WHP and Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 Environment Plan

TM-50-PLN-I-00001

Rev 0

FACILITY	TM - Montara Field
REVIEW INTERVAL	60 Months

Rev No	Date	Approval		
		Owner	Reviewer	Approver
		Drilling & Wells Manager	Environment Lead	Country Manager
0	06-Jan-20	E. Lintott	M. Patt	O. Hobbs
		E. Lintott	M. Patt	O. Hobbs

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JADESTONE ENERGY (AUSTRALIA) PTY LTD
Level 8, 1 William Street, Perth, Western Australia 6000 | PO Box 5388 Perth WA 6000
Telephone: +61 8 9486 6600 Website: www.jadestone-energy.com (ACN: 613 671 819)

REVISION HISTORY

Revision	Author / Editor	Amendment
0	M. Patt	Prepared for assessment by NOPSEMA

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Acronyms and Abbreviations

Abbreviation	Description
AFZ	Australian Fishing Zone
AHV	Anchor handling vehicle
ALARP	as low as reasonably practicable
AMP	Australian Marine Parks
AMSA	Australian Maritime Safety Authority
AQIS	Australian Quarantine and Inspection Service
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
BCF	Bioconcentration factor
BIA	Biologically important areas
BOD	Biological oxygen demand
BOP	Blowout preventer
CAA	Civil aviation authority
CHARM	Chemical Hazard and Risk Management
CMMS	Computerised Maintenance Management System
DAH	Dissolved aromatic hydrocarbons
DAWR	Department of Agriculture and Water Resources (now DOA)
DBCA	Department of Biodiversity, Conservation and Attractions
DEC	Department of Environment and Conservation (now DBCA)
DEWHA	Department of the Environment, Water, Heritage and the Arts (now DoEE)
DIIS	Department of Industry, Innovation and Science
DMIRS	Department of Mines, Industry Regulation and Safety (previously Department of Mines and Petroleum, DMP)
DOA	Department of Agriculture
DoF	Department of Fisheries (now DPIRD)
DoEE	Department of the Environment and Energy
DP	Dynamically Positioned
DPaW	Department of Parks and Wildlife (now DBCA)
DPIRD	Department of Primary Industries and Regional Development (previously Department of Fisheries)
DSD	Department of Sustainable Development
DSEWPaC (now DoEE)	Department of Sustainability, Environment, Water, Population and Communities

Abbreviation	Description
DSV	Dive Support Vessel
dwt	Dry weight tonnes
EEZ	Economic Exclusion Zone
EH&S	Environmental Health & Safety
EMBA	Environment that may be affected
ENVID	Environmental hazard identification (process)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EP	Environment Plan
EPA	Environmental Protection Authority
EP Act	Environmental Protection Act 1986
EPO	Environmental performance outcome
EPS	Environmental performance standard
ESD	Emergency Shut-Down system
FPSO	Floating production storage and offtake (facility)
FRC	Fast response craft
HLO	Helicopter landing officer
HP	High pressure
HPU	Hydraulic power unit
H2S	Hydrogen sulphide
HSE	Health safety and environment
ICAO	International civil aviation organisation
ICCS	Interface central control system
ICD	Inflow control devices
IMCRA	Integrated marine and coastal regionalisation of Australia
IMO	International Maritime Organisation
IMPS	Introduced marine pest species
IMR	Integrity, maintenance and repair
ITF	Indonesian Throughflow (current)
IWC	International Whaling Commission
JEE	Jadestone (Eagle) Energy Pty Ltd
KEFs	Key Ecological Features
Kl	Kilolitre
KO	Knock out (drum)
Ksm^3	Thousand Standard Cubic Metres

Abbreviation	Description
LC50	Lethal concentration of a compound at which 50% of test species dies within a specified time frame
LAT	Lowest astronomical tide
LMS	Listed migratory species
LP	Low pressure
LSA	Low specific activity
MAOP	Maximum Allowable Operating Pressure
MARPOL	Marine pollution (legislation)
MCR	Marine Conservation Reserve
MDP	Montara Development Project
mg/L	Milligrams per litre
MGPS	Marine growth protection system
MMA	Marine Management Area
mmscfd	Million Standard Cubic Feet per Day
MODU	Mobile offshore drilling unit
MPRA	Marine Parks Reserves Authority
MSDS	Material safety data sheet
NCB	North Coast Bioregion
NEBA	Net Environmental Benefit Assessment
NES	National Environmental Significance
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NORMs	Naturally Occurring Radioactive Materials
NSF	Northern Shark Fishery
NWS	North-West Shelf
NWSTF	North-West Slope Trawl Fishery
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone Depleting Substances
OGP	Oil and gas producers (association)
OIM	Offshore Installation Manager
OIW	Oil-in-water
OPEP	Oil pollution emergency plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS (E) Regs	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009

Abbreviation	Description
OPMF	Onslow Prawn Managed Fishery
OSCP	Oil Spill Contingency Plan
OSMP	Operational and scientific monitoring plan
PAH	Polycyclic aromatic hydrocarbons
PHG	Pre-hydrated gel
PLONOR	Pose little or no risk
POB	Persons on board
PPD	Personal protection device
ppm	parts per million
PRS	Production Reporting System
PSZ	Petroleum safety zone
PTS	Permanent Threshold Shift
PW	Produced water
ROV	Remote Operated Vehicle
SBFTF	Southern Bluefin Tuna Fishery
SCM	Subsea control module
SCSSV	Surface controlled subsurface safety valve
SDS	Safety data sheet
SDU	Subsea distribution unit
SIL	Safety integrity level
SIMOPs	Simultaneous operations
SMP	Scientific monitoring program
SO2	Sulphur dioxide
SRB	Sulphur Reducing Bacteria
SSS	Side-Scan sonar
STP	Sewage Treatment Plant
SWL	Safe Working Load
TEMPSC	Totally enclosed motor propelled survival craft
TPH	Total petroleum hydrocarbons
TRSV	Tubing retrievable safety valve
TTS	Temporary Threshold Shift
UPS	Universal power supply
UV	Ultraviolet
VBSA	Vessel based support activity

Abbreviation	Description
VDU	Vacuum distillation unit
VOC	Volatile organic compounds
WA	Western Australia
WAF	Water accommodated fraction
WBM	Water based mud
WHCP	Wellhead hydraulic control panel
WHP	Wellhead platform
WSTF	Western Skipjack Tuna Fishery
WTBF	Western Tuna and Billfish Fishery
WOMP	Well Operations Management Plan

ENVIRONMENT PLAN SUMMARY

This Jadestone Drilling Activity Environment Plan Summary has been prepared from material provided in this Environment Plan and associated Oil Pollution Emergency Plan. The summary consists of the following as required by Regulation 11(4):

EP Summary material requirement	Relevant section of EP containing EP Summary material
The location of the activity	Section 2.1
A description of the receiving environment	Section 3 and Appendix B
A description of the activity	Section 2
Details of the environmental impacts and risks	Section 6 and 7
The control measures for the activity	Sections 6.1.3, 6.2.3, 6.3.3, 6.4.3, 6.5.3, 6.6.3, 6.7.3, 6.8.3, 7.1.3, 7.2.3, 7.4.3, 7.6.10 and 7.7.7.
The arrangements for ongoing monitoring of the titleholders environmental performance	Section 8.3
Response arrangements in the oil pollution emergency plan	Section 8.5 and Oil Pollution Emergency Plan
Consultation already undertaken and plans for ongoing consultation	Section 4 and Appendix C
Details of the titleholders nominated liaison person for the activity	Section 1.2

1. INTRODUCTION

1.1 Background

Jadestone Energy (Eagle) Pty Ltd (Jadestone Energy) plans to drill development well H6 in permit area AC/L7 in the Montara Field. The development well Skua-12 in permit area AC/L8 in the Skua Field, and workovers of H3 and Skua-10 within permit AC/L7 and AC/L8, are included in the drilling program as contingencies. All activities are within the Commonwealth waters of the Timor Sea, off northern Western Australia (Figure 1-1). The activities described are collectively referred to as the Drilling Activities.

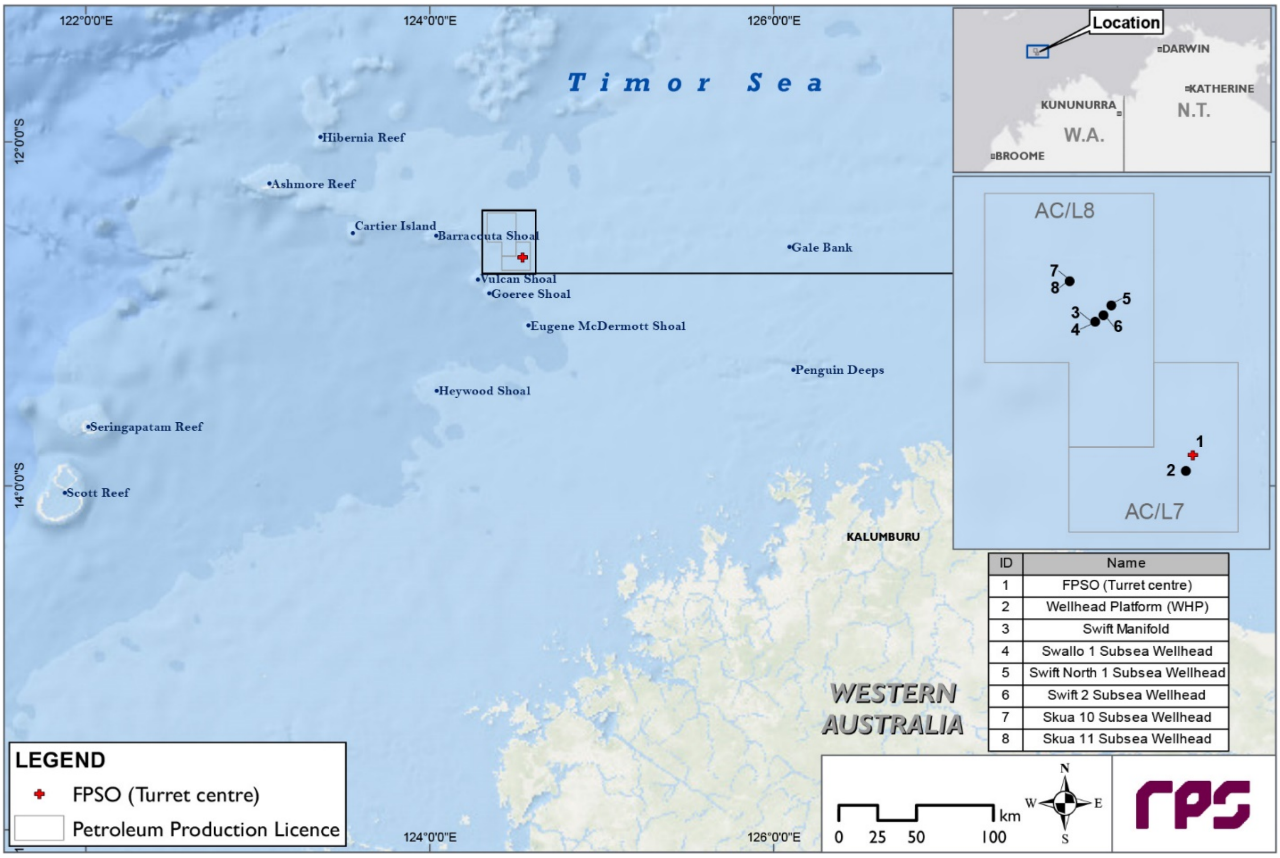


Figure 1-1: Location of the WHP, Subsea Fields AC/L7 and AC/L8 2020 Drilling Activities

1.2 Operator and Titleholder Details

Jadestone Energy is engaged in exploration, appraisal and pre-development activities in South East Asia, with a portfolio of ten exploration and pre-development assets. Jadestone Energy is an active operator within the region and the Company's principal focus is on assets in Australia, Indonesia, Vietnam and the Philippines. Jadestone Energy is the sole titleholder of production licences AC/L7 and AC/L8 with operational control of the drilling and workover activities.

Jadestone Energy's Australian office is located at:

Level 8, 1 William Street
Perth, Western Australia, 6000.
ACN 613 671 819

Jadestone Energy's contact for the WHP and Subsea Fields AC/L7 and AC/L8 2020 Drilling Activities 2020 is:

Ed Lintott, Drilling Manager
Phone: +61 8 9486 6600
Email: ed.lintott@jadestone-energy.com.au

In the event contact details for Jadestone Energy or the liaison contact change within the timeframe of this EP, the Regulator, the National Offshore Petroleum Safety and Environment Management Authority (NOPSEMA) will be advised of the updated details.

1.3 HSE Policy

Protecting the environment, valuing cultural heritage and maintaining open stakeholder communication are an integral part of Jadestone Energy's business approach. This is reflected in Jadestone Energy's HSE Policy (Figure 1-2) and this EP.

1.4 Legislative Framework

The Drilling Activities are located within the Commonwealth Petroleum Jurisdiction Boundary and therefore regulated under Commonwealth legislation; primarily under the OPGGS Act and the OPGGS(E) Regulations. In accordance with Regulation 13(4) of the OPGGS(E) Regulations, this section describes the Commonwealth legislation, international agreements and other relevant guidelines and codes of practice to the Drilling Program. In the unlikely event of an unplanned hydrocarbon release that migrates into state waters, WA or NT legislation will be triggered. Applicable Commonwealth and state legislation are listed in Appendix A, with key legislation summarised below:

Offshore Petroleum and Greenhouse Gas Storage Act 2006

The OPGGS Act and OPGGS(E) Regulations specify the requirements to manage the environmental impacts of petroleum activities. The Regulations require that an EP must be accepted by the regulatory authority (NOPSEMA) prior to commencing the proposed activity. NOPSEMA guidelines outline the requirements for the content of EPs.

Environment Protection and Biodiversity Conservation Act 1999

Under Commonwealth government streamlining arrangements, NOPSEMA's assessment of this EP provides consideration of the impacts to matters of national environmental significance (MNES) protected under Part 3 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This obviates the requirement to refer the project to the Department of the Environment and Energy (DoEE).

Ecologically Sustainable Development

Australia has developed a National Strategy for Ecologically Sustainable Development (ESD) (available at https://www.environment.gov.au/about-us/esd/publications/national-esd-strategy-part1), which identifies four principles and ways to apply them to a range of industry sectors and issues such as climate change, biodiversity conservation, urban development, employment, and economic activity, diversity and resilience. OPGGS(E) Regulation 3 states that any petroleum activity carried out in an offshore area is carried out in a manner consistent with the principles of Ecologically Sustainable Development (ESD) as set out in section 3A of the EPBC Act. These are listed below:

a. Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
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
c. 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
d. The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making, and
e. Improved valuation, pricing and incentive mechanisms should be promoted.

HEALTH, SAFETY & ENVIRONMENT POLICY

Respect Integrity Safety Results-oriented Sustainability Passion

VISION

At Jadestone, HSE performance is central to everything we do. Our vision is to ensure that health, safety and environmental performance is intrinsic to our business activities. We focus on those things that deliver top performance while eliminating waste. Together with our Shared Values, a focus on HSE performance provides a safe and rewarding work environment for our people, and achievement of sustainable business activities in our local and global communities.

EXECUTION

To achieve this Jadestone Energy Inc shall:

- Promote a strong HSE culture through visible leadership and an engaged, competent workforce aligned with Jadestone Shared Values
- Assess all risks and manage them to as low as reasonably practicable
- Maintain an ever-improving HSE management system through setting and monitoring performance targets to achieve our aims
- Take all necessary actions to prevent incidents, with an aspiration of targeting zero. Investigate and apply learnings
- Encourage and promote the ownership of HSE performance by all employees and contractors
- Ensure all contractor companies working with us have a management system that either equals or exceeds the company's own management system
- Manage and maintain plant, equipment and machinery to achieve required performance, safety and integrity
- Openly monitor, evaluate and report HSE performance, and communicate to all relevant stakeholders
- Comply with all regulatory requirements as a minimum

RESPONSIBILITY

Everyone who is engaged in work for Jadestone shall be familiar with this policy and its contents.

Everyone must take responsibility for ensuring their own safety, the safety of those around them, and the protection of the environment, by following Jadestone's policies and procedures. That includes taking all necessary precautions and immediately acting upon and reporting any HSE concerns they may have.

Everyone has the right to stop the job and a responsibility to intervene in work fronts or activities if they feel there is a risk to themselves, their workmates and to the environment.

