concerns about sewage and grey water discharges.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The performance standards outlined in this EP align with the requirements of:
• Navigation Act 2012 (Cth):
o Chapter 4 (Prevention of Pollution).
o AMSA Marine Order 95 (Marine Pollution Prevention - sewage).
• Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth):
o Section 26D (which implements MARPOL Annex IV).
• POWBONS Act 1986 (Vic):
o Section 23G (pollution of prevention by sewage).</td></tr>
</table>

Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Sewage and grey water – ensure sewage and grey water is treated in an appropriate on-site marine sanitary treatment unit in compliance with MARPOL Annex V requirements.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to managing sewage and grey water discharges.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Other waste waters (item 44). Grey and black water should be treated in an appropriate on-site marine sanitary treatment unit in compliance with MARPOL.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	Sewage and grey water discharges do not intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	Sewage and grey water discharges do not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	Sewage and grey water discharges do not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Sewage and grey water discharges do not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	Sewage and grey water discharges do not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	Sewage and grey water discharges do not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring	
• None required	
Record Keeping	
Platform	Vessels
• ISPP certificate. • CMMS records.	• ISPP certificate. • PMS records. • Sewage discharge records.

7.9 IMPACT 9 – Routine Discharges - Cooling and Brine Water

7.9.1 Hazard

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

At Yolla-A, cooling and brine water is discharged at depth from the sewage caisson 7 m below sea level. From the vessels, it is normally discharged to the ocean at surface. Upon discharge, it is 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.

7.9.2 Known and potential environmental impacts

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

- Temporary and very localised increase in sea water temperature, causing thermal stress to marine biota;
- Temporary and very localised increase in sea surface salinity, potentially causing harm to fauna unable to tolerate higher salinity; and
- Potential toxicity impacts to marine fauna from the ingestion of residual biocide and scale inhibitors.

7.9.3 EMBA

The EMBA for cooling water and brine discharges associated with platform and vessel activities is likely to be the top 10 m of the water column and a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program (in the Scott Reef complex), which 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).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.9.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
The platform discharges cooling and brine water.	Vessels will discharge cooling and brine water while undertaking inspections and maintenance along the portion of the RGP within state waters.

7.9.5 Evaluation of Environmental Impact

Temporary and localised increase in seawater 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). As such, impacts to most receptors are expected to be negligible even within this mixing zone.

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 be dispersed 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.' As such, impacts to receptors are expected to be negligible.

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.

The impacts of cooling and brine water discharges to the physical and biological environment are expected to have negligible consequences because of the:

- Low discharge volumes;
- Intermittent nature of the discharge;
- 'Consumption' of the chemicals prior to discharge;
- High dilution and dispersal factor in open waters; and

- Absence of sensitive habitats in the activity area.

7.9.6 Impact Assessment

Table 7.29 presents the impact assessment for the discharge of cooling and brine water.

Table 7.29. Impact assessment for the discharge of cooling and brine water

Summary		
Summary of impacts	Increased sea surface temperature and salinity around the discharge point. Potential toxicity impacts to marine fauna from residual biocide and scale inhibitors.	
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Ongoing for platform operations. Temporary for vessel operations.	
Level of certainty of impact	HIGH – the impacts of sea surface temperature and salinity increases on marine fauna are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
The RO plant and equipment that requires cooling by water is well maintained.	Plant and equipment that requires cooling by water is maintained in good working order in accordance with the Yolla-A CMMS and vessels' PMS.	CMMS (platform) and PMS (vessels) records verify that equipment that requires cooling is maintained in accordance with OEM requirements.
Only low-toxicity chemicals are used in the cooling and brine water systems.	Only OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated chemicals (i.e., low toxicity) are used in the cooling and brine water systems.	Platform and vessel chemical inventories records verify that biocides and scale inhibitors are of low toxicity.
Impact Consequence (residual)		
Minor		
Demonstration of ALARP		
A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.		
Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about cooling and brine water discharges.	
Legislative context	There are no legislative controls regarding cooling and brine water discharges.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	

	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Cooling water and desalination brine – discharge point should be designed to aid rapid dispersion, biocide dosing is kept to a minimum and freshwater generation is limited to the volumes necessary for operational requirements.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to managing cooling and brine water discharges.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Cooling water (items 41 & 42). Antifouling chemical dosing to prevent marine fouling of cooling water systems should be carefully considered and appropriate screens to be fitted to the seawater intake to avoid entrainment and impingement of marine flora and fauna. The cooling water discharge depth should be selected to maximise mixing and cooling of the thermal plume to ensure it is within 3°C of ambient seawater temperature within 100 m of the discharge point. • Desalination brine (item 43). Consider mixing desalination brine from the potable water system with cooling water or other effluent streams.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the volume of wastes produced to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	Cooling and brine water discharges do not intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	Cooling and brine water discharges do not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	Cooling and brine water discharges do not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Cooling and brine water discharges do not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	Cooling and brine water discharges do not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	Cooling and brine water discharges not intersect any state marine parks.

		See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
• None required		
Record Keeping		
• CMMS (platform)/PMS (vessel) records. • Chemical inventories.		

7.10 IMPACT 10 – Routine Discharges - Bilge Water and Deck Drainage

7.10.1 Hazard

Bilge tanks on the vessels 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 this water prior to discharge overboard in order to meet the MARPOL requirement that no greater than 15 ppm oil-in-water (OIW) is discharged overboard. The volume of these discharges is small and intermittent (as required, based on bilge tank storage levels). Where no OWS is present, these fluids are retained in tanks for onshore disposal.

Vessel decks that are not bunded and drain directly to the sea may lead to the discharge of contaminated water, caused by ocean spray and rain ('green water') or deck washing activities capturing trace quantities of contaminants such as oil, grease and detergents, or a chemical (e.g., hydraulic fluids, lubricating oils) or hydrocarbon spill or leak washed overboard.

On Yolla-A, open deck drains (in non-hazardous areas) are directed overboard without treatment (see Section 3.5.9). In the event of contaminants being present, these may be washed overboard during rain or deck washing.

7.10.2 Known and potential environmental impacts

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

- Temporary and localised reduction of surface water quality around the discharge point;
- Acute toxicity to marine fauna through ingestion of contaminated water in a small mixing zone.

7.10.3 EMBA

The EMBA for bilge and deck water discharges is likely to be the top 10 m of the water column and less than a 100 m radius from the discharge point. This is based on modelling of continuous wastewater discharges undertaken by Woodside for its Torosa South-1 drilling program in the Scott Reef complex (Woodside, 2008).

In addition to the quality of the receiving waters, receptors that may occur within this EMBA, either as residents or migrants, are:

- Plankton;

- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

7.10.4 Jurisdiction of hazard

The jurisdictions for the discharge of bilge water and deck drainage are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
The platform discharges deck drainage. Vessels will discharge bilge water and deck drainage while undertaking inspections and maintenance while in the platform PSZ or along the portion of the RGP within Commonwealth waters.	Vessels will discharge bilge water and deck drainage while undertaking inspections and maintenance along the portion of the RGP within state waters.

7.10.5 Evaluation of Environmental Impact

Temporary and localised reduction of surface water quality

Small volumes and low concentrations of oily water (<15 ppm) from bilge discharges and traces of chemicals or hydrocarbons discharged to the ocean through open deck drainage may temporarily reduce water quality.

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. These discharges will be rapidly diluted, dispersed and biodegraded to undetectable levels within a very small mixing zone (as per the EMBA).

Potential toxicity impacts

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

In the event a vessel OWS malfunctions and discharges off-specification water, toxicity impacts may occur, though this is only likely in a highly localised mixing zone (meaning that few individuals would be exposed).

In general, the impacts of bilge water and deck drainage to the physical and biological environment are expected to have negligible consequences because of the:

- Low discharge volumes;
- Intermittent nature of the discharge;
- High dilution and dispersal factor in open waters; and
- Absence of sensitive habitats in the operational area and EMBA.

7.10.6 Impact Assessment

Table 7.30 presents the impact assessment for the discharge of bilge water and deck drainage.

Table 7.30. Impact assessment for the discharge of bilge water and deck drainage

Summary		
Summary of impacts	Increased sea surface temperature and salinity around the discharge point. Potential toxicity impacts to marine fauna from residual biocide and scale inhibitors.	
Extent of impacts	Localised – up to 100 m horizontally and 10 m vertically from the discharge point.	
Duration of impacts	Intermittent for platform and vessel operations.	
Level of certainty of impacts	HIGH – the impacts of oily water discharges to the ocean are well known.	
Impact decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Impact Consequence (inherent)		
Minor		
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Vessels		
Bilge water discharges comply with MARPOL Annex I requirements.	For vessels >400 gross tonnes, all bilge water passes through a MARPOL-compliant OWS set to limit OIW to <15 ppm prior to overboard discharge.	IOPP certificate is current.
	The OWS is maintained in accordance with the vessel PMS.	PMS records verify that the OWS is maintained to schedule.
	The OWS is calibrated in accordance with the vessel PMS to ensure the 15 ppm OIW limit is met.	PMS records verify that the OWS is calibrated to schedule.
No whole residual bilge oil is discharged overboard.	The residual oil from the OWS is pumped to tanks and disposed of onshore.	The Oil Record Book verifies that waste oil is transferred to shore.
Level 1 spills (<10 m^3) of oil or oily water overboard are rapidly responded to by the vessel contractor.	The vessel-specific Shipboard Marine Pollution Emergency Plan (SMPEP) is implemented in the event of an overboard spill of hydrocarbons or chemicals.	Incident report verifies that the SMPEP was implemented.
Platform and vessels		
Planned open deck discharges are non-toxic.	Deck cleaning detergents are biodegradable.	Safety Data Sheets (SDS) verify that deck cleaning agents are biodegradable.
Hydrocarbon or chemical spills to deck are prevented from being discharged overboard.	Hydrocarbon and chemical storage areas (process areas) are bunded and drain to the bilge tank (vessels) or are manually pumped to tote tanks (platform).	Site inspections (and associated completed checklists) verify that bunding is in place and piping and instrumentation diagrams (P&IDs) verify that, for vessels, they drain to the bilge tank.
	Portable bunds and/or drip trays are used to collect spills or leaks from equipment that is not contained within a permanently bunded area (non-process areas).	Site inspections (and associated completed checklists) verify that portable bunds and/or drip trays are used in non-process areas as required.

Personnel are competent in spill response and have appropriate resources to respond to a spill.	The vessel and platform crews are competent in spill response and have appropriate response resources in order to prevent or minimise hydrocarbon or chemical spills discharging overboard.	Training records verify that vessel crews receive spill response training.
	Fully stocked SMPEP response kits and scupper plugs or equivalent drainage control measures are readily available and used in the event of a spill to deck to prevent or minimise discharge overboard.	Site inspections (and associated completed checklists) verify that fully stocked spill response kits and scupper plugs (or equivalent) are available on deck in high-risk locations.
		Review of incident reports indicate that the spills of hydrocarbons or chemicals to deck are cleaned up.

Impact Consequence (residual)

Minor

Demonstration of ALARP

A 'minor' residual impact consequence is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability

Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about bilge water and deck drainage discharges.	
Legislative context	The performance standards outlined in this EP align with the requirements of: • *Navigation Act* 2012 (Cth): o Chapter 4 (Prevention of Pollution). o AMSA Marine Order 91 (Marine Pollution Prevention - oil). • *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): o Part II (Prevention of pollution by oil). o Part III (Prevention of pollution by noxious substances). • *POWBONS Act* 1986 (Vic): o Part 2, Division 1 (Pollution by oil). o Part 2, Division 2 (Pollution by noxious substances).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Deck drainage and bilge water – vessels carry a valid IOPP certificate, hydrocarbon and chemical storage areas are bunded, an Oil record Book is maintained, discharges to sea are treated to ensure <15 ppm OIW.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon	The EPS listed in this table meet these guidelines for offshore activities with regard to: • Management of drain water (item 24). The BAT are met for Yolla-A operations with regard to ensuring

	Exploration and Production (European Commission, 2019)	deck coaming is in place, maintaining a chemical inventory, implementing an inspection, maintenance and repair schedule and ensuring that personnel are trained in the use of spill kits.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Other waste waters (item 44). Bilge waters from machinery spaces in support vessels should be routed to the closed drain system or contained and treated before discharge to meet MARPOL requirements. Deck drainage water should be routed to separate drainage systems. This includes drainage water from process and non-process areas. All process areas should be bunded to ensure that drainage water flows into the closed drainage system.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the impact of routine waste discharges on the marine environment to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	Bilge water and deck drainage discharges do not intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	Bilge water and deck drainage discharges do not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	Bilge water and deck drainage discharges do not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Bilge water and deck drainage discharges do not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	Bilge water and deck drainage discharges do not have any significant impacts on threated or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	Bilge water and deck drainage discharges do not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	None triggered by this hazard. See **Appendix 2** for additional detail regarding the impacts of routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		

- None required

Record Keeping	
Platform	Vessels
• CMMS (records. • Chemical inventories. • SDS. • Site inspection reports. • Personnel training records. • Incident reports.	• IOPP certificates. • PMS records. • Oil Record Books. • Incident reports.

The following sections assess environmental risks (i.e., from unplanned events that *may* happen), as listed in Table 7.1 and presented pictorially in Figure 7.10.

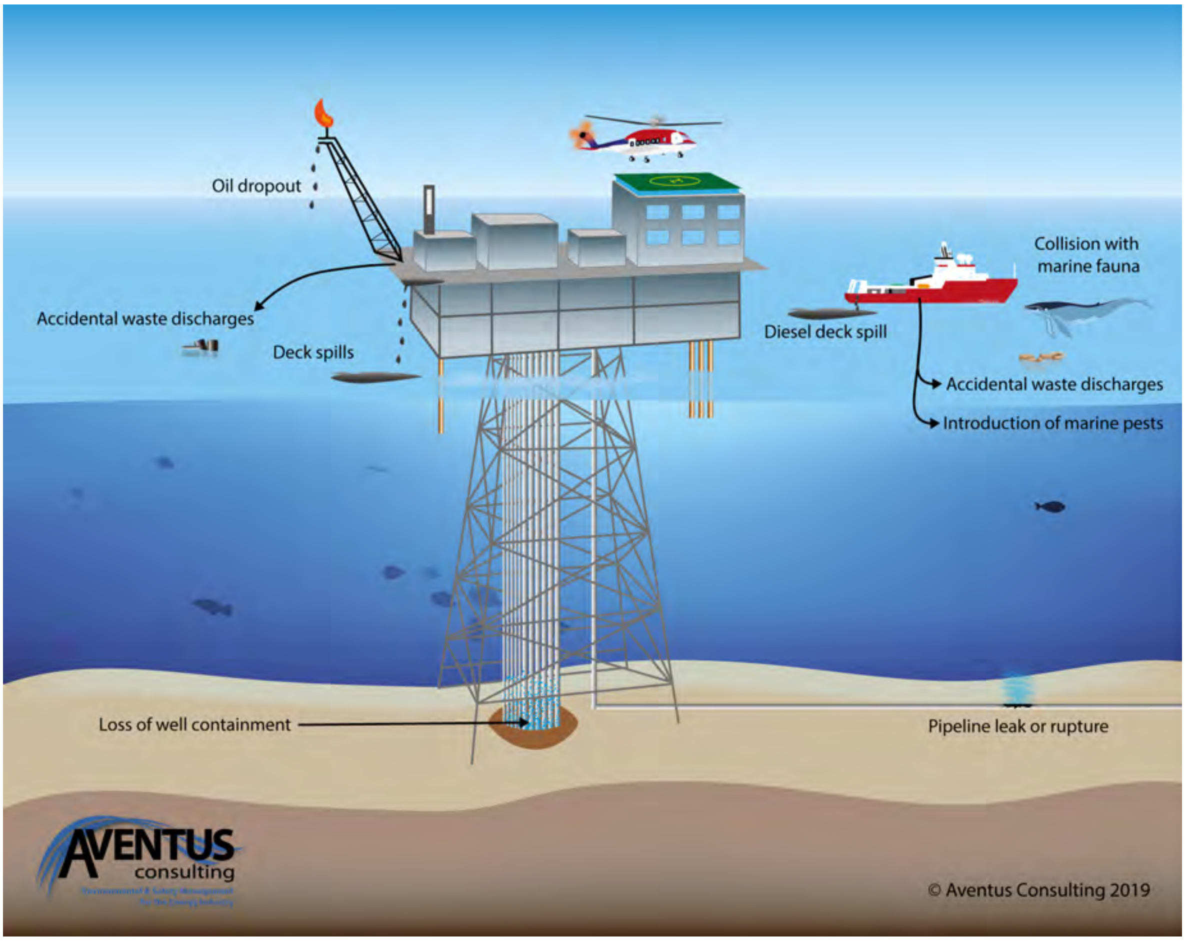


Figure 7.10. Simplified pictorial representation of risks associated with BassGas operations

7.11 RISK 1 - Accidental Discharge of Waste to the Ocean

7.11.1 Hazard

The handling and storage of materials and waste on Yolla-A and vessels has the potential to result in accidental overboard disposal of hazardous and non-hazardous materials and waste, creating marine debris.

Small quantities of hazardous and non-hazardous materials are used in routine operations and maintenance and waste is created, and then handled and stored on the platform and vessels. In the normal course of operations, solid and liquid hazardous and non-hazardous materials and wastes will be stored 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 and aluminium;
- Glass;
- Foam (e.g., ear plugs); and
- Plastics (e.g., hard hats).

The following hazardous materials (defined as a substance or object that exhibits hazardous characteristics, is no longer fit for its intended use and requires disposal, and as outlined in Annex III to the Basel Convention, may be toxic, flammable, explosive and poisonous) 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:

- Hydrocarbons, hydraulic oils and lubricants;
- Hydrocarbon-contaminated materials (e.g., oily rags, pipe dope, oil filters);
- Batteries, empty paint cans, aerosol cans and fluorescent tubes;
- Contaminated personal protective equipment (PPE);
- Laboratory wastes (such as acids and solvents); and
- Larger dropped objects (that may be hazardous or non-hazardous) may be lost to the sea through accidents (e.g., crane operations) include:
    - Sea containers;
    - Towed equipment;
    - ROV; and
    - Entire skip bins/crates.

7.11.2 Potential environmental risks

The risks of the release of hazardous and non-hazardous materials and waste to the ocean are:

- Injury and entanglement of individual animals (such as seabirds and seals); and
- Localised (and normally temporary) smothering or pollution of benthic habitats.

7.11.3 EMBA

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

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

- Benthic fauna;
- Benthic habitat (sand and reef substrates);
- Pelagic fish;
- Cetaceans;
- Pinnipeds; and
- Avifauna.

The EPBC Act-listed species documented as being negatively impacted by the ingestion of, or entanglement in, harmful marine debris (and known to occur in the EMBA) are (according to DoEE, 2019a):

- The three turtle species (loggerhead, green and leatherback);
- Eight albatross species and three petrel species;
- Other birds (flesh-footed shearwater, southern fairy prion);
- Australian fur-seal;
- Indian Ocean bottlenose dolphin; and
- The southern right, pygmy blue, humpback, sei, pygmy right and killer whales.

7.11.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
Accidental discharges could occur during routine operations and maintenance activities.	Accidental discharges could occur from vessels while undertaking inspections and maintenance along/on the portion of the RGP within state waters.

7.11.5 Evaluation of Environmental Risks

Non-hazardous Materials and Waste

If 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 (2015d) 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).

Marine fauna including cetaceans, turtles and seabirds can be severely injured or die from entanglement in marine debris, causing restricted mobility, starvation, infection, amputation, drowning and smothering (DoEE, 2018b). Seabirds entangled in plastic packing straps or other marine debris may lose their ability to move quickly through the water, reducing their ability to catch prey and avoid predators, or they may suffer constricted circulation, leading to asphyxiation and death. In marine mammals and turtles, this debris may lead to infection or the amputation of flippers, tails or flukes (DoEE, 2018b). Plastics have been implicated in the deaths of a number of marine species including marine mammals and turtles, due to ingestion.

If dropped objects such as skip bins are not retrievable (e.g., by crane), 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. The benthic habitats in the operational area are broadly similar to those elsewhere in the region (e.g., extensive sandy seabed), so impacts to very localised areas of seabed will not result in the long-term loss of benthic habitat or species diversity or abundance. Seabed substrates can rapidly recover from temporary and localised 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 or hydrocarbon spills can (depending on the volume released) 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 Bass Strait, it is expected that any minor release would be rapidly diluted and dispersed, and thus temporary and localised. The absence of particularly sensitive seabed habitats and the widespread nature of the sandy seabed present in the activity area further limits the extent of potential impacts.

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. The benthic habitats of the operational area are broadly similar to those elsewhere in the region (e.g., extensive sandy seabed), so impacts to very localised areas of seabed will not result in the long-term loss of benthic habitat or species diversity or abundance.

All hazardous waste is disposed of at appropriately licensed facilities, by licenced contractors, so impacts such as illegal dumping or disposal to an unauthorised onshore landfill that is not lined are highly unlikely to result from BassGas operations.

7.11.6 Risk Assessment

Table 7.31 presents the risk assessment for the accidental disposal of hazardous and non-hazardous materials and waste.

Table 7.31. Risk assessment for the unplanned discharge of solid or hazardous waste to the marine environment.

Summary		
Summary of risk	Localised reduction in water quality. Contamination of marine environment including benthic habitats. Persistent contamination in the marine environment and can negatively impact on marine fauna (e.g., plastic ingested by marine fauna).	
Extent of risks	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 risks	Short-term to long-term, depending on the type of waste and location.	
Level of certainty of risk	HIGH – the effects of inappropriate waste discharges are well known.	
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Risk Assessment (inherent)		
Consequence	Likelihood	Risk rating
Moderate	Possible	Medium
Environmental Controls and Performance Measurement		

EPO	EPS	Measurement criteria
No unplanned release of hazardous or non-hazardous solid wastes or materials.	A MARPOL Annex V-compliant Garbage Management Plan is in place for the platform (and for support vessels >100 gross tonnes or certified to carry 15 persons or more) that sets out the procedures for minimising, collecting, storing, processing and discharging garbage.	A GMP is in place, readily available on board and kept current.
	Waste is stored, handled and disposed of in accordance with the GMP. This includes measures including: • No discharge of general operational or maintenance wastes or plastics or plastic products of any kind. • Waste containers are covered with secure lids to prevent solid wastes from blowing overboard. • All solid wastes are stored in designated areas before being sent ashore for recycling, disposal or treatment. • Any liquid waste storage on deck must have at least one barrier to minimise the risk of spills to deck entering the ocean. This can include containment lips on deck (primary bunding) and/or secondary containment measures (bunding, containment pallet, transport packs, absorbent pad barriers) in place. • Correct segregation of solid and hazardous wastes.	GMP is available and current. Inspections verify that waste is stored and handled according to its waste classification. Inspections verify that waste receptacles are properly located, sized, labelled, covered and secured for the waste they hold. A licensed shore-based waste contract is in place for the management of onshore waste transport and disposal.
	Vessel crews and visitors are inducted into waste management procedures to ensure they understand how to implement the GMP.	Induction and attendance records verify that all crew members are inducted.
	Waste types and volumes are tracked and logged.	Waste tracker is available and current.
	Solid waste that is accidentally discharged overboard is recovered if reasonably practicable.	Incident records are available to verify that credible and realistic attempts to retrieve the materials lost overboard were made.
	A chemical locker is available, bunded and used for the storage of all greases and non-bulk chemicals (i.e., those not in tote tanks) so as to prevent discharge overboard.	Site inspection verifies that greases and chemicals are stored in a chemical locker.
	Crane transfers are undertaken in accordance with the Lifting and Load Safety Operations Procedure (CDN/ID 3674901) and under a Permit to Work (PTW).	PTW records verify that crane transfers are undertaken in accordance with the procedure.
	The platform CMMS and vessels' PMS are implemented to ensure that lifting equipment remains in certification and fit for use at all times to minimise the risk of dropped objects.	CMMS and PMS records verify that lifting equipment is maintained to schedule and in accordance with OEM requirements.

Risk Assessment (residual)		
Consequence	Likelihood	Risk rating
Moderate	Highly unlikely	Low

Demonstration of ALARP
A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability	
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.

<table>
<tr><td>Management system compliance</td><td colspan="2">Chapter 8 describes the EP implementation strategy employed for this activity.</td></tr>
<tr><td>Stakeholder engagement</td><td colspan="2">The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues.
Stakeholders have not raised concerns about accidental waste releases.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The performance standards outlined in this EP align with the requirements of:
• Navigation Act 2012 (Cth):
○ Chapter 4 (Prevention of Pollution).
○ Marine Orders Part 47.
○ Marine Orders Part 94 (Marine pollution prevention – packaged harmful substances).
○ Marine Orders Part 95 (Marine pollution prevention – garbage).
• Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Cth):
○ Part III (Prevention of pollution by noxious substances).
○ Part IIIA (Prevention of pollution by packaged harmful substances).
○ Part IIIC (Prevention of pollution by garbage).
• POWBONS Act 1986 (Vic):
○ Part 2, Division 2 (Pollution by noxious substances).
○ Part 2, Division 2A (Prevention of pollution by garbage).
○ Part 2, Division 2B (Prevention of pollution by packaged harmful substances).
○ Section 23B – Prohibition of disposal of garbage into State waters.</td></tr>
<tr><td rowspan="5">Industry practice</td><td colspan="2">The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to:
• Hazardous waste – segregate hazardous waste in hazardous waste skips and drums or holding tanks prior to disposal, manage wastes in accordance with their SDS.
• Non-hazardous waste – manage in accordance with MARPOL Annex V requirements, no planned offshore disposal of solid waste, segregate waste into recyclable and non-recyclable waste.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>The EPS listed in this table meet these guidelines for offshore activities with regard to:
• Risk management for handling and storage of chemicals (item 19). The BAT are met for Yolla-A operations with regard to implementing chemical transfer procedures and ensuring chemicals are stored in separate, labelled containers.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>Guidelines met with regard to:
• Waste management (items 46). Materials should be segregated offshore and shipped to shore for reuse, recycling or disposal. A waste management plan should be developed and contain a mechanism allowing waste consignments to be tracked.
• Hazardous materials management (item 72). Principles relate to the selection of chemicals with the lowest environmental and health risks.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS listed in this table meet the following offshore development and production objectives:</td></tr>
</table>

		• To reduce the risk of any unplanned release of material into the marine environment to as low as reasonably practical and to an acceptable level.
	Waste management-specific	
	Guidelines for the Development of GMPs (IMO, 2012)	The platform and support vessels' GMPs are developed in accordance with these guidelines.
	International Dangerous Goods Maritime Code (IMO, 2014)	The storage and handling of dangerous goods on the platform and support vessels is managed in accordance with this code.
Environmental context	MNES	
	AMPs (Section 5.4.1)	The unplanned discharge of solid or hazardous waste is highly unlikely to intersect nearby AMPs. The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies marine debris as a threat to the AMP network. The EPS listed in this table aim to minimise the generation of marine debris and are aligned with the strategies outlined in the plan.
	Wetlands of international importance (Section 5.4.4)	The unplanned discharge of solid or hazardous waste is highly unlikely to reach Ramsar wetlands.
	TECs (Section 5.4.5)	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any TECs. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	The unplanned discharge of solid or hazardous waste is highly unlikely to reach any NIWs.
	Nationally threatened and migratory species (Section 5.5)	The unplanned discharge of solid or hazardous waste is highly unlikely to have any impacts on threated or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	The unplanned discharge of solid or hazardous waste is highly unlikely to intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The risks posed by this hazard do not impact this action. The conservation advice for humpback whales (TSSC, 2015d) and the Conservation Management Plan for the Blue Whale (DoE, 2015d) identify marine debris as a threat, but there are no conservation management actions to counter this. The EPS listed in this table aim to minimise the generation of marine debris. The conservation advice for hooded plovers (DoE, 2014) identifies ingestion of marine debris as a threat that requires reducing inshore debris. The EPS listed in this table aim to minimise the generation of marine debris.

		The EPS listed in this table meet objective one of the Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's coasts and oceans (DoEE, 2018b), which is to contribute to the long-term prevention of the incidence of harmful marine debris. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
• Waste tracking.

Record Keeping	
Platform	Vessels
• GMP. • Garbage Record Book. • Crew induction and attendance records. • Inspection records/checklists. • Shore-based waste contract. • Incident reports.	• Vessel contractor pre-qualification report/s. • GMP. • Garbage Record Book. • Crew induction and attendance records. • Inspection records/checklists. • Shore-based waste contract. • Incident reports.

7.12 RISK 2 – Vessel Collision with Megafauna

7.12.1 Hazard

The movement of the PSV in the PSZ and other vessels throughout the operational area has the potential to result in collision with megafauna (defined here as cetaceans and pinnipeds). Such megafauna commonly dwell at or near the water's surface, are large and slow moving (in the case of whales), bow ride (in the case of dolphins) or are inquisitive (seals).

The platform jacket does not present a strike hazard to megafauna as it is fixed in place and is readily detected and avoided by megafauna (or is an attraction in the case of fur-seals). In Bass Strait, fur-seals frolic around platform jackets without any apparent risk of injury.

7.12.2 Potential environmental risks

The risks of vessel strike with megafauna are:

- Injury; and
- Death.

7.12.3 EMBA

The EMBA for vessel strike with megafauna is the immediate area around the vessel. Receptors most at risk within this EMBA are:

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

7.12.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box overpage.

Commonwealth waters	Victorian waters
Yes	Yes
Collisions with megafauna may occur while a vessel is located within the platform PSZ or undertaking inspections and maintenance along the portion of the RGP within Commonwealth waters.	Collisions with megafauna may occur while vessels are undertaking inspections and maintenance along the portion of the RGP within state waters.

7.12.5 Evaluation of Environmental Risks

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 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, and these species may migrate through the waters of the activity area (see Section 5.5.5).
- 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. A number of these species may reside in or pass through the waters of the activity area (see Section 5.5.5).
- 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 be the seal interacting/playing with a boat, with a number of 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 in the operational area and EMBA 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), though the data indicates this is more likely to be associated with container ships and fast ferries (WDCS, 2006). Some cetacean species, such as humpback whales, can detect and change course to avoid a vessel (WDCS, 2006). 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 (2015d) reports that there were two blue whale strandings in the Bonney Upwelling (western Victoria) 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. When support vessels are operating within the platform's PSZ or working along the pipeline, they will be travelling very slowly or will be stationery, so the risk associated with fast moving vessels is eliminated for BassGas operations.

The DSEWPC (2012b) notes that whale entanglement in nets and lines often causes physical damage to skin and blubber. These wounds can then expose the animal to infection. Entanglement can also result in amputation (e.g., of a flipper or tail fluke), and death over a prolonged period. The DoE (2015d) states that entanglement (in the context of fishing nets, lines or ropes) has the potential to cause physical injury that can result in loss of reproductive fitness, and mortality of individuals from drowning, impaired foraging and associated starvation, or infection or physical trauma. There is an almost negligible risk of this occurring to megafauna with tethered ROVs as the tethers are likely to break under the weight of entanglement. The Australian and New Zealand fur-seals are highly agile species that haul themselves onto rocks and platform jackets. As such, it is likely that they will be able to avoid tethered equipment such as ROVs and are unlikely to become entangled within them.

7.12.6 Risk Assessment

Table 7.32 presents the risk assessment for vessel collision with megafauna.

Table 7.32. Risk assessment for vessel collision with megafauna

Summary		
Summary of risks	Injury or death of cetaceans and pinnipeds.	
Extent of risks	Localised – limited to individuals coming into contact with a support vessel.	
Duration of risks	Temporary (if individual animal dies or has a minor injury) to long-term (if there is a serious injury).	
Level of certainty of risk	HIGH – injury may result in the reduced ability to swim and forage. Serious injury may result in death.	
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Risk Assessment (inherent)		
Consequence	Likelihood	Risk rating
Serious	Highly unlikely	Medium
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Vessels only No injury or death of megafauna as a result of vessel strike or entanglement with subsea equipment.	Through constant bridge watch, vessels comply with the *Australian National Guidelines for Whale and Dolphin Watching for Vessels* (DoEE, 2017) when working within the operational area. This means: • Caution zone (300 m either side of whales and 150 m either side of dolphins) – vessels must operate at no wake speed in this zone. • No approach zone (100 m either side of whales and 50 m either side of dolphins) – vessels should not enter this zone and should not wait in front of the direction of travel or an animal or pod/group. • Do not encourage bow riding. • If animals are bow riding, do not change course or speed suddenly. • If there is a need to stop, reduce speed gradually.	Daily operations reports note when cetaceans and pinnipeds were sighted and what actions were taken to avoid collision or entanglement.
	Vessel crew has completed an environmental induction covering the above-listed requirements for vessel and megafauna interactions.	Induction and attendance records verify that all crews have completed an environmental induction.

Vessel strike or entanglement is reported to regulatory authorities.	Vessel strike causing injury to or death of a cetacean is reported to the DoEE via the online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike) within 72 hours of the incident.	Electronic record of report submittal is available. Incident report is available within the OMS.
	Entanglement of megafauna (such as ROV tether) is reported to the Whale and Dolphin Emergency Hotline on 1300 136 017 as soon as possible. No attempts to disentangle megafauna should be made by vessel crew.	Incident report verifies contact was made with the Whale and Dolphin Emergency Hotline.

Risk Assessment (residual)		
Consequence	Likelihood	Risk rating
Serious	Remote	Low

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about collisions with megafauna.	

Legislative context	The performance standards outlined in this EP align with the requirements of:
	• *Wildlife Act* 1975 (Vic).
	  ○ Section 77 (Action to be taken with respect to killing or taking a whale).
	• Wildlife (Marine Mammal) Regulations 2013 (Vic).
	  ○ Part 2 (Prescribed minimum distance).
	  ○ Part 3 (General restrictions on activities relating to marine mammals).
	• *EPBC Act* 1999 (Cth):
	  ○ Section 199 (failing to notify taking of listed species or listed ecological community).
	• EPBC Regulations 2000 (Cth):
	  ○ Part 8 (Interacting with cetaceans and whale watching).
	  ○ AMSA Marine Notice 2016/15 – Minimising the risk of collisions with cetaceans.	

Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Collision with marine fauna – vessels should monitor for the presence and movements of large cetaceans and pinnipeds so that avoidance action can be taken where marine fauna is observed on a collision course with vessels.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to minimising the risk of collisions with megafauna.

	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	There are no guidelines regarding minimising the risk of vessel strike or entanglement with megafauna.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the risks to the abundance, diversity, geographical spread and productivity of marine species to ALARP and to an acceptable level.
	Megafauna collision-specific	
	The Australian Guidelines for Whale and Dolphin Watching (DoEE, 2017)	The EPS listed in this table are aligned with the requirements of these guidelines, despite the fact that the support vessels are not acting in the capacity of dedicated whale or dolphin watching vessels.
	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE, 2017).	The EPS listed in this table are aligned with objective 3 of this strategy, which is to reduce the likelihood and severity of megafauna vessel collisions.
Environmental context	MNES	
	AMPs (Section 5.4.1)	The risk of collisions with megafauna does not have any effect on nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	The risk of collisions with megafauna does not have any effect on Ramsar wetlands.
	TECs (Section 5.4.5)	The risk of collisions with megafauna does not have any effect on TECs. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	The risk of collisions with megafauna does not have any effect on NIWs.
	Nationally threatened and migratory species (Section 5.5)	The low frequency of PSV movements to and from Yolla-A, along with the infrequent nature of vessel-based inspection and maintenance activities, makes it unlikely that vessel strike or entanglement with megafauna will occur. If vessel strike or entanglement does occur to individual animals, this will not be a significant impact in the context of species' populations.
	Other matters	
	State marine parks (Section 5.4.9)	The risk of collisions with megafauna does not have any effect on state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Vessel collisions (and/or entanglements) are listed as a threat to cetaceans in the: • Conservation Management Plan for the Southern Right Whale (DSEWPC, 2012b); • Conservation Management Plan for the Blue Whale (DoE, 2015d);

		• Conservation advice for the sei whale (TSSC, 2015b); • Conservation advice for the fin whale (TSSC, 2015c); and • Conservation advice for the humpback whale (TSSC, 2015d). The EPS listed in this table aim to minimise the risk of vessel strike and entanglement with megafauna and do not breach the management actions of the above-listed whale conservation plans. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring
• Opportunistic megafauna sightings by vessel crew.

Record Keeping
• Vessel crew induction presentation and attendance records. • Megafauna sighting records. • Incident reports.

7.13 RISK 3 - Introduction and Establishment of Invasive Marine Species

7.13.1 Hazards

The DAWR (2018) defines marine pests (referred to in this EP as invasive marine species, IMS) as:

> *non-native marine plants or animals that harm Australia's marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia's marine environment.*

The following activities have the potential to result in the introduction of IMS in the operational area:

- Discharge of ballast water from the PSV and other vessels containing foreign species; and
- Translocation of foreign species through biofouling on vessel hulls, niches (e.g., thruster tunnels, sea chests) or in-water equipment (e.g., ROV and tethers).

The PSV and vessels undertaking inspection and maintenance activities 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.

Biofouling is the accumulation of aquatic microorganisms, 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, 2015).

The DAWR estimates that ballast water is responsible for 30% of all marine pest incursions into Australian waters (DAWR, 2018). The DAWR 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), while DAWR (2018) notes that the movement of vessels and marine infrastructure is the primary pathway for the introduction of IMS.

Because the Yolla-A platform is fixed in place and does not discharge ballast water, it does not present a risk of introducing IMS to the operational area. As such, this risk assessment is focused on the PSV and other support vessels.

7.13.2 Potential environment risks

The risks of IMS introduction (assuming their survival, colonisation and spread) include:

- Reduction in native marine species diversity and abundance;
- Displacement of native marine species;
- Depletion of commercial fish stocks (and associated socio-economic effects); and
- Changes to conservation values of protected areas.

7.13.3 EMBA

The EMBA for IMS introduction is anywhere within the operational area, though if IMS survive the introduction and go on to colonise and spread, this EMBA could extend to large parts of Bass Strait.

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

- Benthic fauna (because of their limited ability to move to other suitable areas);
- Benthic habitat; and
- Pelagic fish.

7.13.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box below.

Commonwealth waters	Victorian waters
Yes	Yes
Vessels working within the platform PSZ or undertaking inspections and maintenance along the portion of the RGP within Commonwealth waters.	Vessels undertaking inspections and maintenance along the portion of the RGP within state waters.

7.13.5 Evaluation of Environmental Risks

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., activity 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.

If successful invasion takes place, the IMS is 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 approximately one in six introduced marine species becomes pests (AMSA, n.d). 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 (AMSA, n.d). For example, the introduction of the Northern Pacific seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries. Similarly, the ability of the New Zealand screw shell (*Maoricolpus roseus*) to reach densities of thousands of shells per square metre has presented problems for commercial scallop fishers (MESA, 2017). The ABC (2000) reported that the New Zealand screw shell is likely to displace similar related species of screw shells, several of which occupy the same depth range and sediment profile.

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.

During routine operations, the risk of introducing IMS to the operational area is low because the PSV is locally-based (operating primarily from Port Anthony Marine Terminal in Corner Inlet) and very occasionally operating from the Port of Hastings and Corio Quay, see Section 3.8.2). The PSV does not undertake international voyages. This means that species contained within the vessel's ballast water or within hull fouling are local and unlikely to be IMS.

While the Port of Hastings and Corio Quay are not part of the Port of Melbourne, The Commonwealth government's Marine Pests Interactive Map (www.marinepests.gov.au) identifies marine pests that are known to occur or do occur in Port Phillip Bay. Given the PSV operates out of Corio Quay (located in Port Phillip Bay), there is the potential for IMS that have already successfully established in Port Phillip Bay to be transported out of the bay and into Bass Strait.

The following species are are identified in the Marine Pests Interactive Map as known to occur within Port Phillip Bay:

- Asian date or bag mussel (*Arcuatula senhousia*);
- European fan worm (*Sabella spallanzanii*);
- European shore crab (*Carcinus maenas*);
- Japanese kelp (*Undaria pinnatifida*); and
- Northern Pacific seastar (*Asterias amurensis*).

While there is a risk of transferring IMS from Port Phillip Bay into the operational area, the control measures adopted by the PSV render the risk of successful transportation as low. For example, biofouling is managed in accordance with National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (AQIS, 2009), which involves in-water inspections, cleaning of vessel niches and applying anti-fouling coating. In addition, the PSV will be managed in accordance with the International Maritime Organisation (IMO) Biofouling Guidelines which recommends vessel maintain and implement a Biofouling Management Plan and Biofouling Record Book in order to control and minimise the transfer of aquatic IMS while conducting routine operations on the activity.

During maintenance activities at the platform or along the pipeline, non-locally-based specialist vessels (e.g., diving support vessels) may be contracted. The IMS risks posed by these vessels will be managed in accordance with the EPS outlined in Table 7.33 and will begin with a pre-qualification undertaken by the new vessel contractor prior to charter in order to determine that its biofouling and ballast water controls meet the requirements of this EP.

7.13.6 Risk Assessment

Table 7.33 presents the risk assessment for the introduction of IMS.

Table 7.33. Risk assessment for the introduction of IMS

Summary		
Summary of risks	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.	
Extent of risk	Localised (isolated locations if there is no spread) to widespread (if colonisation and spread occurs).	
Duration of risk	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 risk	HIGH – the impacts associated with IMS introduction are well known and the vectors of introduction are known. Regulatory guidelines controlling these vectors are well established.	
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Risk Assessment (inherent)		
Consequence	Likelihood	Risk rating
Major	Unlikely	Medium
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Vessels used to support operations and maintenance do not introduce IMS.	A pre-qualification is undertaken for all new vessel contractors against Beach's Introduced Marine Species Management Plan ((IMSMP) S4000AH719916) prior to charter to ensure biofouling and ballast water controls meet these EP requirements. The requirements of the IMSMP are outlined herein.	Vessel contractor pre-qualification audit report verifies the vessel meets the requirements outlined in the IMSMP.
Biofouling		
Vessels do not introduce IMS to the operational area.	Vessels are managed in accordance with the *National Biofouling Management Guidance for the Petroleum Production and Exploration Industry* (AQIS, 2009) and the to ensure they present a low biofouling risk. This means: • Biofouling risk is assessed. • Conducting in-water inspection by divers or inspection in drydock if deemed necessary (based on risk assessment). • Cleaning of hull and internal seawater systems, if deemed necessary. • Anti-fouling coating status taken into account, with antifouling renewal undertaken if deemed necessary.	Biofouling assessment report prior to mobilising to site confirms acceptability to enter operational area.
	Vessels >400 gross tonnes carry a current International Anti-fouling System (IAFS) Certificate that is complaint with Marine Order Part 98 (Anti-fouling Systems).	IAFS Certificate is available and current.
	Vessels are managed in accordance with the *Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive*	Vessel contractor Biofouling Management Plan and Biofouling Record Book are available and current.

	Aquatic Species (IMO, 2011), which involves ensuring that vessels: • Maintain a Biofouling Management Plan; • Maintain a Biofouling Record Book; • Install and maintain an anti-fouling system; • Undertake in-water inspections (and in-water hull cleaning, if appropriate); and • Instruct crews on the application of biofouling management procedures.	
	An IMS risk assessment is undertaken for new PSVs or other vessels based on the following: • Inspecting the IAFS certificate to ensure currency. • Reviewing recent vessel inspection/audit reports to ensure that the risk of IMS introduction is low. • Reviewing recent ports of call to determine the IMS risk of those ports. • Determining the need for in-water cleaning and/or re-application of anti-fouling paint if neither has been done recently in line with anti-fouling and in-water cleaning guidelines (DoA/DoE, 2015). • Implementing the biofouling guidance provided in Part 5 of the Offshore Installation Biosecurity Guideline (DAWR, 2019, v1.3).	IMS risk assessment document verifies that the biofouling risk evaluation took place and that the IMS risk is 'low.'
	Prior to vessel transits out of Port Phillip Bay to the operational area, Beach will ensure that the vessel contractor undertakes a biofouling risk assessment (based on the controls outlined above) and submits this to Beach prior to voyage to ensure that the vessel has a low risk of transferring IMS.	The biofouling risk assessment document verifies it took place prior to exit from Port Phillip Bay and that the IMS risk is 'low.'
Immersible equipment (e.g., ROV) does not introduce IMS to the operational area.	Immersible equipment is cleaned (e.g., biofouling is removed) prior to initial use in the operational area.	Records are available to verify that immersible equipment was cleaned prior to use.
Ballast water		

Internationally-sourced vessels discharge only low risk ballast water.	Vessels fulfil the requirements of the *Australian Ballast Water Management Requirements* (DAWR, 2017, v7). This includes requirements to:
	• Carry a valid Ballast Water Management Plan (BWMP).
	• Submit a Ballast Water Report (BWR) through the Maritime Arrivals Reporting System (MARS).
	  ○ If intending to discharge internationally-sourced ballast water, submit BWR through MARS at least 12 hours prior to arrival.
	  ○ If intending to discharge Australian-sourced ballast water, seek a low-risk exemption through MARS.
	• Hold a Ballast Water Management Certificate (BWMC).
		BWMP is available and current.
		BWR (or exemption) is submitted prior to entry to the activity area.
		A valid BWMC is in place.
		An up-to-date BWRS is in place.
		An ePAR is available and signed off by DAWR.

	• Ensure all ballast water exchange operations are recorded in a Ballast Water Record System (BWRS).	
Vessels only discharge low risk ballast water.	As above, except a BWR is not required for domestic journeys (i.e., when moving between Australian ports and 200 nm of the coastline). *Note: ballast water management is not required between Australian ports and platforms if:* • *Ballast water is taken up and discharged in the same place.* • *Potable water is used as ballast.* • *Ballast water was taken up on the high seas only.* • *The vessel receives a risk-based exemption from ballast water management.*	As above, except for the BWR.
	Prior to vessel transits out of Port Phillip Bay to the operational area, Beach will ensure that the vessel contractor undertakes a ballast water risk assessment (based on the controls outlined above) and submits this to Beach prior to voyage to ensure that the vessel has a low risk of transferring IMS.	The ballast water risk assessment document verifies it took place prior to exit from Port Phillip Bay and that the IMS risk is 'low.'
Reporting		
Known or suspected non-compliance with biosecurity measures are reported to regulatory agencies.	Non-compliant discharges of domestic ballast water are to be reported to the DAWR immediately (contact details in Section 8.9).	Incident report notes that contact was made with the DAWR regarding non-compliant ballast water discharges.

Risk Assessment (residual)		
Consequence	Likelihood	Risk rating
Major	Highly unlikely	Medium

Demonstration of ALARP

A 'medium' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability	
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about the introduction and establishment of IMS.

Legislative context	The performance standards outlined in this EP align with the requirements of:
	• *Biosecurity Act* 2015 (Cth):
	  ○ Chapter 4 (Managing biosecurity risk).
	  ○ Chapter 5, Part 3 (Management of discharge of ballast water).
	• *Protection of the Sea (Harmful Anti-fouling Systems) Act* 2006 (Cth):
	  ○ Part 2 (Application or use of harmful anti-fouling systems).
	  ○ Part 3 (Anti-fouling certificates and anti-fouling declarations).

	○ Marine Order 98 (Marine pollution – anti-fouling systems). Note that as of September 2017, ballast water management in Victorian waters is managed in line with Commonwealth requirements. Former Victorian EPA requirements (e.g., Victorian Environment Protection (Ships Ballast Water) Regulations 2008) no longer apply.	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Introduction of IMS – develop an IMS Management Plan (where applicable), ensure vessels have a valid IAFS certificate, undertake regular vessel hull inspections, manage ballast water in accordance with local guidelines and carry a ballast water record book and ballast water management certificate.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	There are no guidelines for offshore activities with regard to minimising the risk of introducing IMS.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	There are no guidelines regarding preventing the introduction of IMS.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the risk of introduction of marine pests to ALARP and to an acceptable level. • To reduce the impacts to benthic communities to ALARP and to an acceptable level.
	IMS-specific	
	Offshore Installations - Quarantine Guide (DAWR, 2019, v1.3)	The EPS in this table reflect the guidance regarding ballast water and biofouling management in the DAWR guide.
	Australian Ballast Water Management Requirements (DAWR, 2017, v7)	The EPS in this table reflect the guidance regarding ballast water management in the DAWR guide.
	Anti-Fouling and In-Water Cleaning Guidelines (DoA/DoE, 2015).	The EPS in this table reflect the general guidance regarding managing fouling in the DoA/DoE guidelines, which have since been updated in the aforementioned DAWR (2019) quarantine guide.
	Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species (IMO, 2011)	The EPS in this table reflect the guidance regarding minimising the transfer of IMS from biofouling.
	National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (DAFF, 2009)	The EPS in this table reflect the guidance regarding biofouling management in the DAFF guide.
Environmental context	MNES	
	AMPs (Section 5.4.1)	The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies IMS and

		diseases translocated by shipping, fishing vessels and other vessels as a threat to the AMP network. The long distance from the operational area (>65 km) and the deeper cooler waters of the closest AMPs make it unlikely that IMS will become established in those AMPs.
	Wetlands of international importance (Section 5.4.4)	The risk of introducing IMS is highly unlikely to affect Ramsar wetlands.
	TECs (Section 5.4.5)	The risk of introducing IMS is highly unlikely to affect TECs. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	The risk of introducing IMS is highly unlikely to affect NIWs.
	Nationally threatened and migratory species (Section 5.5)	The threatened and migratory species within the EMBA are all highly mobile species. There are no EPBC Act-listed or FFG Act-listed benthic species listed as occurring in the EMBA; these are generally more susceptible to the effects of IMS than mobile fauna.
	Other matters	
	State marine parks (Section 5.4.9)	This hazard does not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The National Strategic Plan for Marine Pest Biosecurity (2018-2023) (DAWR, 2018) has five objectives. The EPS listed in this table are aligned with the plan's objective to minimise the risk of marine pest introductions, establishment and spread (noting that the other four objectives do not apply to BassGas operations). See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
	Is there a threat of serious or irreversible environmental damage?	Possibly. But the EPS aim to avoid this.
	Is there scientific uncertainty as to the environmental damage?	Yes. Individual species fill different ecological niches and understanding how one or more species are likely to behave outside their native habitat is generally unknown until it occurs.

Environmental Monitoring

- None required.

Record Keeping

- Vessel contractor pre-qualification reports.
- Biofouling risk assessment.
- Ballast water risk assessments.
- BWMP.
- BWR.
- BWMC.
- BWRS.
- IMSMP.
- IAFS Certificates.
- DAWR-signed ePARs.

7.14 RISK 4 – LoC of Bulk Chemicals and Hydrocarbons

7.14.1 Hazards

The following activities have the potential to result in accidental overboard discharges of chemicals and hydrocarbons:

- Platform topside operations – crane transfers, bunkering operations, failure of or damage to bunding systems, hose failures, deck washdowns, bund overfills; and
- Support vessel operations – cane transfers, failure of or damage to bunding systems, hose failures, hydraulic cable fail from ROV, deck washdowns and bund overfills.

Specifically, spills overboard may be caused by, but not limited to:

- Hose or connection failure (due to equipment condition or failure of a PSV to keep station);
- Failure to align valves correctly during transfer to tanks;
- Overfilling of tanks on platform or vessel;
- Dropped objects from crane transfers; and
- Accidental or emergency disconnection of hoses.

Products that may be accidentally discharged overboard includes:

- Bulk chemicals (e.g., methanol, corrosion inhibitor and hydraulic fluid, generally in 1 m^3 IBCs); and
- MDO.

Jet A1 fuel used for helicopter refuelling has been excluded because there are no refuelling facilities on the Yolla-A platform.

The design of the platform assists in minimising the LoC of chemicals and hydrocarbons from the topsides, in so far as process equipment drains to the closed drain header, which is routed back to the flare KO drum. Deck open drains also drain to the dump caisson, with hydrocarbons recovered via the flare KO drum.

7.14.2 Potential environmental risks

The known and potential risks of the LoC of bulk chemicals and hydrocarbons are:

- Temporary and localised reduction of water quality; and
- Acute toxicity to marine fauna through ingestion or absorption.

7.14.3 EMBA

The EMBA for the LoC of bulk chemicals and hydrocarbons is likely to range from tens to hundreds of metres from the release site (the platform or a vessel when within 500 m of BassGas infrastructure), depending on the product and volume spilled, so a precise EMBA cannot be determined. Receptors most at risk, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans; and
- Pinnipeds.

7.14.4 Jurisdiction of hazard

The jurisdictions for this hazard are outlined in the box overpage.

Commonwealth waters	Victorian waters
Yes	Yes
Vessels working within the platform PSZ or undertaking inspections and maintenance along the portion of the RGP within Commonwealth waters.	Vessels undertaking inspections and maintenance along the portion of the RGP within state waters.

7.14.5 Evaluation of Environmental Risk

The risks associated with the LoC of chemicals are described in Section 7.10 (bilge water and deck drainage). Quantities inferred here (in the order of several cubic metres at most) will be greater than Section 7.10, though the nature of the impacts will be the same, albeit over a larger area.

The risks associated with the LoC of MDO are described in Section 7.17. In the quantities inferred here (in the order of several cubic metres at most), the risks to water quality and marine fauna will remain low.

7.14.6 Risk Assessment

Table 7.34 presents the risk assessment for the LoC of bulk chemicals and hydrocarbons.

Table 7.34. Risk assessment for the LoC of bulk chemicals and hydrocarbons

Summary		
Summary of risks	Reduction of surface water quality around the discharge point. Acute toxicity to marine fauna through ingestion/absorption of contaminated water.	
Extent of risk	Localised – tens to hundreds of metres from release site.	
Duration of risk	Short-term.	
Level of certainty of risk	HIGH – the effects of chemical and hydrocarbon discharges to marine waters are well known.	
Risk decision framework context	A – nothing new or unusual, represents business as usual, well understood activity, good practice is well defined.	
Risk Assessment (inherent)		
Consequence	Likelihood	Risk rating
Minor	Highly Unlikely	Low
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Chemicals and hydrocarbons are stored and transferred in a manner that prevents bulk release.	All hydrocarbons and chemicals are stored within secure receptacles (DNV rated) within bunded areas or dedicated chemical lockers that drain to bilge tanks (except methanol, due to safety risk).	Visual inspection verifies that hydrocarbons and chemicals are stored within secure receptacles within bunded areas or dedicated chemical lockers that drain to bilge tanks.
	The platform CMMS and vessels' PMS are implemented to ensure the integrity of chemical and hydrocarbon storage areas and transfer systems are maintained in good order. For the platform specifically, this includes the dump caisson pump, back-up pump and alarms.	CMMS (platform) and PMS (vessels) records verify that chemical and hydrocarbon storage areas and transfer systems (e.g., bunds, tanks, pumps, alarms and hydraulic hoses) are maintained to schedule and in accordance with OEM requirements.

	Where hydrocarbons and chemicals are stored within open draining decks, receptacles are stored on/in temporary bunds.	Visual inspection verifies that where hydrocarbons and chemicals are stored within open draining decks, receptacles are stored on/in temporary bunds.
	Crane transfers of bulk chemicals and hydrocarbons are undertaken in accordance with the Lifting and Load Safety Operations Procedure (CDN/ID 3674901) and under a Permit to Work (PTW).	PTW records verify that crane transfers of bulk chemicals and hydrocarbons are undertaken in accordance with the procedure.
Chemicals are of the lowest toxicity possible.	Wherever operationally possible, OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated chemicals are used (in preference to higher toxicity chemicals).	Platform and vessel chemical inventories verify that bulk storages of chemicals are predominantly rated as low toxicity.
	Platform only - all new chemicals introduced to the platform are risk assessed and approved in accordance with the Hazardous Materials and Secondary Containment Directive (CDN/ID 14176239) and listed in the Yolla Hazmat Register.	The Yolla Hazmat Register is current.
Platform and vessel crews are well prepared to respond to a spill.	The platform and vessels have approved SMPEPs (or equivalent appropriate to class) that are implemented in the event of a bulk LoC.	Current SMPEPs are available.
		Spill incident report verifies that the actions were taken in accordance with the SMPEP.
	Platform and vessel crews are regularly trained in spill response techniques in accordance with their SMPEP.	Training records verify that all marine crew are trained in spill response.
	In accordance with the SMPEP, oil spill response kits are available in relevant locations around the platform and vessel, are fully stocked and are used in the event of hydrocarbon or chemical spills to deck.	Inspection/audit records verify that SMPEP kits are readily available on deck.
		Incident reports for hydrocarbon spills to deck record that the spill is cleaned up using SMPEP resources.

Risk Assessment (residual)		
Consequence	Likelihood	Risk rating
Minor	Highly Unlikely	Low

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required.

Demonstration of Acceptability	
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about the LoC of bulk chemicals and hydrocarbons.

Legislative context	The performance standards outlined in this EP align with the requirements of:
	• *Navigation Act* 2012 (Cth):
	  ○ Chapter 4 (Prevention of Pollution).
	  ○ AMSA Marine Order 91 (Marine Pollution Prevention - oil).
	• *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth):
	  ○ Part II (Prevention of pollution by oil).
	  ○ Part III (Prevention of pollution by noxious substances).

	• *POWBONS Act* 1986 (Vic):
	  ○ Part 2, Division 1 (Pollution by oil).
	  ○ Part 2, Division 2 (Pollution by noxious substances).	

Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Accidental release of bulk chemicals – vessels to have IOPP certificate in place, harmful substances must comply with MARPOL Annex III, chemical storage and handling procedures are in place, chemical spill containment and recovery equipment is available near chemical inventories, chemical transfers are only undertaken in suitable weather conditions.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	The EPS listed in this table meet these guidelines for offshore activities with regard to: • Risk management for handling and storage of hydrocarbons (item 18) and chemicals (item 19). The BAT are met for Yolla-A operations by having deck coaming in place, a facility-specific OPEP, ensuring that personnel are trained in the use of spill kits, ensuring storage of chemicals in bunded areas and using chemicals with a low toxicity (as rated by the OCNS).
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Other waste waters (item 44). All process areas should be bunded to ensure that drainage water flows into the closed drainage system.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the risk of any unplanned release of material into the marine environment to ALARP and to an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	The LoC of bulk chemicals or hydrocarbons is highly unlikely to intersect nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	The LoC of bulk chemicals or hydrocarbons will not intersect any Ramsar wetlands.
	TECs (Section 5.4.5)	The LoC of bulk chemicals or hydrocarbons will not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	The LoC of bulk chemicals or hydrocarbons will not intersect any NIWs.
	Nationally threatened and migratory species (Section 5.5)	A temporary and localised reduction in water quality, or ingestion of chemicals or hydrocarbons by a small number

		of individuals, will not result in any significant effects to populations of threatened or migratory fauna.
	Other matters	
	State marine parks (Section 5.4.9)	The LoC of bulk chemicals or hydrocarbons will not intersect any state marine parks. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	The LoC of bulk chemicals or hydrocarbons does not compromise the specific objectives or actions (regarding marine pollution) of any of the species Recovery Plans, Conservation Management Plans or Conservation Advice referenced in this EP. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
• Not applicable.		
Record Keeping		
• CMMS (platform) and PMS (vessel) records. • Environmental inspection/audit records.	• Crew training records. • Incident reports.	

7.15 RISK 5 – Loss of Well Control

7.15.1 Hazards

During operation of the Yolla wells, there is the risk that there could be a LoWC as a result of:

- Equipment failure;
- Well integrity failure;
- Inadequate maintenance;
- Vessel collision/impact;
- Dropped objects (while carrying out platform crane lifts etc);
- Extreme weather;
- Human error;
- Sabotage; and
- Fire/explosion on platform.

The *Assessment of the Risk of Pollution from Marine Oil Spills in Australian Ports and Waters* (DNV, 2011) states that the frequency of blowouts from oil production wells, including external causes, is estimated as 3.9 x 10^{-5} (i.e., 0.000039) per well year. This is based on data from the Gulf of Mexico, UK and Norway during 1980-2004, with adjustment for trends. It applies to well operations of North Sea standard. Based on Australia having 410 oil/condensate wells at the time of the report (2011), this frequency implies there is a 3% chance of a production well blowout somewhere in Australian waters each year (DNV, 2011). The report also states that the frequency of oil spills >1 tonne due to production blowouts is 2.0 x 10^{-5} (i.e., 0.00002) per well year.

Updated data in the *Risk Assessment Data Directory – Blowout Frequencies* (IOGP Report 434-02, 2019) provides the following blowout frequencies (per well year) for gas production wells:

- North Sea operations (and equivalent operations elsewhere working to these standards) – 7.2 x 10^{-5} (excluding external causes) (or 0.000072) and 2.7 x 10^{-5} (external causes, such as storms and ship collision) (or 0.000027);
- USA Gulf of Mexico operations – 1.6 x 10^{-4} (excluding external causes) (or 0.00016) and 3.4 x 10^{-5} (external causes) (or 0.000034); and
- Well operations not of North Sea standard or unknown – 3.3 x 10^{-5} (surface flow) (or 0.000033) and 4.0 x 10^{-6} (underground flow) (or 0.000004).

Data from Volkman et al (1994) and AMSA (2019) indicates that while there have been at least six blowouts during drilling of offshore wells in Australia (the most notable, due to the duration of the LoWC, being during drilling at the Montara Platform in the Timor Sea in 2009), there has only been one during offshore operations. This was during wireline operations at Marlin A4 (Gippsland Basin) in 1971. This indicates that the risk of a LoWC occurring during routine operations is remote.

Oil Spill Trajectory Modelling

To understand the risks posed by a LoWC, Beach commissioned RPS to undertake OSTM for a revised LoWC scenario based on current production rates (RPS, 2020b), using the Yolla condensate properties outlined in Section 3.4.1. In summary, Yolla condensate is classified as a Group I oil by the International Tankers Owners Pollution Federation (ITOPF) with an API of 52.1, density of 770.6 kg/m^3 (at 15°C) and a low viscosity (0.14 cP). This means the condensate evaporates readily when on the water surface with limited persistent components to remain on the water surface over time. Table 7.35 outlines the key OSTM inputs and Table 7.36 lists and justifies the spill thresholds used in the OSTM.

Determining Spill Duration and Volume

The duration of a LoWC scenario is based on the estimated time required to kill the well (86 days), as outlined in the BassGas Relief Well Plan (T-5100-35-MP-005, March 2018). This includes securing a drill rig, mobilising it to site, drilling a relief well and pumping kill fluid.

The release volume (2,375 bbl/day) is based on current production rates. Table 7.35 summarises the parameters used in the OSTM.

Table 7.35. Summary of the LoWC OSTM inputs.

Parameter	Details
Oil Type	Yolla condensate
Total spill volume	204,250 bbl (32,472 m^3)
Release type	Subsea
Release location	Yolla-A platform
Release duration	86 days

Release rate	2,375 bbl/day
Simulation duration	100 days
Surface oil concentration thresholds (g/m^2)	1 g/m^2 – low exposure 10 g/m^2 – moderate exposure 50 g/m^2 – high exposure
Shoreline load threshold (g/m^2)	10 g/m^2 – low exposure 100 g/m^2 – moderate exposure 1,000 g/m^2 – high exposure
Dissolved aromatic dosages to assess potential exposure	10 ppb – low exposure 50 ppb – moderate exposure 400 ppb – high exposure
Entrained oil dosages to assess potential exposure	10 ppb – low exposure 100 ppb – high exposure

Table 7.36. Spill concentration thresholds used in the OSTM study

Segment/ Threshold	Threshold equivalency	Threshold justification
Sea surface		
Low exposure 1 g/m^2	• 0.001 mm thick • 1 µm • Rainbow sheen • 0.1 m^3/km^2	Visible oil, below thresholds that cause environmental harm but may have socio-economic effects Oil that is 1 µm thick is considered below levels that would cause ecological harm and it is more indicative of the areas perceived to be affected due to its visibility on the sea-surface and potential to trigger temporary closures of areas (i.e., fishing grounds) as a precautionary measure. It is also close to the practical limit of observing oil in the marine environment. It is indicative of a 'visual impact' only. This oil thickness is likely to be observed in areas where the hydrocarbon is spread thinly, and as such has already undergone evaporation and weathering. The majority of the lighter, more toxic compounds will have been removed from the surface in that process.
Moderate exposure 10 g/m^2	• 0.01 mm thick • 10 µm • Metallic sheen • 1 m^3/km^2	Lower limit for harmful exposures to birds and marine mammals This is the minimum thickness of oil that could impart ecological impacts. Research has shown that harm to seabirds through ingestion from preening of contaminated feathers, or the loss of thermal protection of their feathers occurs at 10 µm. This is considered the lower actionable threshold, where oil would be thick enough for containment and recovery as well as treatment through dispersant application (AMSA, 2015).
High exposure 50 g/m^2	• >0.5 mm thick • >50 µm • Metallic sheen • 5 m^3/km^2	Approximates surface oil slick A concentration of surface oil greater than 25 µm on the sea surface would be harmful for all marine birds that come in contact with the oil. Mortality would result from ingestion during preening, or from hypothermia from matted feathers.
Shoreline exposure*		
Low exposure 10 g/m^2	• Oil stain/film • 0.01 mm thick	Socio-economic impacts

Segment/ Threshold	Threshold equivalency	Threshold justification
	• 2 tsp/m²	A threshold of 10 g/m² is a conservative threshold used to define regions of socio-economic impact, such as triggering temporary closures of adjoining fisheries or the need for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, and marinas).
Moderate exposure 100 g/m²	• Oil coating • 0.1 mm thick • ½ cup/m²	Prediction of area requiring clean-up effort An oil exposure threshold of 100 g/m² for shorebirds and wildlife (fur-bearing aquatic mammals and marine reptiles) is based on studies for sub-lethal and lethal impacts. This threshold for shoreline contact is also recommended by AMSA (2015) in its 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. The recommendation applies to shoreline types including sandy beach, boulder shorelines, pebble shorelines, rock platforms and industry facility structures. A 100 g/m² threshold is considered the lethal threshold for invertebrates living on hard substrates (rocky, artificial/man-made, rip-rap, etc.) and sediments (mud, silt, sand or gravel) in intertidal habitats. This thickness would be enough to coat the animal and likely impact its survival and reproductive capacity (French-McCay, 2009).
High exposure >1,000 g/m²	• Oil cover • >1 mm thick • 1 litre/m²	Prediction of area requiring intensive clean-up effort Loadings of more than 1,000 g/m² of oil during the growing season would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing oil impacts on mangroves. This exposure is representative of accumulation levels that could have a higher potential for ecological impacts (i.e., ecosystem based impacts).
Dissolved aromatic dosages		
Low exposure 10 ppb	Very sensitive species	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers.
Moderate exposure 50 ppb	Average sensitive species	Approximates potential toxic effects, particularly sub-lethal effects to sensitive species.
High exposure 400 ppb	Tolerant species	Approximates toxic effects, including lethal effects to sensitive species.
Entrained oil dosages		
Low exposure 10 ppb	Very sensitive species	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers The 10 ppb threshold represents the lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC (2000) water quality guidelines. Due to the requirement for relatively long exposure times (> 24 hours) for these concentrations to be significant, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes, or when entrained hydrocarbons adhere to organisms or trapped against a shoreline for periods of several days or more. Exposure to entrained oil at 10 ppb is not considered to have significant biological impacts and is therefore outside the adverse exposure zone. This exposure zone represents the area contacted by the spill. This area does not

Segment/ Threshold	Threshold equivalency	Threshold justification
		define the area of influence as it is considered that the environment will not be affected by the entrained hydrocarbon at this level.
High exposure 100 ppb	Tolerant species	This represents potential toxic effects, particularly sub-lethal effects to sensitive species.

* *Sandy beach shoreline was assumed as the default shoreline type for the modelling herein, as it allows for the highest carrying capacity of oil (of the available open/exposed shoreline types). Hence the results contained herein would be indicative of a worst-case scenario, where the highest volume of oil may be stranded on the shoreline (when compared to other shoreline types, such as exposed rocky shores).*

A summary of the OSTM results for the LoWC is presented in Table 7.37, along with weathering results of Yolla condensate in Figure 7.11, which shows that evaporation is the key weathering mechanism.

Table 7.37. Summary of the sea surface OSTM results for the LoWC scenario

Distance and direction	Zones of predicted exposure		
Sea surface exposure	Low (1-10 g/m^2)	Moderate (10-50 g/m^2)	High (>50 g/m^2)
Maximum distance travelled from release site	17.3 km	No contact	No contact
Direction	South-southeast	No contact	No contact
Shoreline exposure	Low (10 g/m^2)	Moderate (100 g/m^2)	High (>1,000 ppb)
Maximum length of shoreline coating	No contact	No contact	No contact
Dissolved hydrocarbon exposure	Low (10-50 ppb)	Moderate (50-400 ppb)	High (>400 ppb)
Maximum distance travelled from release site	223 km	65 km	No contact
Direction	East-northeast	East-northeast	No contact
Entrained hydrocarbon exposure	Low (10-100 ppb)	Moderate (N/A)	High (>100 ppb)
Maximum distance travelled from release site	495 km	-	43 km
Direction	East-northeast	-	West

The OSTM results for sea surface contact are presented in Figure 7.12, entrained hydrocarbons in Figure 7.13 and dissolved hydrocarbons in Figure 7.14.

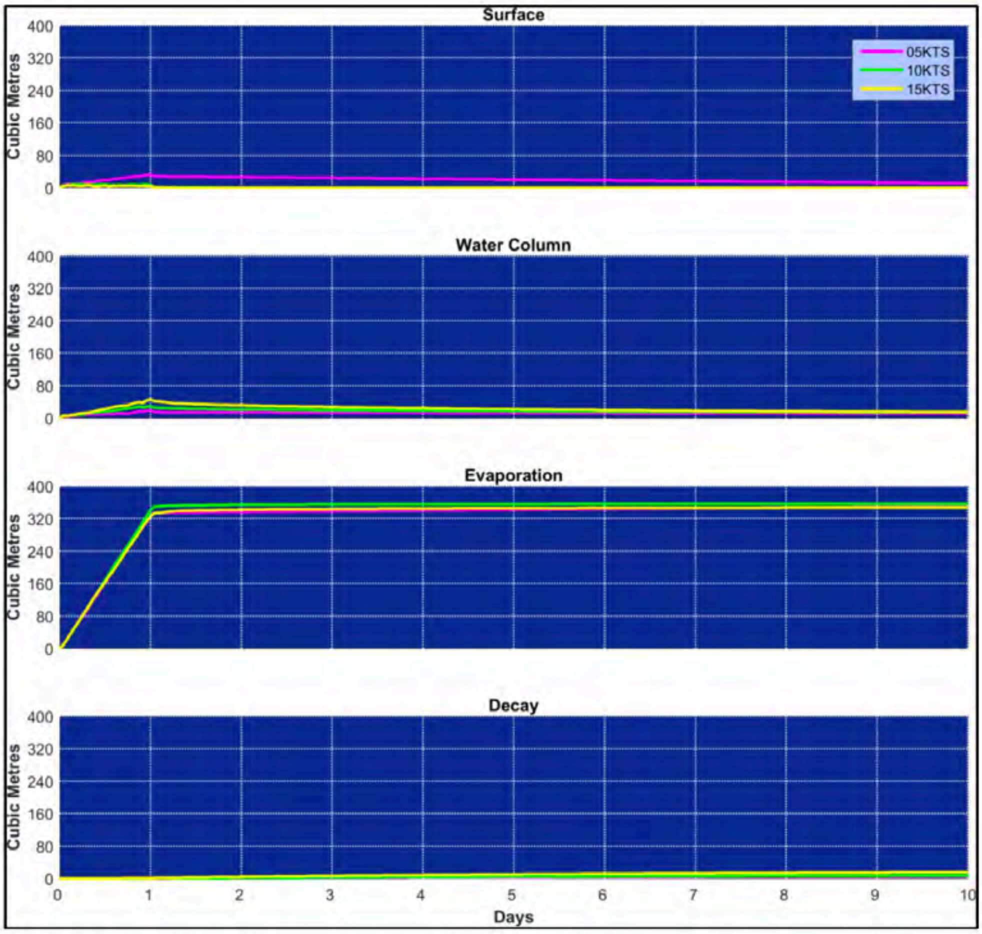


Figure 7.11. Weathering of Yolla condensate under three static wind conditions based on a 2,375 bbl spill released over 24 hours and tracked for 10 days, representative of the LoWC scenario

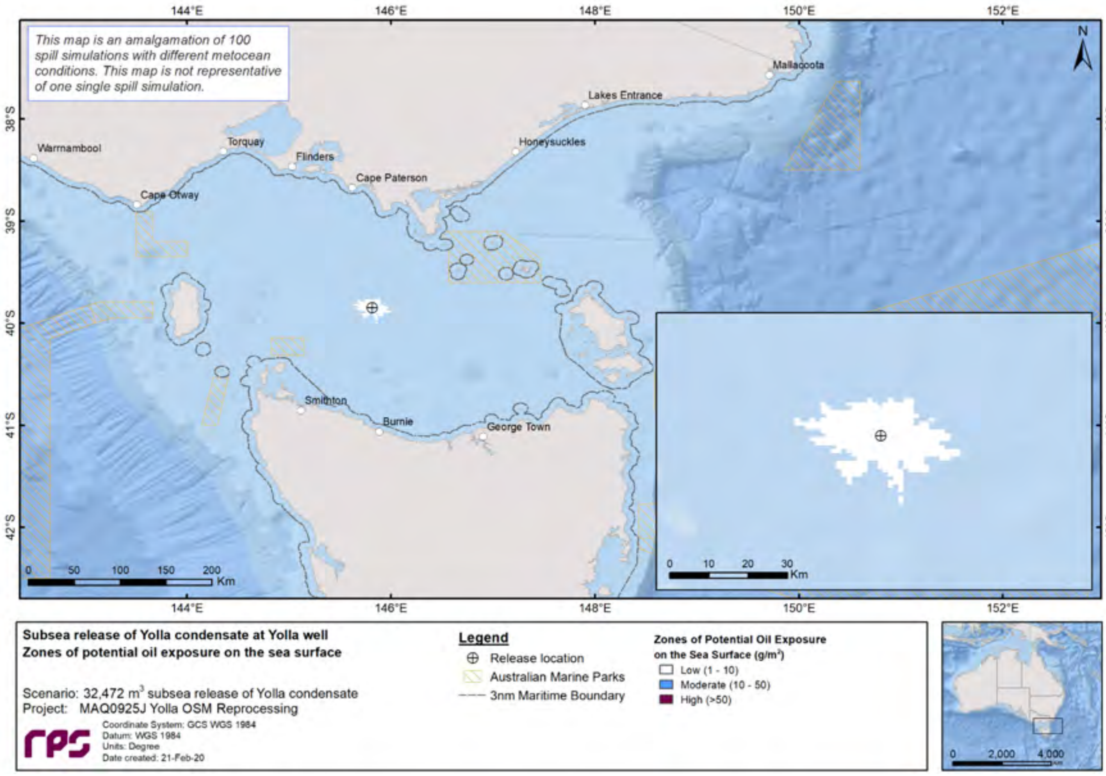


Figure 7.12. Zones of potential exposure on the sea surface in the event of a 204,225 bbl subsea release of Yolla condensate over 86 days and tracked for 100 days based on 100 spill trajectories during annual conditions

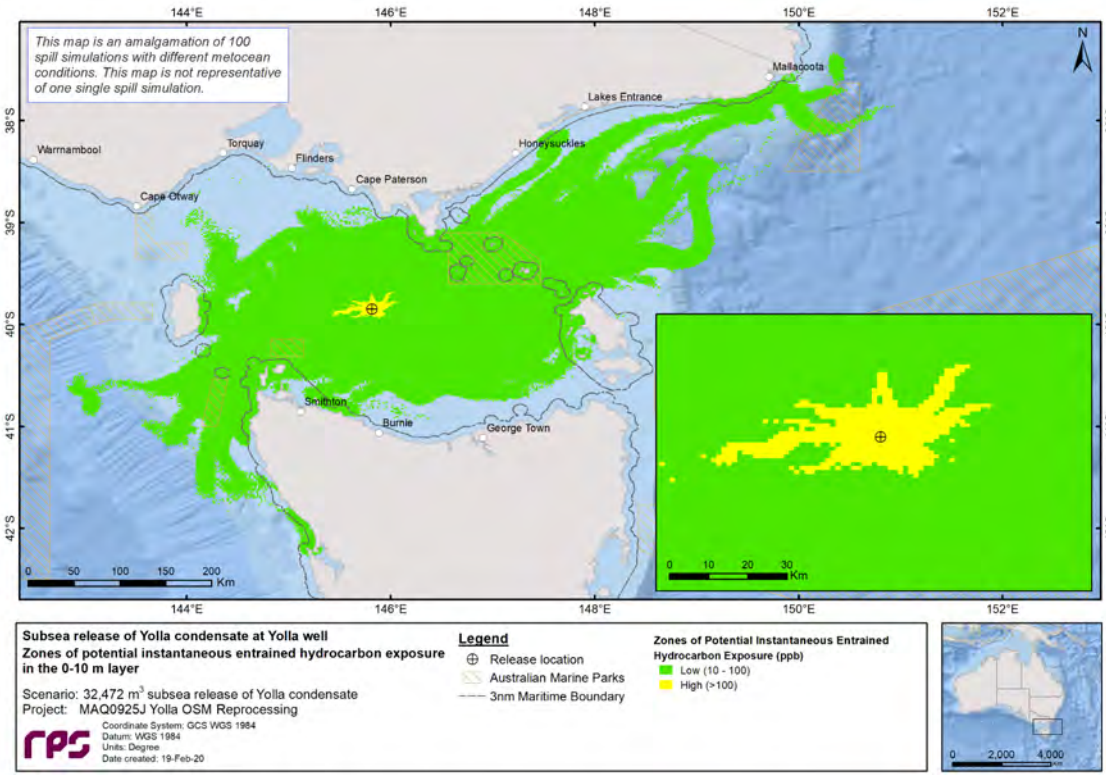


Figure 7.13. Zones of potential entrained aromatic hydrocarbons exposure at 0-10 m below the sea surface in the event of a 204,225 bbl subsea release of Yolla condensate over 86 days and tracked for 100 days

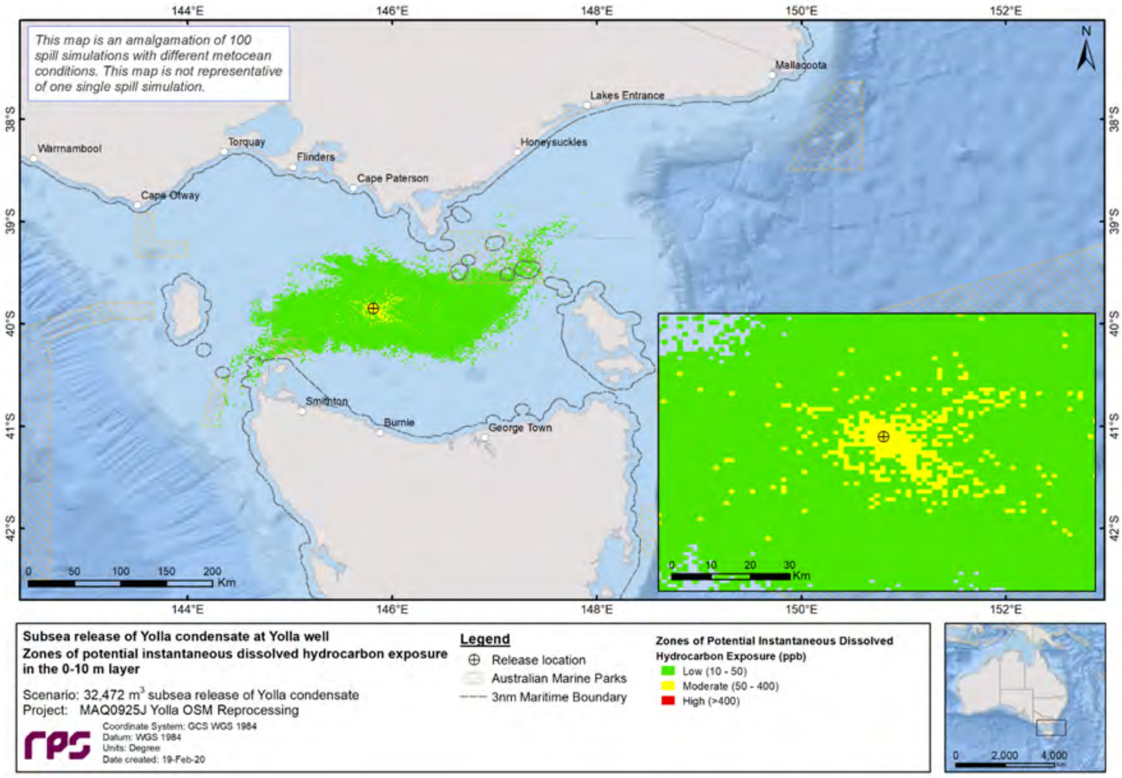


Figure 7.14. Zones of potential dissolved aromatic hydrocarbons exposure at 0-10 m below the sea surface in the event of a 204,225 bbl subsea release of Yolla condensate over 86 days and tracked for 100 days

7.15.2 Potential Environmental Risks

Potential environmental risks resulting from a LoWC include:

- Localised air pollution due to methane emissions;
- Localised and temporary reduction of water quality;
- Potential injury or death of marine life;
- Disruption to third-party operations such as shipping and commercial fishing (e.g., potential loss of fisheries income resulting from temporary fisheries closures, mortalities from fish stocks [reducing target species availability and subsequently catch per unit effort] or tainted catches); and
- Temporary reduction in some values of some coastal marine reserves; and
- Temporary restriction in recreational values of the coastline.

7.15.3 EMBA

The EMBA for the LoWC is illustrated in Figure 7.12, Figure 7.13 and Figure 7.14 and is based on a 204,250 bbl (32,472 m^3) subsea release of Yolla condensate for a duration of 86 days (the time predicted to kill the well). Receptors most at risk, either as residents or migrants, are:

- Plankton;
- Pelagic fish;
- Cetaceans; and
- Pinnipeds.

Socio-economic receptors at risk include:

- Commercial fisheries; and

- Merchant shipping.

7.15.4 Jurisdiction of Hazard

The jurisdictions for the LoWC are outlined in the box below.

Commonwealth waters	Victorian & Tasmanian waters
Yes	**Yes**
The OSTM predicts that an 86-day release of Yolla condensate will contact Commonwealth waters.	The OSTM predicts that an 86-day release of Yolla condensate will result in entrained hydrocarbons reaching Victorian and Tasmanian state waters (no surface, shoreline or dissolved phase hydrocarbons).

7.15.5 Evaluation of Environmental Risk

Table 7.38 provides the criteria used to determine the sensitivity of receptors within the EMBA. The evaluation of environmental risks to these receptors (including fauna, marine parks and fisheries) resulting from the LoWC is presented in Table 7.39 to Table 7.48.

Table 7.38. Criteria used to determine receptor sensitivity in the EMBA.

Sensitivity	Protected areas	Species status	BIA	Coastal sensitivity	Receptors in the EMBA
Low	State - no marine protected areas. Cth - multiple use zones are the dominant component of the AMP.	Species not threatened (or limited to only a few species of a particular faunal grouping). Present in the EMBA only occasionally or as vagrants. Populations known to recover rapidly from disturbance.	No BIA (or limited to only a few species of a particular faunal grouping).	Low sensitivity habitat, such as fine-grained beaches, exposed wave-cut platform and exposed rocky shores, with rapid recovery from oiling (~ 1 year or less). Public recreation beaches not present or not widely used. No harbours or marinas.	• Benthic assemblages. • Plankton. • Pelagic fish. • Macroalgae. • Sandy beaches. • Rocky shores.
Medium	State – no marine protected area. Cth - little to no special purpose zonation.	Species may be threatened (or some species of a particular faunal grouping). Species may or may not be present at time of activity. Some susceptibility to oiling. Populations may take a moderate time to recover from oiling.	Some intersection with one or more BIAs, generally for distribution or foraging rather than breeding.	Moderately sensitive habitat present, such as sheltered rocky rubble coasts, exposed tidal flats, gravel beaches, mixed sand and gravel beaches, with a medium recovery period from oiling (~2-5 years). Public recreation beaches present but not often used. No harbours or marinas.	• Marine reptiles.
High	State - marine protected area present. Cth - special purposes zones are the dominant component of the AMP.	Species are threatened (or most species of a particular faunal grouping). Species known to be present at time of activity. Known to be susceptible to oiling. Populations may take a long time to recover from oiling.	Significant intersection with one or more BIAs, particularly with regard to breeding or migration.	Sensitive habitat present, such as mangrove, salt marshes, and sheltered tidal flats, with long recovery periods from oiling (> 5 years). Public recreation beaches present that are widely used. Busy harbours or marinas.	• Cetaceans. • Pinnipeds. • Seabirds. • Shorebirds. • Commercial fishing. • Marine parks.

Table 7.39. Potential risks of LoWC on benthic fauna

General sensitivity to oiling – benthic fauna	
Sensitivity rating of benthic species and communities:	Low
A description of benthic fauna in the EMBA is provided in:	Section 5.5.1

Surface hydrocarbons

Benthic species are generally protected from exposure to surface hydrocarbon. The primary modes of exposure for benthic communities in oil spills include:

- Direct exposure to dispersed oil (e.g., physical smothering) where bottom discharges stay at the ocean bottom;
- Direct exposure to dispersed and non-dispersed oil (e.g., physical smothering) where oil sinks down from higher depths of the ocean;
- Direct exposure to dispersed and non-dispersed oil dissolved in sea water and/or partitioned onto sediment particles; and
- Indirect exposure to dispersed and non-dispersed oil through the food web (e.g., uptake of oiled plankton, detritus, prey, etc.) (NRDA, 2012).

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. However, the presence of an exoskeleton (e.g., crustaceans) will reduce the impact of hydrocarbon absorption through the surface membrane. Other invertebrates with no exoskeleton and larval forms may be more prone to impacts from pelagic hydrocarbons.

Water column/seabed hydrocarbons

Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms, while impacts to adult species is reduced as a result of the presence of an exoskeleton. Localised impacts to larval stages may occur which could impact on population recruitment that year. If invertebrates are contaminated by hydrocarbons, tissue taint can remain for several months, although taint may eventually be lost. For example, it has been demonstrated that it took 2-5 months for lobsters to lose their taint 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 (that might be taken up by the gills or digestive tract) (McCay-French, 2009). Toxicity is primarily attributed to water soluble PAHs, specifically the substituted naphthalene (C_2 and C_3) as the higher C-ring compounds become insoluble and are not bioavailable. ANZECC/ARMCANZ (2000) identifies the following 96-hr LC50 concentrations for naphthalene (a key primary PAH dissolved phase toxicant in crude oils):

- For the bivalve mollusc, *Katelysia opima*, a concentration of 57,000 ppb; and
- For six species of marine crustaceans, a concentration between 850 and 5,700 ppb.

Other possible impacts from the presence of dispersed and non-dispersed oil include effects of oxygen depletion in bottom waters due to bacterial metabolism of oil (and/or dispersants), and light deprivation under surface oil (NRDA, 2012).

Surveys undertaken after the Montara well blowout in the Timor Sea in 2009 found no obvious visual signs of major disturbance at Barracouta and Vulcan shoals (Heyward *et al.*, 2010), which occur about 20-30 m below the water line in otherwise deep waters (generally >150 m water depth). Later sampling indicated the presence of low-level severely degraded oil at some shoals, though in the absence of pre-impact data, this could not be directly linked to the Montara spill. Levels of hydrocarbons in the sediments were, in any case, several orders of magnitude lower than levels at which biological effects become possible (Heyward *et al.*, 2012; Gagnon & Rawson, 2011).

Studies undertaken since the Macondo well blowout in the Gulf of Mexico (GoM) in 2010 have shown that fewer than 2% of the more than 8,000 sediment samples collected exceeded the EPA sediment toxicity benchmark for aquatic life, and these were largely limited to the area close to the wellhead (BP, 2015). Studies of offshore benthic seaweeds in the northwest GoM prior to and after the Macondo well blowout at Sackett and Ewing banks (in water depths of 55-75 m) found a dramatic die-off of seaweeds after the spill (60 species pre-spill compared with 10 species post-spill) (Felder *et al.*, 2014). Benthic decapod assemblages (crabs, lobsters, prawns) associated with the seaweeds and benthic substrate also showed a strong decline in abundance at both banks post-spill (species richness on Ewing Bank reduced by 42% and on Sackett Bank by 29%), though it is noted that these banks are exposed to influences from Mississippi River discharges that vary year to year, so definitive links to the oil spill are not possible. It is noted, however, that petroleum residues were observed on Ewing Bank and it is possible that this may have caused localized mortalities, reduced the fecundity of surviving female decapods or reduced recruitment (Felder *et al.*, 2014). Felder *et al* (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. Recovery of benthic habitats exposed to entrained hydrocarbons would be expected to return to background water quality conditions within weeks to months of contact. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Committee on Oil in the Sea, 2003).			
Potential risks from LoWC			
Sea Surface	Water column – dissolved phase	Water column – entrained phase	Shorelines
Not applicable.	Only contact at the low threshold was predicted in waters 0-10 m and 10-20 m below the surface. In nearshore waters, where there is interaction with the benthic environment, the probability of contact is 1 to 4% in Tasmanian state waters (around the Albatross, Curtis and Hunter islands, and the Kent Island Group). At this low threshold, the risks of toxic or sub-lethal impacts to benthic fauna or habitats are **low**.	Contact at the low and moderate thresholds was predicted in waters 0-10 m below the surface, and only contact with the low threshold was predicted in waters 10-20 m below the sea surface. In nearshore waters, where there is interaction with the benthic environment, the probability of contact ranges from 1 to 67% in Tasmanian state waters around numerous islands with predominantly rocky shorelines and presumably rocky seabeds. At this low threshold, the risk of toxic or sub-lethal impacts to benthic fauna or habitats are **low**.	There is no shoreline contact from surface oil. There is contact with dissolved and entrained hydrocarbons at low thresholds as described in the columns to the left. Wave-action at the shoreline will naturally disperse and weather the hydrocarbons quickly. At low thresholds, the risk of toxic or sub-lethal impacts to benthic fauna or habitats are **low**.

Table 7.40. Potential risks of LoWC on macroalgal communities

General sensitivity to oiling – macroalgal communities	
Sensitivity rating of macroalgal species and communities:	Low
A description of macroalgal species and communities in the EMBA is provided in:	Section 5.5.3

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.

Smothering, fouling and asphyxiation are some of the physical effects that have been documented from oil contamination in marine plants (Blumer, 1971; Cintron *et al.*, 1981). In macroalgae, oil can act as a physical barrier for the diffusion of CO_2 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 et al (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 contamination) 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).

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).

The toxicity of macroalgae to hydrocarbons varies for the different macroalgal life stages, with water-soluble hydrocarbons more toxic to macroalgae (Van Overbeek & Blondeau, 1954; Kauss *et al.*, 1973; cited in O'Brien and Dixon, 1976). Toxic effect concentrations for hydrocarbons and algae have varied greatly among species and studies, ranging 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).

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.

Potential risks from LoWC			
Surface oiling	Water column – dissolved phase	Water column – entrained phase	Shoreline
Floating vegetation in central Bass Strait may be exposed to low concentrations of hydrocarbons at the sea surface. The nature of the spill in this scenario (occurring in central Bass	Only contact at the low threshold was predicted in waters 0-10 m and 10-20 m below the surface. In nearshore waters, where there is interaction with macroalgal communities, the probability of contact is 1 to 4% in Tasmanian state waters (around the Albatross, Curtis and Hunter islands, and the Kent Island Group).	Contact at the low and moderate thresholds was predicted in waters 0-10 m below the surface, and only contact with the low threshold was predicted in waters 10-20 m below the sea surface. In nearshore waters, where there is interaction with the macroalgal communities, the probability of contact ranges from 1 to 67% in Tasmanian state waters around numerous	There is no shoreline contact from surface oil. There is contact with dissolved and entrained hydrocarbons at low thresholds as described in the columns to the left.

Strait water ~60-80 m deep) means the risk to macroalgal communities is **low**.	Due to the low concentrations of hydrocarbons and the well-mixed nature of the waters of the EMBA, coating of macroalgae by hydrocarbons is considered highly unlikely. Thus, the risk to macroalgal communities is considered **low**.	islands with predominantly rocky shorelines and presumably rocky seabeds. At this low threshold, the risk of toxic or sub-lethal impacts to benthic fauna or habitats is **low**.	Wave-action at the shoreline will naturally disperse and weather the hydrocarbons quickly. At low thresholds, the risk of toxic or sub-lethal impacts to macroalgal communities is **low**.

Table 7.41. Potential risk of LoWC on plankton

General sensitivity to oiling – plankton	
Sensitivity rating of plankton:	Low
A description of plankton communities in the EMBA is provided in:	Section 5.5.2

Plankton is found in nearshore and open waters beneath the surface 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, hydrocarbons dissolved or entrained in the water column.

Phytoplankton is typically not sensitive to the impacts of oil, though they do accumulate it rapidly due to their small size and high surface area to volume ratio (Hook et al., 2016). If phytoplankton is exposed to hydrocarbons at the sea surface, this may directly affect their ability to photosynthesize and would have implications for the next trophic level in the food chain (e.g., small fish) (Hook et al., 2016). In addition, the presence of surface hydrocarbons may result in a reduction of light penetrating the water column, which could affect the rate of photosynthesis for phytoplankton in instances where there is prolonged presence of surface hydrocarbons over an extensive area such that the phytoplankton was restricted from exposure to light. Oil can affect the rate of photosynthesis and inhibit growth in phytoplankton, depending on the concentration range. For example, 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 et al., 2004).

Zooplankton (microscopic animals such as rotifers, copepods and krill that feed on phytoplankton) are vulnerable to hydrocarbons due to their small size and high surface area to volume ratio, along with (in many cases) their high lipid content (that facilitates hydrocarbon uptake) (Hook et al., 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 et al., 2016).

Plankton is generally abundant in the upper layers of the water column and acts as the basis for the marine food web, meaning that a MDO spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. Variations in the temporal scale of oceanographic processes typical of the ecosystem have a greater influence on plankton communities than the direct effect of spilt hydrocarbons. This is because reproduction by survivors or migration from unaffected areas would be likely to rapidly replenish any losses from permanent zooplankton (Volkman et al., 2004).

Field observations from oil spills show minimal or transient effects on marine plankton (Volkman et al., 2004). Once background water quality conditions have re-established, the plankton community will take weeks to months to recover (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics.

Potential risks from LoWC	
Surface oiling & water column	Shoreline
Plankton found in open water 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 dissolved and dispersed hydrocarbons. Once background water quality conditions are rapidly re-established following the natural weathering and dispersion of the hydrocarbons, plankton populations are expected to recover rapidly due to recruitment of plankton from surrounding waters. The risk of hydrocarbon spills on plankton populations is considered **low**.	Not applicable.

Table 7.42. Potential risk of LoWC on pelagic fish

General sensitivity to oiling – pelagic fish	
Sensitivity rating of pelagic fish:	Low
A description of pelagic fish in the EMBA is provided in:	Section 5.5.8

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 these species are highly mobile and as such are 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., they area site-attached).

Fish are exposed to hydrocarbon droplets through a variety of pathways, including:

- Direct dermal contact (e.g., swimming through oil or waters with elevated dissolved hydrocarbon concentrations and other constituents, with diffusion across their gills (Hook *et al.*, 2016));
- Ingestion (e.g., directly or via food base, fish that have recently ingested contaminated prey may themselves be a source of contamination for their predators); and
- Inhalation (e.g., elevated dissolved contaminant concentrations in water passing over the gills).

Exposure to hydrocarbons at the surface or entrained or dissolved in the water column 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, which reduces the risk of bioaccumulation of contaminants in the food web (and human exposure to contaminants through the consumption of seafood) (NRDA, 2012).

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, fish are high mobile and unlikely to remain in the area of a spill for long enough to be exposed to sub-lethal doses of hydrocarbons.

Fish are most vulnerable to hydrocarbon discharges during their embryonic, larval and juvenile life stages. Eggs and larvae of many fish species are highly sensitive to oil exposure, resulting in decreased spawning success and abnormal larval development (see Table 7.33 'Plankton').

Since fish and sharks do not generally break the sea surface, the impacts of surface hydrocarbons to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Volkman *et al.*, 2004). As a result, wide-ranging pelagic fish of the open ocean generally are not highly susceptible to impacts from surface hydrocarbons. Adult fish kills reported after oil spills occur mainly to shallow water, near-shore benthic species (Volkman *et al.*, 2004).

Hydrocarbon in the water column can physically affect reef fish (that have high site fidelity and cannot move out of harm's way) exposed for an extended duration (weeks to months) by coating of gills, leading to lethal and sub-lethal effects from reduced oxygen exchange and coating of body surfaces that may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food, leading to reduced growth (Volkman *et al.*, 2004).

The threshold value for species toxicity in the water column is based on global data from French et al. (1999) and French-McCay (2002, 2003), which showed that species sensitivity (fish and invertebrates) to dissolved aromatics exposure >4 days (96-hour LC50) under different environmental conditions varied from 6 to 400 µg/L (ppb), with an average of 50 ppb. This range covered 95% of aquatic organisms tested, which included species during sensitive life stages (eggs and larvae). Based on scientific literature, a minimum threshold of 6 ppb over 96 hours or equivalent was used to assess in-water low exposure zones, respectively (Engelhardt, 1983; Clark, 1984; Geraci and St Aubin, 1988; Jenssen, 1994; Tsvetnenko, 1998). French-McCay (2002) indicates that an average 96-hour LC50 of 50 ppb and 400 ppb could serve as an acute lethal threshold to 50% and 97.5% to biota, respectively.

Studies of oil impacts on bony fishes report that light, volatile oils are likely to be more toxic to fish. Many studies conclude that exposure to PAHs and soluble compounds are responsible for the majority of toxic impacts observed in fish (e.g., Carls *et al.*, 2008; Ramachandran *et al.*, 2004). A range of lethal and sub-lethal effects to fish in the larval stage has been reported at water-accommodated fraction (WAF) hydrocarbon concentrations (48–hour and 96-hour exposures) of 0.001 to 0.018 ppm during laboratory exposures (Carls *et al.*, 2008; Gala, 2001). In contrast, wave tank exposures reported much higher lethal concentrations (14-day LC50) up to 1.9 ppm for herring embryos and up to 4.3 ppm for juvenile cod (Lee *et al.*, 2011).