A. Paul Blakeley
President & Chief Executive Officer

Figure 1-2: Jadestone Energy's HSE Policy (July 2019)

Jadestone Energy has incorporated the principles of ESD into the decision-making framework described in Section 5 and in the development of control measures and environmental performance outcomes proposed in Sections 6 and 7. Jadestone Energy believes that the commitments made within this EP demonstrate that the environmental management of the activity will be conducted in accordance of the principles of ESD.

Australia is signatory to several international environmental protection agreements and conventions which are relevant to the region, including for the protection of wetlands and environmental values. Australia is also a signatory to several international conventions of potential relevance to the activity, including:

- Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974 (Memorandum of Understanding Box);
- Convention on the Conservation of Migratory Species of Wild Animals 1979 (Bonn Convention);
- International Convention on Oil Pollution Preparedness, Response and Co-operation 1990;
- Protocol to International Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter 1996;
- International Convention for the Prevention of Pollution from Ships (MARPOL); and
- United Nations Convention on the Law of the Sea 1982.

A summary of conventions, standards, guidelines and policies relevant to the Drilling Activities is provided below in Table 1-1.

1.5 This Environment Plan

The Drilling Activities for the WHP and Subsea Fields AC/L7 and AC/L8 2020 Environment Plan (this EP hereafter) has been prepared in accordance with the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations) under the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (OPGGS Act) and as administered by NOPSEMA.

The objectives of this EP are to ensure that:

- All activities associated with the Drilling Program are planned and conducted in accordance with Jadestone Energy's Health, Safety and Environmental (HSE) Policy in Section 1.3;
- Potential adverse environmental impacts and risks associated with the proposed activities, during both routine and non-routine operations, are continually reduced to as low as reasonably practicable (ALARP) and of acceptable levels; and
- That the environmental performance outcomes (EPO) and environmental performance standards (EPS) outlined in this EP are met.

This EP contains the environmental impact assessment for the Drilling Program. The assessment aims to systematically identify and assess the potential environmental impacts and risks associated with the drilling activity and to stipulate mitigation measures to avoid and/or reduce any adverse impacts to the marine environment to ALARP and acceptable levels. The implementation of the EPOs specified within this document will provide Jadestone Energy with the required level of assurance that the activities are being managed in an environmentally responsible manner.

NOPSEMA's Guidance Note for Environment Plan Content Requirements (GN-1344; Rev 4, April 2019) was referred to in the preparation of this EP.

Table 1-1: Summary of Applicable International Conventions, Industry Standards, Guidelines and Policy Documents

Guideline	Description
Australian and New Zealand guidelines for fresh and marine water quality (online guidance tool, 2018 revision)	These guidelines provide a framework for water resource management and state specific water quality guidelines for environmental values, and the context within which they should be applied.
Australian Ballast Water Requirements, Version 7, 2017	Australian Ballast Water Management Requirements outline the mandatory ballast water management requirements to reduce the risk of introducing harmful aquatic organisms into Australia's marine environment through ballast water from international vessels. These requirements are enforceable under the *Biosecurity Act 2015*.
Australian Marine Parks	Australian Marine Parks are established by proclamation under the *EPBC Act* for the purpose of protecting and maintaining biological diversity in the parks. An environment plan (EP) must be consistent with the Australian Marine Park Management plans. In all cases where an activity has potential to impact or present risk to AMPs, regardless of whether the activity is inside or outside a park, the EP should evaluate how these impacts and risks will be of an acceptable level and reduced to as low as reasonably practicable (ALARP).
Bilateral Agreements on the Protection of Migratory Birds	Australia has negotiated bilateral agreements with Japan (Japan-Australia Migratory Birds Agreement [JAMBA], 1974), China (China-Australia Migratory Birds Agreement [CAMBA], 1986) and the Republic of Korea (Republic of Korea – Australia Migratory Birds Agreement [ROKAMBA], 2007) to protect species of migratory birds with international ranges. In November 2006, the East Asian-Australasian Flyway Partnership (Flyway Partnership) was launched in order to recognise and conserve migratory waterbirds in the East Asian – Australasian Flyway for the benefit of people and biodiversity.
Bonn Agreement for Cooperation in Dealing with Pollution of the North Sea by Oil and other harmful substances (Bonn Agreement)	The Bonn Agreement is the mechanism by which the North Sea states, and the European Union (the Contracting Parties), work together to help each other in combating pollution in the North Sea area from maritime disasters and chronic pollution from ships and offshore installations; and to carry out surveillance as an aid to detecting and combating pollution at sea. The Bonn Agreement Oil Appearance Code (BAOAC) may be used during spill response activities.
Convention on Biological Diversity (1992)	The objectives of the convention are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.
EPBC Act-related guidelines	Relevant guidelines/policies and marine bioregional plans are considered in the management of impacts and risks
International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) 2004	The International Convention for the Control and Management of Ships Ballast Water and Sediment entered into force on 8th September 2017 (IMO Briefing 22 2016). It aims to prevent the spread of harmful aquatic organisms from one region to another, by establishing standards and procedures for the management and control of ships' ballast water and sediments. Ballast Water Management systems must be approved by the Administration in accordance with this IMO Guidelines.
International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL 73/78)	This convention is designed to reduce pollution of the seas, including dumping, oil and exhaust pollution. MARPOL 73/78 currently includes six technical annexes. Special areas with strict controls on operational discharges are included in most annexes.
International Convention for the Safety of Life at Sea (SOLAS) 1974	In the event of an offshore emergency event that endangers the life of personnel, the International Convention for the Safety of Life at Sea (SOLAS) 1974 may take precedence over environmental management.
International Convention on Civil Liability for Oil Pollution Damage (1969)	The convention and the associated International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1971 set up a system of compulsory insurance and strict liability up to a certain figure for damages suffered as a result of an oil spill accident.
International Convention on Oil Pollution Preparedness, Response and Co-operation (1990)	This convention sets up a system of oil pollution contingency plans and cooperation in fighting oil spills.
International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001	This convention prohibits the use of harmful organotin in anti-fouling paints used on ships and establishes a mechanism to prevent the potential future use of other harmful substances in anti-fouling systems.
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (1969)	The convention gives States Parties powers to intervene on ships on the high seas when their coastlines are threatened by an oil spill from that ship.
London (Dumping) Convention (1972)	Dumping at sea is regulated by the convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter 1972 (the 'London Convention'). Article 4 provides a general prohibition on dumping of wastes except as specified in the Convention. The convention has annexed to it two lists of substances, the 'black list' of substances which may not be dumped at all, and the 'grey list' of substances which may only be dumped under a specific permit.

Guideline	Description
Marine Bioregional Plans	Marine bioregional plans are identified and considered in Section 3. Key Ecological Features (KEF) are elements of the Commonwealth marine environment that are considered to be of regional importance for either a region's biodiversity or its ecosystem function and integrity. Five KEFs intersect with the EMBA: • Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters; • Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex; • Continental Slope Demersal Fishery; • Ancient Coastline at 125 m Depth Contour; and • Carbonate Bank and Terrace System of the Sahul Shelf.
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia 2009)	A voluntary biofouling management guidance document developed under the National System for the Prevention and management of Marine Pest Incursions. Its purpose is to provide tools to operators to minimise the amount of biofouling accumulating on their vessels, infrastructure and submersible equipment and thereby to minimise the risk of spreading marine pests.
NOPSEMA OPGGS Act-related guidelines	NOPSEMA guidelines applicable to the H6 and Skua-12 Drilling Program include: • NOPSEMA Guidance note: Environment plan content requirements (N04750-GN1344 Rev 4, April 2019); • NOPSEMA Guidance note Environment plan decision-making guideline – Criterion-10A(g) Consultation requirements (N-04750-GL1721629 Rev 51, November June 20186); • NOPSEMA Guidance note: Oil pollution risk management (GN1488 Rev 2 February 2018); • NOPSEMA Guidance note: Notification and Reporting of Environmental Incidents (N-03000-GN0926 Rev 4, 28 February 2014); • NOPSEMA Guidance note: Petroleum activities and Australian Marine Parks (N-04750-GN 1785 Rev 0, 16 July 2018); • NOPSEMA bulletin: Oil Spill modelling (Bulletin #1, April 2019) • National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia, 2009); • Australian Ballast Water Management Requirements (Rev 7, Department of Agriculture and Water Resources 2017). • Australian and New Zealand guidelines for fresh and marine water quality (ANZECC/ARMCANZ 2000) Relevant guidelines/ policies are considered in the management of impacts and risks.
Plans of management for: - World Heritage properties, - Commonwealth/National Heritage places	Sites accepted to the World Heritage listing are only inscribed if considered to represent the best examples of the world's cultural and natural heritage. There are no World Heritage properties that intersect with the EMBAs. The Commonwealth Heritage List is a list of natural, Indigenous and historic heritage places owned or controlled by the Australian Government. There are two Commonwealth Heritage places that intersect with the EMBAs; Ashmore Reef National Nature Reserve and Christmas Island Natural Areas. The National Heritage list is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation. No National Heritage properties intersect with the EMBAs.
Ramsar wetland ecological character descriptions	There are no Ramsar wetlands that have coastal boundaries intersecting with the EMBAs.
Species Profile and Threats Database (DoEE 2019) https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl	This database has been used in Section 3 and Appendix B as a source of information on the receptors. Information accessed has included species details such as habitat, movements, feeding, reproduction and taxonomic comments. Noting that profiles are not available for all species and ecological communities. Results of searching this database are found within Appendix D and Appendix E.
The Australian Petroleum Production and Exploration Association (APPEA) Code of Environmental Practice (APPEA 2008)	In Australia, the petroleum exploration and production industry operate within an industry code of practice developed by the Australian Petroleum Production and Exploration Association (APPEA); the APPEA Code of Environmental Practice (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 Code of Practice 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. The 'offshore 'drilling operations' section of the Code is of relevance. As an APPEA member, Jadestone Energy adheres to this Code of Environmental Practice when undertaking offshore drilling activities.
The Conservation Values Atlas (DoEE 2019) https://www.environment.gov.au/topics/marine/marine-bioregional-plans/conservation-values-atlas)	The Conservation Values Atlas has been developed by the Commonwealth Government. This is used for the identification of Biologically Important Areas (BIA), KEFs etc. which have been presented in the Section 3 and considered in the assessment of impacts and risks in Sections 6 and 7. BIA's are identified by the Commonwealth government, are spatially defined areas where aggregations of individuals of a species are known to display biologically important behaviour, such as breeding, foraging, resting or migration.

Guideline	Description
United Nations Convention on the Law of the Sea (UNCLOS) (1982)	Part XII of the convention sets up a general legal framework for marine environment protection. The convention imposes obligations on State Parties to prevent, reduce and control marine pollution from the various major pollution sources, including pollution from land, from the atmosphere, from vessels and from dumping (Articles 207 to 212). Subsequent articles provide a regime for the enforcement of national marine pollution laws in the many different situations that can arise. Australia signed the agreement relating to the implementation of Part XI of the Convention in 1982, and UNCLOS in 1994.
United Nations Framework Convention on Climate Change (1992)	The objective of the convention is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous interference with the climate system. Australia ratified the convention in December 1992, and it came into force on 21 December 1993.
Vienna Convention on the Protection of the Ozone Layer (1985) and the Montreal Protocol; on Substances that Deplete the Ozone Layer (1987)	The Convention (ratified by Australia in 1987) and the Protocol (ratified in 1989) concern the phasing out of ozone depleting substances.

2. ACTIVITY DESCRIPTION

2.1 Location

The Montara Development Project (MDP) includes developing the Montara, Swift, Skua and Swallow fields and operating the developed facilities for commercial production of the oil reserves. The MDP lies approximately 690 km (373 nautical miles) east of Darwin in a water depth of approximately 80 m (LAT) (Figure 2-1) in Commonwealth waters of the Timor Sea (Table 2-1).

This EP encompasses drilling activities for one development well (platform well H6 within Production Licence AC/L7) and contingencies for another development well as part of the MDP (subsea well Skua-12 within the Production licence AC/L8), as well as the workovers of H3 and Skua-10 in Production Licence AC/L7 and AC/L8 respectively.

Table 2-1: Location of activities

Site	H6 (surface well)	Skua-12 (subsea well)	Skua 10 workover (subsea well)	H3 workover (surface well)
Field	Montara	Skua	Skua	Montara
Licence/Permit	AC/L7	AC/L8	AC/L8	AC/L7
Water depth m	78	80	80	78
Location	12° 40' 20.472'' S 124° 32' 22.297'' E	12° 29’ 43.452” S 124° 25’ 16.855” E	12° 30’ 04.605” S 124° 25’ 05.381” E	12° 40' 20.548'' S 124° 32' 22.162'' E

The locations of key environmental sensitive receptors in closest proximity to the drilling activities Operational Area are provided in Table 2-2.

Table 2-2: Locations of key sensitive receptors in relation to the *Montara Venture* FPSO

Sensitive receptor	Approx. distance from the Operational Area (km)
Goeree Shoal	28
Vulcan Shoal	28
Eugene McDermott Shoal	40
Barracouta Shoal	39
Cartier Island	92
Hibernia Reef	126
Ashmore Reef	147
Cassini Island	181
Browse Island	187
Long Reef	188
Mainland Australia	211
Rote Island (Indonesia)	239
West Timor	244
Seringapatam Reef	288

Sensitive receptor	Approx. distance from the Operational Area (km)
Sandy Islet (Scott Reef)	322
Scott Reef	322
East Timor	339
Savu Island (Indonesia)	351
Flores Island (Indonesia)	486
Sumba Island (Indonesia)	474

2.2 Timing and Duration

The drilling and workover activities are scheduled to commence during Q2 of 2020 and are likely to last for a period of approximately 150 days in total, however timings are subject to weather, drilling vessel availability and operational efficiency. Therefore, this EP validity period for the drilling of H6 and Skua-12 wells and undertaking the H3 and Skua-10 workovers, is from June 2020 to June 2021. Once accepted, Jadestone Energy will be permitted to drill these wells and complete the workovers at any time during this period.

2.3 Petroleum Safety Zone (PSZ)

Once the MODU is on site at the drilling and workover locations, a 500 m radius Petroleum Safety Zone (PSZ) will be gazetted as an exclusion zone around the MODU and will be formally advised to other marine users, via the Notice to Mariners.

Note other PSZs already existing in the MDP area extend 500 m around the following Montara infrastructure:

- FPSO submerged turret production;
- Well head platform;
- Swallow 1 subsea wellhead and Swift manifold (combined);
- Swift North 1 subsea wellhead;
- Swift 2 subsea wellheads; and
- Skua 10 and Skua 11 subsea wellhead (combined).

Pursuant to Section 616 of the OPGGSA, all vessels other than those under the control of Jadestone Energy or authorised by Jadestone Energy, are prohibited from entering or being present in the area of the PSZs.

A cautionary zone of 2.5 NM radius is maintained around the WHP, FPSO and subsea structures including the pipelines. This information has been notated on Admiralty Charts covering the region (#314), and although vessels are requested to avoid navigating, anchoring and fishing, it is not an exclusion zone.

2.4 Operational Area

The Operational Area is defined as a 2 km Restricted Zone around the MODU when at Skua-12 and Skua-10 (production license AC/L7) and at H6 and H3 near the Montara WHP (production Licence AC/L8) (Figure 2-1).

When the MODU and vessels are outside the PSZ and Operational Area and remain within Australian waters (e.g. transiting to or from location or holding position outside the PSZ), they fall under the regulatory jurisdiction of the Australian Maritime Safety Authority (AMSA) under the *Navigation Act 2012*. Accordingly, this EP does not cover activities performed by the support vessels while outside the PSZ and Operational Area; however, this EP does cover oil spill response activities outside the PSZ and Operational Area.