Toxicity in adult fish has been reported in response to crude oils, HFO and diesel (Holdway, 2002; Shigenaka, 2011). Uptake of hydrocarbons has been demonstrated in bony fish after exposure to WAF of between 24 and 48 hours. Danion et al (2011) observed PAH uptake of 148 µg/kg-1 after 48-hour exposures to PAH from Arabian Crude at high concentrations of 770 ppm. 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. The majority of studies, either from laboratory trials or of fish collected after spill events (including the Hebei Spirit, Macondo, and Sea Empress spills) find evidence of elimination of PAHs in fish tissues returning to reference levels within two months of exposure (Challenger and Mauseth, 2011; Davis et al., 2002; Gagnon & Rawson, 2011; Gohlke *et al.*, 2011; Jung, 2011; Law, 1997; Rawson *et al.*, 2011).

During most of their lives, 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).

The toxicity of dissolved hydrocarbons and dispersed oil to fish species has been the subject of a number of laboratory studies (AMSA, 1998). Generally, concentrations in the range of 0.1–0.4 mg/L dispersed oil have been shown to cause fish deaths in laboratory experiments (96-hour LC50). 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.

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 *Pristipomoides multidens*, red emperor *Lutjanus sebae*, rainbow runner *Elegatis bipinnulata* and Spanish mackerel *Scomberomorus commerson*), all 781 specimens were in good physical health at all sites. Results show that:

- Phase 1 study (November 2009, immediately after the blowout ceased) - indicated that in the short-term, fish were exposed to and metabolised petroleum hydrocarbons, however no consistent adverse effects on fish health or their reproductive activity were detected.
- Phase 2 study (March 2010, 5 months after the blowout ceased) – indicated continuing exposure to petroleum hydrocarbons, as detected by elevated liver detoxification enzymes and PAH biliary metabolites in three out of four species collected close to the MODU, and elevated oxidative DNA damage.
- Phase 3 study (November 2010, 12 months after the blowout ceased) – showed a trend towards a return to reference levels with often, but not always, comparable biomarker levels in fish collected from reference and impacted sites. This evidence of exposure to petroleum hydrocarbons at sites close to the spill location suggest an ongoing trend toward a return to normal biochemistry/physiology (Gagnon & Rawson, 2011).

The main finding of the Gagnon & Rawson (2011) study 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. However this was potentially attributed to local nutrient enrichment, or to past exposure to hydrocarbons. Fishes near Heyward Shoal, approximately 100 km southwest of the Montara well, had elevated biomarker responses indicating exposure to hydrocarbons, but were collected close to the Cornea natural hydrocarbon seep. Studies on the Montara discharge have shown recovery in terms of the abundance and composition of fishes, and toxicological and physiological responses of fishes.

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 Macondo well blowout in the GoM (BP, 2014).

No reports of oil spills in open waters have been reported to cause fish kills (though mortality in aquaculture pens has), which is likely to be because vertebrates can rapidly metabolise and excrete hydrocarbons (Hook *et al.*, 2016).

Recovery of fish assemblages depends on the intensity and duration of an unplanned discharge, the composition of the discharge and whether dispersants are used, as each of these factors influences the level of exposure to potential toxicants. Recovery would also depend on the life cycle attributes of fishes. Species that are abundant, short-lived and highly fecund may recover rapidly. However less abundant, long-lived species may take longer to recover. The range of movement of fishes will also influence recovery. The nature of the receiving environment would influence the level of impact on fishes.

Potential risks from LoWC	
Surface oiling & water column	Shoreline
Because the majority of fish tend to remain in the mid-pelagic zone, they are not likely to come into contact with the modelled exposure of low sea surface hydrocarbons. Some syngnathid species associated with rafts of floating seaweed may come into contact with surface oil though the low concentration of hydrocarbons is not sufficient to cause long-term harm to these populations. The extent of the area affected by dissolved hydrocarbons at the low threshold is extensive, travelling up to 223 km from the well sites. At the low threshold, water quality triggers are exceeded, but there are no toxicity effects to fish. The extent of area affected by the dissolved hydrocarbons at the moderate threshold is up to 65 km from the well site. Fish exposed to hydrocarbons at this concentration for an extended period may experience sub-lethal or toxic effects. However, hydrocarbons at this threshold do not reach sensitive sites, such as AMPs, coastal marine parks or state waters. Given the highly mobile nature of fish likely to be present in this EMBA (i.e., an absence of site-attached species), significant impacts to pelagic fish from dissolved hydrocarbons are not expected. The sea surface area affected by the hydrocarbon release scenario represents a very small percentage of the broader Bass Strait area and NOAA (2013) and ITOPF (2011a) state that hydrocarbon spills in open water (such as those of Bass Strait) are so rapidly diluted that fish kills are rarely observed. Oceanographic data described in Section 5.3 describes the well-mixed nature of Bass Strait waters and when combined with the light nature of the hydrocarbon in this scenario, the risk from hydrocarbons on pelagic fish species at a population level is considered to be **low**.	Not applicable.

Table 7.43. Potential risk of LoWC on cetaceans

General sensitivity to oiling – cetaceans	
Sensitivity rating of cetaceans:	High
A description of cetaceans in the EMBA is provided in:	Section 5.5.5

Whales and dolphins can be exposed to the chemicals in oil through:

- 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, 1988). 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 vessel 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 can still present a problem by fouling baleen whales feeding systems.

Dolphin populations from Barataria Bay, Louisianna, 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 risks from LoWC		
Surface oiling	Water column	Shoreline
The OSTM shows that low zones of exposure to sea surface hydrocarbon will overlap the foraging and distribution BIAs for pygmy blue whales. It is possible that pygmy blue whales may be present in the EMBA depending on the time of year that the spill occurs. If present, these species (and other cetaceans) may be exposed to oil in the manner described in this table. If large quantities of zooplankton (key prey species, though unlikely to occur in such proximity to the shoreline) exposed to the spill were ingested, chronic toxicity impacts may occur. Biological consequences of physical contact with localised areas of low concentrations of hydrocarbons at the sea surface are unlikely to lead to any long-term population 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). Therefore, the risk to cetaceans migrating or foraging in the EMBA, at the population level, for this scenario is **low**.	The OSTM shows a large area of dissolved and entrained phase hydrocarbons at low threshold would occur through central Bass Strait. At the low threshold, water quality triggers are exceeded, but there are no toxicity effects to cetaceans. The extent of area affected by the dissolved hydrocarbons at the moderate threshold is up to 65 km from the well site, and up to 43 km for entrained hydrocarbons at the high threshold. Highly mobile and transient species such as cetaceans moving through an area of hydrocarbons at the moderate or high exposure makes it unlikely that individual cetaceans would experience any toxicity effects of the oil nor would population level impacts be likely. The area potentially impacted by dissolved hydrocarbons at the moderate threshold and entrained hydrocarbons at the high threshold is a very small area of cetacean BIAs, so the risk of impacting on the health of a population is negligible. As described by the oceanographic data presented in Section 5.3, the well-mixed waters of central Bass Strait are likely to assist in weathering of the hydrocarbons. The OSTM predicts that 320 m^3 of ~378 m^3 will evaporate after one day. The oceanographic conditions, the light nature of the Yolla condensate and the low concentration of hydrocarbons in the water column means the risk to cetaceans populations is **low**.	Not applicable.

Table 7.44. Potential risk of LoWC on pinnipeds

General sensitivity to oiling – pinnipeds	
Sensitivity rating of pinnipeds:	High
A description of pinnipeds in the EMBA is provided in:	Section 5.5.6

Pinnipeds (Australian fur-seal and New Zealand fur-seal) are potentially impacted by hydrocarbons at the sea surface, water column and shoreline.

Sea surface oil

Pinnipeds are vulnerable to sea surface exposures given they spend much of their time on or near the surface of the water, as they need to surface every few minutes to breathe and regularly haul out on to beaches. Pinnipeds are also sensitive as they will stay near established colonies and haul-out areas, meaning they are less likely to practice avoidance behaviours. This is corroborated by Geraci and St. Aubins (1988) who suggest seals, sea-lions and fur-seals have been observed swimming in oil slicks during a number of documented spills.

Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. 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 that surround the eyes and line 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 the toxic impacts from the inhalation of volatile components.

For some pinnipeds, fur is an effective thermal barrier because it traps air and repels water. Petroleum stuck to fur reduces its insulative value by removing natural oils that waterproof the pelage. Consequently, the rate of heat transfer through fur seal pelts can double after oiling (Geraci & St. Aubin, 1988), adding an energetic burden to the animal. Kooyman et al (1976) suggest that in fact, fouling of approximately one-third of the body surface resulted in 50% greater heat loss in fur seals immersed in water at various temperatures. Fur-seals are particularly vulnerable due to the likelihood of oil adhering to fur. Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water. Davis and Anderson (1976) observed two gray seal pups drowning, their "flippers stuck to the sides of their bodies such that they were unable to swim".

However, pinnipeds other than fur-seals are less threatened by thermal effects of fouling, if at all. Oil has no effect on the relatively poor insulative capacity of sea-lion and bearded and ringed seal pelts; oiled Weddell seal samples show some increase in conductance (Oritsland, 1975; Kooyman *et al.*, 1976; 1977).

In-water oil

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 & Brodie, 1984; Addison *et al.*, 1986). Geraci & St. Aubin (1988) suggest that a small phocid weighing 50 kg might have to ingest approximately 1 litre of oil to be at risk.

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 considered likely. If ingested in large volumes, hydrocarbons may not be completely metabolised, which may result in death.

Shoreline oil

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 consequently are unlikely to practice oil avoidance behaviours.

ITOPF (2011a) report that species that rely on fur to regulate their body temperature (such as fur-seals) are the most vulnerable to oil as the animals may die from hypothermia or overheating, depending on the season, if the fur becomes matted with oil.

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 ingest oil. All pinnipeds examined to date have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt, 1982; Addison and Brodie, 1984; Addison *et al.*, 1986).

The long-term Environmental Impact and Recovery report for the Iron Barren oil spill (in Tasmania, 1995) concluded that "The number of seal pups born at Tenth Island in 1995 was reduced when compared to previous years. There was a strong relationship between the productivity of the seal colonies and the proximity of the islands to the oil spill wherein the islands close to the spill showed reduced pup production and those islands more distant to the oil spill did not" (Tasmanian SMPC, 1999).

Pinnipeds are further at risk because they appear to rely on scent to establish a mother-pup bond (Sandegren, 1970; Fogden, 1971), and consequently oil-coated pups may not be recognisable to their mothers. This is only theorised, with studies and research indicating interaction between mothers and oiled pups were normal (Davis and Anderson, 1976; Davies, 1949; Shaughnessy & Chapman, 1984).

Australian sea-lions have 'naturally poor recovery abilities' due to 'unusual reproductive biology and life history' (TSSC, 2005).

Due to the extreme philopatry of females and limited dispersal of males between breeding colonies, the removal of only a few individuals annually may increase the likelihood of decline and potentially lead to the extinction of some of the smaller colonies. Extinction of breeding colonies has the potential to further reduce genetic diversity and the already limited genetic flow between colonies. This, in turn, may weaken the genetic resilience of the species and impact on its ability to cope with other natural or anthropogenic impacts. In addition, the extreme philopatry of females suggests that extinction of breeding colonies may lead to a contraction of the range of the species as re-colonisation of breeding sites via immigration is limited.

For the reasons outlined above, small breeding colonies are under particular pressure of survival from even low levels of anthropogenic mortality.

Potential risks from LoWC		
Surface oiling	Water column	Shoreline
The foraging range for New Zealand fur-seals and Australian fur-seals may be temporarily exposed to low concentration of hydrocarbons at the sea surface. As fur-seals forage for prey within the water column rather than at the sea surface, exposure to oil at the sea surface will only result when resting at the surface. The EMBA for a LoWC does not reach shorelines where seals are likely to be entering and exiting the water. Depending on the duration of time spent at the sea surface, exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. Given the very small area of moderate exposure oil threshold at the sea surface, and absence of high exposure, acute or chronic toxicity impacts are not likely for multiple individuals. The highly mobile nature of the pinniped species likely to be present means areas on the sea surface impacted by low hydrocarbon exposure can be avoided. Given the generally brief time spent at the sea surface by pinnipeds and the rapid weathering of the condensate, the risk of permanent injury or mortality to multiple individuals that could impact on the populations present in Bass Strait is **low**.	Given that fur-seals forage for prey within the water column, exposure to hydrocarbons (either via ingestion of contaminated prey or direct contact with oil droplets) may occur, however the low concentrations modelled are below those likely to impart permanent injury or mortality to pinniped populations in Bass Strait. The zones of dissolved hydrocarbons meeting the moderate threshold and entrained hydrocarbons meeting the high threshold are small in comparison to the wider area available to pinnipeds for foraging, and these zones are not located close to breeding or haul-out sites. This means there is a low probability that pinnipeds would be feeding exclusively on prey found in these areas of higher hydrocarbon thresholds for long periods of time. The area potentially affected by hydrocarbons represents a very small area in which fur-seals are known to forage in Bass Strait and is unlikely to be habitat critical to their survival. The risk to fur-seals for hydrocarbons in the water column is therefore considered to be **low**.	No shoreline loading was predicted under the conditions modelled for the LoWC scenario. There is no risk of hydrocarbon stranding on shorelines known to be used by New Zealand and Australian fur-seals as breeding or haul-out sites. As such, the risk is **low**.

Table 7.45. Potential risk of LoWC on marine reptiles

General sensitivity to oiling – marine reptiles	
Sensitivity rating of marine reptiles:	Medium
A description of marine reptiles in the EMBA is provided in:	Section 5.5.8

Marine reptiles can be exposed to hydrocarbon through ingestion of contaminated prey, inhalation or dermal exposure (Hook *et al.*, 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. Oil exposure affects different turtle life stages in different ways. Each turtle life stage frequents a habitat with notable potential to be impacted during an oil spill. Thus, information on oil toxicity needs to be organized by life stage. Turtles may be exposed to chemicals in oil in two ways:

1. Internally – eating or swallowing oil, consuming prey containing oil-based chemicals, or inhaling of volatile oil related compounds; and
2. Externally – swimming in oil or dispersants, or oil or dispersants on skin and body.

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, 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.

Impacts to sea snakes during marine hydrocarbon spills are known from limited assessments, undertaken following the Montara spill in the Timor Sea in 2009. Two dead sea snakes were collected during the incident, one of which was concluded to have died as a result of exposure to the oil, with evidence of inhaled and ingested oil and elevated concentrations of PAHs in muscle tissues. The second snake showed evidence of ingestion by oil but no accumulation in tissues or damage to internal organs and it was concluded that the oil was unlikely to be the cause of death (Curtin University, 2009; 2010).

There is potential for contamination of turtle eggs to result in similar toxic impacts to developing embryos as has been observed in birds. Studies on freshwater snapping turtles showed uptake of PAHs from contaminated nest sediments, but no impacts on hatching success or juvenile health following exposure of eggs to dispersed weathered light crude (Rowe *et al.*, 2009). However, other studies found evidence that exposure of freshwater turtle embryos to PAHs results in deformities (Bell *et al.*, 2006, Van Meter *et al.*, 2006).

Turtles may experience oiling impacts on nesting beaches and eggs through chemical exposure, resulting in decreased survival to hatching and developmental defects in hatchlings. Turtle hatchlings may be more vulnerable to smothering as they emerge from the nests and make their way over the intertidal area to the open water (AMSA, 2015). Hatchlings that contact oil residues while crossing a beach can exhibit a range of effects including impaired movement and bodily functions (Shigenaka, 2003). Hatchlings sticky with oily residues may also have more difficulty crawling and swimming, rendering them more vulnerable to predation.

Ingested oil may cause harm to the internal organs of turtles. 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. Turtles may experience oiling impacts on nesting beaches when they come ashore to lay their eggs, and their eggs may be exposed during incubation, potentially resulting in increased egg mortality and/or possibly developmental defects in hatchlings.

Potential risks from LoWC		
Surface oiling	Water column	Shoreline
Some individual transient marine reptiles may come into contact with low hydrocarbon exposure on the sea surface and very localised areas of moderate hydrocarbon exposure. This may result in irritation of skin or cavities. However, due to the absence of turtle BIAs in Bass Strait and the low chance of encountering turtles in Bass Strait in general, the risk to marine reptiles (individuals or populations) is considered to be **low**.		No shoreline contact is predicted under the conditions modelled for the LoWC scenario.

Table 7.46. Potential risk of LoWC on seabirds and shorebirds

General sensitivity to oiling – seabirds and shorebirds	
Sensitivity rating of seabirds:	High
Sensitivity rating of shorebirds:	High
A description of seabirds and shorebirds in the EMBA is provided in:	Section 5.5.4

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 *et al.*, 2016). Species that raft together in large flocks on the sea surface are particularly at risk (ITOPF, 2011a).

Birds foraging at sea have the potential to directly interact with oil on the sea surface some considerable distance from breeding sites 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 plumage, which may result in hypothermia due to a reduction in the ability of the bird to thermo-regulate and impair water-proofing (ITOPF, 2011a). A bird suffering from cold, exhaustion and a loss of buoyancy (resulting from fouling of plumage) may dehydrate, drown or starve (ITOPF, 2011a; DSEWPC, 2011; AMSA, 2013). It may also result in impaired navigation and flight performance (Hook *et al.*, 2016). Increased heat loss as a result of a loss of water-proofing results in an increased metabolism of food reserves in the body, which is not countered by a corresponding increase in food intake, and may lead to emaciation (DSEPWC, 2011). The greatest vulnerability in this case occurs when birds are feeding or resting at the sea surface (Peakall *et al.*, 1987). In a review of 45 marine hydrocarbon spills, there was no correlation between the numbers of bird deaths and the volume of the spill (Burger, 1993).

Toxic effects of hydrocarbons on birds may result where the oil is ingested as the bird attempts to preen its feathers, and the preening process may spread the oil over otherwise clean areas of the body (ITOPF, 2011a). Whether this toxicity ultimately results in mortality will depend on the amount of hydrocarbons 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, mimicking the effect of oil transfer by parent birds, 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/m^2). Scholten et al (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 of individual birds (ingestion or soiling of feathers) and indirect impacts through the contamination of foraging areas that may result in 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 also be damaged if an oiled adult sits on the nest. Fresh crude was shown to be more toxic than weathered crude, which had a medial lethal dose of 21.3 mg/egg (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 *et al.*, 2016). The Iron Baron vessel 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 *et al.*, 2016).

Potential risks from LoWC		
Surface oiling	Water column	Shoreline
Most of the seabird species described in Section 5.5.4 that may occur in the EMBA forage over an extensive area and are distributed over a wide geographic area. Seabirds plunge diving through the sea surface for prey are most likely to encounter the low concentration of hydrocarbons. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with oil. However, this level of exposure is not expected to result in the lethal impacts of feather matting and hypothermia. Given the extensive ocean foraging habitat available to species such as albatross and petrel, the small area and temporary nature of the hydrocarbon release on the sea surface makes it unlikely that a spill will limit their ability to forage for unaffected prey, nor will the unlikely event of exposure at the sea surface result in permanent injury or mortality. The absence of breeding colonies or nesting areas in the EMBA for albatross and petrel further limits potential exposure to spilled hydrocarbons. Therefore, the overall risk to birds is considered **low**.	The zones of dissolved hydrocarbons meeting the moderate threshold and entrained hydrocarbons meeting the high threshold are small. It is these small areas where sub-lethal or toxic effects to fish may occur. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in these small areas of higher hydrocarbon thresholds, meaning there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. Therefore, the overall risk to birds is considered **low**.	No shoreline contact was predicted under the LoWC scenario. The shorebird species described in Section 5.5.4 are not likely to be exposed to the low concentrations of hydrocarbons because of their habitat preferences and the distinctly marine nature of the spill. The shorebird species (e.g., plovers, godwits, curlews, etc.) prefer varying habitats including tidal flats, open saltmarsh, freshwater wetlands, open grasslands and sandy beaches. These habitats are not affected by a LoWC, so risks to shorebird species are **low**.

Table 7.47. Potential risk of LoWC on sandy beaches

General sensitivity to oiling – sandy beaches	
Sensitivity rating of sandy beaches (environmental):	Low
Sensitivity rating of sandy beaches (socio-economic):	Medium
A description of sandy beaches in the EMBA is provided in:	Section 5.3.7

Sandy beaches are regularly cleaned by wave action and have low sediment total organic carbon and therefore a low abundance of marine life (Hook *et al.*, 2016). The low concentration of total organic carbon and large particle size of sand means that any oil deposited on the beach would not be retained. However, sandy beaches are important socio-economically, so an oil spill reaching this type of shoreline may attract attention that is disproportionate to its sensitivity (Hook *et al.*, 2016).

Depth of penetration in sandy sediment is influenced by:

- Particle size - penetration is great in coarser sediments (such as beach sand) compared to mud (in estuaries and tidal flats).
- Oil viscosity – MDO quickly penetrates sandy sediments.
- Drainage – coarse beach sands allow for rapid drainage (it may reach depths greater than one metre in coarse well-drained sediments).
- Animal burrows and root pores - penetration into fine sediments is increased if there are burrows of animals such as worms, or pores left where plant roots have decayed.

Areas of heavy oiling (>1,000 g/m^2 threshold) 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. The results of exposure to oil may be acute (e.g., die off of amphipods and replacement by more tolerant species such as worms or chronic (i.e., gradual accumulation of oil and genetic damage) (Hook *et al.*, 2016).

For example, following the Sea Empress 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 Amoco Cadiz spill (in Brittany, France, 1978) (IPIECA, 1999). Following the Sea Empress 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).

In March 2014, small volumes of crude oil from an unidentified source (confirmed to not be offshore oil and gas production facilities) washed up along a 7-km section of sandy beach on the Victorian Gippsland coast as small (a few millimetres thick) granular balls (Gippsland Times, 2014; ABC News, 2014). AMSA (2014b) reported that no impacts were observed over the course of two months following the incident.

The Macondo well blowout resulted in oil washing up on sandy beaches of the Alabama coastline. The natural movement of sand and water through the beach system continually transformed and re-distributed oil within the beach system, and 18 months after the event, mobile remnant oil remained in various states of weathering buried at different depths in the beaches (Hayworth *et al.*, 2011). Other results from beach sampling undertaken at Dauphin Island, Alabama, in May (pre-impact) and September 2011 (post-impact) found a large shift in the diversity and abundance of microbial species (e.g., nematodes, annelids, arthropods, polychaetes, protists, fungi, algae and bacteria). Post-spill, sampling indicated that species composition was almost exclusively dominated by a few species of fungi. DNA analyses revealed that the 'before' and 'after' communities at the same sites weren't closely related to each other (Bik et al., 2012). Similar studies found that oil deposited on the beaches caused a shift in the community structure toward a hydrocarbonoclastic consortium (petroleum hydrocarbon degrading microorganisms) (Lamendella *et al.*, 2014).

Potential risks from LoWC
Shoreline
No shoreline loading was predicted under the LoWC scenario. Condensate entrained in the water column (in the top 10 m) at the low threshold (10-100 ppb) is predicted to intersect sandy shorelines within the Western Tasmanian Aboriginal Cultural Landscape and the southern-most sandy beaches of NSW in the EMBA. Given the distances of these beaches from the spill location, the condensate will be highly weathered and unlikely to result in any toxicity impacts to shoreline invertebrate communities or shoreline bird species feeding on such invertebrates. Intersection with the Western Tasmanian Aboriginal Cultural Landscape will not result in any impacts to the values of this landscape, given that these are values terrestrial values, shoreward of the intertidal zone.

Table 7.48. Potential risk of LoWC on commercial fishing

General sensitivity to oiling – commercial fishing	
Sensitivity rating of commercial fisheries:	High
A description of commercial fisheries operating in the EMBA is provided in:	Section 5.7.6

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.

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 and mollusc tissues 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.

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 Department of Fisheries 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.

Since testing began in the month after the Macondo well blowout in the Gulf of Mexico (GoM) (2010), levels of oil contamination residue in seafood consistently tested 100 to 1,000 times lower than safety thresholds established by the USA FDA, and every sample tested was found to be far below the FDA's safety threshold for dispersant compounds (BP, 2015). FDA testing of oysters found oil contamination residues to be 10 to 100 times below safety thresholds (BP, 2014). Sampling data shows that post-spill fish populations in the GoM since 2011 were generally consistent with pre-spill ranges and for many shellfish species, commercial landings in the GoM in 2011 were comparable to pre-spill levels. In 2012, shrimp (prawn) and blue crab landings were within 2.0% of 2007-09 landings. Recreational fishing harvests in 2011, 2012 and 2013 exceeded landings from 2007-09 (BP, 2014).

In the event of a MDO spill, a temporary fisheries closure may be put in place by the VFA (or voluntarily by the fishers themselves). Oil may foul the hulls of fishing vessels and associated equipment, such as gill nets. A temporary fisheries closure, combined with oil tainting of target species (actual or perceived), may 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).

Potential risks from LoWC			
Fishery	Surface oiling	Water column	Shoreline
General	A short-term fishing exclusion zone may be implemented by AFMA or the VFA. Given the	OSTM predicts large areas may be exposed to dissolved and entrained hydrocarbons at the low exposure threshold, and small	Vessels use local ports, which are not included within the EMBA. As

	temporary nature of any surface slick and the low fishing intensity in the EMBA, there are unlikely to be any significant impact on fisheries in terms of lost catches (and associated income).	areas at the moderate dissolved and high entrained exposure thresholds. A short-term fishing exclusion zone may be implemented by AFMA or the Victorian or Tasmanian fishing authorities. The areas of moderate dissolved and high entrained exposure thresholds represent very small areas available to commercial fishing. The hydrocarbons are predicted to weather quickly and the area would return to pre-spill conditions rapidly.	such, there are no impacts to vessels in port or associated infrastructure (e.g., marinas and jetties).
No Victorian fisheries occur within the EMBA for this scenario.			
Commonwealth fisheries (those known to fish within the LoWC EMBA)			
Scallop	No impact due to their benthic habitat.	Hydrocarbons are not expected to accumulate among benthic sediments in the EMBA due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column. The most intensely fished areas of the fishery, off the east coast of King Island in Commonwealth waters, are not exposed to dissolved or entrained hydrocarbons in the benthic layer. Therefore, the short- or long-term risk to the fishery or its catch species is **low**.	Not applicable, no shoreline contact predicted.
Southern squid jig	The area affected by this LoWC scenario represents 4.5% of the area available to the fishery. The most heavily fished areas of the fishery are located off the east coast of Victoria, which is not exposed to surface oil and exposed to low exposure thresholds for dissolved and entrained hydrocarbons, which will not result in sub-lethal or toxicity impacts to target species. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have a significant impact on the overall function of the fishery or its catch species and is therefore considered to present a **low** risk.		Not applicable, no shoreline contact predicted
SESS – gillnet and shark hook sector	The area affected by this LoWC scenario represents 8% of the area available to the fishery. The most heavily fished areas of the fishery are located off the east coast of Victoria, which is not exposed to surface oil and exposed to low exposure thresholds for dissolved and entrained hydrocarbons, which will not result in sub-lethal or toxicity impacts to target species. A temporary closure of the area affected by hydrocarbons may be implemented. This is not expected to have a significant impact on the overall function of the fishery or its catch species and is therefore considered to present a **low** risk.		Not applicable, no shoreline contact predicted.
SESS – Commonwealth trawl sector	The area affected by this LoWC scenario represents 10% of the area available to the fishery.		Not applicable, no shoreline contact predicted.

	The most heavily fished areas of the fishery are located off the far east coast of Victoria, southwest Victoria and the west coast of Tasmania. These areas are not exposed to surface oil and exposed to low exposure thresholds for dissolved and entrained hydrocarbons, which will not result in sub-lethal or toxicity impacts to target species. A temporary closure of the area affected by hydrocarbons may be implemented though this is not expected to have a significant impact on the overall function of the fishery or its catch species and is therefore considered to present a **low** risk.	
SESS - scalefish hook sector	The area affected by this LoWC scenario represents <5% of the area available to the fishery. The most heavily fished areas of the fishery are located off the east coast of Tasmania, which is outside the EMBA. The area affected by hydrocarbons is among the least intensely fished area for the fishery. A temporary closure of the area affected by hydrocarbons may be implemented though this is not expected to have a significant impact on the overall function of the fishery or its catch species and is therefore considered to present a **low** risk.	Not applicable, no shoreline contact predicted.

7.15.6 Risk assessment

Table 7.49 presents the risk assessment for the LoWC.

Table 7.49. Risk assessment for the LoWC

Summary			
Summary of risks	Pollution of sea surface, water column and shoreline. Injury or death of marine fauna and seabirds through ingestion or contact		
Extent of risks	Up to 35 km from the platform (predominantly northwest direction).		
Duration of risks	Short-term (several days, depending on level of contact, location and receptor).		
Level of certainty of risks	HIGH – the environmental impacts of spilled hydrocarbons are well understood. The risk of blowout for offshore producing gas wells is well known; see the DNV and IOGP risk analysis in Section 7.15.1.		
Risk decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, some uncertainty, some partner interest, may attract media attention.		
Risk Assessment (inherent)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Minor	Highly unlikely	Low
Macroalgal communities	Minor	Highly unlikely	Low
Plankton	Minor	Highly unlikely	Low
Pelagic fish	Minor	Highly unlikely	Low
Cetaceans	Minor	Highly unlikely	Low
Pinnipeds	Minor	Highly unlikely	Low
Marine reptiles	Minor	Highly unlikely	Low
Seabirds	Moderate	Highly unlikely	Low
Shorebirds	Minor	Highly unlikely	Low
Sandy beaches	Minor	Highly unlikely	Low
Commercial fisheries	Minor	Highly unlikely	Low

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Note that design elements of the wells and production equipment that assist in preventing the uncontrolled release of hydrocarbons are not detailed here. These are addressed in the original EIS. This EP focuses on performance standards related to operations activities only.		
Preventative		
There is no LoWC.	BassGas facilities are operated in accordance with the NOPSEMA-accepted Yolla-A Safety Case (CDN/ID 5214686).	The well integrity status of operational wells is communicated to the operations, engineering, wells, and management

	The Yolla wells are operated in accordance with the NOPSEMA-accepted WOMP (CDN/ID 3972817) and the Well Integrity Management Plan (WIMP) (IMP-INT-1000-ENG-PLN-00023).	teams via the Process Safety Report and/or the quarterly Well Integrity Report.
	Production parameters, including flows, pressures, temperatures and erosion are monitored on a 24-hr basis by qualified and trained operators so that abnormalities are quickly detected and resolved.	Electronic records of continuous monitoring are available.
	Operations personnel are qualified, trained and certified as competent to operate and maintain the BassGas facilities.	The BassGas Workforce Capability Requirements Matrix is maintained up-to-date and verifies that operators are qualified, trained and certified as capable.
	The CMMS is used to manage (schedule, record and report) the integrity of Yolla wells and platform operations and maintenance. This includes, but is not limited to: • LOS Gas Detection Systems; • UV/IR Flame Detection; • Fusible loop detection; • ESD systems; • Wellhead maintenance; • SSV leak off tests; and • Last valve off critical function tests.	CMMS records verify that wells and platform are maintained to schedule.
	The Yolla-A platform and the cautionary zone is marked on navigation charts so that vessels are aware of its location and can set navigation paths to avoid colliding with it.	Maritime navigation charts for central Bass Strait have BassGas facilities marked.
	Approval from the Yolla PIC (or Field Manager) must be granted to Vessel Masters seeking to enter the PSZ in order to minimise the risk of collision with the platform.	The communications diary verifies permission is granted for vessels entering the PSZ.
	The Beach Lifting and Load Safety Operations Procedure (CDN/ID 3674901) is used for all transfers to/from the platform to minimise the risk of suspended equipment dropping onto the wells or associated production equipment.	The Lifting and Load Safety Operations Procedure is current. Completed PTWs and/or JSAs verify that the procedure is implemented.
Emergency response		
Well control is regained in the shortest time possible in line with pre-determined plans.	A RWP is in place, developed in line with the Guidelines on Relief Well Planning (OGUK, 2013) (and will be updated by the end of 2020 to align with the IOGP Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells, 2019). The plan outlines the resources (equipment and people) available to respond to a well blowout (sourcing, mobilising and positioning a MODU, drilling and intercepting the well, and killing the well) and is regularly reviewed for currency. The RWP is implemented in the event of the LoWC with the assistance of well control specialists.	The RWP is current. Contracts/agreements are in place with well control specialists. RWP review reports are available and verify the arrangements remain current. Incident reports verify that the RWP was implemented in the event of a LoWC.

	The Beach Well Engineering and Construction Management System (WECS) will be implemented to ensure that the relief well design and operations are fit for purpose and that changes are made in a controlled manner, that appropriate standards are adhered to and that a sufficiently resourced and competent organisation is in place.	Operational logs verify that the WECS was implemented.
	A NOPSEMA-accepted Safety Case (or Safety Case Revision) will be in place for the MODU selected to undertake the relief well drilling. The Safety Case identifies the controls in place to prevent a major accident event.	The Safety Case (or Safety Case Revision) is available, together with the NOPSEMA letter of acceptance.
	A NOPSEMA-accepted WOMP will be in place for the relief well design. The WOMP identifies the well barriers and integrity testing in place for the drilling program.	The WOMP is available, together with the NOPSEMA letter of acceptance.
	An OPEP and ERP are in place and tested annually in desktop exercises by those nominated in the plans to be part of the response strategies.	The OPEP and ERP are current.
		OPEP and ERP training schedule is available and remains live.
		The training matrix is maintained as a live document and verifies that personnel nominated to assist in emergency response are up to date with their training.
		OPEP and ERP exercise reports verify that exercises have been undertaken.
Reporting		
Reporting and monitoring of a LoC from the well/s will take place in accordance with the EP and OPEP.	Beach will report the spill to regulatory authorities within 2 hours of the LoC or becoming aware of the LoC.	Incident report verifies that contact with regulatory agencies was made within 2 hours.
Monitoring		
Collect operational monitoring data to support the spill response and collect scientific monitoring data to characterise environmental impacts.	Beach will undertake operational and scientific monitoring in accordance with the OSMP.	Daily operations reports and study reports verify that the OSMP was implemented.

Risk Assessment (residual)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Minor	Remote	Low
Macroalgal communities	Minor	Remote	Low
Plankton	Minor	Remote	Low
Pelagic fish	Minor	Remote	Low

Cetaceans	Minor	Remote	Low
Pinnipeds	Minor	Remote	Low
Marine reptiles	Minor	Remote	Low
Seabirds	Minor	Remote	Low
Shorebirds	Minor	Remote	Low
Sandy beaches	Minor	Remote	Low
Commercial fisheries	Minor	Remote	Low

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required. However, because this hazard has a Decision Context of 'B', an ALARP analysis is presented.

Good practice	
Avoid/Eliminate	The risk of a LoWC can never be entirely eliminated. However, competent operators operating the wells in accordance with the WIMP, the Well Integrity Standard (CDN/ID 7726350), CMMS and NOPSEMA-accepted WOMP and Safety Case provide a high level of assurance that the integrity of the wells is managed in such a way that a LoWC is prevented. This is demonstrated through the fact that there has been no LoWC to date.
Change the likelihood Change the consequence	The wells are fitted with TRSC-SSSV and pressure/temperature gauges. Personnel operating the platform and wells are trained and competent to operate the facility. 24-hour continuous monitoring of production parameters ensures that any process upsets are quickly detected and responded to in order the minimise the risk of a LoWC. The use of the Beach Lifting and Load Safety Operations Procedure (CDN/ID 3674901) reduce the likelihood of a LoWC occurring.
Reduce the risk	The BassGas ERP, OPEP and RWP are in place and will be implemented in the event of a LoWC.

Engineering risk assessment

The OSTM undertaken for the LoWC scenario is an engineering risk assessment that supports the consequence evaluation, spill response planning and development of the EPS listed in this table. Engineering controls that have been considered for the LoWC but not adopted are outlined below.

Control	Control type	Analysis
Real time leak detection and well shut in	System	Such a system would allow a leak from the wells to be detected and the well shut in immediately, thereby minimising the volume of hydrocarbons releases. However, pressure and temperature instrumentation is ineffective at detecting subsea leaks.
Dedicated oil spill resources (vessels, spill response equipment) available at the PSV shore base	Equipment	This would allow for a slightly quicker response time to reach the source of the spill or nearby shorelines. However, there are substantial costs associated with purchasing and maintaining this equipment (millions of dollars). There is no guarantee that the personnel required to deploy and operate this equipment in the event of a spill would be available at this time. The AMOSC facility located at Geelong is not much further away than Port Anthony (~80 nm additional vessel steam from the west). Beach already pays an annual membership fee to AMOSC, which assists in maintaining this equipment and ensuring there is a pool of trained response personnel available. The additional travel time is negligible in the context of a short- to long-term response activity. The shorter road distance between Melbourne and Geelong, compared with Geelong and Port Anthony (130 km less by road and 1.5 hours less road travel time, one way), makes Geelong a more suitable base than

		Port Anthony to deploy first responders (on the assumption that many first responders fly in from interstate).
Drill top hole of a relief well	Equipment	This option would allow for a relief well to be drilled faster in the event of a LOWC. The very large upfront cost in drilling a top hole (several million dollars) and the environmental impacts associated with this activity (such as the discharge of drill cuttings and muds and atmospheric emissions) outweigh the benefits of this measure, given that the probability of a LOWC are so remote.
Retain a MODU on standby in a nearby port for the drilling of a relief well	Equipment	The costs associated with 'warm-stacking' or 'cold-stacking' a MODU nearby to Yolla-A is not financially feasible. This option would cost millions of dollars per week. The MODU would require an accepted Safety Case to be in place, and a suitable Safety Case Revision to be in place for a relief well drilling program. Quickly mobilising a MODU would also be dependent on accessing a heavy lift vessel (which are unlikely to be locally available) or specialist tug vessels to transport the MODU to the Yolla location. Mobilising a MODU from elsewhere in Bass Strait or the North West Shelf would be likely to be quicker than awaiting a heavy lift vessel to mobilise a cold- or warm-stacked MODU to the Yolla location. The costs of retaining a MODU on standby are grossly disproportionate to the environmental risk, given that the residual risk ratings without adopting this control remain low because a gas condensate release is not predicted to result in shoreline loadings and the sea surface contact area is predicted to be very small.
Use a well capping stack prior to cap a well blowout	Equipment	Section 3.9.2 discusses the well capping stack response option and why this is not a suitable option at Yolla-A.

Cost benefit analysis
Incorporated into the engineering risk assessment above.

Demonstration of Acceptability	
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about the LoWC.
Legislative context	The performance standards outlined in this EP align with the requirements of: • OPGGS Act 2006 (Cth): ○ Section 572A-F (Polluter pays for escape of petroleum). • *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): ○ Section 11A (Shipboard oil pollution emergency plan) (for Australian-registered vessels). ○ AMSA Marine Orders Part 91 (Marine pollution prevention – oil). • OPGGS Act 2010 (Vic): ○ Section 29 (Notifying reportable incidents). • POWBONS Act 1986 (Vic): ○ Section 10 (Duty to report certain incidents involving oil and oily mixtures). • State Environment Protection Policy (Waters of Victoria): ○ Clause 38 (Spills, illegal discharges and dumping of waste).
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.

* Guidelines relevant to relief well drilling are addressed in Section 7.19.	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Major spills from production facilities – OSTM to be undertaken to determine potential environmental impacts, wellbore hydrostatic pressure to be maintained, well integrity testing to be performed, WOMP to be in place, well control contingency plan to be in place, spill preparedness and emergency response measures are in place, ongoing inspections and maintenance take place.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	No guidance is provided regarding preventing or managing an offshore LoWC, other than having a spill contingency plan in place. An OPEP is in place for BassGas operations.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Section 75 (Spills): Conducting a spill risk assessment, implementing personnel training and field exercises, ensuring spill response equipment is available. • Sections 76-79 (Spill response planning): A spill response plan should be prepared.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the risk of any unplanned release of material into the marine environment to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	The EMBA for entrained hydrocarbons intersects three AMPs (Boags, Beagle and Franklin) and the EMBA for dissolved hydrocarbons intersects the Boags and Beagle AMPs. The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies oil pollution from offshore activities as a threat to AMPs. The short-term impacts from a LoWC will not result in lasting impacts on the values or the management aims of these AMPs. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	The low exposure threshold for entrained hydrocarbons is predicted to make contact with the coast adjacent to the Livinia Ramsar wetland and the Western Port Ramsar wetland. At low exposure thresholds, impacts to water quality will be temporary and not have significant impacts on the values of these Ramsar wetlands.
	TECs (Section 5.4.5)	The low exposure threshold for entrained hydrocarbons is predicted to make contact with the Giant Kelp Marine Forests of South East Australia, Assemblages of species associated with open-coast salt wedge estuaries of western and central Victoria and subtropical and temperate coastal saltmarsh.

		At low exposure thresholds, impacts to the values of these TECs will be temporary and not have significant impacts on their values. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	The low exposure threshold for entrained hydrocarbons is predicted to make contact with the shorelines of several NIWs that may or may not be open to sea at the time of a spill. At low exposure thresholds, impacts to water quality will be temporary and not have significant impacts on the values of the wetlands.
	Nationally threatened and migratory species (Section 5.5)	Some threatened species and migratory species have the potential to be present in the EMBA (particularly within their BIAs), but as evaluated in Tables 7.25 – 7.29, the risks to individuals or populations of threatened and migratory species are minor.
	Other matters	
	State marine parks (Section 5.4.9)	The low exposure threshold for entrained hydrocarbons is predicted to make contact with several Victorian and Tasmanian marine parks. At low exposure thresholds, impacts to water quality will be temporary and not have significant impacts on the values of these marine parks. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified for albatross and giant-petrels in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The conservation advice and management plans for blue, humpback, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring

- As per the OPEP and OSMP.

Record Keeping

- Safety Case.
- WOMP.
- Audit reports.
- CMMS records.
- BassGas Workforce Capability Requirements Matrix.
- Training matrix.
- Lifting and Load Safety Operations Procedure.
- GVI reports.
- RWP.
- OPEP.
- ERP.
- Completed PTWs.

• Navigation Charts.	• Completed JSAs.
• Communications diary.	• Incident reports.

7.16 RISK 6 – LoC from Rupture of the Raw Gas Pipeline

7.16.1 Hazards

During the operation of the offshore RGP, there is the risk that there could be an uncontrolled release of hydrocarbons as a result of:

- Pipeline failure through internal or external corrosion;
- Unsupported pipeline span due to erosion and causing metal fatigue;
- Dropped objects (while carrying out platform crane lifts etc);
- Vessel anchor drag/trailer net drag;
- Extreme weather;
- Human error; and/or
- Sabotage.

The Assessment of the Risk of Pollution from Marine Oil Spills in Australian Ports and Waters (DNV, 2011) states that the frequency of leaks from subsea pipelines in the open sea (between the platform safety zone and the pipeline landfall), is estimated as 5.1 x 10^{-5} (i.e., 0.000051) per pipeline-km year. This is based on pipelines ≤ 24" (61 cm) diameter using North Sea data (the BassGas raw gas pipeline is 35 cm in diameter).

Based on Australia having 1,135 offshore kilometres of pipeline at the time the DNV report was published, this frequency implies there is a 6% chance of a pipeline leak somewhere in Australian waters each year (DNV, 2011). No such events are recorded by AMSA in the period 1982-2010 (DNV, 2011). DNV (2011) notes that the frequency of oil spills over 1 tonne due to pipelines in the open sea is 2.0 x 10^{-5} (i.e., 0.00002) per pipeline-km year. There have been no spills from the BassGas raw gas pipeline to date.

Oil Spill Trajectory Modelling

To understand the risks posed by a pipeline rupture, Beach commissioned RPS to undertake OSTM for a revised pipeline rupture scenario based on a location close to shore (caused by vessel anchor drag) and current production rates (RPS, 2020), using the Yolla condensate properties outlined in Section 3.4.1.

Table 7.50 outlines the key OSTM inputs for the pipeline rupture scenario and Table 7.36 in the previous section lists and justifies the spill thresholds used in the OSTM.

Table 7.50. Summary of the pipeline rupture OSTM inputs

Parameter	Details
Oil Type	Yolla condensate
Total spill volume	3,144.9 bbl (500 m^3/315 tonnes)
Spill volume justification	All liquid held in RGP between Yolla-A and rupture point
Release type	Subsea
Rupture size	Pipeline cross-sectional area (86,361.3 mm^2)
Release duration	57 minutes
Release duration justification	Time it would take for the pipeline pressure measured at Yolla-A to reach the pipeline low pressure trip of 4,000 kPag
Release rate	55 bbl/minute
Release rate justification	Based on a flow rate of 87.8 MMscfd
Simulation duration	10 days
Surface oil concentration thresholds (g/m^2)	1 g/m^2 – low exposure 10 g/m^2 – moderate exposure 50 g/m^2 – high exposure
Shoreline load threshold (g/m^2)	10 g/m^2 – low exposure 100 g/m^2 – moderate exposure 1,000 g/m^2 – high exposure
Dissolved aromatic dosages to assess potential exposure (ppb.hrs)	10 ppb – low exposure 50 ppb – moderate exposure 400 ppb – high exposure
Entrained oil dosages to assess potential exposure (ppb.hrs)	10 ppb – low exposure 100 ppb – high exposure

Sea Surface Results

A summary of the sea surface OSTM results for the pipeline rupture scenario is presented in Table 7.51, with the results presented in Figure 7.15. The sea surface OSTM results indicate that low exposure contact would be made with the Bunurong Marine and Coastal Park.

Table 7.51. Summary of the sea surface results for the pipeline rupture scenario

Distance and direction	Zones of potential sea surface exposure		
	Low (1-10 g/m^2)	Moderate (10-50 g/m^2)	High (>50 g/m^2)
Maximum distance from release site	9.4 km	3.0 km	0.7 km
Direction	West-southwest	East-northeast	East-northeast

Weathering results of Yolla condensate for the pipeline rupture scenario are illustrated in Figure 7.16, which shows that evaporation is the key weathering mechanism and that is occurs rapidly.

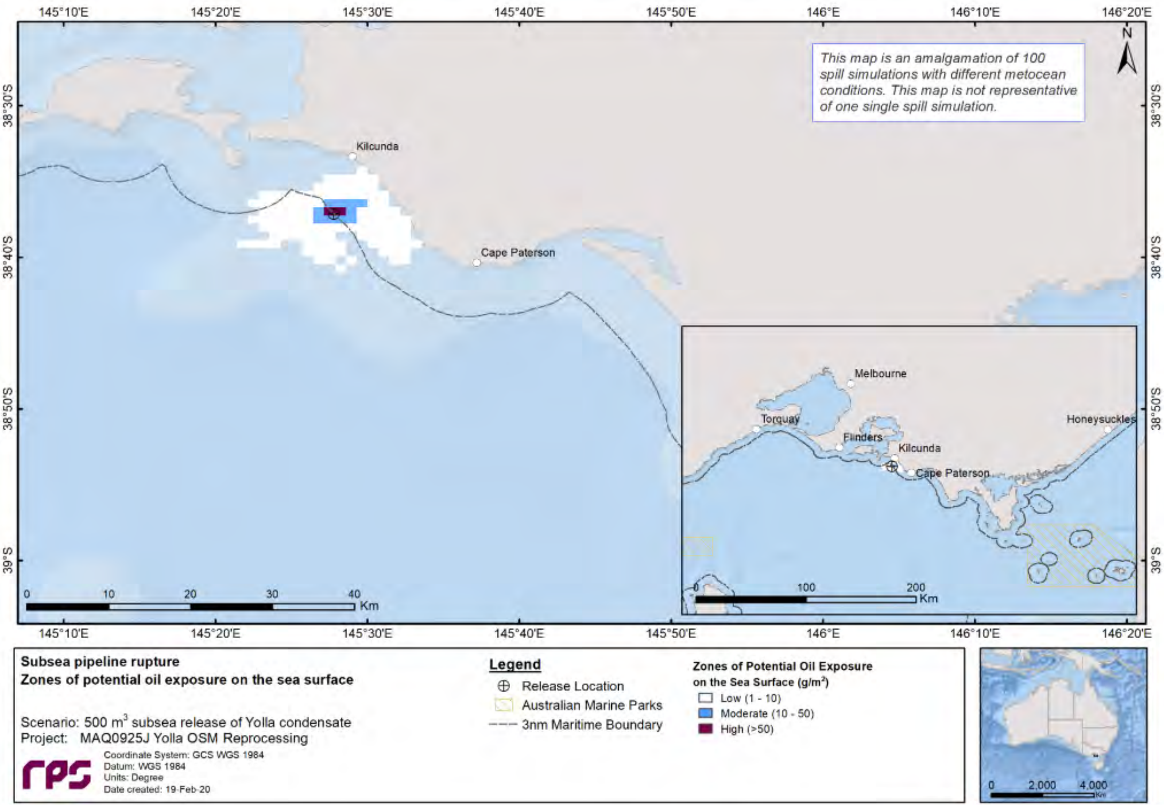


Figure 7.15. Zones of potential exposure on the sea surface in the event of a 3,144.9 bbl (500 m^3) pipeline rupture of Yolla condensate over 57 minutes and tracked for 10 days based on 100 spill trajectories during annual conditions

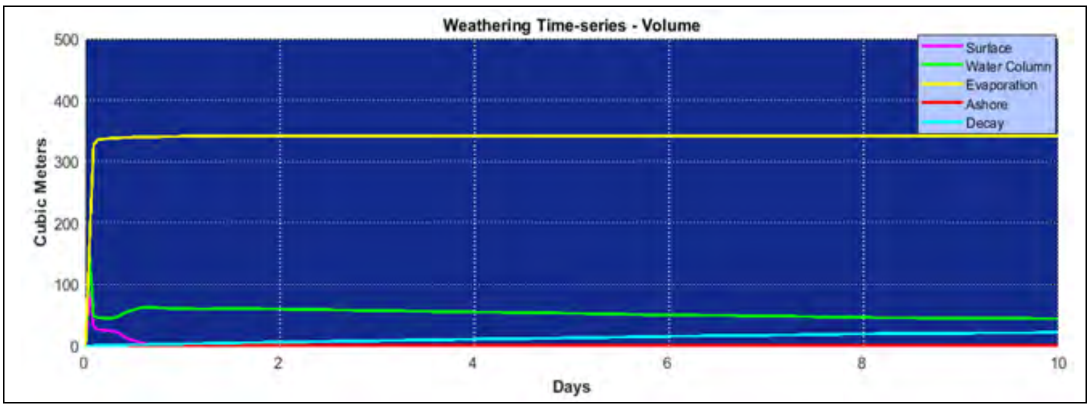


Figure 7.16. Predicted weathering and fate of Yolla condensate for the largest swept area based on a 3,144.9 bbl (500 m^3) pipeline rupture over 57 minutes and tracked for 10 days during annual conditions

Shoreline Results

A summary of the shoreline OSTM results for the pipeline rupture scenario is presented in Table 7.52, and the maximum potential shoreline loading results are illustrated in Figure 7.17. The shoreline OSTM results indicate that contact would be made with the Kilcunda Coastal Reserve, Kilcunda-Harmers Haven Coastal Reserve and Bunurong Marine and Coastal Park.

Table 7.52. Summary of the shoreline contact results above 10 g/m^2 in the event of a 3,144.9 bbl pipeline rupture (500 m^3) over 57 minutes and tracked for 10 days during annual conditions

Shoreline statistics		Results
Maximum probability of contact to any shoreline		8%
Absolute minimum time to shore		12 hours
Maximum volume of hydrocarbons ashore*		21.3 m^3
Average volume of hydrocarbons ashore^		6.8 m^3
10 g/m^2 loading	Maximum shoreline length	5.0 km
	Average shoreline length	3.1 km
100 g/m^2 loading	Maximum shoreline length	4.0 km
	Average shoreline length	2.1 km
1,000 g/m^2	Maximum shoreline length	No contact
	Average shoreline length	No contact

** Maximum volume ashore – the maximum peak volume to come ashore for defined receptors, or all shorelines, from a single simulation/trajectory.*

^ Average volume ashore – the average volume to come ashore for defined receptors, or all shorelines, from a single simulation/trajectory. Only non-zero values are considered.

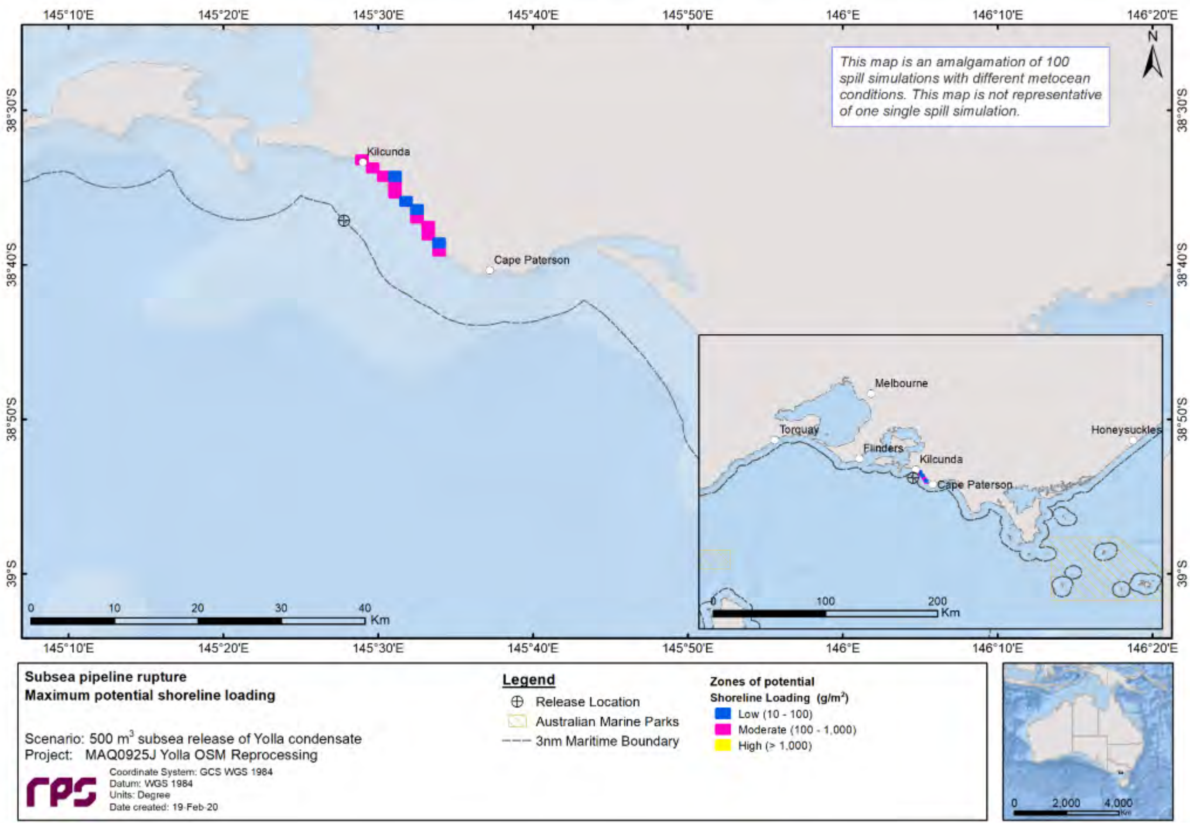


Figure 7.17. Maximum potential shoreline loading in the event of a 3,144.9 bbl (500 m^3) pipeline rupture over 57 minutes and tracked for 10 days based on 100 spill trajectories during annual conditions

Entrained Hydrocarbon Results

Figure 7.18 illustrates the zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface. The maximum predicted distances of entrained hydrocarbons at the low and high exposure thresholds from the release location are predicted to be 136 km (east-southeast) and 49 km (southeast), respectively.

Contact with low and high exposure entrained hydrocarbons is predicted at the Bunurong Marine Park and Bunurong MNP. Contact at the low exposure threshold is predicted for the Beagle AMP, Wilsons Promontory MNP and the Western Port Ramsar site.

There is no contact to entrained hydrocarbons at any threshold in waters below a depth of 10 m.

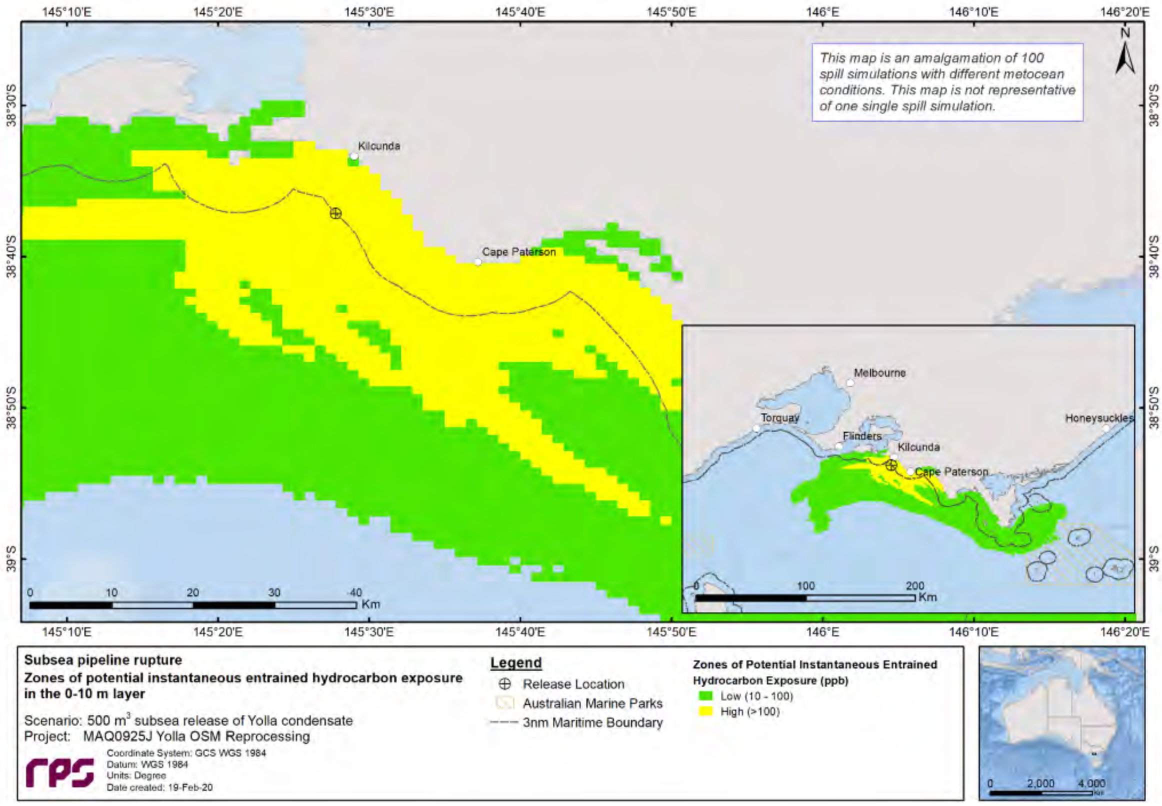


Figure 7.18. Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 3,144.9 bbl (500 m^3) pipeline rupture over 57 minutes and tracked for 10 days based on 100 spill trajectories during annual conditions

Dissolved Hydrocarbons Results

Figure 7.19(a & b) illustrate the zones of potential dissolved hydrocarbon exposure at 0-10 m and 10-20 m below the sea surface, indicating that there is an extensive area of low exposure predicted and a smaller area of moderate exposure. Table 7.53 summarises the OSTM results for dissolved hydrocarbons.

The maximum predicted distances of dissolved hydrocarbons at the low, moderate and high exposure thresholds from the release location are predicted to be 112 km (east-southeast), 83 km (east-southeast) and 3 km (east-southeast), respectively.

In waters 10-20 m below the sea surface, there is only a 1% probability of contact at the moderate threshold, with no contact predicted for the high threshold.

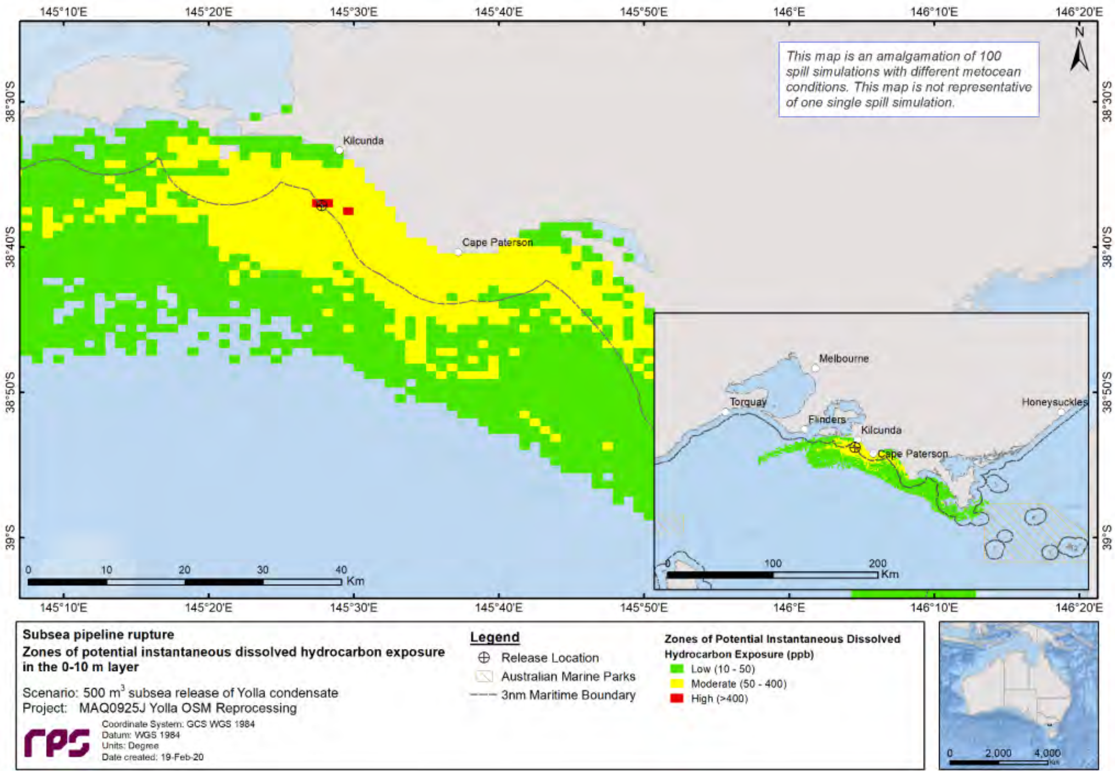


Figure 7.19a. Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea surface in the event of a 3,144.9 bbl (500 m^3) pipeline rupture over 57 minutes and tracked for 10 days based on 100 spill trajectories during annual conditions

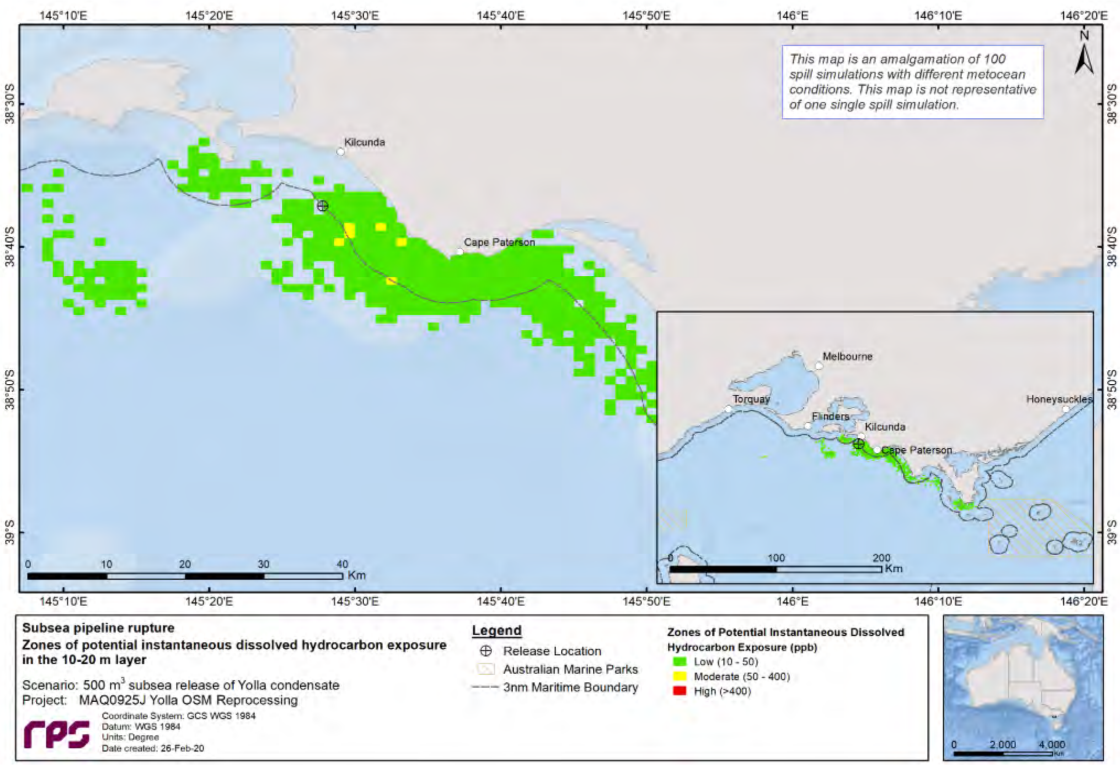


Figure 7.19b. Zones of potential dissolved hydrocarbon exposure at 10-20 m below the sea surface in the event of a 3,144.9 bbl (500 m^3) pipeline rupture over 57 minutes and tracked for 10 days based on 100 spill trajectories during annual conditions

Table 7.53. Probability of exposure to waters from dissolved hydrocarbons in the event of a 3,144.9 bbl (500 m^3) pipeline rupture over 57 minutes and tracked for 10 days based on 100 spill trajectories during annual conditions

Receptor (shoreline segment)	0-10 m below sea surface				10-20 m below sea surface			
	Max. exposure to dissolved aromatics (ppb)	Probability (%) of instantaneous hydrocarbon exposure			Max. exposure to dissolved aromatics (ppb)	Probability (%) of instantaneous hydrocarbon exposure		
		Low	Mod	High		Low	Mod	High
Shorelines								
Phillip Island	81	8	2	NC	21	1	NC	NC
Kilcunda	180	65	25	NC	21	2	NC	NC
Venus Bay	189	61	22	NC	39	5	NC	NC
Cape Liptrap	83	21	4	NC	3,202	1	NC	NC
Waratah Bay	48	16	NC	NC	13	1	NC	NC
Protected areas								
Wilsons Promontory MNP	23	2	NC	NC	30	1	NC	NC
Wilsons Promontory NP	24	3	NC	NC	3	NC	NC	NC
Bunurong MNP	141	50	9	NC	47	3	NC	NC
Bunurong NP	189	59	19	NC	39	4	NC	NC
Western Port Ramsar site	12	1	NC	NC	0.6	NC	NC	NC

7.16.2 Potential risks

Potential environmental risks resulting from a LoC from the pipeline are:

- Increase in methane emissions;
- Localised and temporary reduction of water quality;
- Potential injury or death of marine life;
- Disruption to third-party operations such as shipping and commercial fishing (e.g., potential loss of fisheries income resulting from temporary fisheries closures, mortalities from fish stocks [reducing target species availability and subsequently catch per unit effort] or tainted catches);
- Damage to water filtering equipment at the Victorian desalination plant (at Wonthaggi), contamination of water supply and disruption to the supply of water services;
- Temporary reduction in some values of some coastal marine reserves; and
- Temporary restriction in recreational values of the coastline.

7.16.3 EMBA

The EMBA for the LoC of 3,144.9 bbl of Yolla condensate resulting from a pipeline rupture is illustrated in the figures illustrating sea surface, shoreline, entrained and dissolved hydrocarbon exposures.

7.16.4 Evaluation of Environmental Risk

The evaluation of the environmental risks to the receptors in the EMBA associated with the LoC from pipeline rupture is outlined in Table 7.54 to Table 7.64.

Table 7.54. Potential risk of hydrocarbon release from pipeline on benthic fauna

General sensitivity to oiling – benthic fauna		
Refer to Table 7.38 for general sensitivity information.		
Potential risks from pipeline rupture		
Sea Surface	Water column	Shoreline
Not applicable.	There is predicted to be zones of low to moderate dissolved and entrained hydrocarbon exposure in the benthic layer in the shallow waters along the coast, predominantly between Phillip Island and Cape Liptrap. At these concentrations, the risk to benthic organisms and habitats is considered **low**.	There is a maximum 8% probability of 'low' to 'moderate' hydrocarbon exposure along the Kilcunda shoreline with an average loading of 7 m^3 over a shoreline length of 3 km. This is not expected to cause any long-term ecological harm or damage to man-made features/amenities. Potential impacts to benthic fauna are as per the LoWC. It is therefore predicted that the risk of toxicity effects on benthic assemblages will be **low** in the short-term and **low** in the medium- to long-term.

Table 7.55. Potential risk of hydrocarbon release from pipeline on macroalgal communities

General sensitivity to oiling – macroalgal communities		
Refer to Table 7.39 for general sensitivity information.		
Potential risks from pipeline rupture		
Surface oiling	Water column	Shoreline
Emergent or floating vegetation in the intertidal zone along a ~20 km section of coastline from Kilcunda to Cape Paterson may be exposed to low to moderate concentrations of hydrocarbons at the sea surface. The impacts are likely to be similar to those described in Table 7.32. The Giant Kelp Forest TEC is not present in the EMBA for this scenario and will not be affected. Strong wave-action, an exposed coastline and the light characteristics of the Yolla condensate are all likely to assist in the rapid weathering of hydrocarbons and the risk of short- and long-term affects to macroalgal communities is expected to be **low**.		

Table 7.56. Potential risk of hydrocarbon release from pipeline on plankton

General sensitivity to oiling – plankton		
Refer to Table 7.40 for general sensitivity information.		
Potential risks from pipeline rupture		
Sea Surface	Water column	Shoreline
Plankton found in open water 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 absorption) affected by dissolved and dispersed hydrocarbons. Once background water quality conditions return following the rapid natural weathering and dispersion of the hydrocarbons, plankton populations are expected to recover rapidly due to recruitment of plankton from surrounding waters. The overall risk of hydrocarbon spills on plankton is considered **low** in the short- and long-term under this LoC scenario.		Not applicable.

Table 7.57. Potential risk of hydrocarbon release from pipeline on pelagic fish

General sensitivity to oiling – pelagic fish		
Refer to Table 7.41 for general sensitivity information.		
Potential risks from pipeline rupture		
Sea Surface	Water column	Shoreline
As illustrated in Figure 7.15 and Figure 7.16, there is the probability of exposure to dissolved (low and moderate, limited area of high exposure) and entrained (low and high) hydrocarbons in the water column. Some syngnathid species associated with nearshore reefs and rafts of floating seaweed may come into contact with surface hydrocarbons, however the predominantly low exposure is not expected to result in acute or chronic effects on pelagic fish species. Because the majority of fish tend to remain in the mid-pelagic zone, they are likely to come into contact with areas of low-moderate concentrations of dissolved hydrocarbons. Given the mobile nature of fish and the rapid weathering of Yolla condensate, brief periods of exposure to low-moderate concentrations of hydrocarbons in the water column are unlikely to result in acute or chronic effects to pelagic fish. Due to Bass Strait's generally well-mixed water, the risk from hydrocarbons on the sea surface and in the water column is considered to be **low** at a population level.		Not applicable.

Table 7.58. Potential risk of hydrocarbon release from pipeline on cetaceans

General sensitivity to oiling – cetaceans		
Refer to Table 7.42 for general sensitivity information.		
Potential risks from pipeline rupture		
Sea Surface	Water column	Shoreline
The sea surface spill EMBA overlaps the foraging BIA for pygmy blue whales and known core range of southern right whales. There is a possibility that pygmy blue and southern right whales may be present in the EMBA depending when a LoC occurs. If present, these species (and other cetaceans) may be impacted to hydrocarbons in the manner described in Table 7.35. If large quantities of zooplankton exposed to the spill were ingested, chronic toxicity impacts to some individual cetaceans may occur. Biological consequences of physical contact with very localised areas of high concentrations (maximum 1 km from spill location) of hydrocarbons at the sea surface are unlikely to lead to any long-term population 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). In the broader area of low exposure, risks are expected to be **low**. Evaporation of the hydrocarbons is modelled to occur rapidly in this scenario, thus reducing the duration of the hydrocarbons persisting on the sea surface and reducing the risk to cetaceans. In the context of the size of the BIAs of the pygmy blue whales and southern right whales, and the duration and extent of sea surface hydrocarbons, the risk to cetaceans is **low** and does not represent a long-term threat at the population level of cetaceans migrating through or foraging in the EMBA.	As illustrated in Figure 7.15 and Figure 7.16, there is the probability of exposure to dissolved (low and moderate, limited area of high exposure) and entrained (low and high) hydrocarbons in the water column. These areas overlap with the southern right whale known core range BIA and pygmy blue whale foraging BIA. Transient species such as cetaceans moving through an area of low to (limited areas of) high exposure means there is a **low** risk that cetaceans would experience any hydrocarbon toxicity effects.	Not applicable.

Table 7.59. Potential risk of hydrocarbon release from pipeline on pinnipeds

General sensitivity to oiling – pinnipeds		
Refer to Table 7.43 for general sensitivity information.		
Potential risk from pipeline rupture		
Sea Surface	Water column	Shoreline
The foraging range for Australian and New Zealand fur-seals may be temporarily exposed to low exposure levels of hydrocarbons at the sea surface. This level of exposure is not considered to present toxicity impacts to marine fauna. As fur-seals forage for prey within the water column rather than at the sea surface, exposure to oil at the sea surface will only result when resting at surface or entering and exiting the water. Given the generally brief time they spend at the sea surface, the risk of injury or mortality from sea surface hydrocarbons is **low**.	As illustrated in Figure 7.15 and Figure 7.16, there is the probability of exposure to dissolved (low and moderate, limited area of high exposure) and entrained (low and high) hydrocarbons in the water column. Given that fur-seals forage for prey within the water column, exposure to low to (limited areas of) high concentrations of hydrocarbons (either via ingestion of contaminated prey or direct contact with oil droplets) may occur. But given their highly mobile nature, it is unlikely that fur-seals would experience any hydrocarbon toxicity effects as a result of remaining in small areas of in-water hydrocarbons and thus the risk is **low**.	There is no risk of hydrocarbon stranding on shorelines known to be used by Australian and New Zealand fur-seals as breeding or haul-out sites. As such, the risk that oiling of fur-seals will occur on shorelines is **low**. Given the generally rocky nature of preferred haul-out sites and their ability to self-clean, heavy oiling of pinnipeds at shorelines in general is not expected. The shorelines predicted to be impacted by this LoC scenario are sandy.

Table 7.60. Potential risk of hydrocarbon release from pipeline on marine reptiles

General sensitivity to oiling – marine reptiles		
Refer to Table 7.44 for general sensitivity information.		
Potential risk from pipeline rupture		
Sea Surface	Water column	Shoreline
Some individual transient marine reptiles may come into contact with localised areas of mostly low hydrocarbon exposure on the sea surface when they surface to breath or rest, or dissolved or entrained in the water column. This is not expected to result in toxicity impacts. Due to the absence of turtle nesting sites and BIAs in Bass Strait, the risk to marine reptiles (individuals or populations) is **low**.		There are no turtle nesting beaches within the EMBA for this scenario, so the risk to turtles from shoreline oiling is **low**.

Table 7.61. Potential risk of hydrocarbon release from pipeline on seabirds and shorebirds

General sensitivity to oiling – seabirds and shorebirds		
Refer to Table 7.45 for general sensitivity information.		
Potential risk from pipeline rupture		
Sea Surface	Water column	Shoreline
The threatened bird species likely to occur in the EMBA, such as albatross and petrels, are distributed and forage over an extensive geographic area. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with low levels of hydrocarbons on the surface which will not result in toxicity impacts. The area of moderate or high exposure on the sea surface is extremely localised, meaning there is a **low** risk that seabirds will make contact with this area and that this would result in loss of thermal protection and hypothermia and toxicity impacts through ingestion from preening of contaminated feathers.	The seabirds known to occur in the EMBA would spend only seconds at a time diving for fish in the top 0-10 m of the water column. Consequently, contact with a limited area of dissolved and entrained hydrocarbons (of low to high exposure) in the water column would be unlikely and would be brief (even after numerous dives), meaning that the risk of such contact is **low**.	The maximum length of shoreline predicted to be exposed to loading of hydrocarbons that may have biological impacts on birds (100-1,000 g/m^2 or >1,000 g/m^2) is 5 km. This section of coastline comprises wide sandy beaches that provide habitat for shorebird species such as hooded plovers, terns and snipes, and nesting habitat for seabird species. Condensate is unlikely to persist on the surface of sandy beaches because it quickly penetrates porous sediments (NOAA, 2012). This behaviour limits the duration of exposure to birds using the shoreline. Shorebirds foraging for food in intertidal areas or along the high tide mark and splash zone may encounter weathered hydrocarbons that may be brought back to nests. Hydrocarbon entering the sandy nests of hooded plovers, terns or other bird species is likely to percolate through the sand and not accumulate in the feathers of adults or young. Toxicity effects from ingestion of contaminated prey caught in the intertidal zone or from direct exposure or transport back to nests are unlikely, as the volatile components are likely to have flashed off prior to stranding. The populations of seabird and shorebird species within the EMBA have a wide geographic range, meaning that impacts to individuals or a population at one location will not necessarily extend to populations at other un-impacted locations. Therefore, the risk of such contact is **low**.

Table 7.62. Potential risk of hydrocarbon release from pipeline on sandy beaches

General sensitivity to oiling – sandy beaches
Refer to Table 7.46 for general sensitivity information.
Potential risk from pipeline rupture
Shoreline
There is no predicted contact of exposure to high shoreline loadings of hydrocarbons in the EMBA. There is an 8% probability of low exposure of contact to shorelines in the Kilcunda region, however this is unlikely to result in significant long-term impacts as tidal action is expected to lead to rapid weathering of any hydrocarbons in the intertidal area and populations of exposed communities would rapidly recover. Short-term impacts to tourism and other human uses of the beach may occur as a result of temporary beach closures to protect human health, but this would be due only to perceptions of a polluted environment rather than a requirement to protect the public from persistent pollution. As such, risks to sandy beaches is **low**.

Table 7.63. Potential risk of hydrocarbon release from pipeline to the Victorian desalination plant

General sensitivity to oiling – desalination plant
Watersure advises that damage to its water filtering equipment would cost millions of dollars to repair, while contamination to water supplies and disruption to contracted water supply services would result in reputational damage.
Potential risk from pipeline rupture
Water column
Given that the two intake structures are located at the seabed (8 m high in a water depth of 20 m), there are no risks from condensate at the sea surface or stranded on the shoreline. The OSTM predicts a 73% probability of low exposure to entrained hydrocarbons in the top 10 m of the water column along the Kilcunda shoreline and a 33% probability of high exposure. The OSTM predicts no contact in waters 10-20 m deep along the same section of shoreline (where the intake structures are located). The OSTM predicts a 65% probability of low exposure and 25% probability of medium exposure to dissolved aromatic hydrocarbons in the top 10 m of the water column along the Kilcunda shoreline (with no contact at the high exposure), and a 5% probability of low exposure in waters 10-20 m deep along the same section of shoreline. Given the low risk of exposure to hydrocarbons in the water column along the Kilcunda shoreline, combined with the depth of the water intake structures, the risk of the intake structures drawing in contaminated water is **low**. If hydrocarbons are drawn into the desalination plant, there is potential to damage water filters, contaminate drinking water supplies (noting that these supplies are mixed with fresh water in traditional dams and then treated) and cause reputational damage to Watersure. In the event of a LoC from a pipeline rupture, Beach will implement the OPEP, SERP and EMP to ensure that these risks are reduced to ALARP.

Table 7.64. Potential risk of hydrocarbon release from pipeline on commercial fishing

Fishery	Surface oiling	Water column	Shoreline
General	A short-term fishing exclusion zone may be implemented by the VFA. Given the very small and temporary nature of a surface slick at a threshold that may result in ecological impacts and the low fishing intensity in the EMBA, the risk to fisheries in terms of lost catches (and associated income) is considered **low**.	As illustrated in Figure 7.15 and Figure 7.16, there is the probability of exposure to dissolved (low and moderate, limited area of high exposure) and entrained (low and high) hydrocarbons in the water column. In general, depuration of hydrocarbons from fish tissue is rapid and thus the risks to fisheries (in terms of reduced catch or tainted catch) from hydrocarbon exposure in the water column are considered **low**. A short-term fishing exclusion zone and taint monitoring program may be implemented by fishery management authorities.	Vessels use local ports, which are not located within the EMBA. As such, there will be no impacts (e.g., coating of submerged hulls) to vessels moored in ports.
Victorian fisheries (those known to occur within the pipeline rupture EMBA)			
Scallop	No impacts due to their benthic habitat.	Hydrocarbons are not expected to accumulate among benthic sediments in areas fished for scallops. The most intensely fished areas of the fishery are outside the EMBA by a pipeline LoC (off the east coast of King Island). Therefore, the risk to this fishery and its catch species is **low**.	As per 'general'.
Abalone	No impacts due to their benthic habitat.	The most heavily fished areas of the fishery are located off the east coast of Victoria, which is outside the EMBA by a pipeline LoC. At the fishery-wide scale, the risk is therefore **low**. The abalone lease at Kilcunda is likely to be temporarily closed in the event of a pipeline rupture given its proximity to the pipeline. This may have a **medium** risk on the overall function of the fishery in terms of catch rate and potential financial losses.	As per 'general'.
Rock lobster (San Remo region)	No impacts due to their benthic habitat. There is a **low** risk of rock lobster pot buoys accumulating 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.	The OSTM indicates the maximum extent of low to moderate exposure of the benthic layer to dissolved and entrained hydrocarbons occurs in the nearshore environment between Kilcunda and Cape Liptrap. These waters are likely to be fished for rock lobster where rocky reef is present. Impacts to this fishery may eventuate in the form of a temporary and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. The risk to this fishery is therefore considered **moderate**.	As per 'general'.
Wrasse (central assessment zone)	No impacts due to their pelagic habitat.	The wrasse fishery is potentially exposed to a large area of low exposure entrained and dissolved hydrocarbons and a small area of high exposure entrained and moderate exposure dissolved hydrocarbons.	As per 'general'.

Fishery	Surface oiling	Water column	Shoreline
		Impacts to this fishery may eventuate in the form of a temporary and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. The risk to this fishery is therefore considered **moderate**.	
Pipi (eastern zone)	No impact due to their benthic habitat.	Pipis occur in the intertidal area and are considered under 'shoreline.'	The OSTM indicates there is a maximum 8% probability of shoreline contact above the low and exposure threshold. The EMBA from this LoC scenario represents less than 6% of the state-water fishery. The rapid weathering of hydrocarbons in the intertidal area means the risks to this fishery is **low**.
Ocean purse seine	No impacts due to their pelagic habitat. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.	These fisheries have access to the entire Victorian coastline (except for bays and reserves), so only a small area of the available fishing grounds are exposed to entrained and dissolved hydrocarbons. Impacts to these fisheries may eventuate in the form of a temporary and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. The risk to these fisheries is therefore considered **low**.	As per 'general'.
Ocean access			As per 'general'.
Commonwealth fisheries (those within the pipeline rupture EMBA)			
Southern squid jig	No impacts due to their pelagic habitat. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.	The EMBA represents some of the least intensely fished zones of the fishery, with the highest intensity fishing located off the east coast of Victoria and Tasmania. Impacts to this fishery may eventuate in the form of a temporary and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. The risk to this fishery is therefore considered **low**.	As per 'general'.
SESS - shark gillnet and hook sector	No impacts due to their pelagic habitat. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they	The EMBA also represents some of the least intensely fished zones of the fishery, with the highest intensity located off the south coast of South Australia. Impacts to this fishery may eventuate in the form of a temporary and precautionary exclusion from fishing grounds until water quality monitoring	As per 'general'.

Fishery	Surface oiling	Water column	Shoreline
	are cleaned. A short-term fishing exclusion zone may be implemented by VFA.	verifies the absence of residual hydrocarbons. The risk to this fishery is therefore considered **low**.	

7.16.5 Risk assessment

Table 7.65 presents the risk assessment for a LoC of 3,144.9 m^3 of Yolla condensate from the offshore RGP.

Table 7.65. Risk assessment for a LoC of 3,144.9 m^3 of Yolla condensate from the offshore RGP

Summary			
Summary of risks	Localised and temporary reduction in water quality. Potential toxicity impacts to marine life. Potential temporary fisheries closures.		
Extent of risk	The EMBA is illustrated in Figures 7.12, 7.14, 7.15 and 7.16.		
Duration of risk	Short-term (days to weeks, depending on level of contact, location and receptor).		
Level of certainty of risk	HIGH – spill source volumes are limited in size, the environmental impact of condensate is well understood, a credible spill volume has been modelled and a very conservative threshold has been selected to define the EMBA.		
Risk decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, some uncertainty, some partner interest, may attract media attention.		
Risk Assessment (inherent)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Moderate	Unlikely	Medium
Macroalgal communities	Moderate	Unlikely	Medium
Plankton	Moderate	Unlikely	Medium
Pelagic fish	Moderate	Unlikely	Medium
Cetaceans	Moderate	Unlikely	Medium
Pinnipeds	Moderate	Unlikely	Medium
Marine reptiles	Moderate	Unlikely	Medium
Seabirds	Moderate	Unlikely	Medium
Shorebirds	Moderate	Unlikely	Medium
Sandy beaches	Moderate	Unlikely	Medium
Commercial fisheries	Moderate	Unlikely	Medium
Environmental Controls and Performance Measurement			
EPO	EPS	Measurement criteria	

Note that design elements of the pipeline that assists in preventing the uncontrolled release of hydrocarbons are not detailed here. These are addressed in the original EIS. This EP focuses on performance standards related to operations activities only.		
There is no LoC from the offshore RGP.	The pipeline is operated and maintained in line with the NOPSEMA-accepted BassGas Offshore Pipeline Safety Case (CDN/ID 5214688).	Third-party independent audit reports available confirming operation of the BassGas raw gas pipeline in accordance with the Safety Case.
		Monthly technical monitoring reports verify operation and maintenance of the pipeline in accordance with the Safety Case.
		Biannual cathodic protection survey reports verify the Safety Case is implemented.
		Monitoring reports (e.g., ROV campaigns, intelligent pigging) verify ongoing inspection and maintenance are undertaken.
	The CMMS is used to manage (schedule, record and report) the operations and maintenance of the raw gas pipeline. This includes, but is not limited to: • Glycol dehydration of the well stream (to minimise corrosion); • Continuous corrosion inhibitor injection; • Online monitoring using corrosion probes; • ROV inspections; and • Intelligent pigging inspections.	CMMS records verify operation and maintenance of the pipeline in accordance with the Safety Case.
	The pipeline is marked on navigation maps in order to minimise the risk of vessel anchoring over the pipeline.	Maritime navigation charts for central Bass Strait have BassGas facilities marked.
	Pipeline production parameters, including flows, pressures, temperatures and erosion are monitored on a 24-hr basis by qualified and trained operators so that abnormalities are quickly detected and resolved.	Electronic records of continuous monitoring are available.
		The BassGas Workforce Capability Requirements Matrix is maintained up-to-date and verifies that operators are qualified, trained and certified as capable.
	Operations personnel are qualified, trained and certified as competent to operate and maintain the pipeline.	
	The Beach Lifting and Load Safety Operations Procedure (CDN/ID 3674901) is used for all transfers over the pipeline to minimise the risk of suspended equipment dropping onto the pipeline.	The Lifting and Load Safety Operations Procedure is current.
		Completed PTWs and/or JSAs verify that the procedure is implemented.
	Approval from the Yolla PIC (or Field Manager) must be granted to Vessel Masters seeking to work over/alongside the pipeline in order to minimise the risk of anchor drag or dropped objects.	The communications diary verifies permission is granted for vessels working along the pipeline.
Emergency response		
LoC from the offshore RPG is stopped in the shortest time possible	An OPEP and ERP are in place and tested annually in desktop exercises by those	The OPEP and ERP are current.
		OPEP and ERP training schedule is available and remains live.

in line with pre-determined plans.	nominated in the plans to be part of the response strategies.	The training matrix is maintained as a live document and verifies that personnel nominated to assist in emergency response are up to date with their training. OPEP and ERP exercise reports verify that exercises have been undertaken.
Reporting		
Reporting and monitoring of a LoC from the offshore RGP takes place in accordance with the EP and OPEP.	Beach will report the spill to regulatory authorities within 2 hours of the LoC or becoming aware of the LoC.	Incident report verifies that contact with regulatory agencies was made within 2 hours.

Risk Assessment (residual)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Moderate	Remote	Low
Macroalgal communities	Moderate	Remote	Low
Plankton	Moderate	Remote	Low
Pelagic fish	Moderate	Remote	Low
Cetaceans	Moderate	Remote	Low
Pinnipeds	Moderate	Remote	Low
Marine reptiles	Moderate	Remote	Low
Seabirds	Moderate	Remote	Low
Shorebirds	Moderate	Remote	Low
Sandy beaches	Moderate	Remote	Low
Commercial fisheries	Moderate	Remote	Low

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required. However, because this hazard has a Decision Context of 'B', an ALARP analysis is presented.

Good practice	
Avoid/Eliminate	The risk of a pipeline rupture can never be entirely eliminated. However, operating the pipeline in accordance with the NOPSEMA-accepted Safety Case and undertaking regular inspections and maintenance reduces the risk of a rupture.
Change the likelihood Change the consequence	Personnel operating the pipeline are trained and competent to do so. 24-hour continuous monitoring of production parameters ensures that any process upsets are quickly detected and responded to in order the minimise the risk of a pipeline rupture.
Reduce the risk	The LLGP will shut in production once a pipeline rupture is detected, thereby reducing the volume of condensate released to the ocean. The BassGas ERP and OPEP are in place and will be implemented in the event of a pipeline rupture.

Engineering risk assessment		
The OSTM undertaken for the pipeline rupture scenario is an engineering risk assessment that supports the consequence evaluation, spill response planning and development of the EPS listed in this table. Engineering controls that have been considered for the LoWC but not adopted are outlined below.		
Control	Control type	Analysis
Real time leak detection and well shut in.	System	Such a system would allow a leak from the pipeline to be detected and stop gas flow shut in immediately, thereby minimising the volume of hydrocarbons released. There are many variables associated with the pipeline pressure profile, and it is dependent on the gas flow from Yolla and export rates from LLGP. A subsea leak would need to be significant to be immediately detected. A significant leak is also detected through pipeline pressure monitoring, making leak detection redundant in this case.
Dedicated oil spill resources (vessels, spill response equipment) available at the PSV shore base.	Equipment	This would allow for a slightly quicker response time to reach the source of the spill or nearby shorelines. However, there are substantial costs associated with purchasing and maintaining this equipment (millions of dollars). There is no guarantee that the personnel required to deploy and operate this equipment in the event of a spill would be available at this time. The AMOSC facility located at Geelong is not much further away than Port Anthony (~80 nm additional vessel steam from the west). Beach already pays an annual membership fee to AMOSC, which assists in maintaining this equipment and ensuring there is a pool of trained response personnel available. The additional travel time is negligible in the context of a short- to long-term response activity. The shorter road distance between Melbourne and Geelong, compared with Geelong and Port Anthony (130 km less by road and 1.5 hours less road travel time, one way), makes Geelong a more suitable base than Port Anthony to deploy first responders (on the assumption that many first responders fly in from interstate).
Install more sacrificial anodes along the RGP.	Equipment	The number and type of anodes required to adequately protect the pipeline from corrosion has already been determined during design. Routine inspections monitor the system for adequate cathodic protection and anode wastage, and the last inspection in 2017 reported all was within acceptable limits. Unless the anodes have depleted or become inactive and corrosion is found to be occurring, adding more will not dramatically reduce corrosion risk.
Undertake more regular pigging of the RGP.	Process	Five-yearly pigging is standard for this type of asset and is the frequency required in the integrity management plans. There would need to be a significant driver for an increased frequency, which does not currently exist for the RGP. There are no significant anomalies detected by ILI that warrant more regular pigging. The high cost of contracting vessels, tooling and personnel for more regular pigging is therefore grossly disproportionate to the risk.
Undertake more regular ROV inspections of the RGP.	Process	As per pigging described above, five-yearly ROV inspections are a standard requirement unless there is reason to increase inspection frequency. Past inspections have not identified any reason to move to more frequent ROV inspections. The high cost of contracting vessels, tooling and personnel for more regular pigging is therefore grossly disproportionate to the risk.
Cost benefit analysis		
Incorporated into the engineering risk assessment above.		

Demonstration of Acceptability	
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.

<table>
<tr><td>Stakeholder engagement</td><td colspan="2">The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues.
The only stakeholder to raise concerns about the LoC from the raw gas pipeline was WaterSure (operator of the Victorian desalination plant). A meeting between Beach and WaterSure was held to discuss these concerns. Subsequent to the meeting, WaterSure was satisfied that the risk of a pipeline rupture occurring are remote, and that risks of a spill on their infrastructure and services could be effectively managed.</td></tr>
<tr><td>Legislative context</td><td colspan="2">The performance standards outlined in this EP align with the requirements of:
• OPGGS Act 2006 (Cth):
o Section 572A-F (Polluter pays for escape of petroleum).
• OPGGS Act 2010 (Vic):
o Section 29 (Notifying reportable incidents).
• POWBONS Act 1986 (Vic):
o Section 10 (Duty to report certain incidents involving oil and oily mixtures).
• State Environment Protection Policy (Waters of Victoria):
o Clause 38 (Spills, illegal discharges and dumping of waste).</td></tr>
<tr><td rowspan="5">Industry practice</td><td colspan="2">The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.</td></tr>
<tr><td>Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)</td><td>The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to:
• Pipeline rupture – pipelines are stabilised and protected, periodic monitoring takes place by pigging, corrosion is monitored, SSS and ROV are used for periodic inspections, inspections and maintenance take place, spill preparedness and emergency response measures are in place.</td></tr>
<tr><td>Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)</td><td>No guidance is provided regarding preventing or managing an offshore LoC, other than having a spill contingency plan in place. An OPEP is in place for BassGas operations.</td></tr>
<tr><td>Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)</td><td>Guidelines met with regard to:
• Section 75 (Spills): Conducting a spill risk assessment, implementing personnel training and field exercises, ensuring spill response equipment is available.
• Sections 76-79 (Spill response planning): A spill response plan should be prepared.</td></tr>
<tr><td>APPEA CoEP (2008)</td><td>The EPS listed in this table meet the following offshore development and production objectives:
• To reduce the risk of any unplanned release of material into the marine environment to ALARP and an acceptable level.</td></tr>
<tr><td rowspan="2">Environmental context</td><td colspan="2">MNES</td></tr>
<tr><td>AMPs (Section 5.4.1)</td><td>The EMBA for entrained hydrocarbons intersects three AMPs (Boags, Beagle and Franklin) and the EMBA for dissolved hydrocarbons intersects the Boags and Beagle AMPs.
These are short-term impacts that will not impact on the values or the management aims of these AMPs.</td></tr>
</table>

		See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	There is overlap between the low exposure threshold entrained and dissolved hydrocarbons in the southern part of the Western Port Ramsar site. At this exposure level, there will be no significant impacts to the values of this Ramsar.
	TECs (Section 5.4.5)	Dissolved and entrained hydrocarbons at the low threshold of exposure may intersect the Giant Kelp Forests of South East Australia on the southern coast of Phillip Island. At this exposure level, there will be no significant impacts to giant kelp populations. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	There is overlap between the low exposure threshold entrained and dissolved hydrocarbons at the Western Port and Andersons Inlet NIWs. At this exposure level, there will be no significant impacts to the values of these wetlands.
	Nationally threatened and migratory species (Section 5.5)	Some nationally threatened species and migratory species have the potential to be present in the EMBA, particularly within their BIAs, but as evaluated in the previous tables in this section, the risks to individuals or populations of threatened and migratory species are mostly minor.
	Other matters	
	State marine parks (Section 5.4.9)	There is overlap between the low and moderate exposure thresholds for entrained and dissolved hydrocarbons to the following marine parks: • Wilsons Promontory NP; • Cape Liptrap CP; • Bunurong CR; • Cape Patterson CR; • Cape Patterson Nature CR; • Harmers Haven CR; • Kilcunda CR; • Punchbowl CR; and • Phillip Island NP. This overlap will be temporary and will not have significant effects on the values of these parks. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified for albatross and giant-petrels in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The conservation advice and management plans for blue, humpback, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this.

		See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	
Environmental Monitoring		
• As per the OPEP and OSMP.		
Record Keeping		
• Pipeline Safety Case. • Audit reports. • CMMS records. • BassGas Workforce Capability Requirements Matrix. • Training matrix. • Navigation Charts. • Communications diary.		• Lifting and Load Safety Operations Procedure. • Completed PTWs. • Completed JSAs. • GVI reports. • OPEP. • ERP. • Incident reports.

7.17 RISK 7 – MDO Release

7.17.1 Hazard

A release of MDO may occur from the PSV or vessels undertaking inspection and maintenance activities around the platform or along the raw gas pipeline. An MDO release may occur as a result of:

- A vessel-to-vessel collision;
- A vessel-to-platform collision;
- Vessel grounding;
- Vessel-to-platform refuelling (e.g., top up of crane pedestal);
- Vessel refuelling; and
- Equipment failure.

DNV (2011) indicates that for the period 1982-2010, there were no spills over 1 tonne (1 m^3) for offshore vessels caused by collisions or fuel transfers.

AMSA's annual reports for the last five years (2014/15 to 2018/19) indicate there have been no significant MDO pollution incidents resulting from vessel collisions or groundings, and certainly none relating to vessels supporting offshore oil and gas production activities.

To date, there have been no MDO spills from vessels associated with the operations of the BassGas Development.

MDO properties

The following points summarise the nature and behaviour of MDO, based on NOAA (2012) and APASA (2012):

- MDO is dominated by n-alkane hydrocarbons that give diesel its unique compression ignition characteristics and usually consist of carbon chain C11-C28 but may vary depending upon specifications (e.g., winter vs. summer grades).