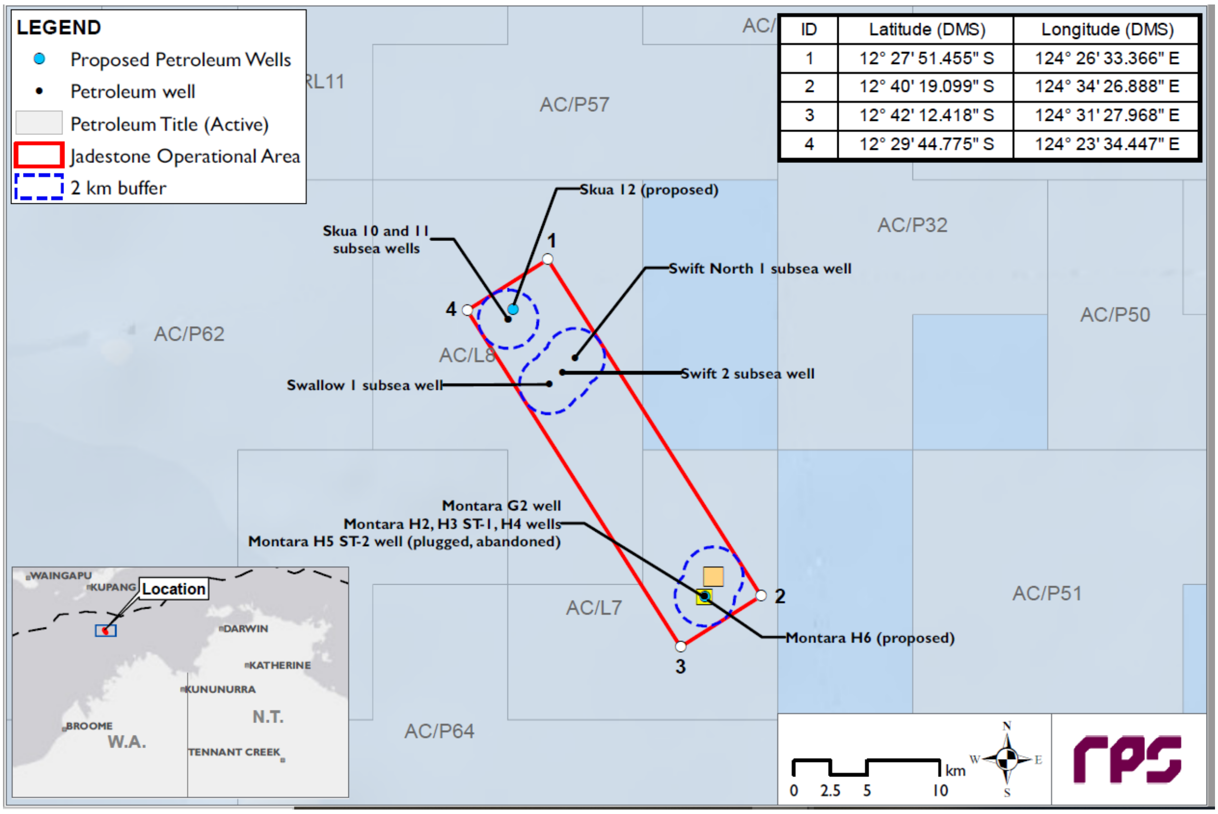


Figure 2-1: Operational Area for the Drilling Activities

2.5 MODU

The mobile offshore drilling unit (MODU) used to drill the wells and undertake the workovers is yet to be contracted. The MODU will be a 'jack up' drilling MODU towed to the drilling sites by support vessels. The Skua-12 site is an undisturbed site approximately 20 km from the Montara WHP and the Skua-10 site is an existing well, while the H6 development well and H3 workover will be undertaken when the MODU is positioned alongside the Montara WHP (Figure 2-2); the MODU will cantilever the drill floor over the WHP to allow positioning the MODU's drill centre over the H6 and H3 slots.

Figure 2-2: Positioning the MODU alongside a Wellhead Platform

The MODU, (Jack-Up), similar to the MODUs used in previous Montara campaigns, can operate in water depths of up to 122 m and drill to depths of up to 10,700 m. Typical maximum number of berths provides for approximately 120 persons onboard (POB).

2.6 Montara Development Project (MDP) Infrastructure

As described in the Montara Operations Environment Plan (MV-90-PLN-I-00001), the MDP consists of the following existing infrastructure and key location coordinates (Table 2-3):

- Unmanned WHP with six (6) well slots, five existing wells, three 14-inch production risers, two 6-inch gas lift risers and one 12-inch umbilical J-tube;
- Five subsea wells for development of the Skua, Swift and Swallow fields;
- Production flowline system: two 6-inch, one 10-inch, three 14-inch flowlines and associated tie-in spools;
- Gas lift flowline system - one 6-inch and three 4-inch flowlines and associated tie-in spools;
- Five infield hydraulic control umbilicals and associated flying leads;
- Four infield electrical control umbilicals and associated flying leads;
- One Inter-facility utility umbilical (FPSO-WHP);
- A subsea manifold (Swift field) for comingling production fluids and distributing the compressed gas and electro-hydraulic services to the subsea wells;
- An FPSO facility and associated mooring system. Two 10-inch Flexible Production Risers and associated riser bases. One 6-inch Flexible Gas Lift Riser and associated riser base. Two control umbilicals and associated riser bases;
- Support/supply vessels, work vessels and tugboats supporting third-party offtake tanker movement, facility logistics, maintenance and provisioning; and
- Helicopter support.

Table 2-3: Montara Development Project Infrastructure Coordinates (Surface) (GDA 94, Zone 51)

Well and Infrastructure Locations	Latitude (South)	Longitude (East)
Montara Venture FPSO (Turret centre)	12° 39' 35.3”	124° 32' 41.1”
Wellhead Platform	12° 40' 20.5”	124° 32' 22.2”
Swallow 1 Subsea well	12° 32' 29.5”	124° 26' 36.8”
Swift North 1 Subsea well	12° 31' 29.9”	124° 27' 33.7”
Swift-2 Subsea well	12° 32' 3.6”	124° 27' 6.0”
Skua 10 Subsea well	12° 30' 4.6”	124° 25' 5.4”
Skua 11 Subsea well	12° 30' 4.6”	124° 25' 5.6”
Montara H5 ST-2 well	12° 40’ 20.466”	124° 32’ 22.320”
Montara H4 well	12° 40’ 20.547”	124° 32’ 22.321”
Montara H3 ST-1 well	12° 40’ 20.548”	124° 32’ 22.162”
Montara H2 well	12° 40’ 20.548”	124° 32’ 22.241”
Montara G2 well	12° 40’ 20.466”	124° 32’ 22.320”

The Montara development consists of subsea and platform wells. Apart from the differences in wellhead and Xmas tree designs, the basic well construction is similar. The subsurface completion consists of the wellbore drilled to penetrate the oil-bearing sands, and all equipment items installed within the wellbore are designed to allow well fluids to be produced in a safe and controlled manner. These items include the steel casing liner cemented into the wellbore. The casing of the wellbore serves several purposes:

- To prevent deterioration of the hole, e.g. caving-in, swelling, washouts;
- To effectively isolate formations penetrated while drilling and hence prevent crossflow of fluids from higher to lower pressure zones;
- To provide a sealed passage for flow of well fluids to the production tubing. The production casing and/or liner are the only sections that are exposed to the well fluid. This is important in avoiding leakage of well fluids to the surface from outside of the wellbore; and
- To provide pressure integrity for gas-lift and well killing.

The production string consists of production tubing, flow control valves, isolation packers, landing nipples, sand excluder/control screens and other specialised equipment to provide a flow path for the reservoir fluids to the wellhead.

The Montara operations activity was granted EPBC Act approval in 2003 by the Commonwealth Environment Minister through the then Department of Environment and Heritage (DEH) subject to certain conditions (EPBC 2002/755) which were varied in December 2012 by the Commonwealth Minister for Sustainability, Environment, Water, Population and Communities (DSEWPaC), now Department of Environment and Energy (DoEE).

More recently, a number of the approval conditions were redacted resulting in a consolidated approval notice that contains a number of conditions relating to the Montara operations activities. A list of the conditions relevant to the operations activities is provided in Appendix G.

2.7 Hydrocarbons

The Montara and Skua crudes are described briefly below. More detail is provided in Section 7.6.2 and in the OPEP Appendices A5 and A6.

2.7.1 Montara crude oil

Montara crude is a medium crude oil. The oil is characterised by a low viscosity (4.5 cP) and a medium density of 845 kg/m^3 (API 35.8) categorising it as a Group III oil in accordance with the International Tanker Owners Pollution Federation (ITOPF 2011). Based on oil assay data available, approximately 27% (by volume) of the Montara crude would be considered persistent hydrocarbons under international oil property benchmarks.

2.7.2 Skua crude oil

Skua crude is a medium crude oil. The oil is characterised by a low viscosity (3.114 cSt at 20^{o}C) and a medium density (15^{o}C) of 815 kg/m^3 (API 41.9) categorising it as a Group II oil in accordance with the International Tanker Owners Pollution Federation (ITOPF 2011).

2.8 MODU positioning

The activities associated with moving the MODU into the field and setting up on location are detailed in a campaign-specific MODU Move Plan.

A summary of activities when positioning the MODU at the WHP are as follows:

- A series of preparations will be made at the Montara WHP prior to the MODU arriving and heavy lift operations taking place. Key activities conducted prior to the MODU move include shutdown status of the WHP during various MODU move phases. As a minimum, the WHP facilities will be shut in with normal production suspended, when there is an increased risk of structural collision with the MODU, such as during final MODU move on (within soft-pin location) and during MODU preload;

- The MODU will obtain approval from the Montara OIM prior to moving within 1 km of the Montara WHP;
- The MODU will do a soft touchdown (rest on seabed with limited down weight) at a suitable distance from the Montara WHP;
- Three support vessels will be used to assist in positioning the MODU at Montara WHP;
- The MODU will be pre-loaded in accordance with the operator preload procedures to test seabed stability;
- The MODU will jack-up to its working height alongside the WHP. Upon positioning, the MODU has three legs (each approximately 169 m in length) that are lowered to the sea floor, so the working platform remains elevated above the water surface. The bases of the legs are each fitted with a 'spud can' (each 18 m in diameter) that sit on the seabed, and due to the heavy weights applied, penetrate the surface sediments to provide stability for the drilling MODU;
- The MODU will then skid the cantilever deck across the WHP top deck until the rotary table is centred above the H6 or H3 well slots; and
- On completion of drilling, the cantilever will be skidded back, the MODU will "hull-down" the legs until afloat, the legs will be lifted, and the MODU will be towed off location.

A summary of activities when positioning the MODU at the subsea drilling locations are as follows:

- Any subsea wells or infrastructure within 100 m of the planned location will shut in and be depressured prior to arrival or departure of the MODU, and repressured when appropriate in accordance with the Matrix of Permitted Operations;
- The MODU will obtain approval from the Montara OIM prior to moving within 1 km of the planned location;
- Two/three support vessels will be used to assist positioning the MODU at the planned location;
- The Surveyor and tow master will confirm the location is within the required tolerance;
- All three legs will be jacked down simultaneously and the MODU preloaded in accordance with the Operator's preload procedures;
- The MODU will jack-up to its working height (+/- 35m above sea level). The bases of the legs are each fitted with a 'spud can' (each 18 m in diameter) that sit on the seabed, and due to the heavy weights applied, penetrate the surface sediments to provide stability for the drilling MODU;
- The MODU will then skid the cantilever deck across until the rotary table is centred above the required location; and
- On completion of drilling, the cantilever will be skidded back, the MODU will "hull-down" the legs until afloat, the legs will be lifted, and the MODU will be towed off location.

2.9 Drilling Activity

The workover plans for H3 and Skua-10, and well designs for H6 and Skua-12 will be finalised in the Well Operations Management Plans (WOMP), which are to be accepted by NOPSEMA prior to commencement of drilling. Provided below is a summary for each of the activities.

2.9.1 H3 Workover

The H3 workover is estimated to take 20 days. Scheduling of activities may be subject to delays (e.g. due to weather and MODU availability). The workover activities detailed below provide the basis for identifying environmental impacts associated with the well activities and implementation of mitigation measures. A summary of the workover activities is detailed below:

- Move jack-up MODU onto platform, establish services and safety systems;
  - Hook up to well and kill the well using a brine mix;
  - Pull Xmas tree and run the BOP;
  - Pull upper completion;
  - Repair 9 5/8” casing;
  - Run upper completion and pressure test;
  - Pull BOP and re-run Xmas tree; and
  - Flow well to FPSO.

The H3 well design and casing schematic, showing the interval and casing details for each hole section, is shown in Figure 2-3.

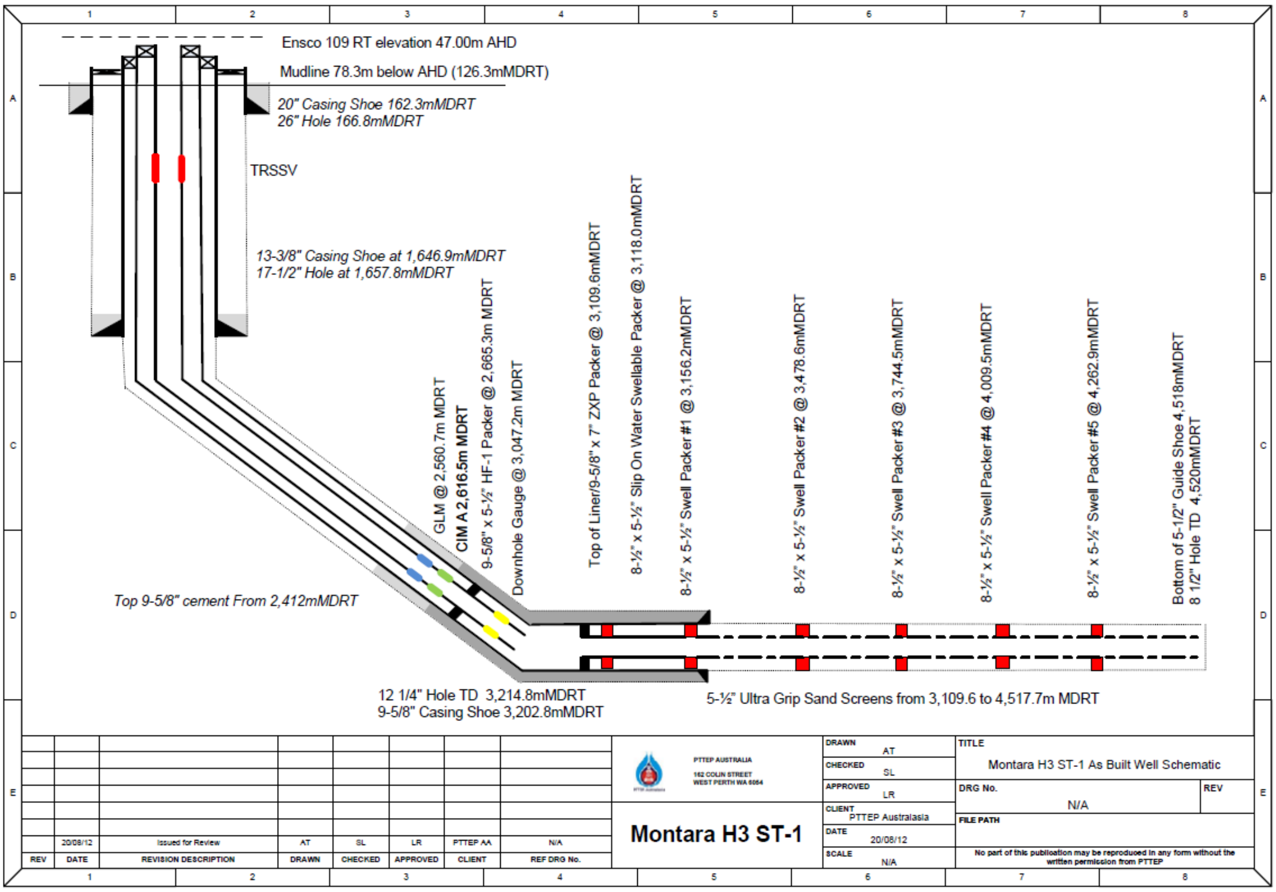


Figure 2-3: H3 Well Schematic

The planned discharges during the workover are described below:

- Operations first isolate the well from the production system and hand the well over to Drilling. This may require bleed off and venting of hydrocarbons to atmosphere;
- It is possible gas will be bled down from the A annulus and from behind the packer tailpipe during the workover, this gas will be vented;
- The wellbore clean-up fluids used will include seawater, brine, viscous pills, acid soaking and a surfactant. Fluids are discharged overboard (refer to Section 6.6 for volumes);

- The brine returned from the well with an oil in water content greater than 15 ppm will be treated on the MODU. When the oil in water content is less than 15 ppm the brine will be discharged to the sea;
- The components recovered with the upper completion string will be returned to shore where they may either be subject to diagnostics, inspection or disposal; and
- Entry into the well using slickline/ wireline to perform intervention activities. Small volumes of gas (approximately 100 scf (<3 m^3)) may be vented to atmosphere from pressure control equipment during slickline runs.

2.9.2 Skua-10 workover

The Skua-10 workover is estimated to take 20 days. Scheduling of activities may be subject to delays (e.g. weather and MODU availability). The workover activities detailed below, provide the basis for identifying environmental impacts associated with the well activities and implementation of mitigation measures.