- While MDOs are generally considered to be non-persistent oils, many can contain a small percentage (approximately 3-7%) by volume of hydrocarbons that are classified as 'persistent' under IOPC Fund definition (i.e., greater than 5% boiling above 370°C) (see table 7.59).
- Diesel fuels are light, refined petroleum products with a relatively narrow boiling range, meaning that when spilled on water, most of the oil evaporates or naturally disperses quickly (hours to days).
- Diesel fuels are much lighter than water, so it is not possible for diesel oil to sink and accumulate on the seabed as pooled or free oil.
- Dispersion into the sea by the action of wind and waves can result in 25–50% of the loss of hydrocarbons from surface slicks and dissolution (solubility of hydrocarbons) can account for 1-10% loss from the surface. While the majority of the MDO evaporates quickly, it is common for the residues of MDO spills after weathering to contain n-alkanes, iso-alkanes and naphthenic hydrocarbons.
- Minor quantities of PAHs will be present.
- When spilled on water, MDO spreads very quickly to a thin film and generally has a low viscosity that can result in hydrocarbons becoming physically dispersed as fine droplets into the water column when winds exceed 10 knots.
- Droplets of MDO that are naturally or chemically dispersed sub-surface behave quite differently to oil on the sea surface. Diesel droplets will move 100% with the currents under water but on the surface are affected by both wind and currents.
- Natural dispersion of MDOs will reduce the hydrocarbons available to evaporate into the air. Although this reduces the volume of hydrocarbons on the water surface, it increases the level of hydrocarbons able to be inhaled.
- This increased hydrocarbon vapour exposure can affect any air breathing animal including whales, dolphins, seals and turtles.
- The environmental effects of MDOs spills are not as visually obvious as those of heavy fuel oils (HFO) or crude oils. Diesel oil is considered to have a higher aquatic toxicity in comparison to many other crudes oils due to the:
  - High percentage of toxic, water-soluble components (such as BTEX and PAH);
  - Higher potential to naturally entrain in the water column (compared to HFO);
  - Higher solubility in water; and
  - Higher potential to bioaccumulate in organisms.
- Diesel fuel oils are not very sticky or viscous compared to black oils. When diesel oil strands on a shoreline, it generally penetrates porous sediments quickly, but is also washed off quickly by waves.
- In open water, diesel oil spills are so rapidly diluted that fish kills are rarely observed (this is more likely in confined, shallow waters).

Oil Spill Trajectory Modelling

To understand the risks posed by a MDO spill, Beach commissioned RPS to undertake OSTM using the scenario of a release of 300 m^3 of MDO at the sea surface at the 3 nm point along the raw gas pipeline for a duration of 6 hours (RPS, 2017), using the MDO properties outlined in Table 7.66.

Table 7.67 presents the physical characteristics of the typical MDO, verifying its volatile nature (i.e., it is quick to weather, though not as quick as Yolla condensate). Table 7.68 outlines the key OSTM inputs for the MDO spill scenario (Table 7.28 lists and justifies the spill thresholds used in the OSTM).

Table 7.66. Summary of the MDO spill OSTM inputs.

Characteristic	Details
Density (kg/m^3)	829 at 25°C
API	37.6
Dynamic viscosity (cP)	4.0 at 25°C
Pour point (°C)	-14
Oil property category	Group II
Oil persistence classification	Light persistent oil

Table 7.67. Physical characteristics of MDO

	Volatiles	Semi-volatiles	Low Volatiles	Residual Oil
Boiling Point (°C)	< 180	180-265	265-380	> 380
MDO (%)	6.0	34.6	54.4	5.0
Persistence	Non-persistent			Persistent

Table 7.68. Summary of the MDO spill OSTM inputs.

Parameter	Details
Oil Type	MDO
Total spill volume	300 m^3
Release type	Sea surface
Release duration	6 hours
Release rate	50 m^3/hr
Simulation duration	20 days
Surface oil concentration thresholds (g/m^2)	1-10 g/m^2 – low exposure 10-50 g/m^2 – moderate exposure >50 g/m^2 – high exposure
Shoreline load threshold (g/m^2)	10 g/m^2 – low exposure 100 g/m^2 – moderate exposure 1,000 g/m^2 – high exposure
Dissolved aromatic dosages to assess potential exposure (ppb)	10 ppb – low exposure 50 ppb – moderate exposure 400 ppb – high exposure
Entrained oil dosages to assess potential exposure (ppb)	10 ppb – low exposure 100 ppb – high exposure

Spill Location

For this assessment, the spill location was chosen as the 3 nm point along the raw gas pipeline, representing the boundary between Victorian and Commonwealth waters. This was chosen as a representative point close to coast to represent worst-case conditions for a shoreline spill for a vessel undertaking inspection or maintenance on the pipeline, but also represents an area of shallow water that is subject to more vessel traffic than points further south along the raw gas pipeline. The OSTM results for this location can be considered representative of other locations along the pipeline, albeit with the nearshore areas having stronger tidal currents and surface ocean currents than in more open waters. To this effect, for surface oil, the EMBA is displayed as a buffer along the entire length of the pipeline rather than just the spill location.

Spill Volume

AMSA's *Technical Guidelines for preparing Contingency Plans for Marine and Coastal Facilities* (AMSA, 2015, pg 24) indicates that an appropriate spill size for a vessel collision (a non-oil tanker) should be based on the volume of the largest tank, while the volume for a non-major grounding should be based on the total fuel volume of one tank. Beach has used this guidance in determining the volume to be modelled for this study. The largest fuel tank on the current PSV, the *Tek Ocean Spirit*, is 99 m^3, so the 300 m^3 spill scenario is considered conservative (even for vessels that may undertake inspections and maintenance along the pipeline).

Potential MDO spills from the platform have not been modelled because the volumes are too small and will not extend far beyond the platform and thus will not impact on sensitive receptors. These scenarios are:

- Vessel-to-platform MDO refuelling – the quantity held in the transfer hose is 160 litres. If spilled, this would be unlikely to travel more than several hundred metres from the platform before weathering. Such a spill has not occurred at Yolla-A to date.
- Loss of MDO during refuelling the crane pedestal – the pedestal holds 8.4 m^3 of MDO. This would be unlikely to travel more than several kilometres from the platform before weathering. Such a spill has not occurred at Yolla-A to date.

Sea Surface Results

A summary of the sea surface OSTM results for the MDO spill scenario is presented in Table 7.69 and illustrated in Figure 7.20. The sea surface OSTM results indicate that low exposure contact would be made with the Bunurong Marine and Coastal Park.

Table 7.69. Summary of the sea surface results for the MDO spill scenario

Distance and direction	Zones of potential sea surface exposure		
	Low (1-10 g/m^2)	Moderate (10-50 g/m^2)	High (>50 g/m^2)
Maximum distance from release site	26.6 km	10.7 km	2.5 km
Direction	East-southeast	South	East-southeast

Weathering results for this MDO spill scenario are illustrated in Figure 7.21, indicating that evaporation accounts for over half of the MDO weathering and that this occurs rapidly.

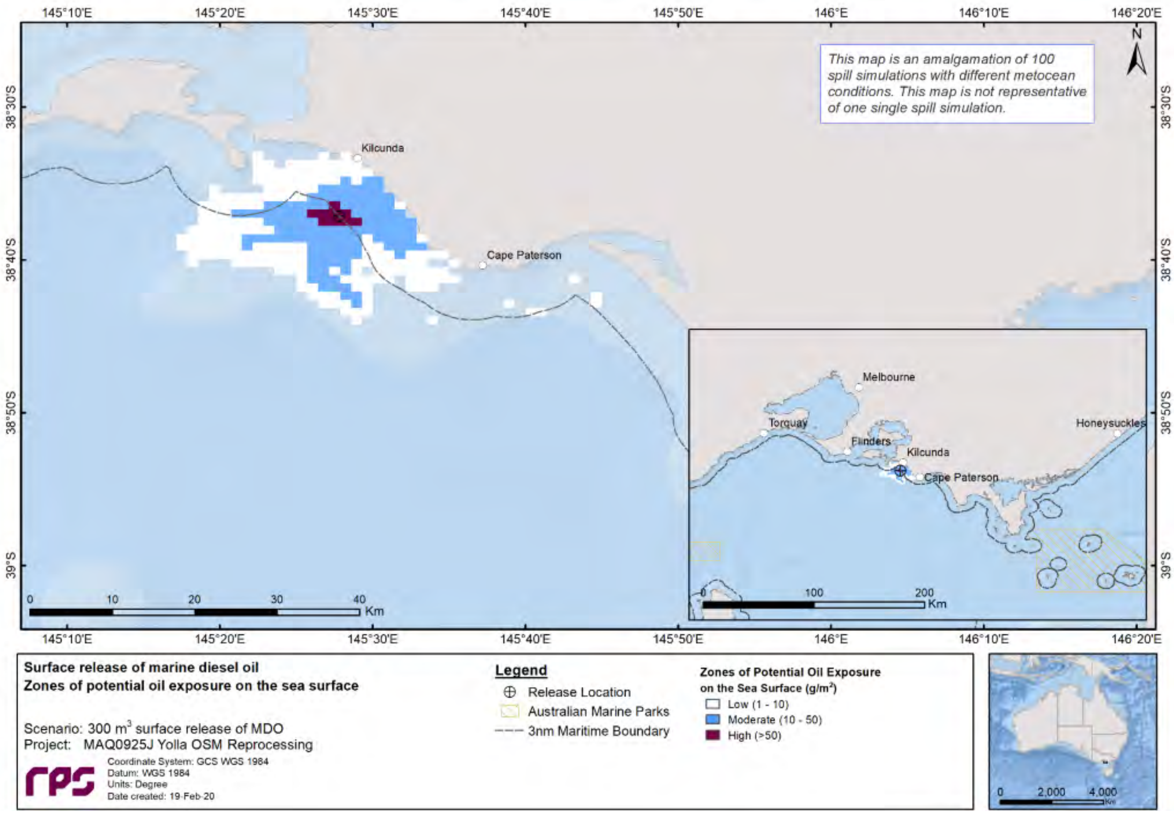


Figure 7.20. Zones of potential exposure on the sea surface in the event of a 300 m^3 surface release of MDO over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions

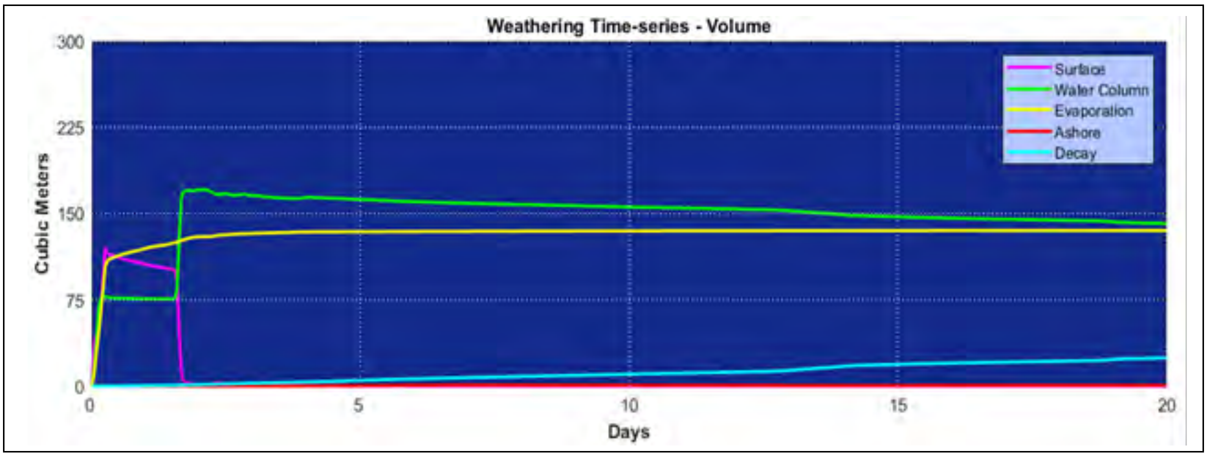


Figure 7.21. Predicted weathering and fate of MDO for the largest swept area based on a 300 m^3 surface release of MDO over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions

Shoreline Results

A summary of the shoreline OSTM results for the pipeline rupture scenario is presented in Table 7.70. The maximum potential shoreline loading results for this scenario are illustrated in Figure 7.22. The shoreline OSTM results indicate that contact would be made with the shorelines of Kilcunda Coastal Reserve, Kilcunda-Harmers Haven Coastal Reserve and Bunurong Marine and Coastal Park.

Table 7.70. Summary of the shoreline contact results above 10 g/m^2 in the event of a 300 m^3 MDO spill over 6 hours and tracked for 20 days during annual conditions

Shoreline statistics		Results
Maximum probability of contact to any shoreline		39%
Absolute minimum time to shore		10 hours
Maximum volume of hydrocarbons ashore*		172 m^3
Average volume of hydrocarbons ashore^		24 m^3
10 g/m^2 loading	Maximum shoreline length	11.0 km
	Average shoreline length	4.9 km
100 g/m^2 loading	Maximum shoreline length	7.0 km
	Average shoreline length	2.9 km
1,000 g/m^2	Maximum shoreline length	4.0 km
	Average shoreline length	1.8 km

** Maximum volume ashore – the maximum peak volume to come ashore for defined receptors, or all shorelines, from a single simulation/trajectory.*

^ Average volume ashore – the average volume to come ashore for defined receptors, or all shorelines, from a single simulation/trajectory. Only non-zero values are considered.

Table 7.71 presents the probability of exposure to shoreline segments and protected areas sea surface waters from the MDO spill scenario.

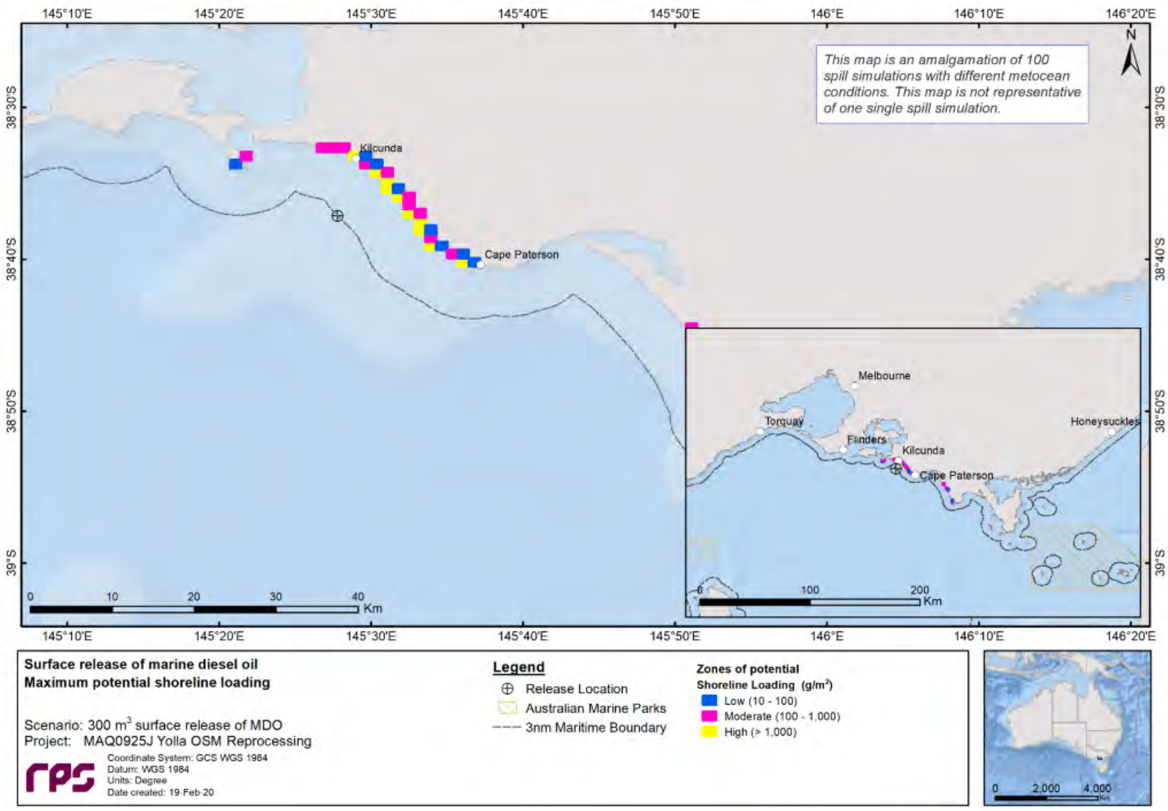


Figure 7.22. Maximum potential shoreline loading in the event of a 300 m^3 surface release of MDO over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions

Table 7.71. Probability of exposure to sea surface waters from a 300 m^3 MDO release over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions and tracked for 20 days

Receptor (shoreline segment)	Probability (%) of exposure on the sea surface			Minimum time before oil exposure on the sea surface (hours)		
	Low	Mod	High	Low	Mod	High
Shorelines						
Phillip Island	1	NC	NC	19	NC	NC
Kilcunda	30	7	NC	8	11	NC
Venus Bay	4	NC	NC	12	NC	NC
Protected areas						
Bunurong MNP	1	NC	NC	28	NC	NC
Bunurong MP	7	1	NC	8	11	NC

NC = no contact

Entrained Hydrocarbon Results

Figure 7.23 illustrates the zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface, indicating that the maximum distance travelled from the release location is 506 km predominantly in an east-northeast location for low exposure hydrocarbons and up to 122 km in the same direction for high exposure entrained hydrocarbons.

There is no contact with entrained hydrocarbons at any threshold in waters below a depth of 10 m from the sea surface. A summary of the entrained MDO OSTM results is presented in Table 7.72.

Table 7.72. Probability of exposure to receptors from entrained MDO based on a 300 m^3 release over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions

Receptor (shoreline segment)	0-10 m below sea surface			>10 m below sea surface		
	Max. exposure to entrained hydrocarbons (ppb)	Probability (%) of exposure to entrained hydrocarbons		Max. exposure to entrained hydrocarbons (ppb)	Probability (%) of exposure to entrained hydrocarbons	
		Low	High		Low	High
Protected areas						
Apollo AMP	21.5	1	NC	NC	NC	NC
Beagle AMP	129.6	17	1	NC	NC	NC
Canyons on the eastern continental slope KEF	36.9	1	NC	NC	NC	NC
Upwelling east of Eden KEF	47.7	2	NC	NC	NC	NC
Bunurong MNP	925	80	39	NC	NC	NC
Churchill Island MNP	40.1	5	NC	NC	NC	NC
Wilsons Promontory MNP	122.9	44	3	NC	NC	NC
Bunurong MP	1,789.6	79	46	NC	NC	NC
Corner Inlet MCP	24.1	5	NC	NC	NC	NC
Wilsons Promontory MP	154.1	42	2	NC	NC	NC
Corner Inlet Ramsar site	24.1	5	NC	NC	NC	NC
Western port Ramsar site	67.1	10	NC	NC	NC	NC

NC = no contact

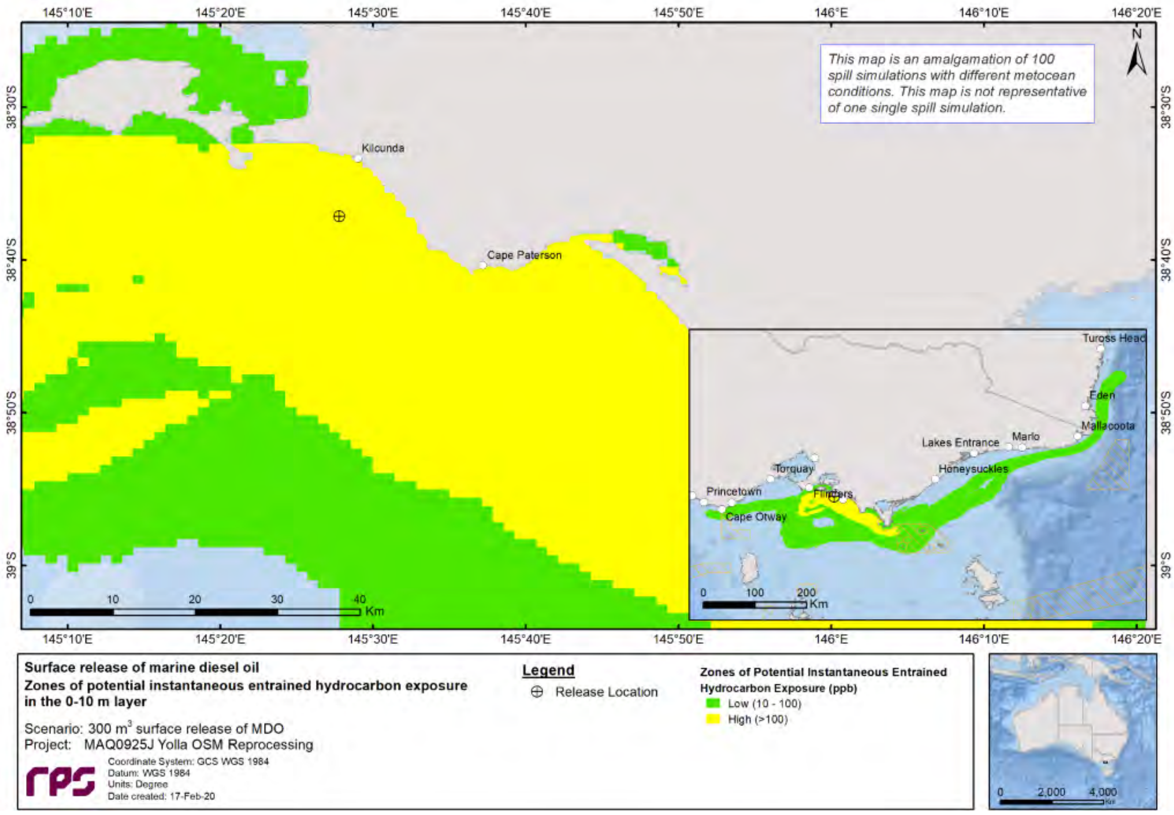


Figure 7.23. Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 300 m^3 surface release of MDO over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions

Dissolved Hydrocarbons Results

Table 7.73 summarises the OSTM results for dissolved hydrocarbons. Figure 7.24 illustrates the zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea surface, indicating that the maximum distance travelled from the release location is 97 km predominantly in a southeast location for low exposure hydrocarbons and up to 9 km in an east-southeast direction for moderate exposure entrained hydrocarbons, with no exposure to high exposure hydrocarbons.

No dissolved hydrocarbon exposure was predicted to occur below a depth of 10 m.

Table 7.73. Probability of exposure to receptors from dissolved MDO based on a 300 m^3 release over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions

Receptor (shoreline segment)	0-10 m below sea surface				>10 m below sea surface			
	Max. exposure to dissolved aromatics (ppb)	Probability (%) of exposure to dissolved aromatics			Max. exposure to dissolved aromatics (ppb)	Probability (%) of exposure to dissolved aromatics		
		Low	Mod	High		Low	Mod	High
Shorelines								
Phillip Island	10.0	1	NC	NC	NC	NC	NC	NC
Bass Coast	64.2	11	1	NC	NC	NC	NC	NC
Protected areas								
Bunurong MNP	36.1	6	NC	NC	NC	NC	NC	NC
Wilsons Promontory MNP	10.7	1	NC	NC	NC	NC	NC	NC
Bunurong MP	51.2	9	1	NC	NC	NC	NC	NC

NC = no contact

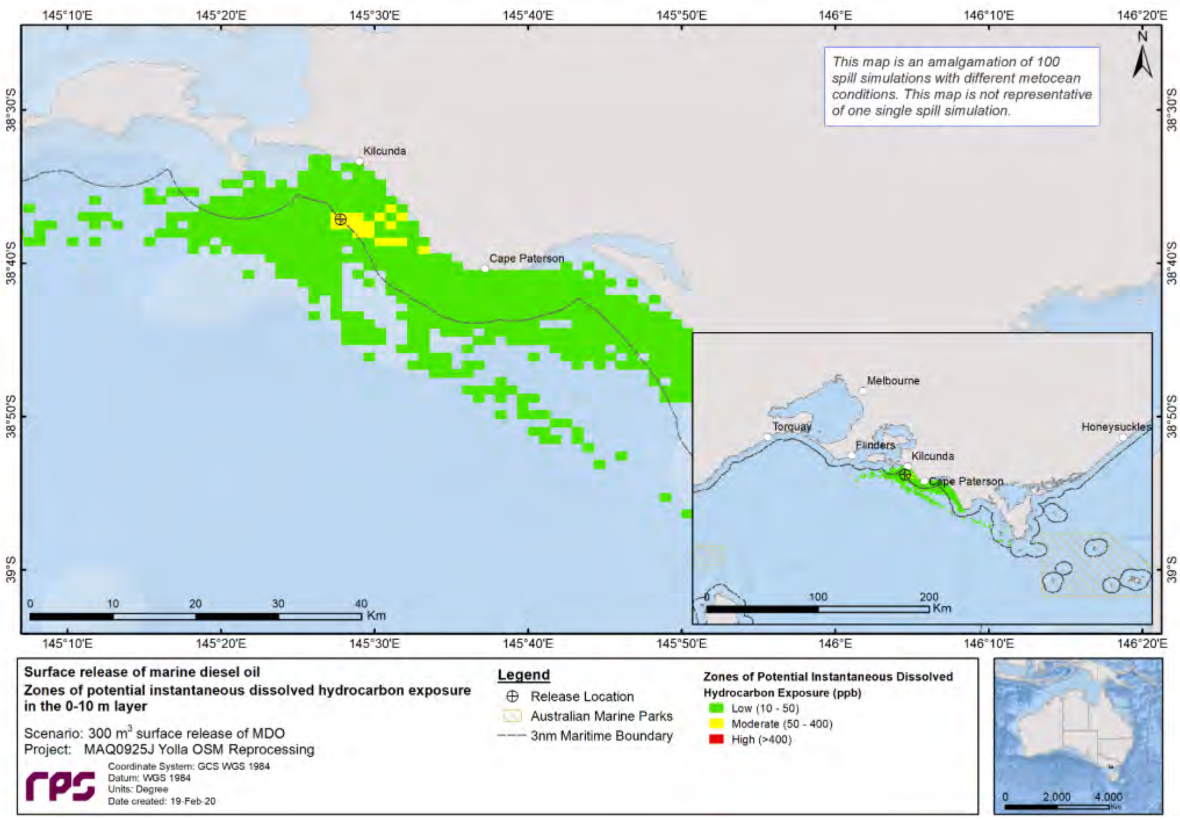


Figure 7.24. Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea surface in the event of a 300 m^3 surface release of MDO over 6 hours and tracked for 20 days based on 100 spill trajectories during annual conditions

7.17.2 Potential environmental risks

The known and potential impacts of an MDO spill are:

- A temporary and localised reduction in water quality;
- Injury or death of exposed marine fauna and seabirds;
- Habitat damage where the spill reaches shorelines;
- Damage to water filtering equipment at the Victorian desalination plant (at Wonthaggi), contamination of water supply and disruption to the supply of water services; and
- Changes to the functions, interests or activities of other users (e.g., commercial fisheries).

7.17.3 EMBA

The EMBA for a 300 m^3 spill of MDO (sea surface, shoreline, entrained and dissolved aromatics) is illustrated in Figures 7.20, 7.22, 7.23 and 7.24. Receptors most at risk within this EMBA, whether resident or migratory, are:

- Plankton;
- Fish;
- Cetaceans;
- Pinnipeds;
- Avifauna; and
- Shoreline habitats.

7.17.4 Evaluation of Environmental Risk

Vessel collisions are a low probability event in open ocean areas without restricted navigation, and shipping traffic along the raw gas pipeline and around Yolla-A is low (see Figure 5.44). Higher commercial and recreational vessel traffic occurs in and around ports and harbours, which is therefore where the greatest risk of collision occurs. While operating along the pipeline or around Yolla-A, vessels will be operating at low speeds, reducing the risk of collision with third-party vessels.

The impacts of MDO spills on key environmental receptors in the MDO EMBA are described in Table 7.74 to Table 7.84. Criteria for the sensitivity of these receptors is presented earlier in Table 7.38.

The impact of a loss of MDO from the platform's crane pedestal (8.4 m^3) or loss of an MDO intermediate bulk container (IBC, or 'bulkie', which have a volume of 1 m^3) during transfer is considered too small to model; the effects from such a release would be concentrated around the platform and the MDO would not travel to any sensitive receptors.

Table 7.74. Potential risk of MDO release on benthic assemblages

General sensitivity to oiling – benthic assemblages		
Refer to Table 7.39 for general sensitivity information.		
Potential risk from an MDO spill		
Sea Surface	Water column	Shoreline
Not applicable.	There are limited areas of low exposure dissolved hydrocarbons in the benthic zone between Phillip Island and Cape Liptrap, and more extensive areas of low and moderate exposure entrained hydrocarbons along the shoreline between Flinders and Corner Inlet. The risk of toxicity effects on benthic assemblages will be **low** in the short to medium term and negligible in the long-term.	There is a 1-34% probability of contact with any shoreline between Phillip Island and Cape Liptrap. Intertidal benthic species would be exposed to MDO (albeit weathered). Resident fauna such as worms, molluscs and crustaceans may suffer lethal impacts where hydrocarbon loadings penetrate into the sediments and persist. While MDO penetrates porous sediments (e.g., sand) quickly, it is also washed off quickly (and weathered within sediments) by waves (NOAA, 2012), thus minimising impacts to intertidal fauna. Similarly, the rock cliffs and intertidal platforms present in the Kilcunda area will facilitate weathering of the hydrocarbons (through wave action pounding on the rocks). The risk of toxicity effects on benthic assemblages will be **low** in the short to medium term and negligible in the long-term.

Table 7.75. Potential risk of MDO release from vessel on macroalgal communities

General sensitivity to oiling – macroalgal communities		
Refer to Table 7.40 for general sensitivity information.		
Potential risk from an MDO spill		
Sea surface	Water column	Shoreline
Emergent or floating vegetation in the intertidal and subtidal zone along the coast from Cape Woolamai to Wilsons Promontory may be exposed to varying levels of hydrocarbon concentrations ranging from low to high at the sea surface, low exposure thresholds for dissolved hydrocarbons and low and high exposure thresholds for entrained hydrocarbons. The impacts to macroalgae are likely to be as per those described in Section 7.11.4. The Giant Kelp Forest TEC is not present in the EMBA for this scenario and will not be affected. Strong wave-action, an exposed coastline and the light characteristics of MDO all assist in the rapid dispersal and dilution of the MDO, meaning that there is a **low** risk of short-term persistence of hydrocarbons to intertidal macroalgal communities.		

Table 7.76. Potential risk of MDO release on plankton

General sensitivity to oiling – plankton		
Refer to Table 7.41 for general sensitivity information.		
Potential risk from an MDO spill		
Sea Surface	Water column	Shoreline
Plankton found in open water 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 surface, dissolved and entrained hydrocarbons. Once background water quality conditions are re-established following the natural weathering and dispersion of the hydrocarbons, plankton populations are expected to recover rapidly due to recruitment of plankton from surrounding waters. The risk to plankton of hydrocarbon spills is considered **low** in the short- and long-term.		Not applicable.

Table 7.77. Potential risk of MDO release on pelagic fish

General sensitivity to oiling – pelagic fish		
Refer to Table 7.42 for general sensitivity information.		
Potential risk from an MDO spill		
Sea Surface	Water column	Shoreline
There is a small area in which moderate exposure (26.6 km) and high exposure (2.5 km) threshold hydrocarbons travel from the spill site on the sea surface. Fish species in the water column and syngnathid species associated with rafts of floating seaweed may come into contact with surface oil, however the maximum distance of moderate exposure threshold from the release site (representing the point at which harmful effects may be encountered) represents a relatively small area of the sea surface in comparison to the wider Bass Strait. Because the majority of fish tend to remain in the mid-pelagic zone, they are not likely to come into contact with surface hydrocarbons, so the risk from hydrocarbons at surface is **low**.	There is a 1% probability of moderate exposure to dissolved hydrocarbons between Kilcunda and Cape Paterson, but a generally higher probability of contact with high exposure entrained hydrocarbons through the EMBA. These thresholds of exposure represents the possibility of sub-lethal impacts to chronically exposed fish species. However, NOAA (2013) and ITOPF (2011a) state that hydrocarbon spills in open water are so rapidly diluted that fish kills are rarely observed. Fish such as the great white shark, shortfin mako and porbeagle shark spend most of their time in the water column (rather than surface waters), meaning they are more likely to be exposed to entrained and dissolved hydrocarbons than surface hydrocarbons. As highly mobile species, they are unlikely to remain in one area for a long period of time, minimising the risk that they would be exposed to toxic levels of hydrocarbons. Due to Bass Strait's generally well-mixed waters, and the high and rapid rate of MDO weathering, the risk of toxicity impacts from MDO in the water column for fish is considered to **low** at a population level.	Not applicable

Table 7.78. Potential risk of MDO release on cetaceans

General sensitivity to oiling – cetaceans		
Refer to Table 7.43 for general sensitivity information.		
Potential risk from an MDO spill		
Sea Surface	Water column	Shoreline
There is a small area in which moderate exposure (26.6 km) and high exposure (2.5 km) threshold hydrocarbons travel from the spill site on the sea surface. This area overlaps the foraging BIA for pygmy blue whales and known core range of southern right whales. There is a chance that pygmy blue and southern right whales may be present in the EMBA depending on the time of year that a spill occurs. If present, these species (and other cetaceans) may be exposed to hydrocarbons in the manner described in Table 7.35. If large quantities of zooplankton exposed to the spill were ingested, chronic toxicity impacts to some individual cetaceans may occur. Biological consequences of physical contact with very localised areas of high concentrations (maximum 2.5 km from the release site) of hydrocarbons at the sea surface are unlikely to lead to any long-term population impacts. Evaporation of the hydrocarbons is expected to occur rapidly in this scenario with ~100 m^3 of the modelled 300 m^3 evaporating within 1 day of the spill occurring, thus reducing the duration of the hydrocarbons persisting on the sea surface. In comparison to the range of the BIAs of the whale species identified, the duration and extent of sea surface hydrocarbons is negligible and does not represent a long-term threat at the population level of cetaceans migrating or foraging in the EMBA. The risk to cetaceans from hydrocarbons at the surface is therefore **low**.	There is a 1% probability of moderate exposure to dissolved hydrocarbons between Kilcunda and Cape Paterson, but a generally higher probability of contact with high exposure entrained hydrocarbons through the EMBA (levels that may have sub-lethal effects to sensitive species). This area overlaps the foraging BIA for pygmy blue whales and known core range of southern right whales. About 45% of the MDO is expected to remain in the water column after 20 days. The pygmy blue whale BIA is for 'likely foraging' and the BIA for southern right whales is for 'migration/resting'. The generally low to moderate exposure thresholds encountered in the EMBA are unlikely to pose a significant threat at the population level to cetaceans given that they are likely to be migrating through the region and not undertaking critical activities such as feeding and breeding and therefore unlikely to accumulate toxic levels of hydrocarbons. The risk to cetaceans from hydrocarbons in the water column is therefore considered **low**.	Not applicable.

Table 7.79. Potential risk of MDO release on pinnipeds

General sensitivity to oiling – pinnipeds		
Refer to Table 7.44 for general sensitivity information.		
Potential risk from an MDO spill		
Sea Surface	Water column	Shoreline
The foraging range for Australian and New Zealand fur-seals may be very temporarily exposed to a very small area of moderate to high exposure thresholds of hydrocarbons at the sea surface. The high level of exposure is considered to be damaging to pinnipeds through either direct contact or ingestion of contaminated prey species. MDO at the sea surface spreads thinly and weathers quickly, reducing the amount of time that fur-seals may be exposed to MDO. As fur-seals forage for prey within the water column rather than at the sea surface, exposure to oil at the sea surface will only result when resting at surface or entering and exiting the water. Toxicity impacts at the individual or population level are unlikely to occur and the risk is therefore considered **low**.	There is a 1% probability of moderate exposure to dissolved hydrocarbons between Kilcunda and Cape Paterson, but a generally higher probability of contact with high exposure entrained hydrocarbons through the EMBA (levels that may have sub-lethal effects to sensitive species). This area affected is likely to overlap with fur-seal foraging ranges. Given that fur-seals forage for prey within the water column, exposure to hydrocarbons may occur (either via ingestion of contaminated prey or direct contact with oil droplets), though at generally low concentrations, the risk of such exposure is likely to be **low** for individuals or populations.	There is no risk of MDO stranding on shorelines known to be used by Australian and New Zealand fur-seals as breeding or haul-out sites. As such, it is unlikely that oiling of fur-seals will occur on shorelines in the EMBA. The nearest site of significance is Seal Rock off the west coast of Phillip Island (35 km from the release site and outside the MDO surface oil EMBA). Given the generally rocky nature of preferred haul-out sites and their ability to self-clean, the risk of oiling of pinnipeds at shorelines is **low**.

Table 7.80. Potential risk of MDO release on marine reptiles

General sensitivity to oiling – marine reptiles		
Refer to Table 7.45 for general sensitivity information.		
Potential risk from an MDO spill		
Sea Surface	Water column	Shoreline
Some individual transient marine reptiles may come into contact with localised areas of high MDO exposure on the sea surface. However, this high concentration is small in area and temporary. Due to the absence of turtle BIAs in Bass Strait and the low chance of encountering turtles in Victorian waters in general, the risk to marine reptiles (individuals or populations) is **low**.		There are no turtle nesting beaches within the EMBA for this scenario, so risk to turtles from shoreline oiling is **low**.

Table 7.81. Potential risk of MDO release on seabirds and shorebirds

General sensitivity to oiling – seabirds and shorebirds		
Refer to Table 7.46 for general sensitivity information.		
Potential risk from an MDO spill		
Sea Surface	Water column	Shoreline
The threatened bird species likely to occur in the EMBA, such as albatross and petrels, forage over an extensive area and are distributed over a wide geographic area. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with moderate to high exposure levels of MDO on the sea surface. These concentrations are generally considered detrimental to birds because of ingestion from preening of contaminated feathers, loss of thermal protection and hypothermia from matted feathers. However, rapid weathering will limit the duration of toxicity impacts. The absence of breeding colonies or nesting areas in the EMBA for most of the seabirds known to occur in the region (particularly albatross and petrels) limits potential exposure to spilled MDO and means the overall risk to birds is **low**.	The seabirds known to occur in the EMBA would spend only seconds at a time diving for fish in the top 0-10 m of the water column. Consequently, contact with MDO at low exposure levels would be brief (even after numerous dives) and the risk of toxicity effects to birds is therefore **low**.	The average length of shoreline predicted to be exposed to MDO that may have biological impacts to birds (100 g/m^2) is 3 km, with an average volume of 24 m^3. This section of coastline, between Kilcunda and Cape Paterson, comprises mostly wide sandy beaches (interspersed with rocky platforms) that provides habitat for shorebird species such as hooded plovers, terns, snipes and sandpipers. MDO is unlikely to persist on the surface of sandy beaches because it quickly penetrates porous sediments. This behaviour limits the duration of exposure to shorebirds. Shorebirds foraging for food in intertidal areas or along the high tide mark and splash zone may encounter weathered hydrocarbons that may be brought back to nests. Hydrocarbon entering the sandy nests of hooded plovers, terns or other bird species is likely to percolate through the sand and not accumulate in the feathers of adults or young. Toxicity effects from ingestion of contaminated prey caught in the intertidal zone or from direct exposure or transport back to nests are unlikely to occur, as the volatile components are likely to have weathered prior to stranding. The populations of seabird and shorebird species within the EMBA have a wide geographic range, meaning that impacts to individuals or a population at one location will not necessarily extend to populations at other un-impacted locations. The risks of shoreline stranding of MDO to birds is therefore considered **low**.

Table 7.82. Potential risk of MDO release on sandy beaches

General sensitivity to oiling – sandy beaches
Refer to Table 7.47 for general sensitivity information.
Potential risk from an MDO spill
Shoreline
The shoreline predicted to be exposed to moderate to high MDO loadings/volumes occur between Kilcunda and Cape Paterson. This area of coastline is exposed, comprising wide sandy beaches and rocky platforms, and is subject to strong wave action. This assists in pushing MDO residues down into beach sediments. Areas of low exposure to shoreline loading are not expected to exhibit environmental harm. Due to the exposed nature of the shoreline and the nature of MDO, long-term toxicity or smothering effects in areas of moderate to high MDO exposure are not expected and natural weathering should be sufficient to aid in recovering communities rapidly. The risk of short-term reductions in tourism and other human uses of the beach is **low**, and may occur as a result of temporary beach closures to protect human health or due to perceptions of a polluted environment, rather than a requirement to protect the public from persistent pollution.

Table 7.83. Potential risk of MDO release to the Victorian desalination plant

General sensitivity to oiling – desalination plant
Watersure advises that damage to its water filtering equipment would cost millions of dollars to repair, while contamination to water supplies and disruption to contracted water supply services would result in reputational damage.
Potential risk from an MDO spill
Water column
Given that the two intake structures are located at the seabed (8 m high in a water depth of 20 m), there are no risks from MDO at the sea surface or stranded on the shoreline. The OSTM predicts no contact in waters 10-20 m deep in the location of the intake structures, and a 10% probability of low exposure to dissolved aromatic hydrocarbons in the top 10 m of the water column (with no contact at the high exposure). The OSTM predicts no contact in waters 10-20 m deep in the location of the intake structures and a 2% probability of low exposure to entrained hydrocarbons in the top 10 m of the water column (with no contact at higher exposures). Given the low probability of exposure to hydrocarbons in the water column in the vicinity of the intake structures, combined with the depth of the water intake structures, the risks of the intake structures drawing in contaminated water is **low**. If MDO is drawn into the desalination plant, there is potential to damage water filters, contaminate drinking water supplies (noting that these supplies are mixed with fresh water in traditional dams and then treated) and cause reputational damage to Watersure. In the event of an MDO release, Beach will implement the OPEP, SERP and EMP to ensure that these risks are reduced to ALARP.

Table 7.84. Potential risk of MDO spill on commercial fishing

Fishery	Surface oiling	Water column	Shoreline
General	A short-term fishing exclusion zone may be implemented by the VFA. Given the temporary nature of any surface slick and the low fishing intensity in the EMBA, there are unlikely to be even minor impacts on fisheries in terms of lost catches (and associated income)	A short-term fishing exclusion zone and taint monitoring program may be implemented by fisheries management authorities.	Vessels use local ports, which are not present within the EMBA. As such, there be no impacts (e.g., coating of submerged hulls) to vessels moored in ports.
Victorian fisheries (those within the MDO spill EMBA)			
Abalone	No impacts due to their benthic habitat.	The most heavily fished areas of the fishery are located off the east coast of Victoria, which is exposed to small areas of low exposure entrained and hydrocarbons. A temporary closure of the area affected by hydrocarbons may be implemented. This is expected to be of minor consequence to the overall function of the fishery or its catch species. This has a **low** risk.	As per 'general'.
Rock lobster (San Remo region)	There is a **low** risk of rock lobster pot buoys accumulating 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.	The OSTM indicates the maximum extent of low exposure of the benthic layer to dissolved hydrocarbons occurs in the nearshore environment between Kilcunda and Cape Liptrap. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of minor consequence to the overall function of the fishery or its catch species. This has a **low** risk.	As per 'general'.
Wrasse (central assessment zone)	No impacts due to their pelagic habitat.	The entrained and dissolved MDO EMBA intersect large areas of the wrasse fishery. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of minor consequence to the overall function of the fishery or its catch species. This has a **low** risk.	As per 'general'.
Pipi	No impact due to their benthic habitat.	Pipis occur in the intertidal area and are considered under 'shoreline.'	The shoreline between Kilcunda and Cape Paterson is at risk of low to high shoreline loadings.

Fishery	Surface oiling	Water column	Shoreline
			The rapid weathering of hydrocarbons in the intertidal area means the risk to this fishery are **low**.
Ocean purse seine	No impacts due to their pelagic habitat. Vessel hulls have a **low** risk of accumulating hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.	This fishery has access to the entire Victorian coastline (except for bays and reserves), so only a very small area of the available fishing grounds are exposed to low exposure entrained and dissolved MDO. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of minor consequence to the overall function of the fishery or its catch species. This has a **low** risk.	As per 'general'.
Ocean access			As per 'general'.
Commonwealth fisheries (those within the MDO spill EMBA)			
Southern squid jig fishery	No impacts due to their pelagic habitat. Vessel hulls may accumulate hydrocarbons if they travel through a slick. The oiled surfaces may themselves be a source of secondary contamination until they are cleaned.	The EMBA represents some of the least intensely fished zones of the fishery, with the highest intensity fishing located off the east coast of Victoria and Tasmania. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of minor consequence to the overall function of the fishery or its catch species. This has a **low** risk.	As per 'general'.
SESS - shark gillnet and hook sector		The EMBA also represents some of the least intensely fished zones of the fishery, with the highest intensity located off the south coast of South Australia. This fishery may be subject to a temporary (e.g., days to a few weeks) and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. This is expected to be of minor consequence to the overall function of the fishery or its catch species. This has a **low** risk.	As per 'general'.

7.17.5 Risk assessment

Table 7.85 presents the risk assessment for an MDO spill.

Table 7.85. Risk assessment for an MDO spill

Summary			
Summary of risks	Localised and temporary reduction in water quality. Potential toxicity impacts to marine life. Temporary fisheries closures.		
Extent of risks	EMBA is defined in Figures 7.20, 7.22, 7.23 and 7.24.		
Duration of risks	Short-term (several days, depending on level of contact, location and receptor).		
Level of certainty of risks	HIGH – spill source volumes can be limited in size though the environmental impacts of spilled hydrocarbons are well understood.		
Risk decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, some uncertainty, some partner interest, may attract media attention.		
Risk Assessment (inherent)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Minor	Highly unlikely	Low
Macroalgal communities	Minor	Highly unlikely	Low
Plankton	Minor	Highly unlikely	Low
Pelagic fish	Minor	Highly unlikely	Low
Cetaceans	Minor	Highly unlikely	Low
Pinnipeds	Minor	Highly unlikely	Low
Marine reptiles	Minor	Highly unlikely	Low
Seabirds	Minor	Highly unlikely	Low
Shorebirds	Moderate	Highly unlikely	Low
Sandy beaches	Minor	Highly unlikely	Low
Commercial fisheries	Minor	Highly unlikely	Low
Public amenity (beaches, recreational fishing)	Serious	Highly unlikely	Medium
Desalination plant	Major	Highly unlikely	Medium
Environmental Controls and Performance Measurement			
EPO	EPS	Measurement criteria	
Preventative controls as per 'Physical presence of infrastructure' and 'Routine emissions – light.' Additional controls are provided here.			
Preparedness			
No MDO is spilled at sea during refuelling activities.	No vessel refuelling is undertaken at sea (this will be done in port) for routine PSV visits.	Bunker log verifies that refuelling was undertaken in port.	

	The Yolla-A Bunkering Procedure (CDN/ID 3973929) and the BassGas Adverse Weather Procedure (CDN/ID 3976810) and Field Support Vessel Operations Procedure (CDN/ID 3974221) is implemented in order to prevent an MDO spill during transfers of MDO between the PSV and Yolla-A (if bulkies are not used) or for at-sea refuelling of vessels undertaking inspection and maintenance activities. This will include (but is not limited to): • A JSA and PTW is signed off for each bunkering event, taking into account spill response considerations. • Bunkering hoses are regularly inspected and replaced as required. • Ensuring that the dry-break refuelling hose couplings assembly is in order to minimise the risk of a spill and hose floats are installed on the refuelling hose so that a hose leak is quickly and easily visible. • Ensuring that communications (visual and/or audio) between the platform and the vessel is tested by the PIC and Vessel Master prior to bunkering commencing. • Ensuring that fuel transfer hoses are replaced in accordance with the CMMS or when they are visibly degraded. • The bunkering operation is supervised at all times by trained and competent personnel. • Ensuring that bunkering only commences during daylight hours and in calm sea conditions. • Ensuring that flotation buoys are fitted to the transfer hoses so that they remain on the sea surface (enabling prompt detection of leaks). • Ensuring that tank level indicators and level alarms are provided in the control room for the bunkering tanks.	PTW and JSA records for bunkering indicate that spill considerations were taken into account. A completed pre-refuelling checklist confirms that dry-break refuelling hose couplings and hose floats are installed on the refuelling hose assembly. PTW indicates that communications were tested between both vessels. Hose register and CMMS indicates regular replacement of fuel hoses. Visual inspection (as noted in completed bunkering checklist) verifies that bunkering was supervised. A completed pre-refuelling checklist confirms that bunkering commenced in daylight hours and in calm sea conditions. A completed pre-refuelling checklist confirms that the tank level alarms are functional.

No MDO is spilled at sea as a result of vessel-to-vessel collision.	In order to minimise the risk of vessel-to-vessel collisions, vessels contracted to work on BassGas activities:
	• Comply with the requirements of:
	  ○ *Navigation Act* 2012 (Cth), Chapter 3, Part 3 (Seaworthiness of vessels).
	  ○ Marine Order 21 (Safety and emergency arrangements).
	  ○ Marine Order 30 (Prevention of Collisions).
	  ○ Marine Order 31 (SOLAS and non-SOLAS certification).
	  ○ Marine Order 91 (Marine pollution prevention - oil).
	• Operate navigational lights and communication systems.
		Vessel audit/assurance reports (prepared or commissioned by Beach) verify that vessels contracted to Beach meet legislative safety requirements.