The Skua-10 well design and casing schematic, showing the interval and casing details for each hole section is shown in Figure 2-4 . The workover activity sequence may change depending upon well diagnostic work; hence the most likely workover activities are summarised below:

- Move jack-up MODU over well, establish services and safety systems;
- Install high pressure riser and BOP, retrieve internal tree cap;
- Install landing string with slickline pressure containing equipment (PCE), retrieve lower crown plug;
- Run leak detection logging tool;
- Bullhead kill the well down the tubing and remove gas from A annulus;
- Release packer and pull upper completion;
- If packer fails to release, cut tubing above packer and pull upper completion;
- If tubing is cut, possibly mill packer and retrieve packer and tailpipe;
- Install 9-5/8 inch isolation plugs, nipple down BOP, retrieve xmas tree and nipple up BOP;
- Replace 9-5/8 inch casing hanger seal assembly and pressure test;
- Nipple down BOP, install xmas tree, nipple up BOP and retrieve 9-5/8 inch casing plugs;
- Install upper completion and pressure test;
- Install internal tree cap, nipple down BOP and riser, install debris cap; and
- MODU down and move off location.

Alternative workover scenarios include installing casing patches internal to the 9-5/8 inch casing and in a worst case, suspend the well.

The planned discharges during the workover are described below:

- The first part of the workover will be for Operations to isolate the well from the production system and hand the well over to Drilling. This may require bleed off and venting of hydrocarbons to atmosphere;
- Gas will be bled down from the A annulus and from behind the packer tailpipe during the workover, and the gas will be vented;
- The wellbore clean-up fluids used will include seawater, brine, viscous pills, acid soaking and a surfactant. Fluids are discharged overboard (refer to Section 6.6 for volumes);
- The brine returned from the well with an oil in water content greater than 15 mg/L will be cleaned to less than 15 mg/L and discharged to the sea;

- The components recovered with the upper completion string will be returned to shore where they may either be subject to diagnostics, inspection or disposal; and
- Entry into the well using slickline / wireline to perform intervention activities. Small volumes of gas (approximately 100 scf (<3 m^3)) may be vented to atmosphere from pressure control equipment during slickline runs.

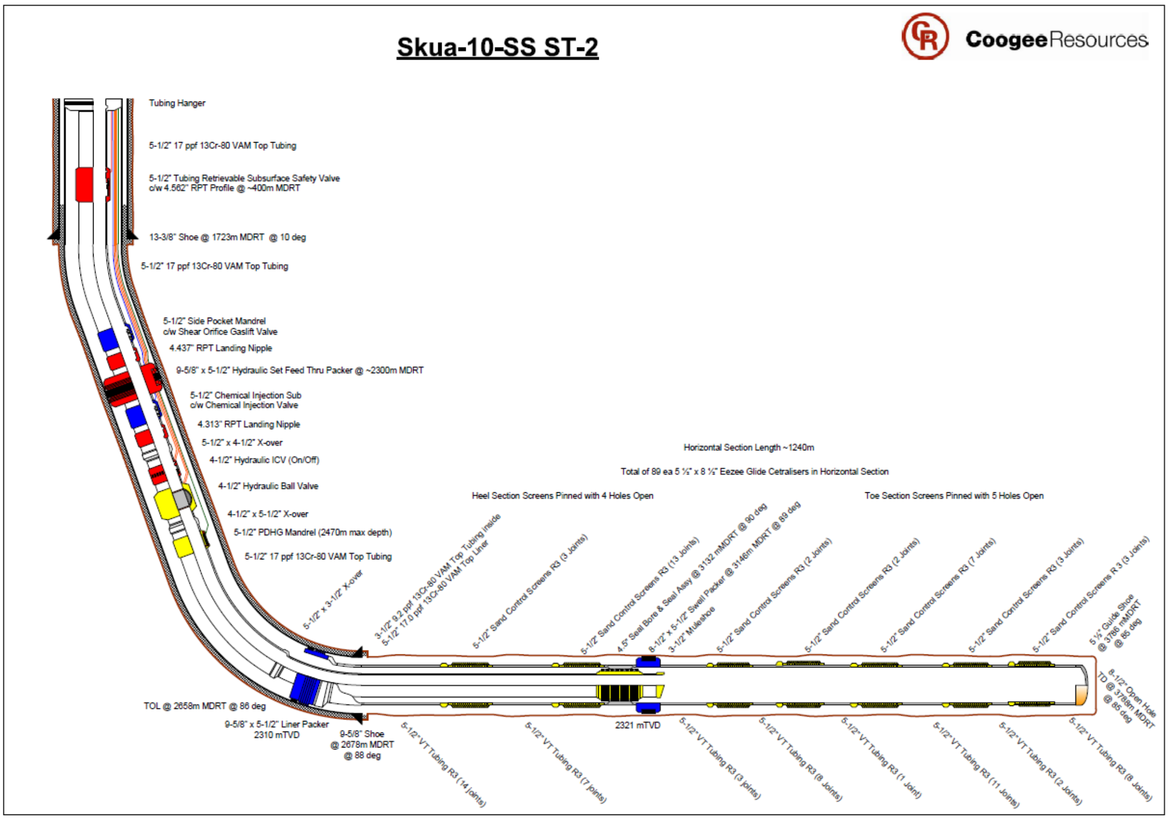


Figure 2-4: Skua-10 Well Schematic

2.9.3 H6 Well

Drilling of the Montara H6 well is estimated to take 80 days. Scheduling of activities may be subject to delays (e.g. weather and MODU availability). The drilling activities, detailed below, provide the basis for identifying environmental impacts associated with the drilling activities and implementation of mitigation measures.

A preliminary well design and casing schematic, showing the interval and casing details for each hole section is shown in Figure 2-5. A summary of the proposed drilling activities is detailed below:

- Skid MODU across the WHP from H3 well slot;
- Drill 26” hole and run 20” conductor;
- Drill 17 ½” hole and run 13 3/8” casing;
- Installation of drilling BOPs;
- Drill directional 12 ¼” hole, then run and cement the 9 ⅝” production casing;
- Drill directional 8 ½” hole, then run and cement the 7” production liner;
- Drill 6 1/8” horizontal hole section;
- Run the lower 4” sand-screen completion and hang off on packer;
- Run the upper 3½” x 5½” completion;

- Suspend the well and install the Xmas Tree; and
- Move MODU off location.

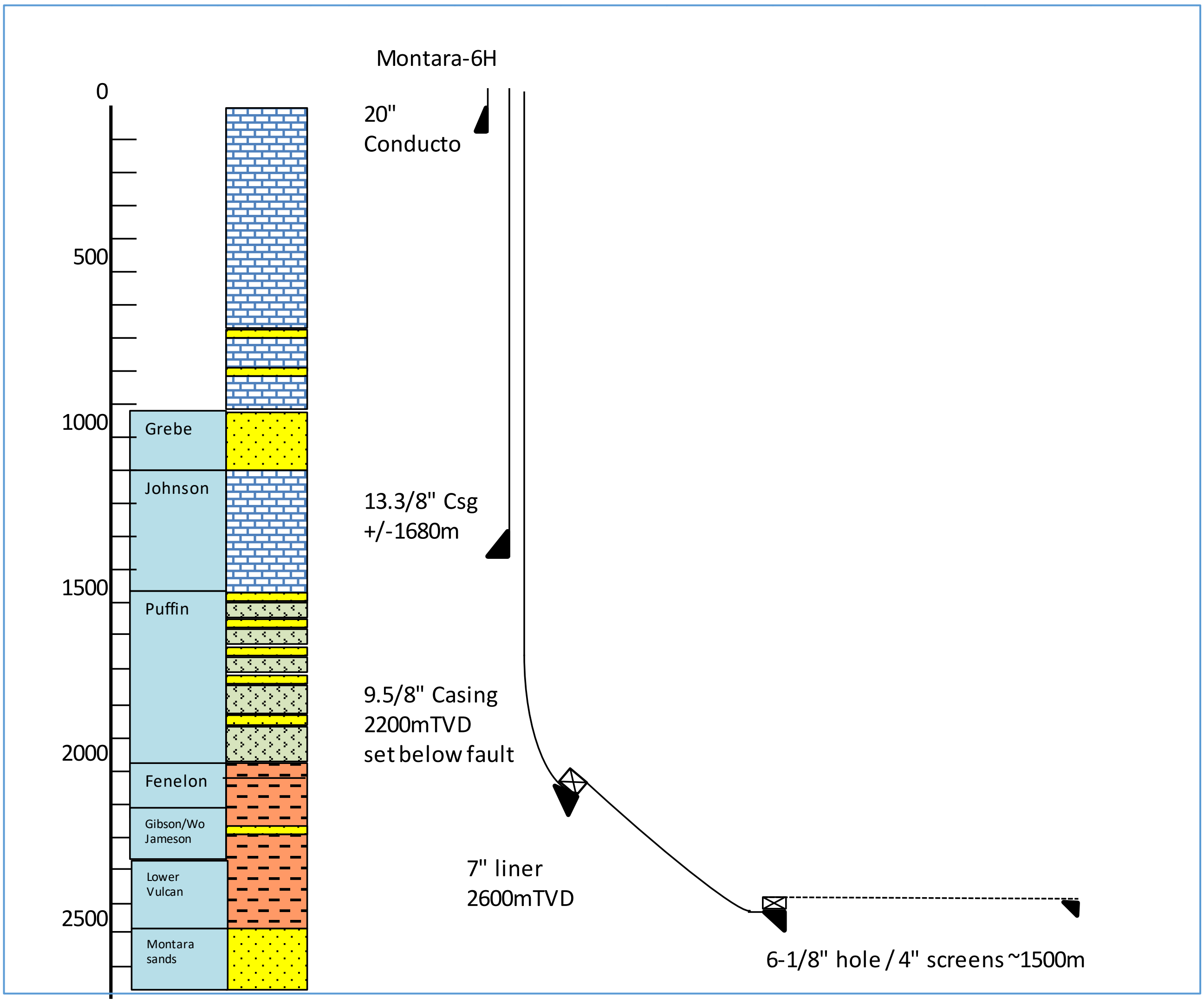


Figure 2-5: H6 well casing schematic

Details of drilling fluids, cuttings and cement during the drilling and completion of H6 can be found in Section 6.6.

2.9.4 Skua- 12 Well

Drilling of the Skua-12 well is estimated to take 50 days. Scheduling of activities may be subject to delays (e.g. weather and MODU availability). The drilling activities detailed below provide the basis for identifying environmental impacts associated with the drilling activities and implementation of mitigation measures.

A preliminary well design and casing schematic, showing the interval and casing details for each hole section is shown in Figure 2-6. A summary of the proposed drilling activities is detailed below:

- Move jack-up MODU onto Skua-12 location;
- Drill 36” hole and run 30” casing;
- Drill 17 ½” hole and run 13 3/8” casing with 13 ⅝” high pressure housing;
- Run high pressure riser and install BOP on H6;

- Drill directional 12 ¼" hole, then run and cement the 9 ⅝" production casing;
- Drill directional 8 ½" hole;
- Run the lower 5 ½" sand-screen completion and hang off on packer;
- Suspend the well, pull riser and BOP and run subsea Xmas tree;
- Re-run BOP and run the upper 5½" completion;
- Install tree plugs and pull BOP; and
- Move MODU off location.

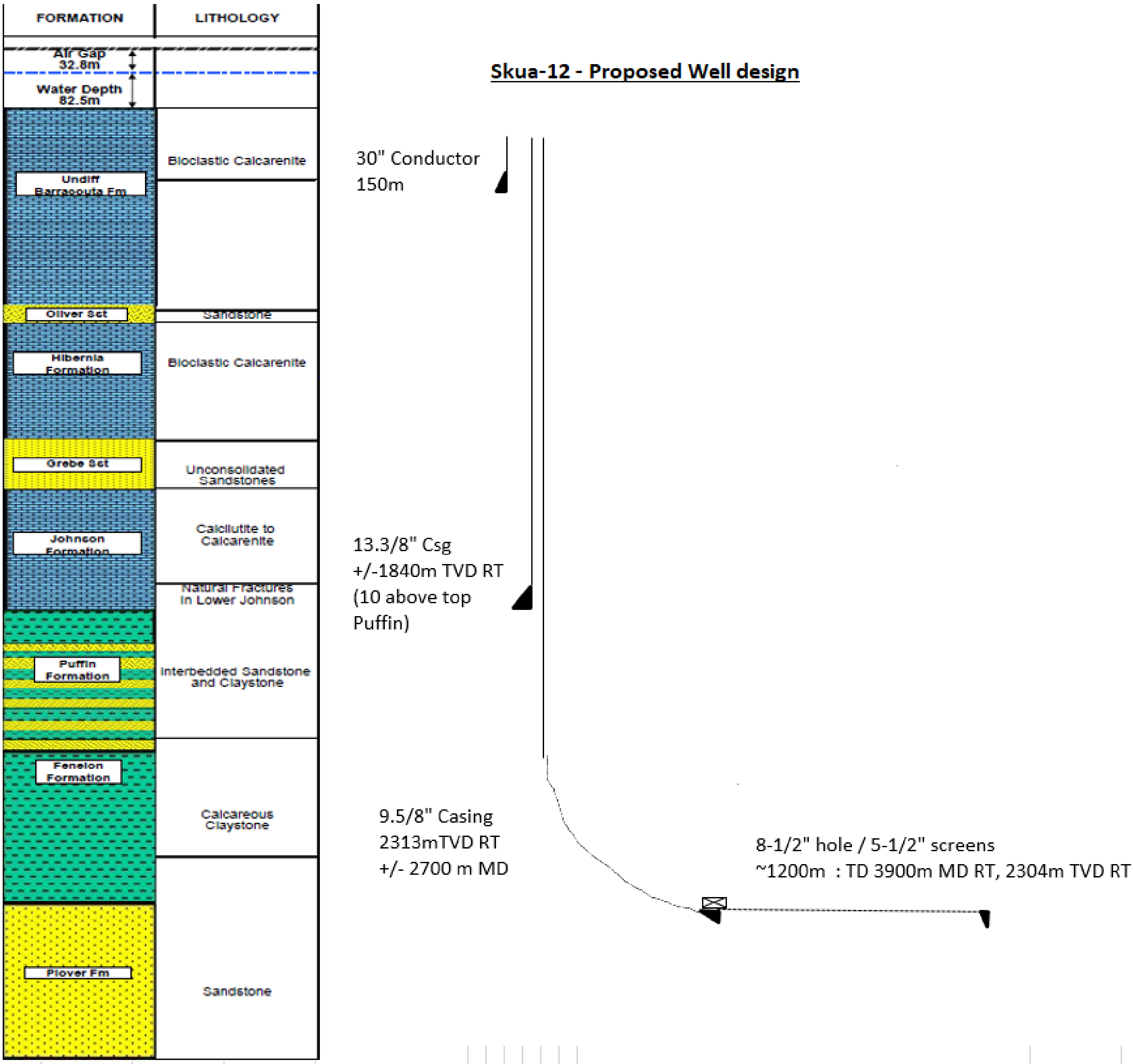


Figure 2-6: Skua-12 well casing schematic

Details of drilling fluids, cuttings and cement during the drilling and completion of H6 can be found in Section 6.6.

2.9.5 Cementing

Cement is used to form permanent barriers and fix casings in place. It may also be used to seal a lost circulation zone, and when abandoning the well. The majority of cement will remain downhole although minor volumes will be discharged at the mudline at the seabed surface, and at sea surface.

Once a hole section has been drilled, steel casing is run into the well. Cement is used to secure the steel casing in the well bore and cementing chemicals are used to modify the technical properties of the cement slurry.

Excess cement (up to a maximum of ~300%) as calculated in the well specific Drilling Program will be used for the riserless sections to account for potential wash outs, over gauge hole and small seepage losses into the formation. This excess typically accumulates on the seabed in the immediate locality of the well.

During cementing operations, there may be some volumes of dry cement (approx. 2 m^3) that will be excess to requirements and may be discharged to sea from the storage hopper. In addition, minor quantities (approx. 2 m^3) of excess mixed cement may also be discharged into the sea during clean-up of the cementing unit (pumps, lines etc) after each job is finished. A number of additives with different chemical functions are required during cementing operations these include defoaming agents, dispersants and fluid loss control additives.

As for the selection and use of drilling fluids, Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033) will be used to select and approve for use prior to application cement used in the drilling activities. At time of EP preparation, the cementing contractor had not been selected. Once selected and cement formulations finalised, proposed cement chemicals will be reviewed to ensure that they are CHARM rated Gold and Silver, or non-CHARM rated D/E and therefore have the least potential for environmental impact. Where proposed chemicals do not meet this selection criteria, alternatives will be sought.

2.9.6 Drilling fluids and cuttings

A drilling fluid program will be developed for the Drilling program. The primary function of the drilling fluid is to control sub-surface formation pressures, cool and lubricate the drill bit, transport the cuttings to the surface, maintain well bore stability and minimise reservoir damage. Drilling fluid is continually circulated down the drill string to the drill bit and returns to the surface via the annulus space between the drill string and the well bore.

The drilling fluids will be water-based muds (WBM) only. WBM typically consist of between 80–90% by volume fresh, or saline water, with the balance made up of water soluble and insoluble drilling fluid additives give the mud the exact properties it requires to meet the desired functions for a particular hole interval. In the marine environment, these additives are either completely inert (naturally occurring benign materials) or readily biodegradable organic polymers, with a fast rate of biodegradation. Drilling fluid additives that are typically used include: sodium chloride, potassium chloride, bentonite (clay)/ pre-hydrated gel (PHG), naturally occurring water soluble polymers, barite and calcium carbonate.

Cuttings will typically be removed at surface from the recirculating mud by shale shakers, desanders, desilters and centrifuges for very fine particles. All cuttings will be discharged overboard at sea surface or just below via a discharge pipe. The fluids are re-used until out of specification, then they will be discharged overboard.

2.9.7 Loss of circulation

Lost circulation is a common occurrence during drilling. In tophole sections drilled with seawater loss zones do not present a problem and no action is taken to attempt to cure the losses. These normally cure as drilling progresses and the loss zone gets plugged with drill cuttings. In intermediate and reservoir hole sections drilled with a closed fluid system, lost circulation is a major problem. As a result, lost circulation encountered while drilling with closed fluid systems will attempt to be cured. To cure losses there is a choice of options available, depending on loss rates. Conventional additives, such as calcium carbonate or fibres, are used for seepage or partial losses. When total losses occur, it may be necessary to pump cement or cross link polymers to heal the loss zones. Some lost circulation material may be brought back to the surface and discharged to sea, so as not to contaminate the mud system.

2.9.8 Chemical selection

The Drilling Fluid Program will detail the chemical additives that will and may be used in the various mud mixtures. In the absence of Australian standards regarding the suitability of chemical additives, the selection of chemicals will be guided by the Offshore Chemical Notification System (OCNS). The OCNS and the Jadestone Energy Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033) provide a framework and updated register which ranks the environmental performance of chemicals used in offshore petroleum activities and discharged to the environment. Chemical selection will be managed using Jadestone's procedure to ensure environmental impacts and risks associated with chemical use are managed to a level that is ALARP and acceptable.

The OCNS uses the OSPAR Harmonised Mandatory Control System (HMCS) to manage chemical use and discharge. The HMCS was introduced with a view to unifying regulations regarding the use and reduction of the discharge of offshore chemicals across the OSPAR signatories. The objective of the HMCS is to protect the marine environment by identifying those chemicals used in offshore oil and gas operations with the potential for causing an adverse environmental impact and restricting their use and discharge to the sea. A series of associated recommendations provide guidance on how to compare the potential environmental impact of different chemicals, to preferentially select those with low potential for impact while fulfilling other (e.g. technical, HSE and availability) requirements. This involves the generation of an environmental data set (i.e. toxicity, persistence and bioaccumulation potential) and its evaluation using pre-screening criteria and a decision-support tool called the CHARM (Chemical Hazard Assessment and Risk Management) Model. In cases where the CHARM-ranking is not amenable or applicable (e.g. for inorganic substances), equivalent assessments will be done by in accordance with the OCNS guidelines.

Jadestone Energy's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033) defines the process for the assessment of the offshore use and discharge of chemicals. This document shall be applied to the selection of all drilling chemicals which, through their mode of use, are expected to be discharged to sea. This includes chemicals discharged during drilling operations and extends to MODU washes, pipe dopes and hydraulic fluids used to control wellheads.

In summary, this procedure ensures:

- Selected chemical substances comply with relevant regulatory requirements and approved activity environment plans;
- Selected chemical substances are subject to mandatory risk review and formal approval before procurement;
- Transport, storage and handling of chemicals is in accordance with relevant regulations and manufacturer requirements;
- Least hazardous chemicals are preferentially selected for use thereby minimising and/ or eliminating potential safety and environmental impacts;
- If chemicals required are classified as hazardous and/ or dangerous goods, the control measures for safe transport, storage and handling are deemed adequate;
- Selected chemical substances meet technical specifications and are fit for purpose; and
- Selected chemical substances are commercially evaluated and competitively priced.

2.9.9 Well evaluation

Mud logging

Mud logging will be undertaken during drilling operations to evaluate the formation. This will involve the collection and processing of cuttings samples, analysis of mud gas, monitoring and recording of all drilling parameters, pressure detection and full evaluation of the formation.

Formation Evaluation

Formation evaluation is the interpretation of a combination of measurements taken inside the wellbore to detect and quantify oil and gas reserves in the rock adjacent to the well. Mud logging will be undertaken during drilling to evaluate the drilled formations. This will involve collection and processing of cuttings samples, analysis of mud gas, monitoring and recording of all drilling parameters, pit levels and pressure detection. A wireline log is a continuous measurement of formation properties with electrically powered instruments to enable decisions to be made about drilling operations. Wireline logging may be required to confirm cement isolation in the 7” x 8-1/2” casing annulus (H6), and the 9-5/8” x 12-1/4” (H6 and Skua-12) casing annulus.

2.10 Drilling Support Operations

2.10.1 Vessels

Support for the drilling activities will be provided by three support vessels (Table 2-4) which will operate out of Darwin. Support vessels (typically 60–90 m in length) will supply equipment, bulk chemicals, liquid drilling fluids, diesel fuels etc. to the drilling MODU.

Each vessel will have approximately 10–20 POB and an appropriately sized and maintained MARPOL compliant sewage and bilge systems.

Table 2-4: Indicative support vessel specifications

Aspect	Primary Tow Vessel/Support 180 MT BP	2nd Support Vessel 140 MT BP	3rd Support vessel
Type/Service	Tug/support/supply vessels/construction vessel		
Length (m)	86	66	66
Gross Registered Tonnage (tonnes)	4,566	2,147	2,147
Maximum Speed (knots)	16	16	16
Accommodation (berths)	35	32	32
Total Fuel Tank Capacity (m^3)	1594	827	827
Rescue Capabilities per vessel	1 fast rescue craft >100 persons rescue capacity	1 fast rescue craft >100 persons rescue capacity	1 fast rescue craft >100 persons rescue capacity

2.10.2 Helicopters

Helicopter support will be provided by Babcock. A shared Sikorsky S-92 helicopter and flight crew, along with shared technical back-up helicopter, will be based at Mungalalu–Truscott air base to support the MODU as follows:

- Personnel transfers between Mungalalu-Truscott and the MODU for crew changes;

- Down-manning of the MODU for tropical cyclone response (note: an additional Helicopter and crew will be available during cyclone season); and
- Emergency response, including medivac, evacuation of the MODU, and search and rescue.

Routine helicopter operations are expected to be during daylight hours and helicopter flight time between Mungalalu-Truscott and the MODU is 70 minutes with approximately five to seven flights per week anticipated. Helicopter refuelling is planned and will use the permanent helicopter refuelling facilities on the MODU.

2.11 Out of Scope

Activities that are not covered by this EP are:

- Vertical Seismic Profiling (VSP) or flaring;
- Nearby shipping activity, third-party offtake tankers, and Operational support activities outside the Operational Area;
- Vessel based seismic surveys or use of side scan sonar;
- Anchoring of vessels (other than in an emergency) or MODU;
- Drilling support vessels associated with the Activity outside the Operational Area (where they will adhere to applicable maritime regulations, and Commonwealth and State environmental management obligations);
- Commissioning of new production wells;
- Production; and
- Decommissioning.

3. EXISTING ENVIRONMENT

3.1 Definition of Areas

Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, Regulation 13(2) requires the proponent to:

'(a) describe the existing environment that may be affected by the activity; and

(b) include details of the particular relevant values and sensitivities (if any) of that environment.'

To address this requirement, Jadestone has evaluated the values and sensitivities within two types of areas related to the activity:

- The Operational Area – the geographical area encompassing the environment that may be affected by the planned activities (Section 2.4); and
- The Environments that May Be Affected (RISK EMBAs) – the geographical area encompassing the environment that may be affected by the unplanned events associated with the activities described (Section 2). Refer to Appendix F and Section 7.6.3 for more detail on how the thresholds were defined and the modelling underpinning the EMBAs delineation.

The spatial extent of the EMBAs and location of the Operational Area is presented in Figure 7-1.

To assist in the later impact assessment, four sub-categories of EMBA were defined:

1. Surface hydrocarbons EMBA– hydrocarbons that are 'on' the water surface (1 g/m^2)
2. Entrained hydrocarbons EMBA– hydrocarbon that is entrained 'in' the water; (100 ppb)
3. Dissolved hydrocarbons EMBA– the dissolved component of hydrocarbon in' the water (70 ppb), and
4. Shoreline loading EMBA – hydrocarbons greater than 10 g/m^2.

Collectively the total area of impact they intersect with is referred to as the "EMBAs".

The environmental values and sensitivities in the EMBAs have been used to inform the assessment of unplanned events, particularly diesel and oil spill response planning and oil spill risk assessment (Section 7.6 and Section 7.7). Full details of the environmental values and sensitivities in the RISK EMBA is contained in Appendix B, and not discussed any further here.

3.2 Marine Regional Setting

Australia's offshore waters have been divided into six marine regions in order to facilitate their management by the Australian Government under the EPBC Act. The Montara operations activity is located within the North West Marine Region (NWMR). The NWMR encompasses Commonwealth waters from the Western Australia/ Northern Territory border in the north, to Kalbarri in the south. The main physical features and values of the NWMR are:

- Ashmore Reef, Cartier Island, Seringapatam Reef and Scott Reef (Section xx), which have been identified as regionally important areas supporting a high biodiversity of marine life and supporting foraging and breeding aggregations. Ashmore Reef and Cartier Island are located approximately 160 km and 100 km north-west, respectively, from the Operational area;
- A number of key ecological features (KEFs) have been identified in the region (Section 5.4.6). The Continental Slope Demersal Fish Community has been identified as an important marine community, due to its high species diversity and endemism. The Carbonate Bank and Terrace System of the Sahul Shelf has also been identified as regionally important as it is a unique sea floor feature; contributing to the biodiversity and productivity of the local area; and

- Other priority areas in the NWMR include Rowley Shoals and Ningaloo Reef. However, these areas are at least 700 km from the Operational area.

Within the NWMR the Operational Area lies at the junction of two provincial bioregions summarised in **Table 3-1**.

Table 3-1: Provincial bioregions in Operational Area

Area	Description
Timor Province	The Timor Province covers an area of 24,040 km^2 and predominantly covers shelf terrace and the continental slope, extending into waters 200 – 300 m deep in the Arafura Depression. The oceanographic environment is mainly influenced by tides, with some influence from the Indonesian Throughflow current. These open waters support pelagic species, including whale sharks, an unusual array of threadfin fish species and distinct genetic stocks of red snapper.
Northwest Shelf Transition	The Northwest Shelf Transition covers the mostly shallow waters (<100 m) between Cape Leveque (WA) and the Tiwi Islands (NT). This transition has a diverse seafloor topography including submerged terraces, carbonate banks, pinnacles, reefs and sand banks.

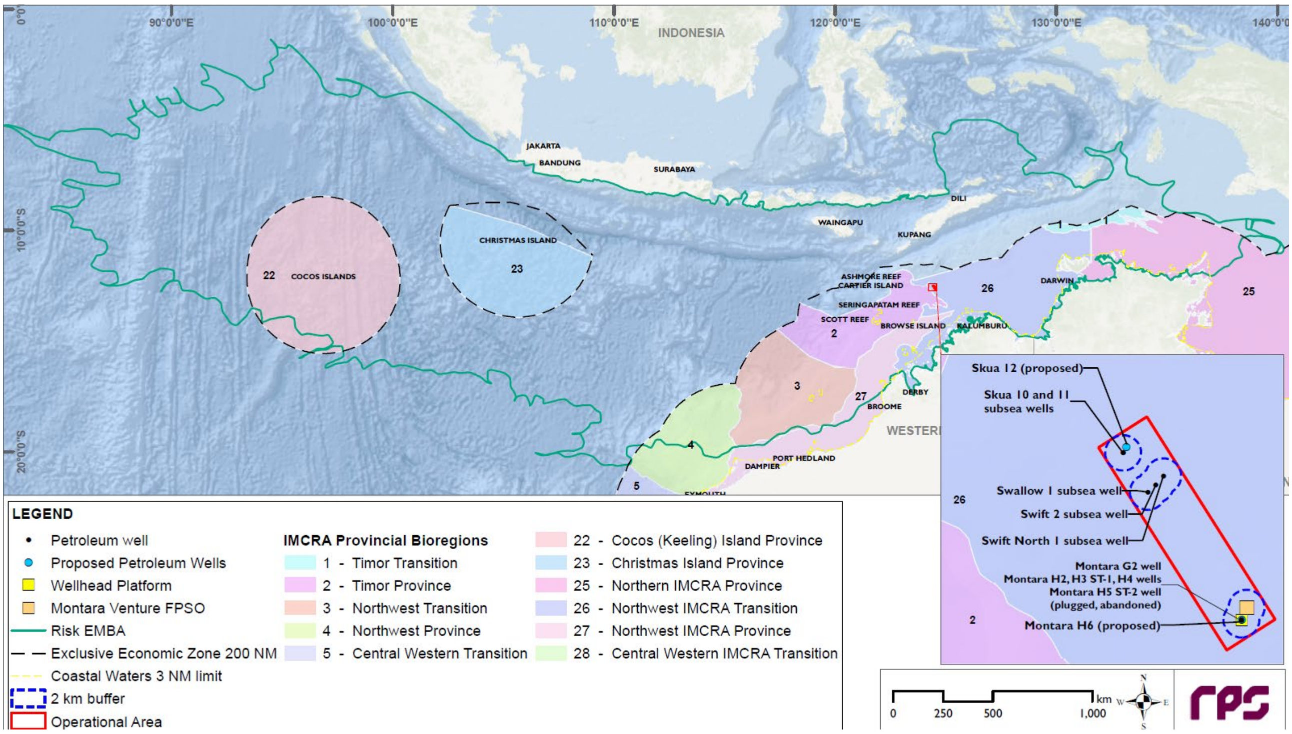


Figure 3-1: Provincial Bioregions relevant to the Operational Area

3.3 Physical Environment

3.3.1 Climate

The Operational Area experiences a monsoonal climate with two predominant seasons including a hot wet summer season, October to March and a cool dry winter season April to September, which are referred to as the northwest and southeast monsoons, respectively. The climate is influenced by two major atmospheric pressure systems: the subtropical ridge of high-pressure cells referred to as highs or anticyclones, and a broad tropical low-pressure region called the monsoon trough (RPS Metocean 2008). These two major systems create three discrete weather phenomena that influence conditions within the Operational area and wider EMBA:

- The north-west monsoon season occurs from October to March, or wet season, and is characterised by north-west to south-west winds. The monsoon season is generally associated with broad areas of cloud and rain including periods of widespread heavy rainfall;
- Steady north-east to south-east winds (south-east trade winds) from April to September (dry season) caused by development and intensification of anticyclones over south-western Australia, bring predominantly fine conditions with low rainfall in most areas; and
- Cyclonic activity occurs between November to April and the area will experience on average three cyclones a year. Cyclones can bring very large amounts of rain, with strong swell and rough seas common during these events.

In general, January to February and May to July are the windiest months however, peak wind velocities are associated with tropical cyclones that occur during the wet season. Cyclone probability is estimated to be one per annum within 180 km of the site and four per annum within 1,100 km of the site.

Mean annual rainfall in the region is 1,770 mm. Mean air temperature ranges from 24.9ºC in July and 29.6ºC in December. The closest meteorological station to the Montara field is located at Troughton Island approximately 630 km south-west of the Operational area (Bureau of Meteorology (BoM) 2012) (Table 3-2).

Table 3-2: Meteorological conditions representative of the Montara Field (Troughton Island)

Month	Mean Monthly Maximum Temperature (Cº)	Mean Monthly Minimum Temperature (Cº)	Mean Rainfall (mm)	Mean Relative Humidity (%)
January	31.8	26.3	273.0	77
February	31.4	26.1	137.9	78
March	31.9	26.4	145.3	74
April	32.7	26.8	31.2	64
May	31.1	25.3	40.5	58
June	28.9	23.2	7.6	56
July	28.1	22.1	2.8	58
August	28.8	22.5	0.6	62
September	30.2	24.5	0.3	69
October	31.7	26.3	2.9	69
November	32.9	27.4	9.4	69
December	32.9	27.3	120.1	69
Annual	31.0	25.3	828.9	67

3.3.2 Oceanography (Tides and Currents)

Broad scale oceanography in the north-west Australian offshore area is complex, with major surface currents influencing the Region, including the Indonesian Throughflow, the Leeuwin Current, the South Equatorial Current and the Eastern Gyral Current (Figure 3-2).