	• Maintain navigational lights and communication systems in accordance with their PMS. • Have trained and competent crew maintaining 24-hour visual, radar and radio watch for other vessels.	
	For vessels undertaking work along the pipeline, AMSA and DJPR (EMD) are notified within two weeks of the commencement of the activity so that Notices to Mariners can be generated.	Notice/s to Mariners are available for pipeline-related inspection and maintenance activities.
	BassGas notifies relevant stakeholders ahead of major vessel-based inspection and maintenance campaigns so that third-party marine users are aware of vessel location and timing.	Stakeholder correspondence and the stakeholder register verify that Beach made contact with relevant stakeholders about the timing and location of pipeline-related vessel activities.
No MDO is spilled at sea as a result of vessel-to-platform collision.	The 3-km-radius cautionary zone is monitored by the platform using AIS. Radio contact is made with vessels breaching the cautionary zone.	The communications diary, daily log and CMO records verify that contact was made with vessels breaching the cautionary zone.
		The CMO incident register includes breaches of the cautionary zone.
	The Yolla-A PIC must grant permission for all vessels to enter the 500-m radius PSZ in accordance with the Field Support Vessel Operations Procedure (CDN/ID 3974221).	The communications diary verifies permission is granted for vessels entering the PSZ.
		The CMO incident register includes breaches of the PSZ entry protocol.
Platform and vessel crews are prepared to respond to a spill.	The platform and support vessels have approved SMPEPs (or equivalent appropriate to class) that is implemented in the event of a large MDO spill.	Current SMPEPs are available
		Spill incident report verifies that the actions were taken in accordance with the SMPEP.
	Platform and support vessel crews are trained in spill response techniques in accordance with their SMPEP.	Training records verify that crews are trained in spill response.
	In accordance with the SMPEP, oil spill response kits are available in relevant locations around the platform, are fully stocked and are used in the event of hydrocarbon or chemical spills to deck.	Inspection/audit confirms that SMPEP kits are readily available on deck.
		Incident reports for hydrocarbon spills to deck record that the spill is cleaned up using SMPEP resources.
	Desktop oil spill response exercises are conducted to test the interfaces between the oil spill response strategies and the Beach BassGas OPEP and ERP.	Oil spill response exercise spreadsheet verifies that exercises have been undertaken.
Emergency response		
Platform and vessel crews promptly respond to a spill.	An OPEP and ERP are in place and tested annually in desktop exercises by those nominated in the plans to be part of the response strategies.	The OPEP and ERP are current.
		OPEP and ERP training schedule is available and remains live.
		The training matrix is maintained as a live document and verifies that personnel

		nominated to assist in emergency response are up to date with their training.
		OPEP and ERP exercise reports verify that exercises have been undertaken.
	The Vessel Master will authorise actions in accordance with the vessel-specific SMPEP (or equivalent according to class) in order to stop or reduce the flow of MDO to the sea.	Daily operations reports verify that the SMPEP was implemented.
	The BassGas OPEP is implemented to limit the release of a Level 2 or 3 MDO spill.	Daily operations reports verify that the OPEP was implemented.
Recording and reporting		
Beach and regulatory authorities are promptly made of aware of near-misses and spills.	All incidents of spatial conflict with other marine users will be reported in the Beach incident register (CMO).	The CMO is current.
	Beach will report the spill to regulatory authorities within 2 hours of the spill or becoming aware of the spill.	Incident report verifies that contact with regulatory agencies was made within 2 hours.
Monitoring		
Characterise environmental impacts of a Level 2 or 3 spill.	Beach will undertake operational and scientific monitoring in accordance with the OSMP.	Daily operations reports and overall study reports verify that the OSMP was implemented.

Risk Assessment (residual)			
Receptor	Consequence	Likelihood	Risk rating
Benthic fauna	Minor	Remote	Low
Macroalgal communities	Minor	Remote	Low
Plankton	Minor	Remote	Low
Pelagic fish	Minor	Remote	Low
Cetaceans	Minor	Remote	Low
Pinnipeds	Minor	Remote	Low
Marine reptiles	Minor	Remote	Low
Seabirds	Minor	Remote	Low
Shorebirds	Moderate	Remote	Low
Sandy beaches	Minor	Remote	Low
Commercial fisheries	Minor	Remote	Low
Public amenity (beaches, recreational fishing)	Serious	Remote	Low
Desalination plant	Serious	Remote	Low
Demonstration of ALARP			

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required. However, because this hazard has a Decision Context of 'B', an ALARP analysis is presented below.

Good practice	
Avoid/Eliminate	Vessels are needed to support the platform operations and undertaken inspection and maintenance activities, so the use of vessels cannot be avoided. The use of MDO for vessels cannot be eliminated. Substituting MDO for the use of another fuel, such as heavy fuel oil, would have a higher environmental impact than MDO if spilled.
Change the likelihood	The Yolla-A PIC controls access into the PSZ, including approach directions and speed. This reduces the likelihood of a vessel-to-platform collision and the consequence.
Change the consequence	Other measures in place to reduce the likelihood and consequence of an MDO spill are that vessels are equipped with navigation aids, are equipped with dynamic positioning and are manned by qualified and experienced personnel.
Reduce the risk	Vessel specific SMPEPs are in place and are implemented. The BassGas ERP and OPEP are implemented in the event of a Level 2 or 3 spill.

Engineering risk assessment

The OSTM undertaken for the MDO release scenario is an engineering risk assessment that supports the consequence evaluation, spill response planning and development of the EPS listed in this table. Engineering controls that have been considered to reduce the risk of an MDO spill but not adopted are outlined below.

Control	Control type	Analysis
Eliminate or substitute the use of MDO in vessels.	Eliminate	The use of MDO as vessel fuel cannot be eliminated. Substituting MDO for the use of another fuel, such as heavy fuel oil, would have a higher environmental impact than MDO if spilled.
Use smaller PSVs or ISVs.	Equipment	The market for vessels in Victoria that are suitable for use as PSVs or ISVs is limited. The vessels must meet certain technical requirements that make them suitable for working alongside platforms and over pipelines. Beach is limited to selecting vessels
Standby vessel to monitor the 3-km radius cautionary zone and 500-m radius PSZ.	System	The platform has AIS and is able to detect third-party vessels that are on a collision course with it. There have been no near misses to date with regards to third-party vessels entering the cautionary zone or PSZ. The significant cost in retaining a standby vessel to guard these zones (in the order of hundreds of thousands of dollars per week) is disproportionate to the environmental risk.
Replace MDO bunkering (via hose from PSV to platform) with transfers via drums/containers.	Equipment, System	While this measure would remove the risk of a fuel spill via hose, the risk of spills through dropped objects would replace it. The time taken to transfer the necessary volumes of fuel using this method (compared to the hose transfer method) has more health and safety risks associated with it, given that the longer the PSV remains on location close to the platform, the greater the probability of an incident occuring. The increased number of crane movements to transfer fuel by container results in a higher likelihood of dropped objects occurring.
Keep on-water spill response equipment (beyond SOPEP requirements) available on the PSVs/ISVs and Yolla-A	Equipment	This option may allow for more rapid on-water response in the event of an MDO spill. There is very limited space available on Yolla-A and most vessels to store the necessary on-water equipment such as booms and skimmers. There are also significant costs (purchase, maintenance and training) for this equipment for both Beach and contracted vessel operators. This option does not guarantee a faster oil spill response because it is unlikely that platform- or vessel-based personnel will have the same level of on-water oil spill response training as Beach, AMOSC and AMSA-trained personnel. Without this training, they are more likely to put themselves and

		others in harm's way and may not respond to the spill itself in the most environmentally appropriate manner. These specialist tasks are best left to trained personnel.
Require all PSVs and ISVs to be double-hulled.	Equipment	This option would reduce the risk of fuel loss in the event of a minor collision that breached the outer hull but not the inner hull. Vessels are subject to availability and are required to meet Beach standards prior to contract; requirement of a double hull on vessels would limit the number of vessels available and requiring vessels to be retrofitted with double hulls would be prohibitively expensive for the vessel contractors. This measure is grossly disproportionate to the low risk of an MDO spill.
Cost benefit analysis		
Incorporated into the engineering risk assessment above.		

Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. The only stakeholder to raise concerns about an MDO spill was WaterSure (operator of the Victorian desalination plant). A meeting between Beach and WaterSure was held to discuss these concerns. Subsequent to the meeting, WaterSure was satisfied that the risk of an MDO spill are remote, and that risks of a spill on their infrastructure and services could be effectively managed.	

Legislative context	The performance standards outlined in this EP align with the requirements of:
	• *Navigation Act* 2012 (Cth):
	  ○ Chapter 4 (Prevention of Pollution).
	• OPGGS Act 2006 (Cth):
	  ○ Section 572A-F (Polluter pays for escape of petroleum).
	• OPGGS(E):
	  ○ Part 3 (Incidents, reports and records).
	• OPGGS Regulations:
	  ○ Part 2.3 (Notifying reportable incidents).
	• *Protection of the Sea (Prevention of Pollution by Ships) Act* 1983 (Cth):
	  ○ Section 11A (SOPEP).
	• POWBONS Act 1986 (Vic):
	  ○ Section 10 (Duty to report certain incidents involving oil and oily mixtures).	

Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Refuelling and bunkering – refuelling to be undertaken by trained personnel using defined procedures and during daylight hours in calm seas, transfer hose integrity is regularly inspected, tank levels are continuously monitored to prevent overflow, dry break or breakaway couplings are used, all vessels have a SOPEP in place.

	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	No guidance is provided regarding preventing or managing an offshore MDO spill, other than having a spill contingency plan in place. An OPEP is in place for BassGas operations.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Section 75 (Spills): Conducting a spill risk assessment, implementing personnel training and field exercises, ensuring spill response equipment is available. • Sections 76-79 (Spill response planning): A spill response plan should be prepared.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives: • To reduce the risk of any unplanned release of material into the marine environment to ALARP and an acceptable level.
Environmental context	MNES	
	AMPs (Section 5.4.1)	There is a 1% probability of low exposure entrained MDO intersecting the Apollo AMP, and a 17% probability of low exposure entrained MDO intersecting the Beagle AMP. At this exposure concentration, the values of these AMPs will not be affected in the long-term. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	There is a 5% probability of low exposure entrained MDO intersecting small portions of the Western Port Ramsar site and 10% probability of low exposure entrained MDO with the Corner Inlet Ramsar site. At this exposure concentration, the values of these wetlands will not be affected in the long-term.
	TECs (Section 5.4.5)	The MDO EMBA does not intersect any TECs. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	The MDO EMBA (entrained phase hydrocarbons) is predicted to intersect the Anderson Inlet NIW. Low threshold entrained hydrocarbons are not predicted to have toxicological impacts on the waterbird species that use this habitat.
	Nationally threatened and migratory species (Section 5.5)	Some nationally threatened species and migratory species have the potential to be present in the MDO spill EMBA, particularly within their BIAs, but as evaluated in the previous tables in this section, the risks to individuals or populations of threatened and migratory species are mostly low.
	Other matters	
	State marine parks (Section 5.4.9)	The MDO EMBA intersects the following state marine parks: • Bunurong MP/MNP; • Wilsons Promontory MP/MNP. • Cape Howe MNP; • Churchill Island MNP; • Point Hicks MNP;

		• Corner Inlet MCP; and • Shallow Inlet MCP. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified for albatross and giant-petrels in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The conservation advice and management plans for blue, humpback, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring

- As per the OPEP and OSMP.

Record Keeping

Platform	Vessels
• BassGas bunkering procedure. • Bunker log. • Bunkering PTWs/JSAs. • Completed bunkering checklists. • Hose register. • CMMS records. • BassGas Workforce Capability Requirements Matrix. • Training records. • Navigation Chart. • Communications diary. • CMO incident register. • BassGas OPEP. • Beach ERP.	• Vessel assurance reports. • Notices to Mariners. • Stakeholder consultation correspondence and register. • SMPEPs. • OPEP. • ERP. • Crew training records. • Bunkering procedure. • Bunkering PTWs, JSAs, inspection checklists. • Oil spill response exercise records. • Inspection/audit reports. • Incident reports.

7.18 RISK 8 - Hydrocarbon Spill Response Activities (other than relief well drilling)

This section assesses the environmental and socio-economic risks associated with the hydrocarbon spill response strategies outlined in the OPEP. Not all oil spill response options are appropriate for every spill type – responses vary based on key factors such as hydrocarbon type (light oil, heavy oil, refined oil), volume, location, sea state and trajectory.

Table 7.86 summarises the feasibility and effectiveness of the strategies available to respond to Level 2 and 3 Yolla condensate and MDO spills, and whether they will be adopted. Only those that will be adopted are risk assessed in this section.

The risk assessment for drilling a relief well is provided in Section 7.19, as this requires more detail than other oil spill response strategies.

Table 7.86. BassGas operations hydrocarbon spill response options

Response option	Feasibility and effectiveness analysis	Implement?
Condensate		
Source control (see Section 7.19)	**Effective.** This is the preferred manner to control a hydrocarbon release. **Feasible.** The following plans will be enacted: • Pipeline – shut down of production from Yolla-A, LLGP or valve at the shore crossing. • Production wells – implementation of the RWP. A surface or subsea well cap is not a feasible response option for BassGas (as described in Section 3.9.2).	Yes
Monitor and Evaluate	**Effective.** Condensate evaporates and disperses rapidly. Monitoring is a fundamental part of any hydrocarbon spill response to gain situational awareness of the nature and scale of the spill and the direction of movement. This includes monitoring along the shoreline by foot. **Feasible.** Condensate will be visible on the sea surface using satellite monitoring, vessel and aerial based observations and observations from the shoreline. Trained personnel within the industry are readily available to undertake this monitoring.	Yes
Assisted Natural Dispersion	**Effective.** Mechanical dispersion could be undertaken in slightly weathered condensate once the volatiles have flashed off to disperse the condensate into the water column to create smaller droplets and enhance biodegradation (only if monitoring indicates the slick is moving to sensitive shorelines). **Feasible.** The use of motorised vessels to break up slicks using propeller wash creates an inherent safety risk because of the presence of an ignition source (condensate is highly volatile). Vessels of opportunity (VoO) are available to Beach to undertake this activity if deemed safe and effective under the conditions at the time.	Possible, but unlikely
Chemical Dispersants	**Not effective.** Not recommended for Group I oils such as condensate due to its very low viscosity (i.e., easy spreading) and high volatility (i.e., it evaporates rapidly). **Not feasible.** Dispersant use will have a net negative effect on the environment. Dispersants push the hydrocarbons into the water column, creating longer lasting impacts in the water column than allowing the condensate to weather naturally from the sea surface.	No
Offshore Containment and Recovery (e.g., booms and skimmers)	**Low effectiveness.** The high volatility of condensate creates inherent safety risks when attempting to contain and recover it mechanically. Due to the low viscosity of gas condensate, the ability to contain and recover it is extremely limited. Condensate evaporates faster than the collection rate of a thin surface film present. It spreads in less time than equipment could be deployed to contain it. **Not feasible.** This response technique is dependent on adequate hydrocarbon thickness (generally >10 g/m^2), calm seas and significant areas of unbroken surface slicks. There is no recoverable condensate (>10 g/m^2) at the sea surface for a LoWC scenario, and a very limited area under the pipeline rupture scenario. The condensate would weather in less time than it would take to deploy response equipment.	No

Response option	Feasibility and effectiveness analysis	Implement?
Protection and Deflection	**Low effectiveness.** The high volatility of condensate creates inherent safety risks when attempting to use protection and deflection booms. Oceanic environments such as Bass Strait often do not present suitable conditions for the use of booming material (i.e., swell and waves deem this strategy ineffective). **Potentially feasible.** The OSTM for a LoWC indicates no shoreline contact and therefore no shorelines to protect. The OSTM for a LoC from the pipeline indicates that there would be a maximum shoreline loading of 21 m^3 of condensate. Prevailing south-westerly winds would push deflected condensate to other sandy beaches along the Bass coastline (albeit more weathered [and thus less toxic] by the time it reached those shorelines), including to populated areas such as Inverloch. The resources available to Beach to implement a shoreline clean-up strategy are available (through AMOSC).	Possible, but unlikely
Shoreline Clean-up	**Low effectiveness.** Condensate is highly volatile and will evaporate rapidly even after making shoreline contact. Condensate also quickly infiltrates sand, where it is then remobilised by wave action (reworking) until it has naturally degraded. This quick infiltration through sediments makes it very difficult to recover without also recovering vast amounts of shoreline sediments. **Low feasibility.** The OSTM for a LoWC indicates no shoreline contact and therefore no shorelines to protect. Based up a clean-up rate of 1 m^3 per day per person, a single clean-up team (10 persons) could clean 10 m^3/day. Based on a waste generation (bulking) factor of 10:1, waste clean-up and recovery could take up to 1 month for a team of 10 people. This assumes that all 21 m^3 of stranded hydrocarbon is both accessible and retrievable (which it would not be). Given the volume of clean sand likely to be retrieved in the clean-up process, this response may create more environmental damage than the spill itself.. The resources available to Beach to implement a shoreline clean-up strategy are available (through AMOSC, especially core group responders). However, environmental impacts to the shoreline are likely to be higher when implementing this response technique compared to the natural degradation.	Possible, but unlikely
Oiled Wildlife Response (OWR)	**Low effectiveness.** Because gas condensate evaporates and disperses rapidly, most fauna is unlikely to be exposed to sub-lethal or lethal hydrocarbon concentrations that warrant wildlife capture and treatment, especially at the sea surface. **Feasible.** The limited length of shoreline potentially affected by a pipeline LoC and the close proximity of the Phillip Island wildlife rescue centre to the affected shoreline makes an OWR response feasible. However, more wildlife harm could occur (during the handling and treatment process) using this response technique compared to allowing for natural cleaning (especially given the light nature of the condensate). Hazing may be considered to disperse animals away from a slick (such as seabirds, shorebird, seals and dolphins) or any shoreline areas where condensate has not infiltrated beach sediments. Only DELWP officers (or those authorised by DELWP) are permitted to handle and treat oiled wildlife under the Victorian Wildlife Response Plan for Marine Pollution Emergencies (meaning AMOSC responders are unlikely to be able to do so, despite the available of OWR kits). This may limit the effectiveness and feasibility of this response in terms of the number of responders and therefore the number of affected fauna that could be treated.	Possible, but unlikely

Response option	Feasibility and effectiveness analysis	Implement?
MDO		
Source control	**Effective.** This is the preferred manner to control a hydrocarbon release (e.g., transferring fuel from the rupture tank to an intact tank). **Feasible.** The vessel-specific SMPEP will be implemented to minimise the volume of MDO released.	Yes
Monitor and Evaluate	As per condensate. **Effective. Feasible.**	Yes
Assisted Natural Dispersion	As per condensate. **Effective. Feasible.**	Possible, but unlikely
Chemical Dispersants	**Not effective.** Although the use of dispersants is 'conditional' for Group II oil such as MDO, the potential spill volume and the natural tendency of spreading into very thin films is evidence that dispersant application will be an ineffective response. Dispersant droplets will penetrate through the thin oil layer and cause 'herding' of the oil, which creates areas of clear water and could be mistaken for successful dispersion. **Not feasible.** Dispersant use will have a net negative effect on the environment. Dispersants push the hydrocarbons into the water column, creating longer lasting impacts in the water column than allowing the MDO to weather naturally from the sea surface.	No
Offshore Containment and Recovery (e.g., booms and skimmers)	**Low effectiveness.** This response technique is dependent on adequate hydrocarbon thickness (generally >10 g/m^2), calm seas and significant areas of unbroken surface slicks. There is a small area of recoverable MDO (>10 g/m^2) at the sea surface. **Not feasible.** The MDO is likely to weather in less time than it would take to deploy response equipment. This method creates significant waste volumes, requires calm water conditions (rare in Bass Strait) and generally recovers only 10-15% of total spill residues.	No
Protection and Deflection	**Low effectiveness.** The OSTM for an MDO spill close to shore indicate that there could be a maximum shoreline loading of 172 m^3 of MDO. The MDO is likely to reach the shoreline and percolate through shoreline sediments before response equipment can be deployed. **Potentially feasible.** Oceanic environments such as Bass Strait often do not present suitable conditions (i.e., swell and waves deem this strategy ineffective) for the efficient use of booming material (such as absorbent, zoom boom and beach guardian). Prevailing south-westerly winds would push deflected MDO to other sandy beaches along the Bass coastline (albeit more weathered [and thus less toxic] by the time it reached those shorelines), including to populated areas such as Inverloch. There are no less sensitive areas (e.g., rocky shorelines) that the MDO could be deflected to. The resources available to Beach to implement a protection and deflection strategy are available (through AMOSC). However, this response may create more environmental damage than the spill itself.	Possible, but unlikely
Shoreline Clean-up	**Low effectiveness.** The OSTM for an MDO release close to the shoreline indicates a maximum shoreline loading of 172 m^3. MDO quickly infiltrates sand, where it is then remobilised by wave action (reworking) until it has naturally degraded. This quick infiltration through sediments makes it very difficult to recover without also recovering vast amounts of shoreline sediments. **Low feasibility.**	Possible, but unlikely

Response option	Feasibility and effectiveness analysis	Implement?
	The resources available to Beach to implement a shoreline clean-up strategy are available (through AMOSC). Based up a clean-up rate of 1 m^3 per day per person, a single clean-up team (10 persons) could clean 10 m^3/day. Based on a waste generation (bulking) factor of 10:1, waste clean-up and recovery could take up to 170 days (6 months) for a team of 10 people. This assumes that all stranded MDO is both accessible and retrievable (which it would not be). Given the volume of clean sand likely to be retrieved in the clean-up process, this response may create more environmental damage than the spill itself.	
OWR	**Effective.** There is potential for marine fauna to be oiled in areas of moderate to high sea surface MDO exposure or along the coastline (with up to 11 km of shoreline affected). **Feasible.** The close proximity of the Phillip Island wildlife rescue centre to the affected shoreline makes an OWR response feasible. However, more wildlife harm could occur (during the handling and treatment process) using this response technique compared to allowing for natural cleaning. Hazing may be considered to disperse animals away from a slick (such as seabirds, shorebird, seals and dolphins) or any shoreline areas where MDO has not infiltrated beach sediments. Only DELWP officers (or those authorised by DELWP) are permitted to handle and treat oiled wildlife under the Victorian Wildlife Response Plan for Marine Pollution Emergencies (meaning AMOSC responders may not be able to do so, despite the availability of OWR kits). This may limit the effectiveness and feasibility of this response in terms of the number of responders and therefore the number of affected fauna that could be treated.	Possible, but unlikely

Table 7.86 indicates that only the following responses may be used to respond to a hydrocarbon spill:

- Source control (see Section 7.19 for relief well drilling);
- Monitor and evaluate;
- Assisted natural dispersion;
- Protection and deflection;
- Shoreline clean-up; and
- OWR.

7.18.1 Scope of Activity

Source Control

In the event of a vessel-based MDO release, the key method of source control is outlined in the vessel-specific SMPEP (or equivalent based on class). The key response measures typically involve:

- Moving further out to sea (away from shoreline sensitivities) if the vessel is still able to navigate; and
- Transferring MDO from the affected tank/s to non-affected tanks.

Monitor and Evaluate

Ongoing monitoring and evaluation of a hydrocarbon spill is critical for maintaining situational awareness and to complement and support the other response activities. In some situations, monitoring may be the primary response strategy if natural dispersion and weathering processes are effective in reducing the volume of hydrocarbons reaching sensitive receptors (as is likely to be the case in the BassGas hydrocarbon release scenarios).

Operational monitoring includes the following:

- Aerial observation (primarily by helicopter);
- Vessel-based observation;
- OSTM (computer-based and/or manual vector analysis); and
- Foot access along shorelines potentially at risk of contact (based on real-time OSTM).

Assisted Natural Dispersion

Assisted natural dispersion involves the use of motorised vessels to break up hydrocarbon slicks using propeller wash; essentially navigating a vessel in whatever pattern maximises travel through the slick to create smaller droplets and enhance biodegradation in the water column.

This activity is generally only necessary if monitoring indicates the slick is moving to sensitive shorelines.

Protection and Deflection

Protection and deflection involves deploying boom to protect coastal sensitivities from the impacts of hydrocarbons. This response will be activated onshore and in nearshore waters if monitoring identifies that coastal areas of high or moderate sensitivity are likely to be contacted.

In brief:

- Deflection booming – is deployed to deflect/divert the oil to a suitable collection point on the shoreline or at sea (generally to a less sensitive area than the receptor being protected) for subsequent removal.
- Protection booming – is deployed to hold the oil back away from environmental or socio-economic sensitivities (e.g., river mouths, shorebird nesting sites, seal haul-out sites).

Various anchoring methods are required depending on the type of boom and its location. For example, when used on the shoreline itself, boom skirts are replaced with water-filled chambers designed to allow the boom to settle on an exposed shoreline at low tide.

In general, booming techniques are only suitable in calm, low-energy environments.

Shoreline Clean-up

A clean-up response will be preceded by a shoreline clean-up assessment techniques (SCAT) survey. NOAA (2010) describes this process as the systematic approach to collecting data on shoreline oiling conditions using the following steps:

- Conduct reconnaissance survey;
- Segment the shore;
- Assign teams and conduct shoreline surveys;
- Develop clean-up guidelines and endpoints;
- Submit reports and sketches to Planning Section (of the IMT);
- Monitor effectiveness of clean-up;
- Conduct post-clean-up inspections; and
- Do final evaluation of clean-up activities.

A trained SCAT team will be deployed by the Planning Section of the IMT at the time of shoreline stranding (informed by monitoring) to provide feedback on best methods for clean-up.

Shoreline clean-up consists of different manual and mechanical recovery techniques to remove oil and contaminated debris from the shoreline to reduce ongoing environmental contamination and impact. It may include the following techniques:

- Natural recovery – allowing the shoreline to self-clean (no intervention undertaken);
- Manual collection of oil and debris – the use of people power to collect oil from the shoreline;
- Mechanical collection – use of machinery to collect and remove stranded oil and contaminated material;
- Sorbents – use of sorbent padding to absorb oil;
- Vacuum recovery, flushing, washing – the use of high volumes of low-pressure water, pumping and/or vacuuming to remove floating oil accumulated at the shoreline;
- Sediment reworking – move sediment to the surf to allow oil to be removed from the sediment and move sand by heavy machinery;
- Vegetation cutting – removing oiled vegetation; and
- Cleaning agents – application of chemicals such as dispersants to remove oil.

OWR

OWR may form a key component of the response to an MDO release (less so for a condensate release), both at sea (especially nearshore) and at the shoreline because of the known presence of seabirds (e.g., albatross and petrels) and nesting shorebirds (e.g., fairy terns, hooded plovers and little penguins).

Broadly, oiled wildlife response involves the following three-tiered approach:

1. Primary response – involves undertaking surveillance to determine the location and extent of wildlife injuries or death, and deflecting oil away from areas of high sensitivity where practicable.
2. Secondary response – involves deterring or displacement strategies, by hazing (scaring animals through auditory bird scarers, visual flags or balloons, barricade fences, or pre-emptive capture).
3. Tertiary response – involves capture and stabilisation of oiled wildlife (on vessels or the beach), transport to treatment facilities, treatment of affected animals and rehabilitation and release of affected animals.

OWR equipment owned and maintained by AMOSC, DELWP and AMSA is available at various locations along the Victorian coastline, and can be deployed to affected areas on an as-required basis (as units transportable by road or air). These will be called on through the SMEP, NatPlan (and AMOSPlan, if required), with DELWP taking the lead in any activities involving OWR with support from other agencies as requested.

7.18.2 Capability Assessment

Monitor and Evaluate

Beach (through its membership with AMOSC) and the DJPR (Emergency Management Branch, EMB) maintain operational monitoring capability as outlined in Table 7.79. The deterministic OSTM results indicate that the largest swept areas of visible oil for each spill scenario are 5 km (pipeline rupture), 13 km (MDO release) and 16.5 km (for LoWC). These are small areas to cover by vessel or aircraft. Given these small areas of exposure, the resources listed in Table 7.79 are deemed to be adequate for monitoring purposes.

Beach acknowledges that are likely to be multiple vessels on the water in and around the source of a spill that are assisting with source control or evacuating personnel to safety and are therefore not able to be dedicated to undertake spill monitoring and evaluation duties. However, in the event of a well blowout, few vessels are likely to be required until a MODU is mobilised to location (given that well capping [with its associated vessel requirements] is not a feasible option for well control). Similarly, few vessels are required to begin repairs on a pipeline rupture, so both condensate spill scenarios are unlikely to deplete the pool of vessels of opportunity (VoO) available from nearby ports.

Beach is confident that the vessel resources outlined in Table 7.87 will be sufficient, especially in light of the fact that aerial surveillance is the most efficient means for monitoring a spill on the sea surface. , and that this may affect

Table 7.87. Resources available for monitoring and evaluation

Resource required	Beach resources	DJPR (EMB) resources
Aviation	Beach will activate its contract with AMOSC to access helicopter and/or fixed aircraft to assist in spill monitoring. Beach can also request its helicopter contractor (used for routine personnel transfers to and from Yolla-A) to assist with aerial observation duties.	Access to Emergency Management Victoria's (EMV's) State Aircraft Unit. Air support can be mobilised within 4 hours of request. Additionally, NatPlan resources can be activated.
Trained observers	Beach can request the assistance of AMOSC's Core Group personnel (>120 oil and gas industry personnel nation-wide) who are available 24/7 to respond to marine oil spills.	EMV's State Response Team (SRT) or AMSA Search and Rescue resources can be called upon, but is unlikely to be required given the AMOSC resources available. These resources are available within 4 hours of request. The SRT has 10 State Emergency Service (SES) volunteers and one DEDJTR staff member that are trained in oil on water observation.
Vessel-based observations	Beach can access its PSV to assist in undertaking vessel-based observations. It can also request the PSV contractor to assist in sourcing additional vessels, should they be required. Beach can also use its vessel broker to assist in rapidly sourcing additional VoO. Independently of the PSV contractor, VoO based in ports nearest to the BassGas infrastructure, such as San Remo and Queenscliff would be engaged directly by Beach as required. VoO from ports slightly further afield, such as Geelong, Barry Beach (in Corner Inlet) and Lakes Entrance would also be considered.	
OSTM	Beach will activate its contract with AMOSC to access 24/7 emergency OSTM. OSTM results can generally be provided within 4 hours of request.	Available via AMSA upon request, who are likely to contract RPS.

Assisted Natural Dispersion

The PSV and VoO outlined under 'monitor and evaluate' would be used to implement assisted natural dispersion.

Protection and Deflection

The low effectiveness of this response option makes it unlikely that this equipment would be deployed. However, should an operational NEBA determine that this response is suitable, AMOSC has significant quantities of protection and deflection booming at its Corio headquarters, along with the vessels and personnel (up to 120 core group personnel) to deploy it.

Shoreline Clean-up

The low effectiveness and low feasibility of this response option makes it unlikely that shoreline clean-up equipment would be deployed. However, should an operational NEBA determine that this response is suitable due to the extent and/or volume of shoreline loading, AMOSC has significant quantities of shoreline clean-up equipment available at its Corio headquarters, along with access to highly trained Core Group personnel (up to 120 people) that Beach can access. Beach can also call on EMB to assist with shoreline clean-up.

For a vessel-based spill, AMSA's NatPlan resources can be called upon to assist with providing personnel and equipment (with equipment located in Melbourne and co-located at AMOSC's facility in Geelong).

The small volume of hydrocarbons predicted to strand ashore (maximum of 21 m^3 for the pipeline rupture scenario and 172 m^3 for the MDO release) and short length of coastline subject to stranding (maximum of 5 km for the pipeline rupture scenario and 11 km for the MDO release), combined with their weathered nature, means that the resources available to Beach are sufficient if this response is activated.

OWR

DELWP is the responsible agency for responding to wildlife affected by a marine pollution incident in the Victorian jurisdiction. DELWP manages the rescue and rehabilitation with assistance from Parks Victoria (a DELWP agency) and Phillip Island Nature Park. DELWP's wildlife response is undertaken in accordance with the Wildlife Response Plan (a sub-plan of the Maritime Emergencies NSR Plan (EMV, 2016)) by trained DELWP officers. The resources available for OWR are outlined in Table 7.88.

DELWP resources include OWR kits stored at Lakes Entrance and Port Welshpool (with additional resources at Long Island Point, Melbourne, Geelong, Warrnambool and Portland). If the NatPlan is activated, additional AMSA and AMOSC resources can be sourced from Geelong and Melbourne.

The Tasmanian DPIPWE (Resource Management and Conservation Division) is responsible for OWR in Tasmanian state waters and Tasmanian shorelines (many of the small islands in the EMBA are within the Tasmanian jurisdiction). Tasmanian OWR is undertaken in accordance with the Tasmanian Oiled Wildlife Response Plan ('WildPlan') (DPIW, 2006). In the event that condensate reaches Tasmanian islands, it is unlikely to require an active OWR other than monitoring and evaluation (due to the highly weathered nature of the hydrocarbon and unsafe shorelines [rocky, steep, strong wave action]).

Based on the maximum swept areas of sea surface and maximum shoreline lengths (and loadings) listed previously, and the very small areas of shoreline exposure to hydrocarbons at high thresholds (no exposure for the pipeline rupture scenario and 4 km of shoreline for the MDO release), Beach assesses that the OWR resources available are sufficient if this response is activated.

Table 7.88. Resources available for OWR

Resource	Availability	Provider
Specialist OWR capability	Wildlife Response Commander.	DELWP
OWR team supervisor	One per team.	DELWP
OWR personnel	Trained group of first response personnel.	DELWP
	Volunteers (working under direction of DELWP).	Beach
	Core group responders (working under direction of DELWP).	AMOSC
OWR kit	Bairnsdale, Port Phillip, Colac, and Warrnambool with one kit each, and one State-wide trailer.	DELWP (~50 units per day)
	Geelong (2 kits).	AMOSC (~100 units per day)

7.18.3 Hazards

The hazards associated with each of these response options are:

- Additional vessel activity (over a greater area than the operational area), resulting in additional routine emissions (air, noise) and routine discharges (sewage, putrescible waste, cooling water, etc);
- Sound generated by helicopters; and

- Hazing of target fauna may deter non-target species from their normal activities (e.g., resting, feeding, breeding);
- Distress, injury or death of target fauna from inappropriate handling and treatment;
- Euthanasia of target individual animals that cannot be treated or have no prospects of rehabilitation; and
- Damage to shoreline areas from the establishment of OWR response centres.

7.18.4 Impacts and Risks of the Response Activities

The impacts and risks associated with these response options are:

- Routine and non-routine impacts and risks associated with vessel operations (as outlined throughout this chapter) and drilling operations (as outlined in Beach's Otway Development Drilling and Well Abandonment EP, Rev 0, 29 August 2019, CDN/ID S4100AH717905);
- Noise disturbance to marine fauna and shoreline species by aerial flights;
- Damage to foreshore environments from foot access;
- Temporary exclusion of the public from beaches; and
- Disturbance, injury or death of target or non-target wildlife.

7.18.5 Evaluation of Environmental Impacts and Risks

Monitor and Evaluate

The impacts and risks associated with routine and non-routine vessel and helicopter activities are described and assessed throughout this chapter and are not repeated here. Foot access to beaches is not addressed in the EP and is therefore evaluated below.

Damage to shoreline habitat (such as sand dunes providing shorebird nesting habitat) may be caused if personnel veer from formed tracks. The noise, light and general disturbance created by shoreline monitoring activities (likely to involve foot traffic only, rather than vehicle traffic), may disturb the feeding, breeding, nesting or resting activities of resident and migratory fauna species that may be present. This is particularly the case for beach-nesting shorebirds such as hooded plovers, which are known to occur along the coast of the EMBA. As an example, the eggs of hooded plovers (that nest only on sandy beaches) have small eggs that are very well camouflaged, so they are easily trodden on by accident. If the incubating adult is scared off the nest by passers-by, the eggs may literally bake in the sun, or become too cold in the cool weather. Either way, it kills the chick developing in the egg, and the egg will not hatch. Similarly, when people disturb a chick, it quickly runs into the sand dunes and hides. While it is running, the chick uses up valuable energy, and while it is hiding it is unable to feed (they usually forage at the water's edge), so that a chick that is forced to run and hide throughout the day could easily starve (Birdlife Australia, 2016). Any erosion caused by responder access to sandy beaches, may also bury nests. In isolated instances, this is unlikely to have impacts at the population level.

The presence of stranded hydrocarbons may necessitate temporary beach closures (likely to be in the order of days, depending on the degree of oiling). This means recreational activities (such as swimming, walking, fishing) in affected areas will be excluded until access is again granted by DELWP or the local government authority. Given the prevalence of sandy beaches and the sparse nature and small population of towns along the coastline of the EMBA, the predicted rapid weathering of condensate and MDO on the shoreline, this is likely to represent a minor impact to residents and tourists.

Assisted Natural Dispersion

The impacts and risks associated with routine and non-routine vessel activities are described and assessed throughout this chapter and are not repeated here.

Protection and Deflection Booming

The nature of disturbance to the shoreline from vehicle and foot access (and associated land use activities such as equipment laydown areas, ablution facilities for responders, etc) is dependent on the location and scale of activities in any given area.

Beach will prepare an operational NEBA at the time of a spill if any estuaries in the path of a hydrocarbon spill are open, tailored to the conditions at the time.

The following impacts may eventuate in the event of deploying protection and deflection booming:

- Damage to nearshore habitats (such as seagrass meadows) from inshore shallow draught vessel activities and boom anchoring may temporarily alter the dynamics of local ecosystems. Sandy habitats are generally able to quickly self-repair due to tidal movements that replenish sand.
- Damage to shoreline environments from vehicle and foot access and associated land use may disturb Aboriginal cultural heritage areas (such as shell middens), and temporarily disturb shoreline bird feeding, nesting, roosting or breeding activities, which may in turn impact on local population dynamics. Coastal vegetation disturbed as a result of gaining access to response sites is likely to regenerate once disturbance has ceased (or can be actively revegetated if natural regeneration is not successful). Shoreline access may also result in soil compaction and erosion, which may result in poor vegetation growth or vegetation death.
- As a result of digging trenches along the beach to trap oil, together with vehicle and foot access along the shore, oil may mix deeper into the beach sediments than it would normally. This has the potential to increase the duration of exposure to toxic components of the oil by delaying the natural weathering process, though constant wave action along the exposed coastline encourages rapid weathering.
- Secondary contamination of the shoreline may occur through vehicle, equipment and foot access spreading oil along and immediately behind the shoreline in areas not originally oiled. This exposes more habitat, flora and fauna to oiling than originally impacted by the spill itself, with the associated impacts of smothering (toxicity is unlikely with weathered condensate or MDO), together with potentially creating larger recreational activity exclusion zones.

Shoreline Clean-up

The risks to shorelines from clean-up activities are as described under 'Monitor and Evaluate' with regard to damage to habitats.

The vertical infiltration of oil into shoreline sediments caused by heavy machinery and equipment can expose fauna to oil that would not otherwise have been exposed. This exposes the base of the foodweb to contamination that may bioaccumulate up through the food chain. It also results in the need for the increased removal of contaminated substrate, exacerbating risks such as beach erosion.

The movement of people, vehicles and equipment through sand dunes may disturb cultural heritage artefacts that occur at the surface or are buried. The most likely cultural heritage artefacts to be present are Aboriginal shell middens, especially where freshwater and brackish water sources occur nearby, such as river mouths.

The influx of shoreline clean-up personnel to a given region will place increased demand on the resources of small coastal towns such as Kilcunda, such as accommodation, meals, vehicle hire, fuel, groceries and other day-to-day consumables. In most instances, the increased activity associated with clean-up operations may provide a temporary increase in money being spent in local towns, however sudden influxes of workers to small Australian towns is often fraught with social unrest as the demand for goods and services can negatively impact on the provision of services to residents and tourists. This is likely to be temporary and localised to one or two towns.

OWR

It is preferable to have oil-affected animals that have no prospect of surviving or being successfully rehabilitated and released to the environment humanely euthanised than to allow prolonged suffering. The removal of these individuals from the environment has additional benefits in so far as they are not consumed by predators/ scavengers, avoiding secondary contamination of the food web. There are no species within the EMBA with such a small or geographically-restricted population that the death of a small number of individuals would result in population-wide impacts.

Hazing and exclusion of wildlife from known congregation, resting, feeding, breeding or nesting areas may have a short- or long-term impacts on the survival of that group if cannot access preferred resources. These effects may be experienced by target and non-target species. For example, low helicopter passes flown regularly over an beach to deter coastal birds from feeding in an oil-affected area may deter penguins from leaving their burrows to feed at sea, which may impact on their health.

Onshore, the establishment of OWR centres will preferentially avoid locating infrastructure on or in close proximity to native habitat, thereby avoiding impacts associated with vegetation clearing (such as habitat loss, reduction in local native species diversity and abundance). Facilities such as portable toilets and showers may be established to deal with day-to- day requirements of first responders so wastes are not discharged to the environment. Similarly, facilities will be supplied for the collection and/or treatment of oily water and detergents associated with the treatment of oiled wildlife so these wastes are not inappropriately discharged to the environment. A licensed waste management contractor will coordinate the supply of waste facilities and regular removal of wastes (including animal carcasses) to licensed facilities for disposal and/or treatment.

Untrained resources capturing and handling native fauna may cause distress, injury and death of the fauna. To prevent these impacts, only DELWP-trained oiled wildlife responders will approach and handle fauna. This will eliminate any handling impacts to fauna from untrained personnel and reduce the potential for distress, injury or death of a species.

7.18.6 Environmental Impact and Risk Assessment

Table 7.89 presents the risk assessment for hydrocarbon spill response activities (excluding relief well drilling, which is covered in the next seection).

Table 7.89. Risk assessment for hydrocarbon spill response activities (excluding relief well drilling)

Summary			
Summary of risks	Disturbance to marine and shoreline fauna. Fauna hazing, injury or distress. Damage to shorelines. Disturbance to local residents.		
Extent of risk	Localised (area immediately around vessel or aircraft, or along beaches accessed by personnel monitoring for shoreline impacts).		
Duration of risk	Short-term (days to a week).		
Level of certainty of risk	HIGH – The impacts associated with vessel and drill rig discharges and noise disturbance to fauna from vessels, drill rigs and helicopters are well understood, and controls are documented in legislation.		
Risk decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, some uncertainty, some partner interest, may attract media attention.		
Risk Assessment (inherent)			
Receptor	Consequence	Likelihood	Risk rating
Fauna disturbance	Minor	Possible	Medium

Fauna injury	Minor	Possible	Medium
Fauna death	Minor	Possible	Medium
Shoreline habitat damage	Minor	Possible	Medium

Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Preparedness		
Source control Beach and its vessel contractors are operationally ready to respond to a LoC.	Vessels contracted to BassGas activities have a current SMPEP (or as appropriate to class) in place.	Inspection/audit records verify current SMPEPs in place.
Monitor and evaluate, protection and deflection, shoreline clean-up Beach maintains capability to implement hydrocarbon spill monitoring and response in a Level 2 or 3 spill event.	Access to operational response capabilities is maintained through a current contract with AMOSC.	Contract with AMOSC is available and current.
	A tactical response plan (TRP) will be prepared by mid-2021 for the most at-risk section of coastline from a hydrocarbon spill (San Remo to Cape Paterson).	The TRP is available.
	A register of equipment and services providers is readily available.	Register is available and current.
	Access to <u>vessel</u> monitoring capabilities is maintained through contracts with the PSV contractor and VoO.	Contracts with the PSV contractor and VoO are available and current.
	Access to <u>aerial</u> monitoring capabilities is maintained through the contract with the helicopter provider (Bristow), who can quickly deploy helicopters for monitoring purposes.	Contract with Bristow is available and current.
	Access (24/7) to <u>OSTM</u> capabilities is maintained through a contract with RPS.	Contract with RPS is available and current.
	A monthly review is undertaken of the Beach operational and scientific monitoring capabilities to ensure that the Offshore Victoria OSMP can be effectively implemented.	Monthly OSMP readiness review reports are available.
	AMOSC undertakes regular testing of response arrangements and equipment to ensure it is always ready to respond rapidly.	Beach records verify that AMOSC response capabilities are maintained in a manner that permits them to respond to spills rapidly.
	Beach undertakes annual desktop drills in accordance with the BassGas Offshore Operations OPEP to test internal and external spill response capabilities.	Exercise drill reports are available verifying that response capabilities are maintained.
	Vessels contracted to BassGas activities have a current SMPEP (or as appropriate to class) in place.	Inspection/audit records verify current SMPEPs in place.
Response		
Source control The source of the release is stopped in the shortest time possible in	MDO loss is managed through implementation of the vessel SMPEP (or equivalent according to class).	Incident logs verify that the SMPEP is implemented.

accordance with established procedures.		
Monitor and evaluate Undertake visual observations to monitor spill behaviour and determine whether it is likely to reach sensitive receptors.	Visual observations from the platform and/or PSE and VoO (depending on source of release) is initiated immediately.	Incident report verifies that visual observations commenced immediately following a spill.
	An Incident Action Plan (IAP) is prepared by the IMT Planning Officer within the first 24 hours of the spill notification, which is used to guide response activities (see the BassGas OPEP for further details).	The IAP is available and time stamped to verify is was prepared within 24 hours of the spill notification, and daily reports verify it is implemented.
	An operational NEBA is prepared to determine the most appropriate spill response strategies within 12 hours of the spill notification.	The operational NEBA is available and time stamped to verify is was prepared within 12 hours of the spill notification.
	Visual observations from helicopters are initiated within 6 hours of request (subject to daylight hours).	Incident report verifies that visual observations from the air commenced within 6 hours of the request.
The trajectory of the spill is predicted based on the spill location in order to inform response strategies.	Vectoring is undertaken by an onsite spill assessor within 3 hours of spill notification.	Incident records verify IMT Planning Unit commenced vector analysis within 3 hours of the spill.
	Real-time OSTM is initiated within 4 hours of notification of the spill and results provided as soon as they are available.	Incident records verify IMT Planning Unit requested OSTM within 4 hours of the spill.
		OSTM report is available.
Protection and deflection, shoreline clean-up Undertake protection and deflection booming operations appropriate to the nature and scale of the predicted or observed shoreline impacts.	Within 6 hrs of spill event notification, a shoreline assessment team has mobilised to areas of predicted impact (daylight permitting). This information and the status of estuaries is provided to the EMT for inclusion in an operational NEBA.	Incident log verifies a shoreline assessment team was mobilised in suitable timeframes.
	An operational NEBA is prepared by the EMT to determine the net benefits of a booming strategy for estuarine areas predicted to be contacted within 4 hours of receiving real-time OSTM.	The operational NEBA is available and was undertaken prior to the deployment of equipment.
	Personnel and equipment resources are deployed to site to undertake the protection and deflection and clean-up activities within timeframes outlined in the IAP.	Incident report verifies that personnel and equipment were mobilised within the timeframes outlined in the IAP.
	The TRP is implemented.	Incident report verifies that the TRP is implemented.
	Booming operations (and clean-up, as required) continue until such time as no further sheen is visible on the sea surface, at the direction of the EMT Leader.	Incident logs verify the continued use of booming until there is no further visible sheen.
OWR OWR resources are implemented appropriate to the nature and scale of predicted and/or observed impacts.	DELWP personnel and OWR kits are mobilised to site within 24 hours of the notification from monitoring personnel that fauna are impacted or at risk.	Incident records verify that OWR personnel and kits are deployed to site within 24 hours.
	An operational NEBA is prepared to determine the most appropriate OWR strategies.	The operational NEBA is available.

Activity controls		
Monitor and evaluate, protection and deflection Monitoring activities are undertaken in a manner that protects sensitive fauna and habitat.	Helicopters will maintain a buffer distances of 500 m around cetaceans in accordance with EPBC Regulations 2000 (Part 8).	Fight instructions document these constraints.
	Vessels will maintain buffer distances around whales and dolphins in accordance with The Australian National Guidelines for Whale and Dolphin Watching (DoEE, 2017) for those individuals not visibly affected by hydrocarbons (closer approaches may be necessary to determine impacts).	Incident reports note when cetaceans were sighted and what actions were undertaken.
	Environmental briefings are conducted for shoreline monitoring crews to identify site-specific risks and suitable controls.	Briefing records are available.
	Access to shorelines is via established tracks (or areas devoid of native vegetation). Access outside of existing tracks is determined in consultation with local DELWP representatives.	Incident records and photos verify access was via existing tracks and/or cleared areas.
	Vessels do not anchor in and booms are not anchored to areas of OSRA-mapped or visible kelp forest, reef, sponge gardens or seagrass meadows.	Incident records verify anchoring takes place in non-sensitive environments.
	Adequate monitoring personnel are in place at booming locations to maintain and attend to the operability of booms, including the release of fauna caught in booms (where safe to do so).	Incident logs verify that monitoring personnel are in place to maintain booms.
Shoreline clean-up There are no spills of recovered oil or oily water to the environment.	Waste storage tanks and hoses are located within a contained, impervious area. Spill kits are available at oil recovery area and it is under supervision and secured from public access.	Incident records verify waste storage facility has been appropriately set-up and supervised.
	Collected waste is disposed in accordance with Victorian EPA waste disposal requirements.	EPA Waste Transport Certificates verify use of appropriate disposal locations.
OWR OWR activities minimise further harm to wildlife.	Wildlife is only handled and treated by authorised DELWP, DPIPWE and AMOSC personnel or Phillip Island Nature Park wildlife clinic oiled wildlife responders.	Licencing records of response personnel verify they are qualified to handle and/or treat oiled wildlife.

Risk Assessment (residual)

Receptor	Consequence	Likelihood	Risk rating
Fauna disturbance	Minor	Unlikely	Low
Fauna injury	Minor	Unlikely	Low
Fauna death	Minor	Unlikely	Low
Shoreline habitat damage	Minor	Unlikely	Low

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required. However, because this hazard has a Decision Context of 'B', an ALARP analysis is presented below.

Table 7.78 provides a guide as to the suitability of response techniques for condensate and MDO spills, including in the context of the OSTM undertaken for BassGas operations. This should be taken into account into this demonstration of ALARP.