The oceanographic regime of the north west Australian offshore area is strongly influenced by the Indonesian Through Flow (ITF) which transports warm, low salinity, oligotrophic waters through a complex system of currents, linking the Pacific and Indian Ocean via the Indonesian Archipelago (Department of State Development (DSD) 2010). The strength of the ITF fluctuates seasonally and reaches maximum strength during the south-east monsoon (May to September) and weakens during the north-west monsoon.

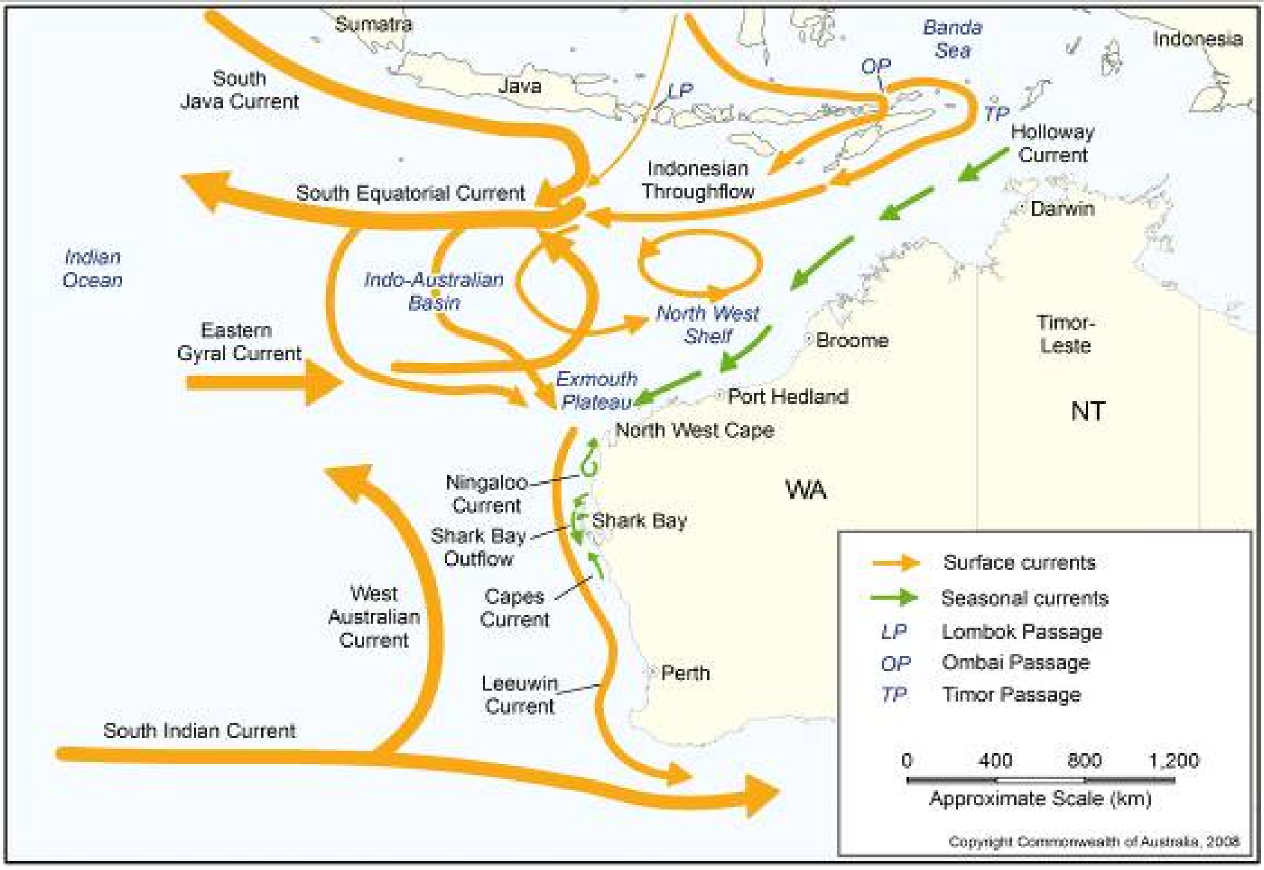
Currents in the Kimberley region are also generated by several more localised factors, including tidal forcing, local wind forcing, inertial oscillations, shelf waves, seiche and trapped waves. Studies undertaken in the vicinity of Scott Reef and Seringapatam Reef suggest that the ITF does not directly influence these systems, but it is the eddies that peel off the min ITF current and travel along the shelf-break that have a greater influence on the reefs. In general, the tidal regime and wind forcing are the major contributors to local currents in the area. The currents in the Operational area and wider EMBA are influenced by the semi-diurnal tides that have four direction reversals per day. Both the semidiurnal and diurnal tides appear to travel north-eastwards in the deep water leading to the Timor Trough prior to propagation eastwards and southwards across the wide continental shelf. The NWMR experiences some of the largest tides along a coastline adjoining an open ocean in the world.

In the eastern section of the EMBA, the area is influenced primarily by strong diurnal tidal flows and less by ocean currents. The Joseph Bonaparte Gulf is subject to the highest tidal range in the region (up to 7–8 m).

Wind driven currents from monsoons and cyclones and drift currents (ITF) are likely to prevail during neap tides or during periods of strong influence when one of the current reversals may be suppressed. Maximum tidal range is 5.7 m and tidal currents flood to the southeast and ebb to the northwest and under normal conditions (i.e. no storms), maximum recorded current speed at the surface is 0.95 m/s, mainly due to the tide. Current speeds decrease with depth below the surface. The strength and direction of tidal current flow is also strongly influenced by local bathymetry.

Wind induced currents result from local wind forcing at the surface and are most pronounced during cyclones with development of transient oscillations known as inertial currents following the passage of cyclones. Wind driven surface currents and their direction are generated by prevailing seasonal winds from the west in summer and from the east and south east during winter. The following current data has been estimated for one in 50-year storm conditions:

- Surface currents = 2 m/s;
- Mid depth currents = 1 m/s; and
- Seafloor currents = 0.67 m/s.



Source: DEWHA (2008)

Figure 3-2: Key ocean currents influencing Western Australia

3.3.3 Waves

Surface waves and sea swell in the region can vary widely in direction depending on wind direction, locations of major storms and local bathymetric effects such as the shelf break or proximity to islands such as Ashmore Reef. Waves are subject to the following key influences:

- Locally generated wind waves, seas: generally, from west during wet season and from the east during the dry season; and
- Remotely generated swells: South to south westerly swells persist from storms in the southern Indian Ocean and occasional, low amplitude waves up to 1 m originate from earthquakes in the Sunda Trench, between Australia and Indonesia.

In general, the maximum and mean sea swells are larger in winter than summer as a result of the strong easterly wind-generated seas and larger winter swell from the Southern and Indian Oceans. Occasional monsoonal storms and cyclones can result in much larger waves and swell. Extreme winds associated with cyclones can generate waves up to 21 m in height from any direction (RPS Metocean 2008).

Significant wave heights are experienced in the Montara field are as follows:

- Greater than 2 m, 7.7% of the time; and
- Greater than 4 m, 0.4% of the time.

The following wave data has been estimated for one in 50-year storm conditions as:

Maximum wave height = 16.1 m;

Significant wave height = 8.6 m; and

Peak wave period = 11.4 seconds.

3.3.1 Temperature, Salinity and Turbidity

Seawater temperature in the region generally ranges from 25ºC to 31ºC at the surface and 22ºC to 25ºC at the seafloor. The sub-tropical water temperatures are largely influenced by the ITF and a highly-pronounced thermocline, which is controlled by the ITF (Brewer et al. 2007).

Water quality monitoring at the Montara Venture found surface water temperatures ranged from 28.0ºC to 28.7ºC, with a slight reduction of <1ºC at 20 m depth. Salinity of surface waters was consistently around 33.9 PSU, with low variability (Jacobs 2017).

Turbidity in the surface waters (0.5 m to 23 m depth) near the Montara Venture are typically low (<0.2 NTU; Jacobs 2017).

3.3.2 Bathymetry and Seafloor Geology

Bathymetry of the region is broadly categorised into three distinct zones based on water depth and geometric features. The three zones are (Baker et al. 2008, Heap and Harris 2008):

- Continental shelf;
- Continental slope; and
- Abyssal plain.

The inner continental shelf in the northwest region extends from the coast to approximately 30 m water depth and the middle continental shelf lies between 30 m and 200 m. The outer continental shelf and slope region descends from approximately 200 m water depth. The slope continues to descend over hundreds of kilometres until reaching the almost flat i.e. a less than 1:1,000 gradient, abyssal plain at water depths of approximately 4,000 m. The continental slope is steepest along the western flank of Scott Reef where a steep drop occurs. These steep slopes are incised by erosional gullies and canyons.

The Operational area is located on the continental shelf and the Montara field (within the Operational area) slopes from the east (76 m) to west (86.5 m) and is characterised by a north-south trending gentle scarp. To the south of the area a slight mound rises to 78 m water depth.

The shallow geology of the Operational area is interpreted as a thin, discontinuous layer of unconsolidated surficial sediment overlying a variably consolidated calcarenite sequence. The thickness of unconsolidated sediment varies across the site and ranges from being very thin or absent up to a local maximum of 3.7 m within the Montara survey corridor.

Geophysical interpretation and results from seabed sampling indicate that the unconsolidated sediments are fine to coarse carbonate sands. The sediments appear to be coarser closer to areas of significant relief and at the base of shallow depressions. Sub-bottom profilers did not achieve significant penetration into the calcarenite material, indicating that the upper surface of the calcarenite is relatively hard.

3.3.3 Sediment Quality

Sediment quality sampling undertaken near the Montara Venture found that concentrations of metals, metalloids, hydrocarbons and phenolic compounds in sediment samples were either below the laboratory limit of reporting (LOR) and/or the ANZECC/ARMCANZ Sediment Quality Guidelines detailed in Simpson et al. (2013) (Jacobs 2017).

3.3.4 Sediment Particle Size Distribution

The particle size distributions (PSD) of sediments sampled near the Montara Venture were dominated by fine and coarse sands, with very little clay (Jacobs 2017).

3.4 Conservation Values and Sensitivities

Conservation values and sensitivities listed and protected under the EPBC Act include Matters of Environmental Significance (MNES) and Other Protected Matters. MNES occurring, or potentially occurring, in the Operational Area are summarised in Table 3-3. The full EPBC Act Protected Matters report is provided in Appendix D.

Table 3-3: Summary of conservation values and sensitivities in the Operational Area

MNES and Other Matters Protected under EPBC Act	Operational Area
Commonwealth Marine Area	✓
Listed Threatened Species	✓ (20)
Listed Migratory Species	✓ (32)
Listed Marine Species	✓ (60)
Whales and other cetaceans (many of which are also Listed Threatened or Migratory Species)	✓ (13)
Australian Marine Parks	✕
State and Territory Marine Parks (MP) and Marine Management Areas (MMA)	✕
World Heritage	✕
Wetlands of International Importance (Ramsar)	✕
National Heritage Places	✕
Commonwealth Heritage Places	✕
Threatened Ecological Communities	✕
Key Ecological Features (KEFs)	✕
Nuclear actions and water resources, in relation to coal seam gas or coal mining	✕
Great Barrier Reef Marine Park	✕

3.4.1 Matters of National Environmental Significance (MNES)

Commonwealth Marine Areas

The Operational Area is within the EEZ and Territorial Sea which is a Commonwealth Marine Area. The Commonwealth marine area is any part of the sea, including the waters, seabed, and airspace, within Australia's exclusive economic zone and/or over the continental shelf of Australia, that is not State or Northern Territory waters.

3.4.2 Listed Threatened and Migratory Species

The PMST search (Appendix D) identified 20 Listed Threatened Species (LTS) and 32 Listed Migratory Species (LMS) as having the potential to occur within the Operational area. The LTS included:

- Four species of marine mammals;
- Six species of marine reptiles;
- Five shark species; and
- Five marine bird species.

The relevant sections of this EP discuss the likelihood of these species and their biologically important areas occurring within the Operational Area. Those species that have been identified as likely to be present in the Operational area are summarised in Table 3-5 to Table 3-8 and further detailed below.

Sensitive habitat areas such as an aggregation, resting or feeding or known migratory routes for these species are shown as Biologically Important Areas (BIAs) (**Figures 3-3 to 3-6).** The relevant sections also outline the management such as:

- Recovery plans;
- Conservation advice; or
- Threat abatement plan for the impacts of marine debris on vertebrate marine life (DoEE 2018).

The requirements of the species recovery plans and conservation advices are considered to identify any requirements that may be applicable to the risk assessment.

3.4.3 Others matters protected by the EPBC

Listed marine species

A total of 60 Listed Marine Species are either likely to, or may, occur within the Operational Area, including 17 bird species and three reptile species). Sixteen of these species are also Listed Threatened Species.

Whales and other cetaceans

The Protected Matters search determined that 13 cetacean species or their habitat, may occur within the Operations Area. These species are discussed in Table 3-6. Whales and cetaceans occurring in the broader EMBAs are discussed in Appendix B.

3.4.4 Marine Parks

No State Marine Parks or AMPs intersect with the Operational Area.

3.4.5 Terrestrial Values

The Operational Area is over 200 km from the closest landfall and therefore does not contain any terrestrial sensitivities or values. Specifically, the following terrestrial values are not represented within the Operational Area:

- Ramsar wetland sites;
- State protected wetlands;
- marine and coastal zone;
- nationally important wetlands; and
- State protected terrestrial areas.

3.4.6 Key Environmental Features (KEFs)

Key ecological features (KEFs) are elements of the Commonwealth marine environment that are considered to be of regional importance for either a region’s biodiversity or its ecosystem function and integrity. The Operational Area does not include any KEFs. The nearest of the spatially defined KEFs is the Carbonate bank and terrace system of the Sahul Shelf at approximately 46 km from the Operational Area at its closest point.

3.5 Biological Environment – Species and Communities’ Descriptions

3.5.1 Benthic Habitat and Communities

The benthic habitats in the Operational area generally dominated by soft sediments, sand and mud, with occasional patches of coarser sediments. Spatial and temporal distribution of benthic fauna depends on factors such as sediment characteristics, depth and season.

A benthic habitat assessment was undertaken in the area of Petroleum Production Licence AC/L7 during the 2010 wet season, which included the Montara field and surrounding areas (ERM 2011). Surveys were carried out using a towed video system and seabed sediment samples were also collected for sediment and macrobenthic fauna analysis. Benthic habitats surveyed were characterised by homogenous, flat, featureless soft sediment; predominately comprised of sand with small rubble/shell fragments and marked by low relief ripples with evidence of bioturbation. Sparse patches of epifauna were recorded and included hydroids, octocorals (soft corals, gorgonians and seapens), black corals and ascidians.

Macrobenthic faunal assemblages surveyed had a generally low and highly patchy abundance of individuals. Polychaete bristleworms from the Phylum Annelida contributed the highest relative abundance of macrobenthic assemblages across the surveyed area, ranging from approximately 40 to 60% followed by Malacostracan crustaceans (shrimps, crabs etc.; approximately 13 to 19%). Gastropoda was represented by 33 taxa across the surveyed area with abundance ranging from approximately 0.5 to 5% (ERM 2011).

Hydrozoa and Bryozoa were the other common groups encountered in samples. All other taxa identified across the surveyed areas were minor contributors to macrobenthic assemblages (relative abundance <5%) (ERM 2011).

3.5.2 Plankton and invertebrates

Plankton is divided into two categories: phytoplankton and zooplankton. Phytoplanktonic algae are important primary producers and range in size from 0.2 to 200 mm. Zooplankton are small, mostly microscopic animals that drift with the ocean currents, and it has been estimated that 80% of the zooplankton in waters off Australian continental shelf and shelf margin are the larval stages of fauna that normally live on the seabed (Raymont, 1983). A common feature of plankton populations is the high degree of temporal and spatial variability. Phytoplankton in tropical regions have marked seasonal cycles with higher concentrations occurring during the winter months (June–August) and low in summer months (December–March) (Hayes et al. 2005; Schroeder et al. 2009). Zooplankton rely on phytoplankton as food and are subject to similar seasonality.

3.5.3 Fish, Sharks and Rays

The Operational Area PMST report (Appendix D) identified:

- Five threatened/ migratory; and
- Four migratory.

A description of fish, sharks and rays is provided in Table 3-4.

Numerous marine species occur in the region and have wide distributions that are associated with feeding and migration patterns linked to reproductive cycles. While the distance offshore, depth and lack of suitable foraging benthic habitat may preclude a number of these species, many are likely to occur within the Operational area in transit to and from key mating and foraging grounds. Pelagic foragers are also likely to be feeding within the area.

The Operational area intersects with the Whale Shark foraging BIA (Figure 3-3).

Three offshore banks assessment surveys (2010, 2011 and 2013) were undertaken to identify and assess the level of impact, if any, to the submerged marine banks in the region of the 2009 Montara oil spill (Heyward et al. 2010, 2011a, 2013). The surveys used Baited Remote Underwater Video Stations (BRUVS) to characterise fish assemblages and included the following shoals/banks in the region: Vulcan Shoal, Barracouta Shoals, Echuca Shoal, Eugene McDermott Shoal, Goeree Shoal, Heywood Shoal, Shoal 25 and Wave Governor Bank. BRUVS were deployed on the seafloor from the shallowest areas of the shoals to depths of approximately 60 m for at least 60 minutes (Heyward et al. 2011a). No individuals from the Syngnathidae family were reported (Heyward et al. 2010, 2011a, 2013).

Table 3-4: Fish, Sharks and Rays EPBC listed species

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Whale Shark (*Rhincodon typus*)	V,M	Foraging, feeding or related behaviour known to occur within area	✓	Conservation advice *Rhincodon typus* whale shark (Threatened Species Scientific Committee, 2015d)	Ceased 2010	
Great White Shark (*Carcharodon carcharias*)	V,M	Species or species habitat may occur within area	✓	No	✓ Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013a)	✓ Marine debris
Northern River Shark (*Glyphis garricki*)	E	Species or species habitat may occur within area	✓	✓ Approved Conservation Advice for *Glyphis garricki* (northern river shark) (DoE 2014a)		
Green Sawfish (*Pristis zijsron*)	V	Species or species habitat may occur within area	✓	✓ Approved conservation advice for *Pristis zijsron* green sawfish	Sawfish and river shark multispecies recovery plan (Commonwealth	

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
				(Threatened Species Scientific Committee, 2008b)	of Australia, 2015b)	
Freshwater/ Largetooth sawfish (*Pristis pristis*)	V, M	Species or species habitat known to occur within area	✓	✓ Approved Conservation Advice for *Pristis pristis* (largetooth sawfish) (DoE 2014b)		
Narrow/Knifetooth Sawfish (*Anoxypristis cuspidata*)	M	Species or species habitat may occur within area	✓		Sawfish and river shark multispecies recovery plan (Commonwealth of Australia, 2015b)	
Shortfin Mako (*Isurus oxyrinchus*)	M	Species or species habitat likely to occur within area	✓	No	No	
Longfin Mako (*Isurus paucus*)	M	Species or species habitat likely to occur within area	✓	No	No	
Giant Manta Ray	M	Species or species habitat known to occur within area	✓	No	No	

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
(*Manta birostris*)						
Reef Manta Ray (*Manta alfredi*)	M	Species or species habitat known to occur within area	✓			

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

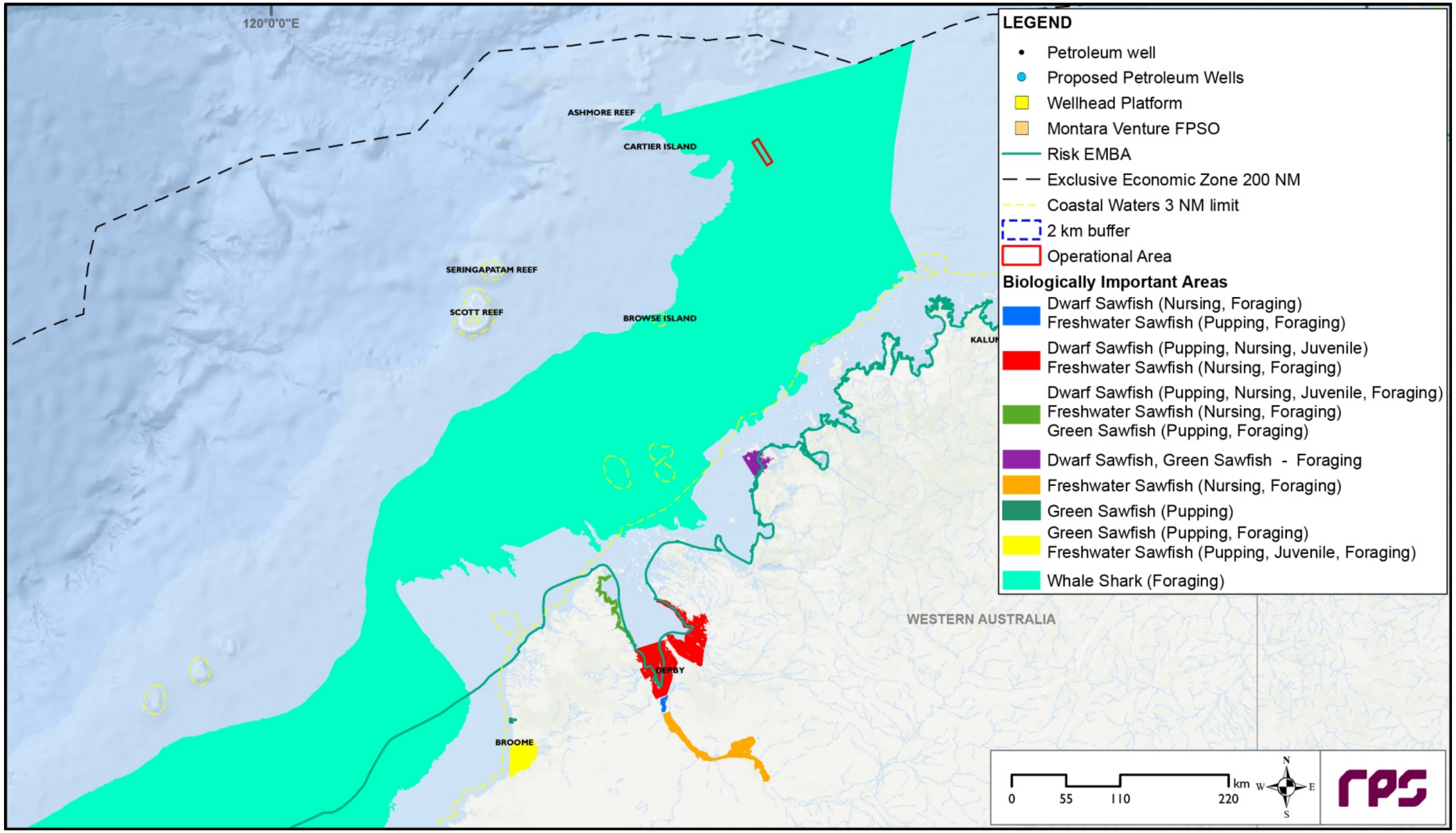


Figure 3-3: Biologically important areas for fish, sharks and rays

Whale Shark (Vulnerable/Migratory)

Whale sharks (*Rhincodon typus*) have a broad distribution in tropical and warm temperate seas. The whale shark is a highly migratory fish and only visits Australian waters seasonally (DoEE 2017b). They are known to aggregate at Ningaloo Reef (approximately 1,500 km south-west of the Operational area) between May and June, and in the Queensland Coral Sea (approximately 2,400 km east of the Operational area) between November and December (DoEE 2017b). Neither of these locations are within the EMBA.

Whale sharks are not known to feed or breed in the Operational area, however, whale sharks may occur in the Operational area due to their widespread distribution and highly migratory nature, albeit in very low numbers. The Operational area is located in the migratory BIA for the whale shark (Figure 3-3). The species migrates south to Ningaloo reef to feed during coral spawning, occurring in March/ April. It is unlikely that whale sharks will be encountered in significant numbers at the Operational area.

Great White Shark (Vulnerable/Migratory)

The Great White Shark (*Carcharodon carcharias*) is widely, but sparsely, distributed in all seas, including cold temperate waters, having been recorded from central Queensland around the south coast to north-west WA, with movements occurring between the mainland coast and the 100 m isobath (DoEE 2017b). The species is known to undertake migrations along the WA coast, with individuals occasionally travelling as far north as North West Cape during spring, before returning south for summer (DoEE 2017b). Given a preference for cooler, southern waters inhabited by seals and sea lions, great white sharks are considered unlikely to be encountered in either the Operational area or EMBA. No great white shark BIAs are intersected by either the Operational area..

Northern River Shark (Endangered)

The Northern River Shark (*Glyphis garricki*) is known to inhabit rivers, tidal sections of large tropical estuarine systems, macrotidal embayments, as well as inshore and offshore marine habitats, although adults have only been recorded in marine environments (DoEE 2017b). Limited data suggests that the species displays a preference for highly turbid, tidally influenced waters with fine muddy substrate. However, the presence of individuals in offshore areas suggests that northern river sharks undertake movements away from rivers and estuaries and are therefore likely to move between river systems (DoEE 2017b). Given the offshore location of the Operational area and the species' preference for turbid, inshore waters, it is unlikely that the species will be encountered in the Operational area, although their preferred habitat occurs within the EMBA.

Shortfin and Longfin Mako Sharks (Migratory)

The shortfin mako (*Isurus oxyrinchus*) and the longfin mako (*Isurus paucus*) are both offshore epipelagic species found in tropical and warm-temperate waters (DoEE 2017b). Both species occur in Australia in coastal waters off WA, NT, QLD and NSW at depths ranging from shallow coastal waters to at least 500 m (DoEE 2017b). These species may migrate through the Operational area and may be found within the wider EMBA.

Reef Manta Ray (Migratory)

The reef manta ray (*Manta alfredi*) is commonly sighted inshore, but also found around offshore coral reefs, rocky reefs and seamounts, tending to inhabit warm tropical or sub-tropical waters (Marshall et. al. 2011a). Long-term sighting records of the reef manta ray at established aggregation sites suggest that this species is more resident to tropical waters and may exhibit smaller home ranges, philopatric movement patterns and shorter seasonal migrations than the giant manta ray (Marshall et al. 2011a).

Based on the species' habitat preferences it is unlikely that the reef manta ray will be encountered in the Operational area. Given the EMBA overlaps with a number of coral and rocky reefs in the region, it is possible the species may be encountered within the EMBA.

Giant Manta Ray (Migratory)

The giant manta ray (*Manta birostris*) inhabits tropical, marine waters worldwide. In Australia, the species is recorded from south-western WA, around the north coast to the southern coast of New South Wales (Australian Museum 2014). The species is commonly sighted along productive coastlines with regular upwelling, oceanic island groups, particularly offshore pinnacles and seamounts. Nearer to shore the giant manta ray is commonly encountered on shallow reefs, while being cleaned, or is sighted feeding at the surface inshore and offshore. It is also occasionally observed in sandy bottom areas and seagrass beds (Marshall et al. 2011b).

Based on the species' habitat preferences it is unlikely that the giant manta ray will be encountered in the Operational area. Given the EMBA overlaps with a number of coral and rocky reefs in the region, it is possible that the species may be encountered within the EMBA.

Freshwater/Largetooth Sawfish (Vulnerable/Migratory)

The freshwater, or largetooth, sawfish (*Pristis pristis*) may occur in all large rivers of northern Australia from the Fitzroy River in WA, to the western side of Cape York Peninsula, Queensland, although is mainly confined to the primary channels of large rivers (DoEE 2017b). In northern Australia, this species is thought to be confined to freshwater drainages and the upper reaches of estuaries, occasionally being found as far as 400 km inland. Few records exist of adults at sea, occurring in fresh or weakly saline water (DoEE 2017b).

Based on the distribution, and preferred habitat of the species, it is considered unlikely that freshwater sawfishes will be found at the Operational area. Given the species' known distribution individuals are likely to be found within the EMBA.

Green Sawfish (Vulnerable/Migratory)

In Australian waters, green sawfishes (*Pristis zijsron*) have been recorded in the coastal waters off Broome in WA, around northern Australia to Jervis Bay, NSW (DoEE 2017b). It is unknown whether green sawfish migrate into Australian waters as adults or juveniles from populations outside Australia (DoEE 2017b). This species inhabits muddy bottom habitats and enters estuaries, although it has also been recorded in inshore marine waters, estuaries, river mouths, embankments and along sandy and muddy beaches, usually in shallow waters (DoEE 2017b).

Based on the offshore, deeper-water activity location, and the species' preference for turbid, inshore water, it is unlikely green sawfishes will be encountered in the Operational area. Based on the known distribution of the species, individuals are known to exist within the EMBA.

Narrow Sawfish (Migratory)

Narrow sawfishes (*Anoxypristis cuspidate*) are bentho-pelagic inhabiting estuarine, inshore and offshore waters to at least 40 m depth (IUCN 2017). Inshore and estuarine waters are critical habitats for juveniles and pupping females, while adults occur predominantly offshore (D'Anastasi et al. 2013). Based on the species' habitat preference it is highly unlikely to be found within the Operational area, although may be encountered within certain areas of the EMBA.

3.5.4 Marine Reptiles

The Operational Area PMST report (Appendix D) identified:

- Six threatened/ migratory; and
- Four migratory

A description of marine reptiles is provided in Table 3-5.

Table 3-5: Marine Reptiles EPBC listed species

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Loggerhead Turtle (*Caretta caretta*)	E,M	Species or species habitat may occur within area Foraging, feeding or related behaviour known to occur within area.	No		✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
Green Turtle (*Chelonia mydas*)	V,M	Foraging, feeding or related behaviour known to occur within area.	No		✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
Leatherback Turtle (*Dermochelys coriacea*)	E,M	Foraging, feeding or related behaviour likely to occur within area.	No	✓ Approved conservation advice for *Dermochelys coriacea* (Leatherback Turtle) (Threatened Species Scientific Committee, 2008a)	✓ Recovery plan for marine turtles in Australia (DoEE 2017)	✓ Marine debris
Hawksbill Turtle (*Eretmochelys imbricata*)	V,M	Foraging, feeding or related behaviour known to occur within area	No		✓ Recovery plan for marine turtles in Australia (DoEE 2017)	
Olive Ridley Turtle (*Lepidochelys olivacea*)	E, M	Foraging, feeding or related behaviour likely to occur within area	No			

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

Marine Turtles

Six threatened/ migratory and four migratory marine turtles are present in the Operatonal Area. Marine turtles are oceanic species, except during nesting seasons where they come ashore to lay eggs. Marine turtles utilise reefs, soft-sediment habitats, seagrass and algal meadows as feeding areas, depending on species, and nest above the high-water mark on sandy beaches and islets within their geographical ranges. The nesting periods are species-dependent, although generally occur between September and March, peaking in December (Pendoley 2005). Hatchlings appear between January and May and immediately leave the shore, moving into open ocean environments for a number of years before returning to inshore areas.

Marine turtles have been observed in the vicinity of the Operational area. Surveys conducted in response to the Montara oil spill in 2009 recorded a total of 25 individual turtles in open water. Two species were confidently identified; loggerhead and green turtles (Watson et al. 2009). Land based surveys recorded green and hawksbill turtle tracks on the islands associated with Ashmore Reef (Watson et al. 2009).

The Operational area does not intersect with any marine turtle BIAs (Figure 3-4). The Operational Area is approximately 80 km to the nearest nesting site at Cartier Island.

Green Turtle (Vulnerable/Migratory)

Green turtles (*Chelonia mydas*) are found in tropical and subtropical waters throughout the world (Marquez 1990; Bowen et al. 1992). The closest known significant breeding/nesting grounds to the Operational area are the Ashmore Reef and Cartier Island CMRs, approximately 125 and 84 km to the northwest of the Operational area, respectively (Figure 3-4).

Green turtles may occasionally pass through the Operational area, as satellite tracking studies have shown that green turtles migrate between breeding grounds and feeding grounds off the northwest coast (Pendoley 2005). However, due to the water depths the area does not provide foraging habitat.

Flatback Turtle (Vulnerable/Migratory)

The flatback turtle (*Natator depressus*) is found in the tropical waters of northern Australia, Papua New Guinea and Irian Jaya. It is the most widely distributed nesting marine turtle species in the Northern Territory (Chatto and Baker 2008), nesting on a wide variety of beach types around the entire coastline. The flatback turtle also nests in the Kimberley Region of Western Australia, with Cape Dommett (Bowlay and Whiting 2007) and Lacrosse Island being important nesting areas for the species. The closest nesting sites to the Operational area are approximately 500 km to the south-east (Lacepede Islands).