Good practice

Avoid/Eliminate	Oil spill response activities will only be undertaken if the operational NEBA demonstrates that the net benefit of the response is greater than allowing the hydrocarbons to weather naturally.
Change the likelihood	The IAP is used to guide the spill response activities. The use of trained personnel to monitor and respond to the spill (through Beach's trained personnel and AMOSC, RPS, VoO, Bristow) reduces the likelihood and consequence of a poor response being implemented and creating more environmental damage than it prevents.
Change the consequence	This reduces the likelihood and consequence of additional environmental damage resulting from the response activities.
Reduce the risk	An exercise schedule is included in the BassGas Offshore Operations OPEP. Implementing this exercise schedule for Beach personnel helps to reduce the risks associated with poor preparedness. Agreements and contracts with various response organisations (e.g., AMOSC, RPS, VoO, Bristow) reduce the risk of delays in instigating response measures.

Engineering risk assessment

The OSTM undertaken for the spill release scenarios is an engineering risk assessment that supports the consequence evaluation, spill response planning and development of the EPS listed in this table. Engineering controls that have been considered to assist with spill response but not adopted are outlined below.

Control	Control type	Analysis
Monitor and evaluate – autonomous underwater vehicles (AUVs)	Equipment	AUVs may be able to provide additional detail on hydrocarbon in the water column. Because there are no practical means for removing hydrocarbons in the water column, this monitoring method does not assist with determining environmentally suitable controls for responding to hydrocarbons on the sea surface or moving towards shorelines. The Beach Offshore Victoria OSMP will be able to be quickly implemented to monitor the environmental impacts of a Level 2 or 3 spill using conventional monitoring techniques with existing contracts.
Monitor and evaluate – night-time infrared monitoring	Equipment	Side-looking airborne radar systems are required to be installed on specific aircraft or vessels to implement this measure. The costs of sourcing such vessels/aircraft is approximately $20,000 per day. Infrared may be used to provide aerial monitoring at night, however the benefit is minimal given trajectory monitoring (and in-field monitoring during daylight hours) will provide good operational awareness. In addition to this, satellite imagery may be used at night to provide additional operational awareness.
OWR – pre-positioning of OWR resources	Equipment	Pre-positioning of OWR equipment at the LLGP (or elsewhere close to the coast, sort as Port Anthony where the PSV is based) does not present a significant time saving with regards to deploying equipment to shorelines. Although the OSTM indicates that MDO could reach shorelines within 10 hours and condensate from a pipeline rupture could reach the shore within 12 hours of release, there are significant benefits in relying on Beach's current oil spill response arrangements: • There are substantial costs associated with purchasing and maintaining OWR equipment. Beach personnel and the PSV contractor are not specialised in this work. • There is no guarantee that Beach or PSV contractor personnel required to deploy and operate this equipment in the event of a spill would be available at this time, as operations and PSV contractor personnel are focussed on day-to-day operations. • Beach pays a membership fee to AMOSC, which covers supply and maintenance of OWR equipment. It is not financially sensible to duplicate these costs.
Chemical dispersant – pre-positioning of	Equipment	Not recommended for use on MDO and condensate (see Table 7.78).

dispersant and associated equipment	Dispersant use will have a net negative effect on the environment. Dispersants push the hydrocarbons into the water column, creating longer lasting impacts in the water column than allowing the condensate to weather naturally from the sea surface.
Cost benefit analysis	
Incorporated into the engineering risk assessment above.	

Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about hydrocarbon spill response activities.	
Legislative context	The performance standards outlined in this EP align with the requirements of: • OPGGS Act 2006 (Cth) and OPGGS(E): ○ Part 6.2 – directs the polluter to take actions in response to an incident and to clean up and monitor impacts. ○ Regulation 13(5) (Risk assessment undertaken to demonstrate ALARP). • OPGGS Regulations 2010 (Vic) and OPGGS Regulations: ○ Regulation 15(3) (Risk assessment undertaken to demonstrate ALARP). • EPBC Regulations 2000: ○ Part 8 (Interacting with cetaceans and whale watching). • *Flora and Fauna Guarantee Act* 1988 (Vic): ○ Section 47 (Offences relating to protected flora). ○ Section 48 (Authorisation to take, trade in, keep, move or process protected flora). • *Wildlife Act* 1975 (Vic): ○ Sections 41, 42 & 43 (Hunting, taking or destroying endangered, notable or protected wildlife). • *Emergency Management Act* 2013 (Vic).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Major spills from production facilities – spill preparedness and emergency response measures are in place.
	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	No guidance is provided regarding oil spill response activities, other than having a spill contingency plan in place. An OPEP is in place for BassGas operations.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Sections 76-79 (Spill response planning): A spill response plan should be prepared.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore development and production objectives:

		• To reduce the risk of any unplanned release of material into the marine environment to ALARP and to an acceptable level.
	Hydrocarbon spill-specific guidelines	
	AMOSPlan (2017)	AMOSC will implement this plan in the event their resources are deployed. The EPS listed in this table complement AMOSPlan.
	Maritime Emergencies Plan NSR (EMV, 2016).	DJPR (EMB) will implement this plan in the event their resources are deployed. The EPS listed in this table complement the Marine Emergencies Plan NSR.
	NatPlan (AMSA, 2014).	AMSA will implement this plan in the event their resources are deployed. The EPS listed in this table complement the NatPlan.
	Contingency planning for oil spills on water – Good practice guidelines for incident management and emergency response personnel (IPIECA/IOGP, 2015).	The EPS listed in this table are prepared cognisant of these guidelines, which discuss oil spill scenarios, various response techniques and the requirements for contingency plan preparation (i.e., an OPEP).
	Oil spill training - Good practice guidelines on the development of training programmes for incident management and emergency response personnel (IPIECA/IOGP, 2014).	The EPS listed in this table are prepared cognisant of these guidelines, in so far as training of Beach personnel in oil spill preparedness and response takes place and is overseen by an emergency response specialist.
	Aerial Observations of Marine Oil Spills (ITOPF, 2011b).	The EPS listed in this table related to monitoring were prepared cognisant of these guidelines, which describe monitoring techniques and outline the importance of monitoring in guiding on-water and shoreline response activities.
	Aerial Observations of Oil Spills at Sea (IPIECA/OGP, 2015).	
	In-water surveillance of oil spills at sea – Good practice guidelines for incident management and emergency response personnel (IPIECA/IOGP, 2016).	The EPS listed in this table are prepared cognisant of these guidelines, which indicate how specialised in-water oil surveillance is. Beach has rightfully deferred this task to the experts (such as AMOSC and AMSA) and will cover the cost of their work.
	Dispersants: surface application – Good practice guidelines for incident management and emergency response personnel (IPIECA/IOGP, 2016).	The EPS listed in this table are prepared cognisant of these guidelines, which discuss application methods, the limitations of dispersants and indicate that dispersant application is best suited to crude oils (not gas condensate or refined MDO, which is best left to weather naturally).
	Use of dispersants to treat oil spill – technical information paper 4 (ITOPF, 2011).	
	A guide to oiled shoreline assessment (SCAT) surveys (IPIECA/OGP, 2014).	The EPS listed in this table are prepared cognisant of these guidelines, which describe how shoreline assessments should be conducted and what information should be recorded in order to inform shoreline responses.
	Use of booms in oil pollution response – technical information paper 3(ITOPF, 2011).	This guideline has been used to inform the effectiveness and feasibility analysis for booming to determine the appropriateness of this technique taking into consideration the hydrocarbon types and nature of the receiving environment.

	Clean-up of oil from shorelines – technical information paper 7 (ITOPF, 2011).	The EPS listed in this table are prepared cognisant of these guidelines, which describe various shoreline clean-up techniques and the response strategies most suitable for different shoreline types.
	Wildlife response preparedness – Good practice guidelines for incident management and emergency response personnel (IPIECA/IOGP, 2014).	The EPS listed in this table are prepared cognisant of these guidelines, which indicate how specialised OWR is. Beach has rightfully deferred this task to the experts (DELWP, DPIPWE, AMOSC personnel and/or Phillip Island Nature Park wildlife clinic oiled wildlife responders), and will cover the cost of their work.
	Key principles for the protection, care and rehabilitation of oiled wildlife (IPIECA/IOGP, 2017).	
Environmental context	MNES	
	AMPs (Section 5.4.1)	Oil and chemical spills are a threat identified in the South-east Commonwealth Marine Reserve Network Management Plan 2013-2023. Spill response will not be undertaken in AMPs given that surface oiling is not predicted. Vessel or aircraft-based monitoring activities will have no significant impacts on AMPs. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	Spill response will not be undertaken in Ramsar wetlands given that surface oiling is not predicted. Vessel or aircraft-based monitoring activities will have no impacts on these wetlands.
	TECs (Section 5.4.5)	Spill response will not be undertaken in areas where TECs exist given that surface oiling is not predicted. Vessel or aircraft-based monitoring activities will have no impacts on TECs. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Spill response will not be undertaken in NIWs given that surface oiling is not predicted. Vessel or aircraft-based monitoring activities will have no impacts on NIWs.
	Nationally threatened and migratory species (Section 5.5)	Some threatened and migratory species have the potential to be present in spill response areas, but given that the key response strategy is centre on monitoring and surveillance because of the volatile nature of the hydrocarbons, vessel or aircraft-based monitoring activities will have no significant impacts on threatened and migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	Many of the Victorian marine and coastal reserve management plans list the protection of marine and terrestrial ecological communities and indigenous flora and fauna, particularly threatened species, as a management aim. Spill response may be undertaken in coastal marine parks given that shoreline loading is predicted to contact some parks. Land, vessel or aircraft-based monitoring activities will

		have no significant impacts on these marine parks or the management objectives of the parks' management plans. See **Appendix 1** for additional detail regarding the impacts of routine activities on the management aims of state marine parks.
	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Marine pollution is a threat identified for albatross and giant-petrels in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The risks posed by response operations do not impact this action. The conservation advice and management plans for blue, humpback, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this. Oil spills and crushing or disturbance of eggs, chicks and nesting birds by human activities are identified as threats in the Conservation Advice for the Hooded Plover (DoE, 2014) and Conservation Advice for the Fairy Tern (DSEWPC. 2011b). Ensuring this threat is not exacerbated by shoreline clean-up activities has been addressed within the controls listed in this table. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans. Land, aerial or vessel-based observations will not conflict with the management objectives of these plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring

- As per the operational studies in the OSMP.

Record Keeping

- Contracts and agreements with third parties.
- Equipment and service provider register.
- Exercise drill reports.
- Inspection/audit reports.
- Incident and daily operations reports.
- IAP.
- Operational NEBA.
- Briefing records.
- Photos.
- OSMP implementation records and reports.
- Oiled wildlife responder licence records.

7.19 RISK 9 - Hydrocarbon Spill Response Activities - Relief Well Drilling

7.19.1 Hazard

Mobilisation of a MODU and drilling of a relief well has been identified as the preferred response to the remote likelihood of a LoWC for suspended and operational wells.

7.19.2 Scope of Activity

In the event of a LoWC, the RWP will be implemented. The scope of this activity essentially means mobilising a MODU to site and drilling a deviated well to kill the well in question. This process is described in the RWP (T-5100-35-MP-005).

A relief well is typically drilled as a straight hole down to a planned kick-off point, where it is turned toward the target well using directional drilling technology and tools to get within 30-60 m of the original well. The aim is to align the two wellbores at an incident angle of 3-5° for the eventual intersect rather than aiming directly at the blowout wellbore. The drilling assembly is then pulled and a magnetic proximity ranging tool is run on wireline to determine relative distance and bearing from the target well. Directional drilling continues to about half the distance to the planned intersection, and another magnetic ranging run is made to update relative distance and bearing. Once the target well is penetrated, dynamic kill commences by pumping mud and/or cement downhole to seal the original well bore.

7.19.3 Capability Assessment

Beach has put in place the following capabilities to implement a relief well drilling activity:

- The use of qualified and experienced offshore drilling engineers and drilling superintendents to design a relief well and develop a RWP specific to the Yolla field. The Beach Wells Team has competent well engineers that would project manage the relief well planning in conjunction with Wild Well Control and be guided by the WECS workflow and technical standards.
- Access to a MODU through either:
    - The APPEA MoU.
    - A rig broker (with monthly reports provided).
- Contracts with world-renowned well control contractors (Wild Well Control and Cudd Well Control) for the provision of specialist personnel and equipment.
- An EMT and SC IMT (and associated plans) that is trained and undertakes regular drills and exercises to maintain a state of preparedness.
- A RWP (T-5100-35-MP-005) that outlines a kill well design, MODU mobilisation times and technical considerations that has been prepared in line with international standards.

7.19.4 Potential environmental risks

Known and potential environmental risks from mobilising and drilling of a relief well include:

- Localised and temporary impacts to marine users and fishing due to physical presence of the drilling rig (similar to those described and assessed in Section 7.1);
- Localised and temporary disturbance to marine fauna due to increased light, atmospheric and noise emissions (similar to those described and assessed in Sections 7.3, 7.4 and 7.5);
- Localised and temporary impacts to water quality due to increased nutrient and turbidity levels from discharge of putrescible wastes, sewage and grey water, cooling and brine water and bilge water/deck drainage (similar to those described and assessed in Sections 7.7, 7.8, 7.9 and 7.10);
- Localised and temporary impacts to water quality and the benthic environment due to the discharge of drill muds, cuttings and cement;
- Localised and temporary disturbance to the benthic environment due to drill rig anchoring; and
- Impacts associated with the introduction of IMS (Section 7.13).

7.19.5 Evaluation of Environmental Risks

Beach's Otway Development Drilling and Well Abandonment EP (CDN/ID S4100AH717905) describes and assesses the impacts and risks associated with drilling activities, and they are therefore not repeated here in their entirety. The EP for the drilling of Yolla-5 and -6 (OEUP-T5100-PLN-ENV-500, Rev 4, May 2014) is a suitable document for the site-specific assessment of the impacts and risks of drilling at the Yolla field, but is not publicly available and therefore not suitable for reference here. Using the Otway Development Drilling and Well Abandonment EP as a proxy for understanding the impacts and risks for drilling a relief well at the Yolla field is suitable because:

- It is publicly available document;
- The drilling process for a standard well and a relief well is much the same, and the emissions and discharges are also similar;
- The physical environment around the Otway drill sites is similar to that found at the Yolla location (soft sediment seabed, open ocean, the presence of the same migrating cetaceans, very similar suite of fish and bird species, etc); and
- The LoWC scenario for the Otway drilling involves condensate, the response strategies to which are the same as for a LoWC from the Yolla wells.

Nonetheless, a brief assessment of the key impacts and risks associated with drilling a relief well are presented here. The reader is directed to Beach's Otway Development Drilling and Well Abandonment EP for a full assessment (available on the NOPSEMA website at https://info.nopsema.gov.au/environmentplans/469/showpublic).

Physical presence

The physical placement of a drill rig will result in physical disturbance of the sea floor. This impact would result in localised physical disturbance to benthic habitats. Surveys of previous seabed disturbances from drilling activities of the Victorian coast Basin indicate that recovery of benthic fauna in soft sediment substrates occurs within 6 to 12 months of cessation of drilling (Currie, 2004).

A safety exclusion zone would be required around the drill rig, which has potential to impact fisheries and shipping activities. Such impacts are not likely to be any greater than those discussed for the Yolla-A platform (Section 7.1), which are assessed as minor. No significant additional impacts on fishing or maritime activities are expected to result from relief well drilling activities.

Routine emissions - light, air and noise

Lights are required for safe operation and navigational safety of a drill rig, with visibility considered one of the key controls in place to prevent collisions with third-party vessels. The impacts of lighting will be similar to those from the platform and vessels, which are addressed in Section 7.3 and determined to have a minor impact.

Air emissions associated with drilling relate to the combustion of MDO on the drill rig and in support vessels. As with the impacts assessed in Section 7.4, these are considered to have a minor environmental impact.

The noise emitted from a drill rig consists of a combination of down-hole drill pipe operations including conductor driving and onboard machinery. This typically produces a low intensity but continuous sound for the duration of the drilling activity. The primary concern arising from noise generation from drilling is the potential effect on marine fauna. Impacts on marine fauna from noise from vessels and operations is addressed in Section 7.5 of this EP. The noise generated from a drill rig is unlikely to result in significant physiological or behavioural impacts when considered individually or cumulatively with existing noise sources. It is expected that any impacts on marine fauna will be limited to behavioural changes of individuals close to the location and will not result in effects at a species population or ecosystem level. The impacts of sound from the drill rig are similar to those of vessels and as outlined in Section 7.5, these impacts are considered minor.

Routine discharges – putrescible waste, sewage and grey water, cooling and brine water, bilge water/deck drainage

Routine discharges from a drill rig are very similar to those as described for vessels and assessed in Sections 7.7, 7.8, 7.9 and 7.10 of this EP.

The key difference is that a drill rig contains more POB (typically about 100 people, compared with up to 8 people on Yolla-A), so there is an increased volume of putrescible and sewage and grey water discharges (though for a short time only). As with the routine discharges of waste from Yolla and vessels, the impacts of such discharges from a drill rig are considered minor.

<u>Introduction of IMS</u>

The introduction of IMS from vessels is addressed in Section 7.13 of this EP. The same issues apply to the operation of a drill rig and support vessels due to ballast water discharges and hull fouling. The drill rig and support vessels will be required to have relevant biosecurity certifications and be in possession of a ballast water discharge log. This risk is likely to be low to medium.

<u>Discharge of drilling muds and cuttings</u>

Drilling fluids are used to transport drilling cuttings to the surface, prevent well control issues, preserve wellbore stability, and cool and lubricate the drill bit and drill string during drilling. Drill cuttings are rock, gravel and sand removed from the well during the drilling process. The characteristics of the cuttings to be discharged can be predicted from the lithology of other wells drilled in the region and are anticipated to be dominated by calcarenite, shale and sandstone. The cuttings are expected to range in size from fine to course, with a mean size no larger than one centimetre.

The most appropriate drilling fluid for the conditions will be used for relief well drilling. It is likely that water-based muds (WBM) would be used, and the assessment of impacts provided below assumes this. Use of synthetic based muds (SBM), although unlikely, cannot be entirely discounted as it is not possible to define specific drilling requirements for all scenarios where relief well drilling may be required. All drilling products selected will have the lowest environmental risk ranking practicable based on CHARM and OCNS. It is likely that bulk discharge of muds would occur at the conclusion of a relief well drilling campaign, as per normal offshore drilling practice.

The known impacts arising from the discharge of WBM drilling fluids and cuttings are:

- Increased turbidity in the water column;
- Burial of benthic organisms; and
- Alteration of the benthic substrate.

There is a substantial amount of literature demonstrating that impacts from the discharged cuttings and muds are generally very localised (100 to 250m from the well), short-lived (less than 24 months), and concentrations of metals or hydrocarbons are generally not detectable beyond 1,000 m (Hinwood *et al.*, 1994).

Potential impacts to water quality and benthic organisms are discussed in the following sections. Note that the volume of muds used will be minimised by use of solids control equipment to ensure maximum retention of fluids within the active mud system.

Water quality and turbidity

Disposal of cuttings with adhered fluid and bulk mud discharges during drilling operations will create plumes of increased turbidity below the point of discharge. Within this plume the larger particles (90-95%) quickly settle on the seabed, usually within a radius of 100-200 m from the drill rig. Such particle behaviour has been demonstrated by Terrens et al (1998) at the Fortescue platform in eastern Bass Strait drilling locations.

The dilution of cuttings and drilling fluid plumes is rapid. Data compiled by the US Environmental Protection Agency (US EPA) from numerous studies on the growth and dilution of drilling mud discharge plumes found that the mud had been diluted by approximately one million times by the time it reached a distance of 1 km from the discharge point (USEPA 1985). Nonetheless, drilling cuttings and muds in suspension have the potential to impact components of the marine ecosystem entrained in a discharge plume. Such exposure will in most cases be short-term, episodic or pulse-wise depending on plume behaviour.

Some studies have demonstrated minor adverse impacts from turbidity induced by WBM discharges on hard bottom fauna abundance (Hyland *et al.*, 1994), scallops (Cranford *et al.*, 1999) and the blue mussel (Bechmann *et al.*, 2006). These studies indicate that the effect mechanism of cuttings and drilling fluid plumes is mainly physical stress, although chemical toxicity cannot unequivocally be ruled out. The levels of suspended WBM and cuttings causing effects have been above 0.5 mg/L. Such levels are typically restricted to a radius of less than 1-2 km in the water masses (Neff, 1987).

During drilling of a relief there will be an increase in turbidity the immediate area of drilling activity as a result of discharges of cuttings and muds. However, this will be a temporary effect. Tidal currents are substantial and the interaction of surface and oceanic currents facilitates the dispersion and dilution of cuttings and muds discharged from the drill rig, aiding in minimising water column turbidity.

Any reductions in primary productivity (i.e., plankton growth) in the water column as a result of discharges of cuttings and muds will be very localised in the context of the surrounding marine environment. The water depth at the Yolla field is beyond the photic zone (depth of ocean that receives sufficient sunlight for photosynthesis to occur). Any shading effect of the discharge plume, therefore, will be very low.

In summary, environmental impacts of a turbid plume of cuttings and muds in the highly localised area around the drill rig are expected to be minor.

Burial of benthic organisms

Most offshore field studies have shown a minor impact of WBM discharges on benthic fauna except immediately adjacent to platforms where cuttings piles form and persist. Some changes in the local infaunal community structure will occur due to burial and the altered sediment character. The increased bottom micro relief afforded by the accumulation of cuttings may also attract fish and other motile animals and alter the character of epibenthic infaunal communities. Bakke et al (1986) found that fauna recolonisation on sediments capped with 10 mm of WBM cuttings differed little in overall diversity from that on natural sediment after 1 year, but the species composition was clearly different, which was thought to be due to the WBM cuttings being classified as 'very fine sand ' as opposed to the natural sediment being 'medium sand'.

Monitoring in the North Sea has not revealed any in situ effects of WBM cuttings on sediment macrofauna community structure, implying that any such effects, if present, will be confined to the innermost stations in these studies (i.e., nearer than 25-250 m from the discharge point) (various studies cited in Bakke *et al.*, 2013).

Environmental studies undertaken at the Fortescue platform in 70 m depth in western Bass Strait showed that effects to benthic communities from discharge of cuttings and water-based fluids were generally localised and short-lived, with most benthic organisms recovering within four months (Currie *et al.*, 2004). This study showed no detectable trace element indicators when water-based fluids alone were used.

For Apache's East Spar Development in Commonwealth Waters, the area of impact from WBM discharges was not more than 100 m from the drill site and short lived with recovery in less than 18 months (SKM, 1996; Kinhill, 1998). Other studies of the effects of WBM cuttings on sediment fauna also suggest that the impact is normally restricted to within 100-250 m and recovery is rapid (various studies cited in Bakke *et al.*, 2013). There is therefore strong evidence to conclude that sedimentation of WBM cuttings onto the seafloor has only local and short-term effects on the sediment fauna.

In summary, impacts to benthic organisms from the discharge of muds and cuttings from drilling of a relief well are expected to be highly localised and short-term. As the seabed sediments in Bass Strait are generally uniform and widespread, any consequences at the ecosystem level due to impacts in the highly localised area of the drilling location are expected to be minor.

<u>Discharge of cement</u>

Cementing of a relief well is required to provide effective isolation of the well, and to abandon the well afterwards. Most cement is pumped downhole, however, a small amount of overfill and cement-contaminated mud is likely to occur during the grouting of the uppermost surface casings. No technology currently exists to prevent cement from the uppermost casing wellbores being fully cemented to surface without cement releasing onto the sea floor.

Cement discharges may result in localised, temporary increases in pH at the discharge site. Discharges on the seabed may result in smothering of benthic organisms and areas where cement is overlying sediments will not be suitable for recolonisation by benthic species. Chemicals in the cement mix may result in localised reductions in water quality at the time of the discharge.

The cement chemicals selected for any relief well drilling will be selected in accordance with the chemical selection process (described in Section 8.19 of this EP) in order to minimise the impact on the environment of the cement prior to setting as an inert aggregate.

7.19.6 Risk Assessment

Table 7.90 presents the risk assessment for drilling a relief well.

Table 7.90. Risk assessment for drilling a relief well.

Summary		
Summary of risk	Routine emissions and discharges as outlined throughout this EP. Reduction in water quality and smothering of benthic environments from the discharge of drill cuttings, muds and cement.	
Extent of risks	Localised – generally within several hundred metres of the drill site.	
Duration of risks	Temporary for all routine emissions and discharges. Temporary (hours to days) for turbid plumes, months for deposited cuttings.	
Level of certainty of risk	HIGH – the impacts and risks of routine and non-routine emissions and discharges from offshore drilling are well known.	
Risk decision framework context	B – new to the organisation or geographical area, infrequent or non-standard activity, some uncertainty, some partner interest, may attract media attention.	
Risk Assessment (inherent)		
Consequence	Likelihood	Risk rating
Minor	Almost certain	Medium
Environmental Controls and Performance Measurement		
EPO	EPS	Measurement criteria
Preparedness		
An RWP is in place and ready for implementation.	Beach has an RWP in place that describes the scope of activities, drill rig specifications, schedule and relief well schematic.	The RWP is available and current.
	Beach undertakes desktop drills in accordance with the BassGas Offshore Operations OPEP to test internal and external RWP capabilities.	Exercise drill records verify that RWP capability tests are undertaken to schedule and attended by the relevant personnel.
	Annual desktop drills and exercises of the Beach EMP are undertaken to test internal and external emergency response capabilities.	The Crisis and EMT Capability Matrix verifies that annual EMT drills and exercises are undertaken.
	Call off contracts are in place with well control specialists to ensure rapid mobilisation to site upon request.	Call off contract/s are available and current.
	Rig broker reports are used to monitor the rig market on a quarterly basis to determine the MODUs readily available to undertake a RWP drilling program.	Rig broker reports are available on file.

	An annual review is undertaken of the Beach operational and scientific monitoring capability to ensure that the Offshore Victoria OSMP can be effectively implemented.	Annual review records verify that OSMP arrangements remain current.
Response		
Well kill is undertaken in accordance with established procedures.	The Beach Emergency Management Team (EMT) is activated by the Yolla PIC or LLGP via NRC as soon as an event has been identified. The EMT will manage the Source Control Incident Management Team (SC IMT) immediately once a well control incident is identified.	Incident management records verify that the EMT and SC IMT were activated.
	The Beach SC IMT activates the APPEA Memorandum of Understanding: Mutual Assistance within 6 hours of assembling to facilitate the transfer of a suitable MODU from another operator.	Incident management records verify that the APPEA MoU was activated within the specified time frame.
	The SC IMT ensures that relief well drilling is undertaken in accordance with the RWP. Specific targets of the RWP are:	Drilling log verifies that the RWP is implemented.
	• Wild Well Control, Boots and Coots and/or Alert Disaster are contacted within 6 hours of the blowout and contracted within 6 hours to source relief well drilling specialists.	Incident management records verify that well control specialists are contacted and contracted in the specified time frame.
	• Rig broker is contacted within 6 hours of the blowout to source a MODU.	Incident management records verify that a rig broker is contacted in the specified time frame.
	• A MODU with an accepted Australian Safety Case is contracted within 14 days of the blowout.	Incident management records verify that a MODU is contracted in the specified time frame.
	• A MODU is mobilised to site within 35 days of it being contracted.	Incident management records verify that a MODU arrives on location in the specified time frame.
	• The well is killed within 86 days of the start of drilling.	Incident management records verify that the hydrocarbon flow ceases within 86 days.
Activity controls		
The EPO and EPS for impacts and risks associated with drilling are similar to those presented throughout this EP (with the exception of PFW discharges and LOC scenarios). Activities that are significantly different to those assessed in this EP are outlined below.		
Drill cuttings and muds Only low-toxicity mud additives are used.	Only OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated base fluids and additives are used in the drilling fluid system to minimise ecotoxicity impacts to marine fauna.	The mud chemical inventory verifies that all drilling mud additives are OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated.
Operations are managed to ensure cuttings and muds discharges are optimised.	Operation of the separation treatment system is monitored on a full-time basis by the Derrickman/Shaker Hand to ensure optimal system performance.	Performance of the system is logged by the Mud Engineer in Daily Fluids Reports.
	Drilling fluid testing is performed by the Mud Engineer working under the supervision of the Drilling Supervisor at least twice per day.	Mud Engineer verifies through the Daily Fluids Reports that fluid properties have been tested and system optimisation activities are actioned.

Cement Only low-toxicity cement additives are used.	Only OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated cement additives are used in the drilling fluid system to minimise ecotoxicity impacts to marine fauna.	The cement chemical inventory verifies that all cement additives are OCNS 'Gold'/'Silver' (CHARM) or 'D'/'E' (non-CHARM)-rated.
Cement losses to the seabed during top hole cementing operations are minimised.	Once good cement returns are noted at the seabed by the ROV Technician, the mixing and pumping of cement will cease, and displacement of the string with drilling fluid will begin.	The Cement Job Report notes visual returns of cement were confirmed and details the pumping schedule.

Risk Assessment (residual)		
Consequence	Likelihood	Risk rating
Minor	Unlikely	Low

Demonstration of ALARP

A 'low' residual risk rating is considered to be ALARP and a 'lower order' impact. An ALARP analysis is therefore not required. However, because this hazard has a Decision Context of 'B', an ALARP analysis is presented below.

Good practice	
Avoid/Eliminate	In the event of a LoWC, there is no alternative to the drilling of a relief well. Section 3.9.2 of the EP describes why the use of a well capping stack is not a viable option for stopping the flow from the Yolla wells.
Change the likelihood	No options identified.
Change the consequence	The consequence of the RWP being poorly executed, and therefore potentially delaying the time it takes to stop the blowout, is reduced through the regular training
Reduce the risk	The RWP and agreements/contracts with well control specialists reduce the risk of delays in implementing well kill. The RWP takes into consideration mobilisation times from the North West Shelf and Singapore as the most likely source of suitable MODUs, the ratings of well control equipment (e.g., BOPs), pump capacities (for dynamic well kill) and water depths. The well design and content of the RWP are prepared in accordance with international best practice (e.g., Relief Well Planning (OGUK, Rev 2, 2013)). The use of rig broker reports to monitor the rig market similarly reduce the risk of delaying the implementation of the RWP and is considered best practice in terms of maintaining current knowledge of the status of MODUs suitable for drilling relief wells. The use of rig brokers is effective because: • The rig broker can be contracted to identify and contract a suitably specified rig (including Australian Safety Case status) within 14 days. This allows sufficient time for Beach to directly engage with other operators and drilling contractors to confirm availability of MODUs with suitable technical specifications to meet the relief well design. • To facilitate timely response, Beach is a signatory to the 'APPEA Memorandum of Understanding: Mutual Assistance for transfer of MODUs between operators' in the case of an emergency. A MODU that is not currently in operation, or in transit to the next operating well, will be preferred and result in a reduced period from the 14 days allowed for engaging and selecting suitable MODUs. The full 14 days will be required where there are no suitable MODUs not currently in operation and the selected MODU will be required to safely suspend well operations on its existing well prior to commencing mobilisation to Yolla-A. The development of a RWP (in line with international standards), regular monitoring of MODU availability, agreements with well control specialists and the formation of the SC IMT and its regular training is considered industry best practice.
Engineering risk assessment	

Engineering controls that have been considered for relief well drilling, but not adopted, are a subset of those for the LoWC and are outlined below.

Control	Control type	Analysis
Drill top hole of a relief well	Equipment	This option would allow for a relief well to be drilled faster in the event of a LoWC. The very large upfront cost in drilling a top hole (several million dollars) and the environmental impacts associated with this activity (such as the discharge of drill cuttings and muds and atmospheric emissions) outweigh the benefits of this measure, given that the probability of a LoWC is so remote.
Retain a MODU on standby in a nearby port for the drilling of a relief well	Equipment	The costs associated with 'warm-stacking' or 'cold-stacking' a MODU nearby to Yolla-A is not financially feasible. This option would cost millions of dollars per week. The MODU would require an accepted Safety Case to be in place, and a suitable Safety Case Revision to be in place for a relief well drilling program. Quickly mobilising a MODU would also be dependent on accessing a heavy lift vessel or specialist tug vessels to transport the MODU to the Yolla location (which are unlikely to be locally available, unless these too are retained on standby with the MODU). Mobilising a MODU from elsewhere in Bass Strait or the North West Shelf would be likely to be quicker than awaiting a heavy lift vessel to mobilise a cold- or warm-stacked MODU to the Yolla location. The costs of retaining a MODU on standby are grossly disproportionate to the environmental risk, given that the residual risk rating without adopting this control remains 'low' because a gas condensate release is not predicted to result in shoreline contact and the sea surface contact area is predicted to be very small.
Use a well capping stack prior to cap a well blowout	Equipment	Section 3.9.2 discusses the well capping stack response option and why this is not a suitable option at Yolla-A.

Cost benefit analysis

Incorporated into the engineering risk assessment above.

Demonstration of Acceptability		
Policy compliance	Beach Environmental Policy objectives are met through implementation of this EP.	
Management system compliance	Chapter 8 describes the EP implementation strategy employed for this activity.	
Stakeholder engagement	The BassGas Offshore Operations SEP is implemented to ensure that stakeholders are aware of operations issues. Stakeholders have not raised concerns about relief well drilling.	
Legislative context	The performance standards outlined in this EP align with the requirements of: • *OPGGS Act* 2006 (Cth): ○ Part 6.2 – directs the polluter to take actions in response to an incident and to clean up and monitor impacts. • *Protection of the Sea (Prevention of Pollution from Ships) Act* 1983 (Cth): ○ Part II (Prevention of Pollution by Oil).	
Industry practice	The consideration and adoption of the controls outlined in the below-listed codes of practice and guidelines demonstrates that BPEM is being implemented.	
	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	The EPS listed in this table meet the relevant mitigation measures listed for offshore activities with regard to: • Major spills from production facilities – well control contingency plan to be in place, spill preparedness and emergency response measures are in place.

	Best Available Techniques Guidance Document on Upstream Hydrocarbon Exploration and Production (European Commission, 2019)	No guidance is provided regarding relief well drilling.
	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Guidelines met with regard to: • Spill response planning (item 78). Arrangements and procedures to mobilise external resources in responding to larger spills and strategies for their deployment.
	APPEA CoEP (2008)	The EPS listed in this table meet the following offshore drilling objectives: • To reduce the risk of release of material into the marine environment to ALARP and to an acceptable level.
	Relief well-specific	
	Health, Safety and Environmental Case Guidelines for mobile Offshore Drilling Units (IADC, 2015)	There is no specific guidance regarding relief well drilling. Section 2.3.12 (drilling and well control operations) states that drilling and well control procedures should be in place.
	IOGP Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells, 2019).	Prior to it being superseded, Beach had applied the Relief Well Planning guidance (OGUK, Rev 2, 2013) to the structure and contents of the RWP, and the relief well design itself, to meet international best practice. The RWP will be updated before the end of 202o to meet the IOGP Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (2019).
Environmental context	MNES	
	AMPs (Section 5.4.1)	Routine activities associated with relief well drilling will not have any impacts on nearby AMPs. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of these AMPs.
	Wetlands of international importance (Section 5.4.4)	Routine activities associated with relief well drilling will not have any impacts on Ramsar wetlands.
	TECs (Section 5.4.5)	Routine activities associated with relief well drilling will not have any impacts on TECs. See **Appendix 8** for additional detail regarding the impacts of non-routine activities on the management aims of TECs in the EMBA.
	NIWs (Section 5.4.8)	Routine activities associated with relief well drilling will not have any impacts on NIWs.
	Nationally threatened and migratory species (Section 5.5)	Routine activities associated with relief well drilling will not have any significant impacts on threatened or migratory species.
	Other matters	
	State marine parks (Section 5.4.9)	Routine activities associated with relief well drilling will not have any impacts on state marine parks. See **Appendix 1** for additional detail regarding the impacts of non-routine activities on the management aims of state marine parks.

	Species Conservation Advice/ Recovery Plans/ Threat Abatement Plans	Routine activities associated with relief well drilling will not have any impacts on the management aims of threatened species plans. See **Appendix 2** for additional detail regarding the impacts of non-routine activities on the management aims of threatened species plans.
ESD principles	The EIA presented throughout this EP demonstrates that ESD principles (a), (b), (c) and (d) are met (noting that principle (e) is not relevant).	

Environmental Monitoring

- Waste tracking.

Record Keeping

- RWP.
- Call off contracts.
- Exercise drill reports.
- Drilling log.
- Mud chemical inventory.
- Daily fluids reports.
- Cement chemical inventory.
- Cement job report.
- Incident reports.

8. Implementation Strategy

This chapter provides a description of how the commitments outlined throughout the EP will be implemented, as required under Regulation 14 of the OPGGS(E) and Regulation 16 of the OPGGS Regulations. Specifically, it describes:

- The Lattice Health, Safety and Environment Management System (HSEMS);
- Environment-specific roles and responsibilities;
- Arrangements for monitoring, review and reporting of environmental performance;
- Preparedness for emergencies; and
- Arrangements for ongoing consultation.

As described in Section 1.4, Beach acquired Lattice in January 2018 and subsequently completed a name change from Lattice Energy to Beach Energy in January 2020. The HSEMS used to guide Beach's offshore operations is one that was developed by Lattice, specifically tailored to include its offshore operations. As part of Beach's continued improvement process, the Lattice HSEMS is in the process of being updated. Until such time as the Beach HSEMS is updated and implemented, the description of the HSEMS in this chapter belongs to Lattice (and is referenced as the 'Lattice HSEMS', LAT-HSE-SYS-001). The EP will be reviewed, and revised where relevant, once the new HSEMS is in place (in line with the MoC standard).

Beach, as the titleholder for BassGas, retains responsibility for ensuring that operations are carried out in accordance with the EPO outlined in this EP. The Implementation Strategy described in this section provides a summary of the Lattice's HSEMS and how it will be applied to effectively implement this EP.

8.1 Health, Safety and Environment Management System

BassGas operations are undertaken in accordance with the Lattice HSEMS. The HSEMS documents the Environmental Policy, HSE Standards, HSE Directives and the key HSE processes and requirements for activities where Lattice is the titleholder. It provides a management framework for achieving the requirements in a systematic way but allows flexibility to achieve this in a manner that best suits the business. The HSEMS is aligned with the requirements of recognised international and national standards including:

- ISO 14001 (Environmental Management);
- OHSAS 18001 (Occupational Health and Safety);
- ISO 31000 (Risk Management); and
- AS 4801 (Occupational Health and Safety Management Systems).

At the core of the HSEMS are 20 performance standards that detail specific performance requirements for the implementation of the Environmental Policy (provided in Section 2.1) and management of potential HSE impacts and risks (Table 8.1). Integral to each Performance Standard are a series of HSE Management Commitments and Processes including Directives, Procedures and other support documents that provide detailed information on requirements for implementation along with specific responsibilities. At the business level, the system is complemented by asset and site procedures and plans such as this EP.

Each of the above-listed HSEMS Standards are discussed in this chapter with specific regard to the implementation of the EP.

Table 8.1. Lattice HSEMS Performance Standards

No	Standard	No	Standard
1	Leadership and Commitment	11	Management of Change
2	Organisation, Accountability, Responsibility and Authority	12	Facilities Design, Construction, Commissioning and Decommissioning
3	Planning, Objectives and Targets	13	Contractors, Suppliers, Partners and Visitors
4	Legal Requirements, Document Control and Information Management	14	Crisis and Emergency Management
5	Personnel, Competence, Training and Behaviours	15	Plant and Equipment
6	Communication, Consultation and Community Involvement	16	Monitoring the Working Environment
7	Hazard and Risk Management	17	Health and Fitness for Work
8	Incident Management	18	Environmental Effects and Management
9	Performance Measurement and Reporting	19	Product Stewardship, Conservation and Waste Management
10	Operations	20	Audits, Assessments and Review

8.2 Leadership and Commitment (HSEMS Standard 1)

The leadership and commitment standard states that the Board and Executive Management establish the HSE Policy, set expectations and provide resources for successful implementation of the HSE Policy and HSEMS.

To this effect, Beach's Environment Policy (provided in Section 2.1) provides a clear commitment to conduct its operations in an environmentally responsible and sustainable manner.

All employees are expected to demonstrate commitment to HSE in all facets of their work. An effective method of showing leadership and commitment is by example. An explicit part of this process is to comply with Directive and Procedures associated with the HSEMS Standards and develop and implement effective HSE plans. These plans are aimed at driving the process of continual improvement in HSE performance.

Demonstratable compliance with this EP is a key commitment for Beach.

8.3 Organisation, Accountability, Responsibility and Authority (HSEMS Standard 2)

This standard states that for Directors, Managers, Supervisors and employees and contractors at all levels, their accountabilities, roles, responsibilities and authority relating to HSE are clearly defined, documented, communicated and understood.

The Beach Energy CEO has the ultimate responsibility for ensuring that Beach Energy has the appropriate organisation in place to meet the commitments established within this EP. However, the Senior Environment Advisor in Beach's Melbourne office, supported by the Head of Environment in the Adelaide office, has the responsibility and delegated authority to ensure that adequate and appropriate resources are allocated to comply with the HSEMS and this EP.

The BassGas organisation structure is illustrated in Figure 8.1 and the roles and responsibilities of key team members are summarised in Table 8.2.

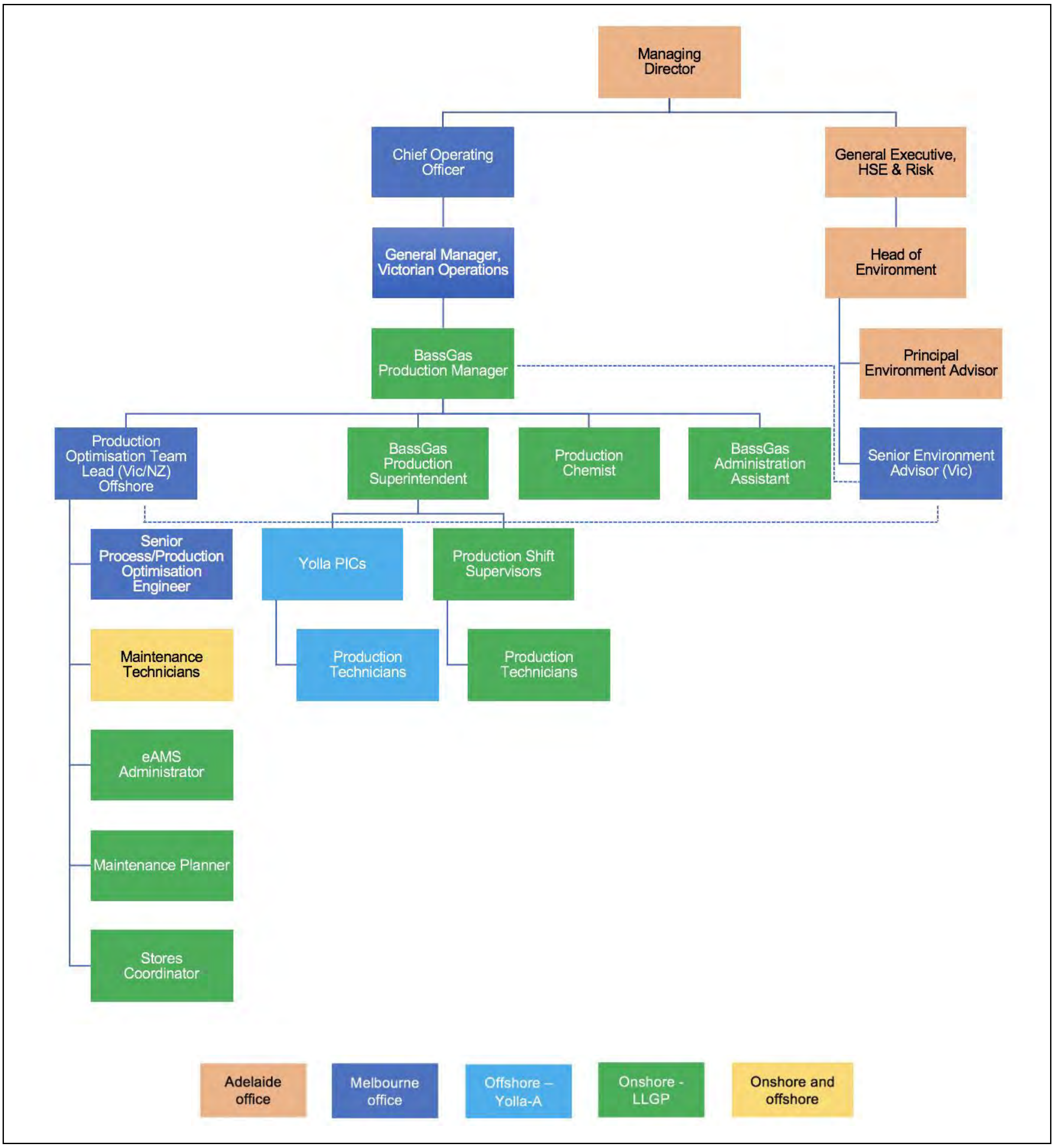


Figure 8.1. BassGas organisation chart

Table 8.2. BassGas roles and key environmental responsibilities

Role	Key environmental responsibilities
Onshore	
Beach Managing Director	• Responsible for HSE performance of all Beach activities. • Ensures policies and systems are in place to guide the company's environmental performance. • Ensures adequate resources are available for the safe operation of all facilities and operations. • Ensures that the HSEME continues to meet the evolving needs of the company.
General Manager – Victorian Operations	• Responsible for HSE performance of all activities across their asset • Responsible Person/Person Conducting Business Undertaking (PCBU) for the development, implementation and compliance with the asset's Safety Cases, Safety Management System, Safety Management Plans and Operations and Environmental Management Plans. • Ensuring the Production Manager and Production Superintendent have the required skills and can fulfil their duties as the 'Accountable Person' for managing HSE performance at each site. • Implementing and ensuring compliance with the HSEMS. • Ensuring that appropriate reporting, verification, authorisation and escalation processes are in place for the review and actioning of all incidents, defects, hazards, inadequacies of procedures. • Maintaining relationship and reporting relevant requirements under the Safety Cases, Safety Management Systems, Safety Management Plans, Operations and Environmental Management Plans and HSE legislation.
BassGas Production Manager	• Responsible for the safe day-to-day operations of the facility. • Ensures compliance with the Environment Policy. • Ensures appropriate and effective HSEMS procedures, work instructions and support documents exist for the facility and activities. • Communicates environmental hazards to the facility crew. • Ensures appropriate risk management is undertaken for the facility and activities in accordance with relevant procedures. • Ensures that processes are implemented to ensure that all employees and contractors (members of the workforce) in their area of responsibility are appropriately inducted and hold the required competencies and licences to undertake their assigned work. • Reports environmental incidents to the Senior Environment Advisor. • Facilitates environmental inspections and audits.
Head of Environment (Adelaide)	• Ensures adequate resources are provided to ensure EP commitments are implemented. • Ensures this EP is revised as required. • Reviews EP audits. • Leads the investigation and reporting of any environmental incidents. • Reviews and approves reportable incident reports to the regulators. • Reviews major changes to operations for their environmental and regulatory implications.
Senior Environment Advisor (Melbourne)	• Maintains ongoing communications with the PIC regarding regulatory requirements and environmental management in general. • Prepares environmental inductions and training packages. • Monitors environmental performance against this EP. • Prepares and submits monthly recordable incident reports to the regulators. • Prepares reportable incident reports for submission to the regulators. • Undertakes facility audits against this EP. • Supports the Management of Change (MoC) process with regard to environmental issues impacting on operations. • Supports the investigation and reporting of any environmental incidents. • Prepares and submits reportable incident reports to the regulators. • Reviews major changes to operations with the Head of Environment.

Role	Key environmental responsibilities
Community Relations Manager (Melbourne)	• Ensures that relevant persons (as defined in Chapter 4) are consulted about operations issues that may impact their functions or interests. • Maintains a record of stakeholder communications. • Reports stakeholder concerns to the PIC and Environment Advisor for resolution. • Keeps relevant persons informed of emergency events that may impact their functions or interests.
Offshore	
Person in Charge (PIC)	• Responsible for the safe day-to-day operations of the facility. • Ensures compliance with the Environment Policy. • Communicates environmental hazards to the facility crew. • Delivers environmental inductions (as required). • Reports environmental incidents to the BassGas Production Manager. • Assists with facility-based environmental inspections and audits. • Acts as the onsite Emergency Response Team (ERT) Leader in the event of major incidents, in line with the ERT structure.
Maintenance Superintendent	• Inspects and maintains plant and equipment in line with the CMMS to ensure all plant and equipment is operating safely and within OEM specifications. • Ensures all maintenance contractors and staff abide by HSE standards, management plans and procedures and that all works have been adequately risk assessed with controls implemented prior to starting works.
LLGP Operator	• Ensures that all asset monitoring and inspection programs are being completed in line with the CMMS, associated plans and procedures. • Participates in environmental inductions and training. • Follows good housekeeping practices. • Reports environmental hazards and incidents promptly to their supervisor. Considers environmental issues in JSAs and PTWs.
Vessel Masters	• Ensures vessel operations are conducted safely and in accordance with this EP. • Reports environmental incidents to the PIC. • Ensures emergency response arrangements are in place and regularly tested.
All offshore crew	• Ensure that all asset monitoring and inspection programs are completed in line with the CMMS, associated plans and procedures. • Participate in environmental inductions and training. • Follow good housekeeping practices. • Report environmental hazards and incidents promptly to their supervisor. • Consider environmental issues in JSAs and PTWs.

8.4 Planning, Objectives and Targets (HSEMS Standard 3)

This standard recognises that a systematic risk-based approach to the management of HSE is in place as an integral part of business planning, and that HSE goals and targets must be established and measured. A philosophy of continuous improvement is applied to HSE.

Targets for environmental performance of BassGas operations are detailed throughout Section 7 of this EP. The EPO and EPS have been established to ensure that the impacts of planned activities and the risks of unplanned events are managed to ALARP and to an acceptable level. The EPO and EPS emerging from this Implementation Strategy are provided in Section 8.22.

8.5 Legal Requirements, Document Control and Information Management (HSEMS Standard 4)

This standard specifies that relevant legal and regulatory requirements and voluntary commitments are identified, documented, made accessible, understood and complied with. Effective HSE document control systems are in place to ensure clarity of company expectations and to facilitate efficient and accurate information management.

8.5.1 Legal Requirements

Chapter 2 of this EP details the key Commonwealth and State environmental legislation applicable to BassGas operations. The acceptability discussion for each hazard assessed in Chapter 7 specifically details the legislation pertaining to each hazard.

8.5.2 Document Control and Information Management

In accordance with Regulations 27 and 28 of the OPGGS(E) and Regulations 32 and 33 of the OPGGS Regulations, documents and records relevant to the implementation of this EP are stored and maintained in the Beach document control system (OpenText) for a minimum of five years. These records will be made available to regulators in electronic or printed form upon request.

8.6 Personnel, Competence, Training and Behaviours (HSEMS Standard 5)

This standard recognises that employees' competence and appropriate behaviours are critical for the safe control of operations and general company success.

This section briefly describes how employees are recruited and trained, how their competency is assessed and monitored and how HSE risks are communicated.

8.6.1 Recruitment and Training

The HSEMS requires that each safety critical role or task is assessed for necessary competencies and skills, utilising formal competency-based assessment. Specific HSE responsibilities are outlined in position descriptions.

The Learning Management System (LMS) records and tracks core and critical HSE and technical compliance training and is managed by the Beach Senior Capability Advisor. The BassGas Workforce Capability Requirements Matrix details the positional HSE and technical competency requirements and is updated on a monthly basis in order to identify training gaps and schedule training.

During its contractor selection process, Beach conducts due diligence to ensure that the chosen contractor has in place procedures to ensure the correct selection, placement, training and ongoing assessment of employees, with position descriptions (including a description of HSE responsibilities) for key personnel being readily available.

8.6.2 Competency Management

The LMS contains competency matrices for operational roles and contains all records of qualifications and completed training of Beach employees. The BassGas Workforce Capability Requirements Matrix (CDN/ID 5180499) includes both Beach-specific competencies and statutory competencies, and refresher requirements on those competencies that have defined re-certification periods. A competency and training needs assessment is completed with new employees to evaluate the individual's competencies for completion of the role. The BassGas Workforce Capability Requirements Matrix sets out the role-specific competencies for Beach personnel to safely operate and maintain the facility.

During its contractor selection process, Beach ensures that the chosen contractor has a competency programme in place that provides ongoing technical and safety training to ensure employee skills are maintained to a high standard and in line with IMO and other requirements at all times. This is covered in the LMS contractor management process managed by Beach's Senior Capability Advisor.

8.6.3 HSE Inductions

All Beach personnel and contractors (including vessel personnel) are inducted into BassGas Offshore EP awareness training every two years. The induction is a two-stage process consisting of:

1. An induction video and questionnaire that covers general HSE requirements such as fitness for work, PPE, emergency response, hazard identification, waste management and incident reporting.
2. Completing the Yolla-A Familiarisation Checklist on arrival to the platform.

It is the responsibility of the vessel contractor to induct their personnel and contractors. Beach verifies that these inductions are undertaken via an annual CMID audit of the vessel contractor.

The BassGas PIC is responsible for ensuring personnel receive this induction on their first visit to Yolla-A. All personnel are required to sign an attendance sheet to confirm their participation in and understanding of the induction.

The environmental component of the HSE induction includes:

- Environmental impacts and risks associated with BassGas operations;
- The requirement to follow procedures and factor environmental issues into JSAs;
- EPO to manage impacts and risks;
- Cetacean sighting and interaction procedures and reporting;
- Oil spill scenarios and response strategies; and
- Incident reporting requirements.

The environmental component of the induction is reviewed each time the EP is revised and after significant environmental incidents.

8.6.4 Emergency Response Exercises

All personnel on site are informed of key elements of the Beach Emergency Management Plan (EMP) (CDN/ID 18025990) during the facility HSE induction and are notified of any changes as part of toolbox meetings. Visitors receive a modified version of this training as a part of their visitor induction. Matters covered include:

- Muster and assembly points;
- Emergency notification (sirens, radio, etc.) and communication arrangements; and
- Communication protocols, equipment and facilities.

The readiness and competency of platform, LLGP and office-based Beach personnel and vessel personnel to respond to incidents and emergencies (including hydrocarbon spills) is tested by conducting desktop emergency response exercises on an annual basis. This satisfies the requirements of Regulation 14(5), 14(8B) and 14(8C) of the OPGGS(E) and Regulation 16(5) and 17(3) the OPGGS Regulations.

Emergency response training, drills and exercises are conducted in accordance with the Beach EMP and is managed by the Senior Crisis Emergency and Security Advisor using a crisis and emergency management team capability matrix as the key tracking tool.

An emergency response scenario may be chosen that combines a risk to human life (such as fire) and risk to the environment (large hydrocarbon spill) so that several plans (i.e., the EMP, OPEP and SMPEPs) can be tested simultaneously.

Such exercises have the objectives of:

- Developing and testing the response arrangements as outlined in the emergency response procedures (outlined in the ERP, SMPEPs and OPEP);
- Ensuring the skills and teamwork of the ERT to respond to major emergency events are up-to-date. In particular, ensuring individual roles, responsibilities and reporting requirements are understood;
- Testing interfaces between all key parties involved in emergency response (Yolla-A, LLGP, Melbourne and Adelaide offices and supply vessel contractor); and
- Ensuring the correct communications are known and used and that contact details (e.g., phone numbers) are correct.

This exercise is facilitated by an experienced facilitator. Debriefs take place immediately after exercises and drills to capture learnings and opportunities for improvement. The results of such exercises and drills are used to improve procedures, systems and equipment as appropriate (such as revising the ERP, EP and/or OPEP as relevant). Recording and tracking of completion of emergency response drills and exercises and follow-up actions is done via the CMO incident management system.

<u>SMPEP-specific training</u>

Regular (quarterly) training of Yolla-A crew in SMPEP procedures is a MARPOL requirement for ships (which includes fixed platforms) over 400 GRT. This is managed through the process previously described.

Similarly, regular (quarterly) training of the PSV crew in SMPEP procedures is also undertaken. Beach ensures that the PSV contractor has been implementing this requirement through annual CMID audits.

<u>OPEP-specific training</u>

The OPEP (S4100AH717907) is tested:

- Not later than 12 months after the most recent test (incorporated into the testing described above); and
- When it is significantly amended.

The ongoing response preparedness and exercise arrangements are outlined in Chapter 12 of the OPEP and the oil spill training and competency requirements are provided in Chapter 13 of the OPEP.

8.7 Communication, Consultation and Community Involvement (HSEMS Standard 6)

This standard specifies that effective, transparent and open communication and consultation with stakeholders is valued and undertaken across the company. Stakeholder consultation specific to BassGas operations is described in Chapter 4 of the EP.

HSE risks are communicated with platform crew and visitors via various meetings as outlined in Table 8.3.

Table 8.3. BassGas HSE communications

Frequency	Meeting	Purpose/content	Attendees from
Daily	Operations	An operations review that includes HSE observations and incidents.	Platform LLGP Melbourne office
	Toolbox	HSE concerns are captured in task-specific toolbox meetings.	Platform
Weekly	Planning	An operations review that includes planning for upcoming environmental monitoring, inspections, audits and so forth.	Platform Melbourne office LLGP
Monthly	Operations	A review of the previous month's operations. The standing agenda includes the review of a range of performance dashboards (HSE, Process Safety, MOC, and CCPS), HSE alerts and notices, as well as site HSE action plans.	Platform LLGP Melbourne office

8.8 Hazard and Risk Management (HSEMS Standard 7)

This standard specifies that HSE hazards and risks associated with the company's activities are identified, assessed and managed to prevent or reduce the likelihood and consequence of incidents.

Chapter 7 identifies and assesses the impacts and risks associated with BassGas operations, and outlines EPO and EPS to manage those impacts and risks. The environmental impacts and risks of operations are reviewed regularly and documented in the BassGas Offshore Impact and Risk Register.

As described in Section 8.12, Beach will undertake a review of this EP to ensure that any changes to activities, controls, regulatory requirements and information from research, stakeholders, industry bodies or any other sources to inform the EP are assessed using the risk management tools nominated. The review will ensure that the environmental impacts and risks of BassGas operations continue to be reduced to ALARP and an acceptable level.

If revision of this EP is trigged though a change in risk or controls, the revision process shall be managed in accordance with Section 8.21.1.

8.9 Incident management (HSEMS Standard 8)

The incident management standard requires that all HSE incidents, including near misses, are reported, investigated and analysed to ensure that preventive actions are taken and learnings are shared throughout the organisation.

Incident reports and corrective actions are managed using the CMO Incident Management System. All staff have access to this system.

The recordable and reportable incident types are described in this section.

8.9.1 Recordable incident management

Regulation 4 of the OPGGS(E) and Regulation 6 of the OPGGS Regulations defines a 'recordable' incident as:

A breach of an EPO or EPS in the EP that applies to the activity that is not a reportable incident.

Routine monthly recordable incident reports, including 'nil' incident reports, are prepared by the Beach Senior Environment Advisor and submitted to NOPSEMA by the 15th of each month. These are reported using the NOPSEMA template *Monthly environmental incident reports* (N-03000-FM0928). Table 8.4 summarises the recordable incident reporting requirements.

Table 8.4. Recordable incident reporting details

Timing	Reporting requirements	Contact
By the 15th of each month	• All recordable incidents that occurred during the previous calendar month. • The date of the incident. • All material facts and circumstances concerning the incidents that the operator knows or is able to reasonably find out. • The EPO and/or EPS breached. • Actions taken to avoid or mitigate any adverse environmental impacts of the incident. • Corrective actions taken, or proposed to be taken, to stop, control or remedy the incident. • Actions taken, or proposed to be taken, to prevent a similar incident occurring in the future. • Actions taken, or proposed, to prevent a similar incident occurring in the future.	NOPSEMA – submissions@nopsema.gov.au

8.9.2 Reportable incident management

Regulation 4 of the OPGGS(E) defines a 'reportable' incident as:

> *An incident that has caused, or has the potential to cause, moderate to significant environmental damage.*

Regulation 6 of the OPGGS Regulations defines a 'reportable' incident as:

> *An incident relating to the activity, whether or not described in an EP in force for the activity, that has caused, or has the potential to cause, moderate to catastrophic environmental consequences and a breach of or non-compliance with the Act, this chapter or the EPO set out in an EP in force for the activity.*

Beach interprets 'moderate to significant' environmental damage (Cth) and 'moderate to catastrophic environmental consequences' (Vic) to be those hazards identified through the EIA and ERA process (see Chapter 7) as having an inherent or residual impact consequence of 'moderate' or greater, or an inherent or residual risk ranking of 'medium' or higher. Impacts and risks with these ratings (as outlined throughout Chapter 7) are:

- Risk 1 – Accidental discharge of waste to the ocean;
- Risk 2 – Vessel collision with megafauna;
- Risk 3 – Introduction of IMS;
- Risk 5 – LoC of MDO from vessels;
- Risk 6 – LoC of condensate from the offshore RGP; and
- Risk 7 – LoWC.

Table 8.5 presents the reportable incident reporting requirements.

Table 8.5. Reportable incident reporting requirements

Timing	Requirements	Contact
Verbal notification		
Within 2 hours of becoming aware of incident	The verbal incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; and • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	• NOPSEMA – 1300 674 472 • DJPR (ERR) – 0419 597 010 (24 hrs)
	Specifically for a Level 1, 2 or 3 hydrocarbon spill, as above.	As above, plus: • AMSA – 1800 641 792 (24 hrs) • Gippsland Ports – 0400 605 645 or 0429 174 606 • MSV – 0409 858 715 (24 hrs)
	Oiled wildlife	• DELWP – 1300 134 444 (24 hrs)
	Suspected or confirmed IMS introduction	• DELWP – 1300 134 444 (24 hrs)
	Injury or death of EPBC Act-listed or FFG Act-listed fauna (e.g., vessel collision)	• DELWP – 1300 134 444 (24 hrs) • DAWE – 1800 803 772 • Whale and dolphin emergency hotline – 1300 136 017 • AGL marine response unit – 1300 245 678
Written notification		
Not later than 3 days after the first occurrence of the incident	A written incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident; and • The action that has been taken, or is proposed to be taken, to prevent similar recordable incidents occurring in the future.	• NOPSEMA – submissions@nopsema.gov.au • DJPR ERR – operational.reports@ ecodev.vic.gov.au
Within 72 hours of the incident	As above, with regard to details of a vessel strike incident with a cetacean	• Upload information to DoEE online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike)

Timing	Requirements	Contact
Within 7 days of the incident	As above, with regard to impacts to MNES, specifically injury to or death of EPBC Act-listed species	• DAWE – protected.species@ environment.gov.au OR compliance@environment.gov.au
Within 7 days of providing written report to NOPSEMA and/or DJPR	As above.	• NOPTA – reporting@nopta.gov.au

8.9.3 Incident investigation

Any non-compliance with the EPS outlined in this EP will be investigated and follow-up action will be assigned as appropriate.

The findings and recommendations of inspections, audits and investigations are documented and distributed to relevant platform, vessel and office-based personnel for review. Tracking the close-out actions arising from investigations is managed via the Beach CMO Incident Management System.

Investigation outcomes are communicated to the Yolla-A crew during daily toolbox meetings before each shift and at weekly HSE meetings.

8.10 Performance Measurement and Reporting (HSEMS Standard 9)

The performance measurement and reporting standard specifies that HSE performance data is collected, analysed and reported to monitor and evaluate ongoing HSE performance and drive continual improvement.

8.10.1 Annual performance report

In accordance with the OPGGS(E) Regulation 14(2) and OPGGS Regulation 16(2), Beach submits an annual report on the environmental performance of the BassGas offshore facilities to NOPSEMA and DJPR (ERR). Performance is measured against the EPO and EPS outlined in Chapter 7.

8.10.2 Emissions and discharge records

Beach maintains a quantitative record of emissions and discharges as required under Regulation 14(7) of the OPGGS(E) and Regulation 16(6) of the OPGGS Regulations. This includes emissions and discharges to air and water (from both planned and unplanned activities). Results are reported in the annual EP performance report submitted to NOPSEMA and DJPR (ERR).

A summary of the environmental monitoring undertaken for BassGas operations is presented in Table 8.6.

The operational and scientific monitoring requirements associated with an oil pollution emergency are discussed in the Offshore Victoria OSMP (S4100AH717908).

8.11 Operational Control (HSEMS Standard 10)

The intent of this standard is that all activities that have the potential to cause harm to the health and safety of people or the environment are carried out in accordance with plans and procedures to ensure safe work practices.

Health and safety risks are managed through the Yolla-A Safety Case (5214686) and Offshore Raw Gas Pipeline Safety Case (CDN/ID 5214688) and are not addressed here.

Activities that have the potential to cause harm to the environment are addressed through the implementation of this EP.

Table 8.6. Summary of BassGas environmental monitoring

Hazard	Monitoring parameter	Monitoring frequency
Yolla-A		
MDO use	Volume consumed	Based on monthly tallies
Fuel gas use		
Flaring	Volume	As flared
Cetacean observations	Opportunistic	Ongoing during operations
PFW (additional detail provided below this table)	TPH concentration	Continuously via the two existing Sigrist online analysers
		Six-monthly characterisation sampling for laboratory testing
	Dispersed oil (OIW) concentration	Continuously via the two existing Sigrist online analysers
		Daily – manual sampling for laboratory testing in a weekly batch
	Dissolved oil (BTEX) concentration	Continuously via the two existing Sigrist online analysers
		Weekly – manual sampling for laboratory testing
	Volume	Continuous
	WET testing	Every 6 months (in 2021) and thereafter as guided by the AMF
	Plume verification	Every 5 years (commencing late 2020) and as guided by the AMF
	Seabed sediment sampling	Every 5 years (commencing late 2020) and as guided by the AMF
Waste	Volume/weight	Each offloading event once ashore
Pipeline		
Cleaning	Volume of grit blasting material	During maintenance campaigns
Vessels		
Cetacean observations	Opportunistic	Opportunistic during operations within the operational area and in the PSZ
Putrescible waste	Volume/weight	Each offloading event once ashore
Bilge water	Volume passed through OWS	Oil record book
MDO use	Volume consumed	Per journey
Waste	Volume/weight taken ashore	Each offloading event

Monitoring programs for the PFW WET testing, plume verification monitoring and seabed sediment sampling program are in development by specialist consultants. These programs will include detail such as:

- Logistics planning;
- Timing and duration of sampling activities;
- Sampling methodology, including:
    - Sampling location (from the platform, vessel adjacent to the platform or adding dye to the PFW stream to identify a plume).
    - In-water sampling locations (e.g., reference points upstream of discharge, sampling of PFW stream prior to discharge, within the discharge caisson and at incremental distances from the discharge point).
    - Water sample collection.
    - Water column profiling.
- Sample preservation methodology;
- Chemical analyses standards and requirements; and
- Reporting requirements.

8.12 Management of Change (HSEMS Standard 11)

The intent of the MoC standard is that all temporary and permanent changes to the organisation, personnel, systems, procedures, equipment, products and materials are identified and managed to ensure HSE risks arising from these changes remain at an acceptable level.

Changes to equipment, systems and documentation are managed in accordance with the MoC Directive to ensure that all proposed changes are adequately defined, implemented, reviewed and documented by suitably competent persons. This process is managed using an electronic tracking database (called 'Stature'), which provides assurance that all engineering and regulatory requirements have both been considered and met before any change is operational. The MoC process includes not just plant and equipment changes, but also documented procedures where there is an HSE impact, regulatory documents and organisational changes that impact personnel in safety critical roles.

Not all changes require a MoC review. Each change is assessed on a case-by-case basis. The potential environmental impacts and/or risks are reviewed by a member of the Environment Team to determine whether the MoC review process is triggered.

8.13 Facilities Design, Construction, Commissioning and Decommissioning (HSEMS Standard 12)

The intent of this standard is to ensure that assessment and management of HSE risks is an integral part of project design, construction, operation and decommissioning of a project. Issues associated with the design, construction and commissioning phases were dealt with prior to the operations phase and are not addressed here.

The EIA and ERA for the decommissioning of the BassGas offshore infrastructure will be dealt with at the end of field life in a separate EP.

8.14 Contractors, Suppliers, Partners and Visitors (HSEMS Standard 13)

The intent of this standard is that contractors, suppliers and partners are assessed for their capabilities and competencies to perform work on behalf of Beach, and that effective arrangements are in place to safeguard the health and safety of visitors to Beach facilities.

This is managed through the Yolla-A Platform Safety Case and Offshore Raw Gas Pipeline Safety Case and is not addressed here. Section 8.6.2 details personnel competency management.

All suppliers go through a detailed procurement process to ensure that they are capable of meeting BassGas HSE requirements, as outlined in Section 8.6.1 and Section 8.6.2.

8.15 Crisis and Emergency Management (HSEMS Standard 14)

The intent of the crisis and emergency response management standard is to ensure that plans, procedures and resources are in place to effectively respond to crisis and emergency situations, to protect the workforce, the environment, the public and customers, and to preserve the company's assets and reputation.

8.15.1 Emergency response framework

The Beach Crisis and Emergency Management Framework consists of a tiered structure whereby the severity of the emergency triggers the activation of emergency management levels. Beach's emergency management response structure (described in the Beach Emergency Management Plan [EMP], CDN/ID 18025990) is based on a three-tier structure based on the severity of the emergency, as illustrated in Figure 8.2. The responsibilities of the Emergency Response Team (ERT), Emergency Management Team (EMT) and Crisis Management Team (CMT) are outlined in Table 8.7.

Table 8.7. Responsibilities of the Beach crisis and emergency management teams

Team	Base	Responsibilities
CMT	Adelaide head office	• Strategic management of Beach's response and recovery efforts in accordance with the Crisis Management Plan. • Provide overall direction, strategic decision-making as well as providing corporate protection and support to activated response teams. • Activate the Crisis Communication Team if required.
EMT	Melbourne office (or Adelaide office, depending on roster)	• Provide operational management support to the ERT to contain and control the incident. • Implement the Business Continuity Plan. • Liaise with external stakeholders in accordance with the site-specific ERP. • Regulatory reporting.
ERT	Yolla-A (and/or LLGP)	• Respond to the emergency in accordance with the site-specific ERP.

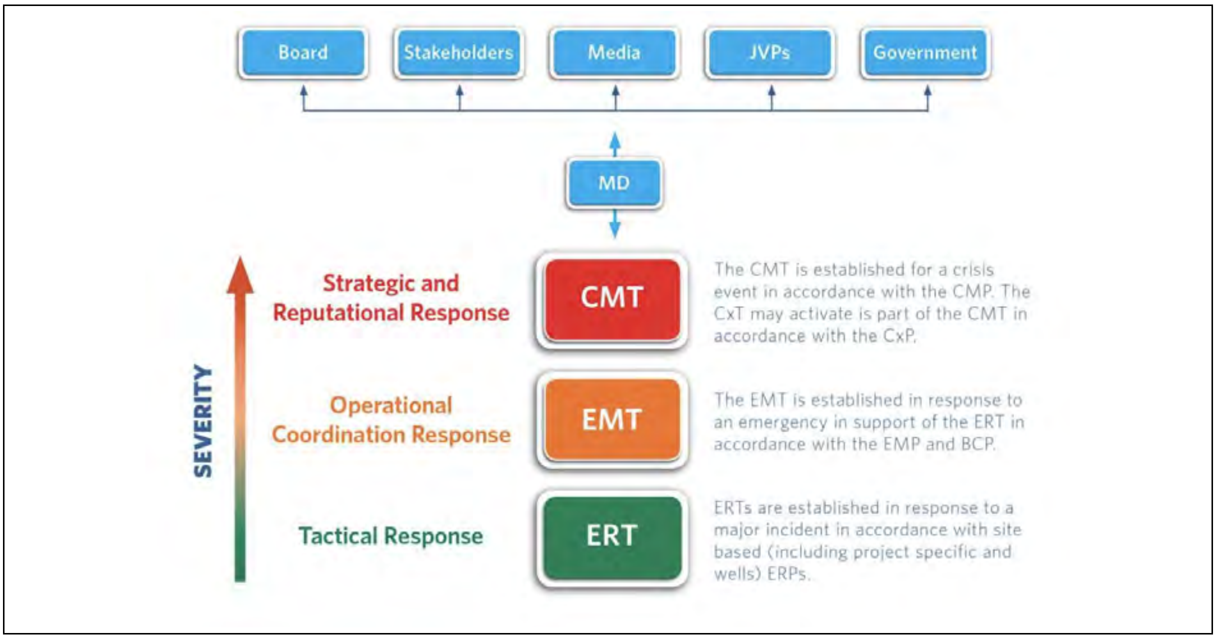


Figure 8.2. Beach crisis and emergency management framework

The key emergency response arrangements for BassGas operations are outlined in the following sections.

Emergency Response Plan

The BassGas ERP (CDN/ID 3974548) addresses emergencies that may arise from BassGas operations (offshore and onshore). The SERP describes the roles and responsibilities for emergency response personnel, including the Incident Controller, ERT, Operations, Planning and Logistics Officers, Muster Coordinator, Scribe and so forth. It also outlines the actions to be taken for particular scenarios (e.g., loss of containment, vessel collision, fire, man overboard, fatality, etc). The BassGas SERP defines the communication requirements to notify both the company and external bodies of the incident so as to obtain assistance where needed and to fulfil reporting obligations.

The BassGas ERP is supported by the Beach EMP. The EMP provides the standard mechanism for the EMT to operate from and includes guidance on effective decision-making for emergency events, identification, assessment and escalation of events and provides training and exercise requirements. The EMP provides information on reporting relationships for command, control and communications, together with interfaces to emergency services specialist response groups, statutory authorities and other external bodies. The roles and responsibilities are detailed for onshore and offshore personnel involved in an emergency, including the response teams, onshore support teams, visitors, contractors and employees. The EMP details the emergency escalation protocol depending on the nature of the emergency.

Associated with the EMP are the Emergency Response Duty Roster and Contact Lists. These documents constitute a suite of emergency response documents that form the basis for Beach's response to an emergency situation.

Where a third-party contractor (TPC) company is required to work under its own HSEMS while on Yolla-A, a bridging ERP detailing the clear reporting lines between the TPC representatives and Beach personnel may be established.

Oil Pollution Emergency Plan

The BassGas OPEP demonstrates that Beach is prepared to respond to an oil spill from BassGas operations. The OPEP describes the arrangements in place to facilitate an appropriate and effective response to worst case hydrocarbon spills that may occur during the facility's operation. The response actions outlined in the OPEP are intended to be implemented within Beach's overarching emergency response structure, as described in the EMP.

Reviews and Testing

The ERP and OPEP are reviewed annually and updated if required. Triggers for an update include:

- Major changes that affect the emergency response coordination or capabilities;
- Findings from routine testing;
- Before installing and commissioning new plant and equipment;
- After a major incident; or
- As directed by a regulator.

In accordance with Regulation 14(8A)(8C) of the OPGGS(E) and Regulation 17(3) of the OPGGS Regulations, the emergency response arrangements in the ERP and OPEP are tested:

- When they are introduced;
- When they are significantly amended; and
- Not later than 12 months after the most recent test.

8.16 Plant and Equipment (HSEMS Standard 15)

The intent of this performance standard is that Beach's facilities, plant, equipment, machinery and tools are purchased, designed, constructed, commissioned, operated, maintained, modified and decommissioned in a manner that ensures HSE risks are effectively managed.

Because BassGas has been operating since 2006, the implementation of this standard currently focuses on ensuring the operation and maintenance of plant and equipment is undertaken in a manner that ensures environmental impacts and risks are ALARP and acceptable, as outlined in this EP.

Plant and equipment inspections and maintenance are undertaken in accordance with the CMMS, a process that is managed by the Yolla-A Maintenance Supervisor.

8.17 Monitoring the Working Environment (HSEMS Standard 16)

The intent of this performance standard is that HSE risks to personnel associated within the working environment are eliminated or reduced to ALARP.

This is managed through the Yolla-A Platform Safety and Offshore Raw Gas Pipeline Safety Case and is not addressed here.

8.18 Health and Fitness for Work (HSEMS Standard 17)

Beach encourages a healthy lifestyle for its employees and provides formal programs to promote health and fitness. This is not related to the implementation of the EP and is not addressed here.

8.19 Environment Effects and Management (HSEMS Standard 18)

The intent of this performance standard is that potential adverse environmental effects resulting from Beach's operations and activities are identified, assessed and monitored and as far as is reasonably practicable, eliminated or minimised.

This EP (and the associated OPEP and OSMP) provide the key means of satisfying this HSEMS standard. A BassGas offshore operations environmental impacts and risk register is in place and was last updated in February 2019 following an environmental risk workshop held at the LLGP in December 2018. The impacts and risk register is reviewed (and updated as necessary) when there are operational changes to the facility (see Section 8.8).

8.19.1 Hazardous substances management

The Hazardous Materials and Secondary Containment Directive (CDN/ID 14176239) details the process for the assessing and approving hazardous materials such as chemicals that are used for BassGas operations. The Directive requires that a risk assessment is undertaken where a hazardous material will or may be discharged offshore. The risk assessment is documented using the Hazardous Material Risk Assessment Form (CDN/ID 8743319).

Figure 8.3 provides a summary of the offshore chemical environmental risk assessment process. The risk assessment process considers aquatic toxicity, bioaccumulation and persistence data, along with the discharge concentration, duration, frequency, rate, and volume. The assessed level of risk determines the acceptance authority (in accordance with the Risk Management Plan) for approving the material for use. Approval is recorded on the Hazardous Material Risk Assessment Form.

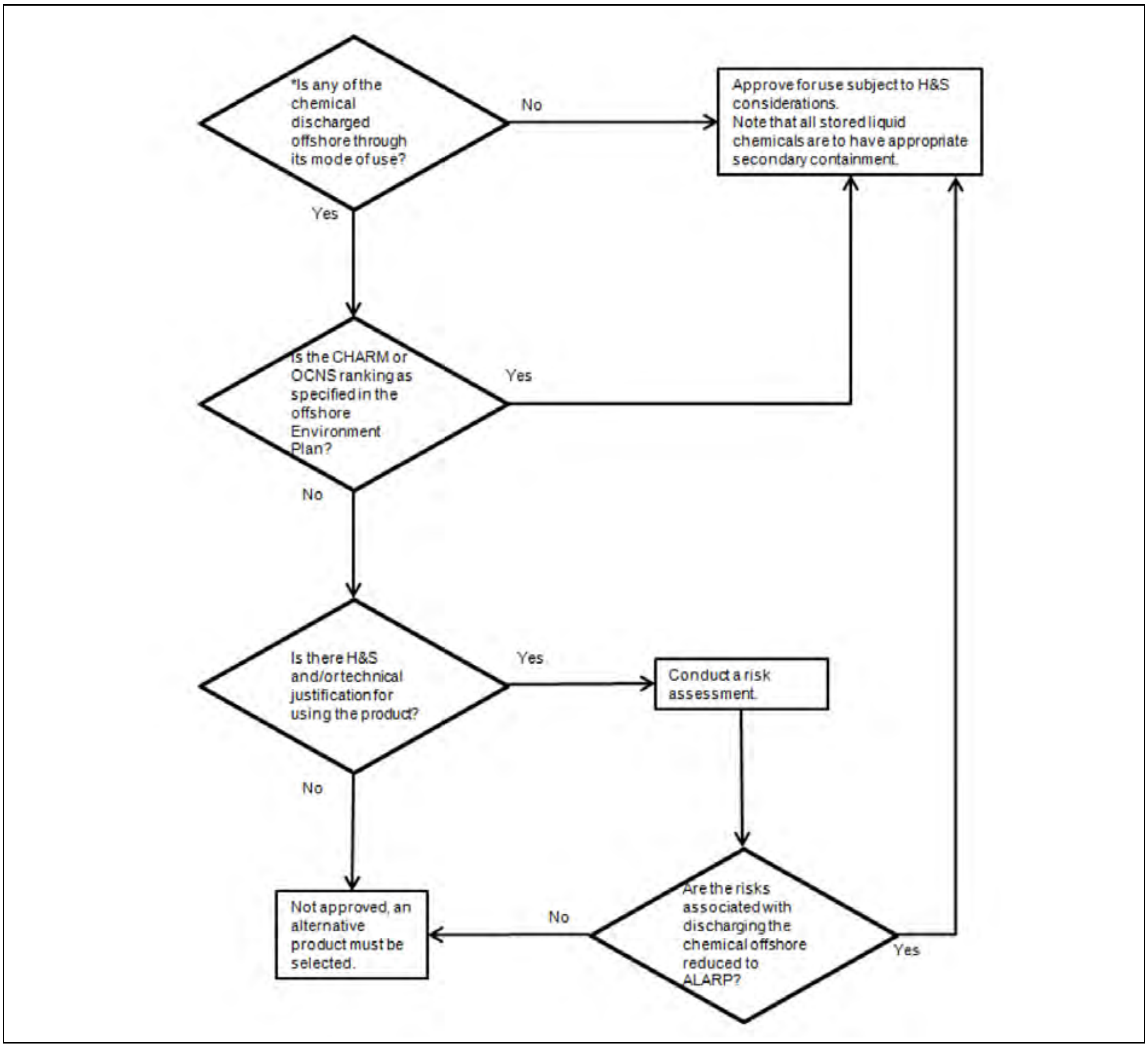


Figure 8.3. Offshore chemical environmental risk assessment process summary

The Hazardous Materials and Secondary Containment Directive describes the requirements for identification, risk assessment, storage, labelling and transport. This Directive requires the following selection criteria to be considered:

- Elimination – eliminating the use of the hazardous material – is it necessary for operations (to protect health, safety or people or operational integrity);
- Substitution – substituting the material by using safer materials or safer forms of the material;
- Isolation – isolating the material through the use of distance or barriers that separate people or property from the hazardous material;
- Engineering – using physical control (plant and equipment) that eliminate or reduce the production of these material or that stop, suppress or contain;
- Administrative – safe work practices; and
- PPE – using PPE as the last line of defence to protect against exposure to hazardous materials.

8.19.2 Assessment of chemicals in line with the OCNS

In terms of approving hazardous materials for use offshore, the Hazardous Materials – Approval and Control procedure refers to the Offshore Chemical Notification Scheme (OCNS).

All production chemicals or products used in the North Sea offshore oil industry are evaluated under the requirements of international legislation established by the Oslo Paris (OSPAR) Convention 1992 in order to monitor their environmental impact. Under this Convention, organic-based compounds used in production are subject to the Chemical Hazard Assessment and Risk Management (CHARM) model, which calculates the ratio of the Predicted Effect Concentration (PEC) against the No Effect Concentration (NOEC). This is expressed as a Hazard Quotient (HQ) and associated with a colour to rank the product and the level of hazard (Table 8.8). The CHARM model requires biodegradation, bioaccumulation and toxicity of a product to be calculated. Testing is carried out on the effect of the product on three different species of aquatic organism: algae, crustaceans and fish.

These results are then published on the Definitive Ranked Lists of Approved Products by the OCNS. The OCNS manages chemical use and discharge by the UK and Netherlands offshore petroleum industries. The scheme is regulated in the UK by the Department of Energy and Climate Change using scientific and environmental advice from CEFAS (the UK's Centre for Environment, Fisheries and Aquaculture Science) and Marine Scotland. In the absence of a similar system in Australia, the OCNS is utilised by Beach to review the environmental acceptability of chemicals used for BassGas operations (see also https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/hazard-assessment-process/).

Table 8.8. The OCNS HQ and colour bands

Minimum HQ Value	Maximum HQ Value	Colour Banding	Hazard
>0	<1	Gold	Lowest hazard
≥1	<30	Silver	↓
≥30	<100	White	↓
≥100	<300	Blue	↓
≥300	<1,000	Orange	↓
≥1,000		Purple	Highest hazard

Products not applicable to the CHARM model (i.e., inorganic substances, hydraulic fluids or chemicals used only in pipelines) are assigned an OCNS grouping A – E, with 'A' being the greatest potential environmental hazard and 'E' being the least (Table 8.9). Products that only contain substances termed PLONORs (Pose Little or No Risk) are assigned the OCNS 'E' grouping. Data used for the assessment includes toxicity, biodegradation and bioaccumulation.

OCNS incorporates "operational" chemicals/products which, through their mode of use, are expected in some proportion to be discharged. The scheme does not apply to chemicals that might otherwise be used on a ship, helicopter or other offshore structure. Products used solely within domestic accommodation areas (such as additives to potable water systems, paints and other coatings, fuels, lubricants, fire-fighting foams, hydraulic fluids used in cranes and other machinery) are also exempt.

Table 8.9. The OCNS non-CHARM environmental ranking system for inorganic substances

OCNS Grouping	Results from Aquatic Toxicity (mg/L)	Results for Sediment Toxicity (mg/L)	Hazard
A	<1	<10	Highest hazard
B	>1 – 10	>10 – 100	⇧
C	>10 – 100	>100 – 1,000	
D	>100 – 1,000	>1,000 – 10,000	
E	>1,000	>10,000	Lowest hazard

The Hazardous Material Risk Assessment form is used to ensure that the impacts and risks associated with offshore discharges are reduced to ALARP. The form includes a flow chart to assist in determining whether an environmental risk assessment is required to approve the material for use and discharge offshore (provided in Figure 8.3). This risk assessment process is described earlier in Section 8.19.1.

8.20 Product Stewardship, Conservation and Waste Management (HSEMS Standard 19)

This standard ensures that the lifecycle HSE impacts of Beach's products and services are assessed and communicated to customers and users to enable responsible usage management. Consumption of resources and materials is minimised as far as reasonably practicable. Wastes are eliminated, reduced, recycled and/or reused as far as reasonably practicable or disposed of appropriately.

To comply with this standard, the BassGas Waste Management Plan (CDN/ID 3974553) is in place, implemented and regularly reviewed and updated as required. A waste manifest is in place that records all waste removed off the Yolla-A platform for disposal to a licenced waste facility by a licenced waste handling contractor and is updated during each backloading event using a supply vessel.

The Beach Greenhouse Gas and Energy Efficiency Directive (14179854) outlines Beach's requirements for managing GHG emissions and energy efficiency. BassGas operations has NGER Act reporting obligations that are reported to the Clean Energy Regulator annually.

8.21 Audits, Assessments and Review (HSEMS Standard 20)

The audits, assessments and review standard ensures that HSE performance and systems are monitored and assessed through periodic reports and audits to identify trends, measure progress, assess conformance and drive continual improvement. Management system reviews are conducted to ensure the continuing suitability, adequacy and effectiveness of the HSEMS.

8.21.1 Environment Plan review

A member of the Beach Environment Team may determine that an internal review of the EP may be necessary based on any one or all of the following factors:

- Changes to hazards and/or controls identified in the review of the BassGas Offshore Impact and Risk Register, which in itself is supported by:
    - Reviewing changes to AMP management arrangements (through subscription to the AMP email update service at https://parksaustralia.gov.au/marine/about/).
    - Environment and industry legislative updates (through subscriptions to NOPSEMA, APPEA and legal firms).

  - Running a new EPBC Act PMST for the EMBA to determine whether there are newly-listed threatened species or ecological communities in the EMBA.
  - Remaining up to date with new scientific research that may impact on the EIA/ERA in the EP (for example, through professional networking and APPEA membership).
  - Remaining in regular contact with stakeholders.
- Annual review of the OPEP results in changes that need to be reflected in the EP;
- Annual environmental performance reporting identifies issues in the EP that require review and/or updating;
- Implementation of corrective actions to address internal or external inspection or audit findings;
- An environmental incident and subsequent investigation identifies issues in the EP that require review and/or updating;
- A modification of the activity is proposed that is not significant but needs to be documented in the EP;
- Changes identified through the MoC process, such as hazards or controls, organisational changes affecting personnel in safety critical roles or HSE management systems; and
- Changes to any of the legislation relevant to the offshore operations.

The Environment Team provides advice to the BassGas Production Manager on the material impact of the items listed above and whether or not a review of the EP should be undertaken. The scope of a review is determined by the factors that trigger the review and an appropriate team will be assembled by the Head of Environment to conduct the review. The team may consist of representatives from the Community, Engineering, HSE, Operations or Supply Chain teams as required by the scope.

All personnel can propose changes to HSE documentation via a register located in the Document Management System. If a review of the EP is initiated, then any proposed changes held in the register will also be considered by the review team.

If a review of the EP relates to a topic that had previously been raised by a stakeholder, an updated response to affected stakeholders will be prepared and provided to affected stakeholders in a process managed by the Community Relations Manager.

Revisions triggering EP re-submission

Table 8.10 outlines the regulations in place specifying when a revised EP must be submitted to the regulators.

Table 8.10. Commonwealth and Victorian OPGGS EP revision requirements

Regulations	OPGGS(E)	OPGGS Regulations
Regulator	**NOPSEMA**	**DJPR (ERR)**
Submission of a revised EP before the commencement of a new activity	Regulation 17(1)	Regulation 20(1)
Submission of a revised EP when any significant modification or new stage of the activity that is not provided for in the EP is proposed	Regulation 17(5)	Regulation 20(2)
Submission of a revised EP before, or as soon as practicable after, the occurrence of any significant new or significant increase in environmental impact or risk not provided for in the EP	Regulation 17(6)	Regulation 20(3)
At least 14 days before the end of each period of 5 years commencing on the day in which the original and subsequent revisions of the EP is accepted	Regulation 19(1)	Regulation 22(1)
Submission of a revised EP if a change in Titleholder will result in a change in the manner in which the environmental impacts and risks of an activity are managed	Regulation 17(7)	Regulation 20(4)

Revisions and re-submission of the EP generally centre around 'new' activities, impacts or risk and 'increased' or 'significant' impacts and risks. Beach defines these terms in the following manner:

- **New** impact or risk – one that has not been assessed in Chapter 7.
- **Increased** impact or risk – one with greater extent, severity, duration or uncertainty than is detailed in Chapter 7.
- **Significant** change –
  - The change to the offshore operations activity deviates from the EP to the degree that it results in new activities that are not intrinsic to the existing Activity Description in Chapter 3.
  - The change affects the ability to achieve ALARP or acceptability for the existing impacts and risks described in Chapter 7.
  - The change affects the ability to achieve the EPO and EPS contained in Chapter 7.

A change in the activities, knowledge, or requirements applicable to the BassGas operations are considered to result in a 'significant new' or 'significant increased' impact or risk if any of the following criteria apply:

- The change results in the identification of a new impact or risk and the assessed level of risk is not 'Low', acceptable and ALARP;
- The change results in an increase to the assessed level of risk for an existing impact or risk described in Chapter 7; and
- There is both scientific uncertainty and the potential for significant or irreversible environmental damage associated with the change.

While an EP revision is being assessed by NOPSEMA and/or DJPR (ERR), any activities addressed under the existing accepted EP are authorised to continue. Additional guidance is provided in NOPSEMA Guideline *When to submit a proposed revision of an EP* (N04750-GL1705, Rev 1, January 2017).

Minor EP Revisions

In accordance with the approach detailed in NOPSEMA's *EP Assessment Policy* (PL1347, Rev 6, April 2017), minor revisions to this EP that do not require resubmission to NOPSEMA will be made:

- Where minor administrative changes are identified that do not impact on the environment (e.g., document references, contact details, etc.).
- Where a review of the activity and the environmental risks and impacts of the activity do not trigger a requirement for a revision, as outlined in Table 8.10.

Minor revisions to the EP will not be submitted to the regulators for formal assessment. Minor revisions will be tracked in the document control system.

OPEP Review

In accordance with OPGGS(E) Regulation 14(8) and Regulation 17 of the OPGGS Regulations, the implementation strategy must ensure that the OPEP is kept up to date. A review of the OPEP occurs on an annual basis and is revised as required. Any of the following factors may trigger a revision of the OPEP:

- Changes to hazards and/or controls identified in the revision of the BassGas Offshore Impact and Risk Register;
- Changes to response and/or monitoring capability;
- Outcomes from annual testing of the response arrangements;
- Revision of emergency management procedures;
- When major changes that may affect the oil spill response coordination or capabilities have occurred;
- After an actual emergency if gaps are identified within the plan;
- Change in state or Commonwealth oil spill response arrangements and resources; and
- Before installing and commissioning new plant and equipment (if risk profile changes).

8.21.2 Ongoing environmental oversight

Oversight of the performance against the EPS outlined in this EP is provided as outlined in Table 8.11.

Table 8.11. Environmental oversight of BassGas operations

Method of environmental oversight	Frequency	Who
Calls with production team	Monthly	Senior Environment Advisor
Platform inspection (completion of checklist)	Weekly	PIC
Review of completed checklists	Quarterly	Senior Environment Advisor
Platform-based EP audit	Annually	Senior Environment Advisor
Incident-based investigations	As required	Senior Environment Advisor, Principal Environment Advisor

8.21.3 Annual EP performance audit

In addition to the ongoing environmental oversight, an annual performance report is prepared that details performance against the EPS in this EP. The information in the annual performance report is based on the information collected using the methods listed in Table 8.11. The EP performance report is issued to NOPSEMA and the DJPR (ERR).

8.21.4 Audit and inspection tracking

Any non-compliances or opportunities for improvement identified at the time of an inspection or audit are communicated to the relevant Beach personnel at the time of the inspection or audit. These are tracked in the OMS incident management system, which includes assigning responsibilities to personnel to manage the issue and verify that it is closed out.

Non-compliances and/or opportunities for improvement are communicated to BassGas personnel at appropriate meetings (listed in Table 8.3).

8.21.5 Inspections by the regulators

Under Part 5 of the OPGGS Act (Cth), NOPSEMA inspectors have the authority to enter Latatice premises, including the Yolla-A platform, to undertake monitoring or investigation against this EP. Similarly, the DJPR (ERR) has monitoring powers under Part 6.5 (specifically Section 649) of the OPGGS Act (Vic).

Beach will cooperate fully with the regulator/s during such investigations. NOPSEMA last undertook a scheduled office-based inspection against the BassGas Operations EP in mid-2019.

8.22 Summary of Implementation Strategy Commitments

Table 8.12 summarises the commitments provided throughout this Implementation Strategy by assigning EPOs, EPS and measurement criteria to each commitment.

Table 8.12.Summary of BassGas operations implementation strategy commitments.

Section	EPO	EPS	Measurement criteria
8.5.2	All records relevant to implementation of the EP are available for 5 years.	All records relevant to implementation of the EP are stored on OpenText.	Documents are readily accessible through OpenText.
8.6.1	Training and competency records are maintained.	The LMS records and tracks core and critical HSE and technical compliance training.	Training records, including the BassGas Workforce Capability Requirements Matrix, are readily accessible through the LMS.
		Due diligence is undertaken on contractors ensure they are competent to work on BassGas facilities.	Contractor due diligence reports are readily available and verify their suitability to work on the facilities.
8.6.3	All personnel working on Yolla-A and vessels associated with BassGas are familiar with their HSE responsibilities.	All personnel working on Yolla-A are inducted into BassGas HSE requirements.	Yolla-A crew and visitor lists, along with induction familiarisation checklists are readily available, verifying that all personnel working on and visiting the platform are inducted.
		All personnel working on the PSV and other vessels are inducted into BassGas HSE requirements.	Vessel crew lists, along with induction familiarisation checklists are readily available, verifying that all personnel working on the vessels are inducted.
		Environmental component of HSE induction is reviewed, and updated if required, after each EP revision.	The record of HSE induction reviews, and updates, aligns with the review and update records of the EP.
8.6.4	Platform- and office-based personnel are familiar with their emergency response responsibilities.	All relevant platform- and office-based personnel participate in OPEP and emergency response training, drills and exercises.	Training records, including the BassGas Workforce Capability Requirements Matrix, are readily accessible through the LMS.

Section	EPO	EPS	Measurement criteria
	The PSV and other vessel contractor personnel are familiar with their oil spill response responsibilities.	All vessel-based personnel participate in SMPEP training, drills and exercises.	Vessel training records are available and verify that relevant personnel are up to date with their training.
8.7	Platform- and office-based personnel are familiar with operations HSE issues.	Regular HSE communications take place between platform- and office-based personnel.	HSE meeting records are available and verify regularity of communications.
8.8	The BassGas impact and risk register is maintained current.	BassGas operations and environmental personnel contribute to the regular review and revision of the impact and risk register.	BassGas Offshore Impact and Risk Register is available and includes review and revision information.
8.9	Incident reports are issued to the regulators as required.	Recordable incidents reports are issued monthly to NOPSEMA.	Recordable and reportable incident reports and associated email correspondence is available to verify their issue to NOPSEMA and DJPR (ERR).
		Reportable incidents are reported to NOPSEMA and DJPR (ERR) in accordance with the timing requirements provided in Table 8.5.	
8.9.3	Incidents are investigated.	Incident investigations are undertaken by suitably qualified and experienced personnel in a timely manner.	Incident investigation reports are available and align with incidents recorded in the CMS incident management system.
8.10.1	An Annual EP Performance Report is submitted to the regulators.	The Annual EP Performance Report is issued each year to NOPSEMA and DJPR (ERR).	Annual EP Performance Reports and associated email correspondence is available to verify their issue to NOPSEMA and DJPR (ERR).
8.10.2	Emissions and discharges from Yolla-A, the PSV and other vessels are recorded.	Emissions and discharges from Yolla-A, the PSV and other vessels, in line with Table 8.6, are recorded.	Monitoring records are available and align with the requirements in Table 8.6.
8.12	Changes to approved plans (including this EP), equipment, plant, standards or procedures are assessed through the MoC process.	Changes are documented in accordance with the MoC Directive.	MoC records are available in the Stature database.
8.15	Platform- and office-based personnel are familiar with their ERP and OPEP responsibilities.	All relevant platform- and office-based personnel participate in annual ERP and OPEP training, drills and exercises.	Training records, including the BassGas Workforce Capability Requirements Matrix, verify that ERP and OPEP exercises are undertaken annually.
8.19	Risk assessments are undertaken for hazardous materials that are discharged offshore.	The handling, use and storage of hazardous materials and dangerous goods is assessed in a Hazardous Materials Risk Assessment.	Completed Hazardous Materials Risk Assessment forms are available.
8.20	Waste is managed such that non-routine discharges overboard are avoided.	A BassGas Waste Management Plan is in place and implemented to ensure that waste is appropriately managed.	Waste disposal records are in place and verify that relevant wastes are received onshore for disposal.
8.21.1	This EP is reviewed and updated on an as-required basis.	This EP is reviewed and updated based on the triggers presented in Section 8.21.1 on an as-required basis.	A record of EP reviews and updates is available in OpenText.
			The review and/or update details are recorded in the document control page of this EP.

Section	EPO	EPS	Measurement criteria
		If the review identifies that significant changes to the EP are required, the EP (and OPEP, if required) is updated and re-issued to the regulators.	A record of EP revision is included in the document control page of this EP.
			Associated correspondence is available to verify the re-issue of the EP to NOPSEMA and DJPR (ERR).
8.21.2	There is continuous environmental management oversight of BassGas operations.	Beach employs environmental personnel to ensure there is continuous environmental management oversight of BassGas operations.	Environmental meeting notes, annual EP performance reports and environmental inspection and audit reports are available and verify continuous environmental management oversight.

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