While flatback turtles make lengthy reproductive migrations, up to 1,300 km from nesting beaches (Limpus et al. 1983), movements are generally restricted to the continental shelf (DoEE 2017b). Flatback turtles nesting within the Pilbara region migrate to their foraging grounds in the Kimberley region along the continental shelf at the end of the nesting season (RPS 2010). Due to their migrations between the Pilbara and the Kimberley regions of WA, individual flatback turtles may transit the Operational area during migration. However, given the distance from known aggregation areas, it is unlikely that significant numbers of flatback turtles will be encountered within the Operational area. Due to the water depths the area does not provide foraging habitat.

Hawksbill Turtle (Vulnerable/Migratory)

Hawksbill turtles (*Eretmochelys imbricata*) are found in tropical, subtropical and temperate waters in all oceans of the world. There are no known nesting or breeding areas in or near to the Operational area.

Leatherback Turtle (Endangered/Migratory)

The Leatherback turtle (*Dermochelys coriacea*) has the widest distribution of any marine turtle, and can be found in tropical, subtropical and temperate waters throughout the world (Marquez 1990). No major centres of nesting activity have been recorded in Australia, although scattered isolated nesting (1-3 nests per annum) occurs in southern Queensland and Northern Territory (Limpus and McLachlin 1994). As such, it is expected that very few leatherback turtles will be encountered in the Operational area.

Loggerhead Turtle (Endangered/Migratory)

The loggerhead turtle (*Caretta caretta*) has a global distribution throughout tropical, sub-tropical and temperate waters (Marquez 1990). The closest known breeding/nesting grounds to the Operational area are found at Muiron Island and the beaches of the Northwest Cape (Baldwin et al. 2003), approximately 1,500 km south-west of the Operational area and outside the EMBA. Loggerhead turtles have been recorded in the reserves of Ashmore Reef (125 km) and Cartier Island (84 km), west- northwest of the Operational area (Guinea 1995). Loggerhead turtles are unlikely to be encountered within the Operational area in significant numbers.

Olive Ridley Turtle (Endangered/Migratory)

The olive ridley turtle (*Lepidochelys olivacea*) has a circum-tropical distribution, with nesting occurring throughout tropical waters. No concentrated nesting has been found in Australia, although low density nesting occurs along the Arnhem Land coast of the Northern Territory, including the Crocodile, McCluer and Wessel Islands, Grant Island and Cobourg Peninsula (Chatto and Baker 2008). Therefore, Olive Ridley turtles are unlikely to be encountered within the Operational area in significant numbers. No olive-ridley turtle BIAs are intersected by the Operational area.

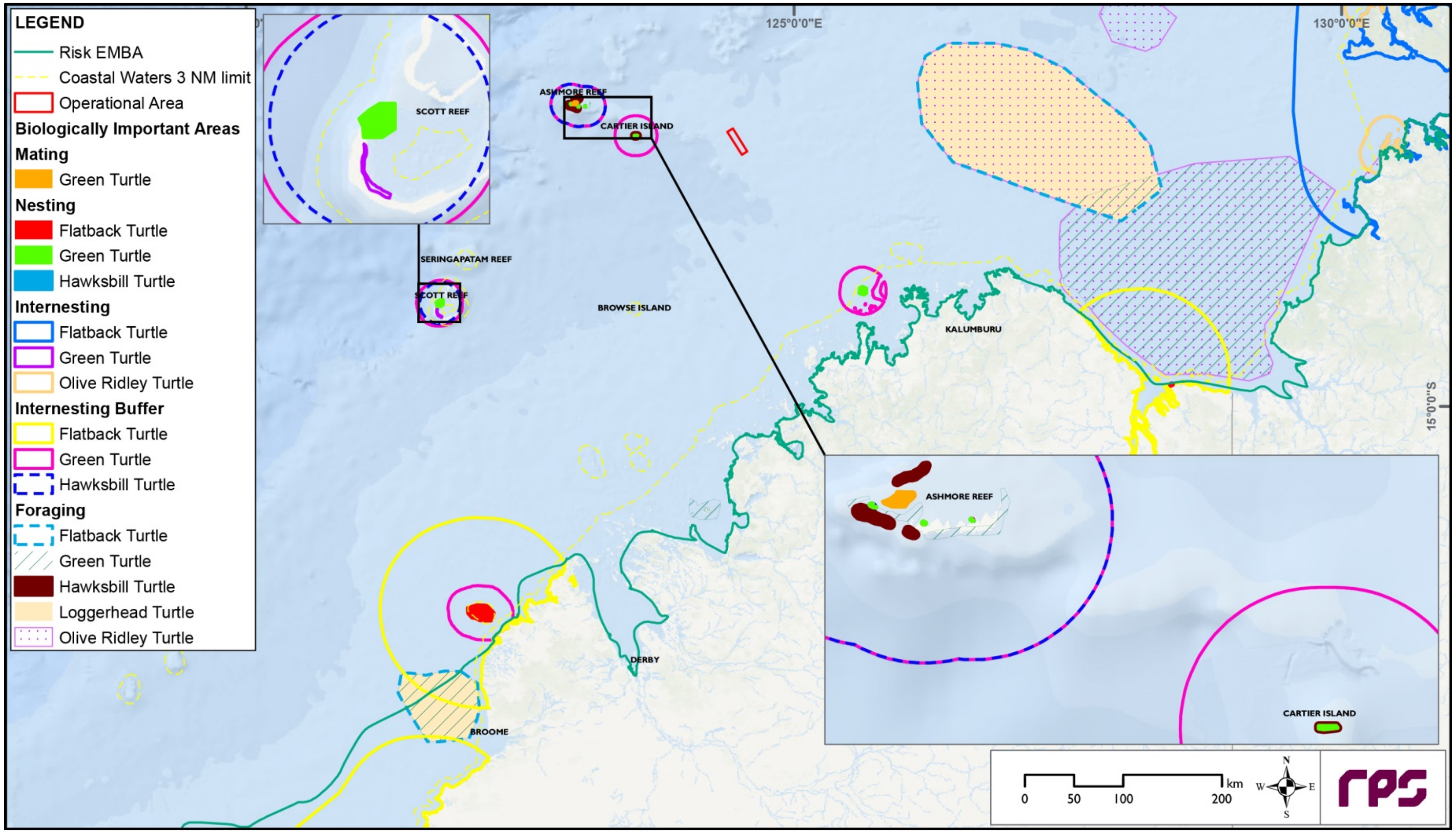


Figure 3-4: Biologically important areas for marine reptiles

3.5.5 Marine Mammals

The Operational Area PMST report (Appendix D) identified:

- Four threatened/ migratory; and
- Three migratory

A description of marine mammals is provided in Table 3-6.

Cetaceans

The region is thought to be an important migratory pathway between feeding grounds in the Southern Ocean and breeding grounds in tropical waters for several cetacean species. Pygmy blue whales (*Balaenoptera musculus*), fin whales (*Balaenoptera physalus*), dwarf minke whales (*Balaenoptera acutorostrata*) and Antarctic minke whales (*Balaenoptera bonaerensis*) may travel through the region on their way to breeding grounds, which are thought to be in deep oceanic waters around the Indonesian Archipelago.

During ambient noise monitoring at the southern (AC/L7) permit area in June–December 2011, numerous cetacean vocalisations were recorded (McPherson et al. 2012). Two species of odontocetes (toothed whales and dolphins) were identified during the first six-months of deployment, false killer whales and common bottlenose dolphins.

Pygmy blue whales (*B. m. brevicauda*) were detected at the nearby Cash-Maple (AC/RL7 block) permit area, which coincided with the timing of the northern and southern migrations (McCauley 2011). Humpback whales were only recorded during two periods in July and August 2011 at the Southern station. The vocalisations of bryde's whales were also detected at the southern permit area at the time of survey. Based on the most recent scientific literature (Cerchio et al. 2015) and re-analysis of data, some of the Bryde's whales (*Balaenoptera edeni*) reported are now believed to be the calls of Omura's whale (*Balaenoptera omurai*) (McPherson et al. 2017). Omura's whales therefore appear to be present year-round along the region's continental shelf but showed seasonal differences in occurrence at specific sites (McPherson et al. 2017). Overall, they are most commonly detected in the Timor Sea in winter.

The blue pygmy whale distribution BIA overlaps the Operational area (Figure 3-5).

Table 3-6: Marine Mammal EPBC listed species

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Humpback Whale (*Megaptera novaeangliae*)	V,M	Species or species habitat likely to occur within area	No	✓ Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee, 2015a)	Ceased 2015	✓ Marine debris
Blue whale (*Balaenoptera musculus*) Including Pygmy Blue Whale	E,M	Species or species habitat likely to occur within area	**No**	No	✓ Conservation management plan for the blue whale: A recovery plan under the EPBC Act 1999 2015-2025 (Commonwealth of Australia, 2015a)	✓ Marine debris
Sei Whale (*Balaenoptera borealis*)	V, M	Species or species habitat likely to occur within area	No	✓ Conservation advice *Balaenoptera borealis* sei whale (Threatened Species Scientific Committee, 2015b)	Ceased in 2015	✓ Marine debris

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Fin Whale (*Baleenoptera physalus*)	V, M	Species or species habitat likely to occur within area	No	✓ Conservation advice *Balaenoptera physalus* fin whale (Threatened Species Scientific Committee, 2015c)	Ceased 2015	✓ Marine debris
Bryde's Whale (*Balaenoptera edeni*)	M	Species or species habitat may occur within area	No		No	
Orca, Killer Whale (*Orcinus orca*)	M	Species or species habitat may occur within area	No		No	
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) (*Tursiops aduncus*)	M	Species or species habitat may occur within area	No		No	

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

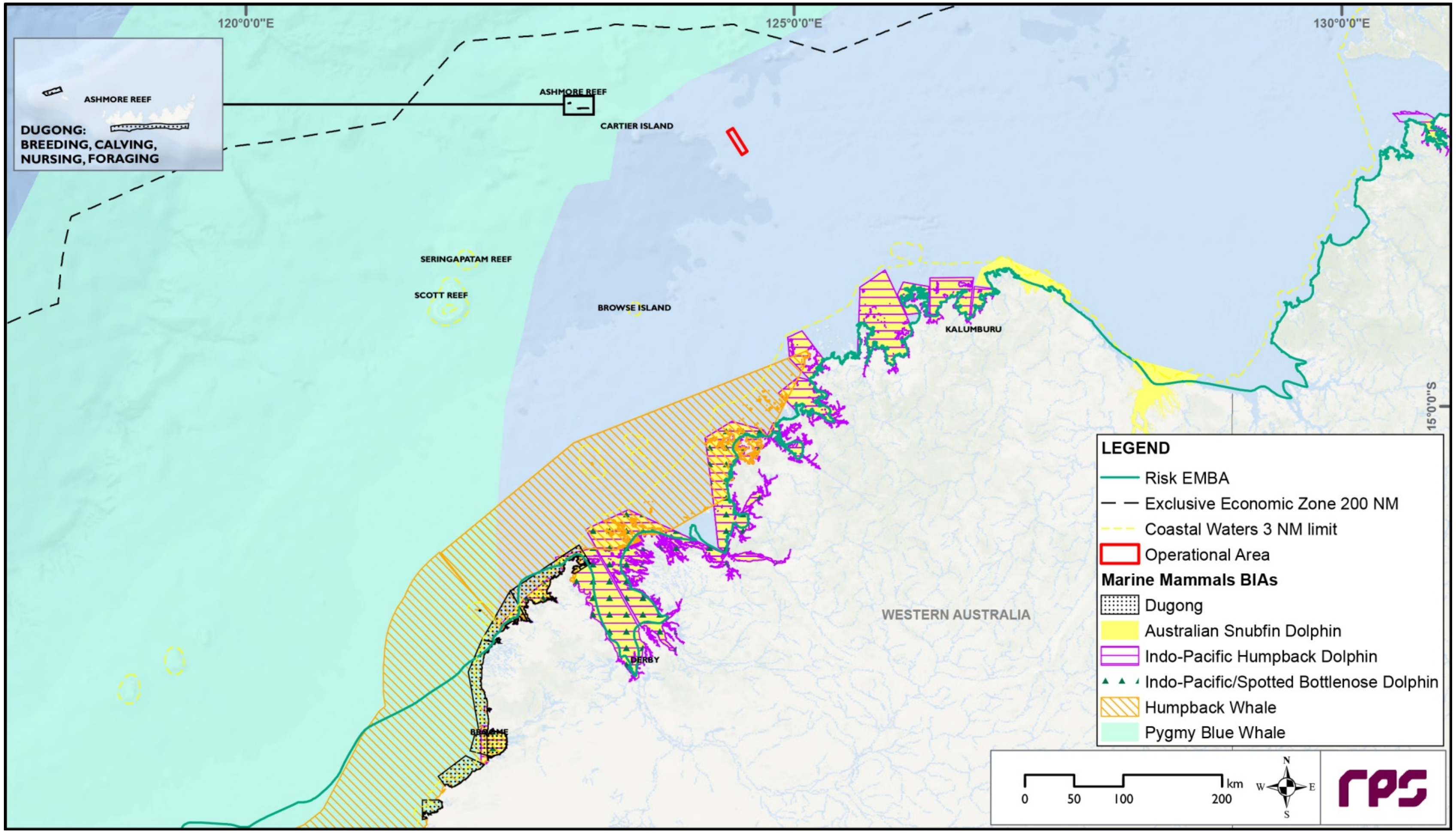


Figure 3-5: Biologically important areas for marine mammals

Blue Whale (Endangered/Migratory)

Blue whales (*Balaenoptera musculus*) are widely distributed throughout the worlds' oceans. There are two subspecies in the Southern Hemisphere: the southern blue whale (*Balaenoptera musculus intermedia*) and the pygmy blue whale (*Balaenoptera musculus brevicauda*) (DEWHA 2008). In general, the southern blue whale is found south of 60° S and pygmy blue whales are found north of 55° S (DEWHA 2008), making it likely that any blue whales frequenting the waters of the Operational area would be pygmy blue whales.

Blue whale migration is thought to follow deep oceanic routes, although little is known about their precise migration routes (DoEE 2017b). Sea noise loggers set at various locations along the coast of Western Australia have detected a seasonal presence indicating a pattern of annual northbound and southbound migration of pygmy blue whales past Exmouth and the Montebello Islands and locations to the north (McCauley and Jenner 2010). Pygmy Blue whales appear to migrate south from Indonesian waters passing Exmouth through November to late December each year. Observations suggest most Pygmy Blue whales pass along the shelf edge out to water depths of 1,000 m depth contour. The northern migration passes Exmouth over an extended period ranging from April to August (McCauley and Jenner 2010). They are believed to calve in tropical waters in winter and births peak in May to June, however the exact breeding grounds of this species are unknown (Bannister et al. 1996).

The Operational area does not include any recognised blue whale migratory routes or known feeding, breeding or resting areas. However, low numbers of blue whales migrating to and from Indonesian waters may occasionally pass through the Operational area, most likely during the southern migration (October to November) (DoEE 2017b). Ambient noise monitoring conducted for PTTEP AA in and around the Montara field documented the presence of cetacean species over a full 12-month period between December 2010 and December 2011. The data support the well documented seasonal timings of pygmy blue whales in the region, and the low numbers recorded are consistent with the field area being outside the recognised BIAs for this species.

Humpback Whale (Vulnerable/Migratory)

Humpback whales (*Megaptera novaeangliae*) have a wide distribution, having been recorded from the coastal areas off all Australian states other than the Northern Territory (Bannister et al. 1996). Humpback whales migrate north and south along the eastern and western coasts of Australia from calving grounds in the tropical north to feeding grounds in the Southern Ocean (DoEE 2017b). Peak migration off the north-western coast of Australia occurs from late July to early September. From June to mid-September the inshore waters (landward of the 100 m isobath) between the Lacepede Islands and Camden Sound (approximately 400 km south-west of the Operational area) are used as a calving area for this species (Jenner et al. 2001).

The Operational area is located outside of the recognised humpback whale migratory routes, which are usually within 30 km of the coastline. The EMBA overlaps with the humpback whale BIA identified for breeding and calving at Camden Sound Marine Park, adjacent to the Kimberley coast (Figure 3-5).

Given the Operational area is situated north of the northernmost point of the humpback whale migration it is considered unlikely that the species will be encountered. Individuals may be encountered within the wider EMBA.

Sei Whale (Vulnerable/Migratory)

Sei whales (*Balaenoptera borealis*) are a cosmopolitan species, found in the waters off all Australian states (DoEE 2017b). The Australian Antarctic waters are important feeding grounds for sei whales, as are temperate, cool waters (DoEE 2017b). The species has also been observed feeding in the Bonney Upwelling area in South Australia, indicating the area as potentially being an important feeding ground.

Breeding in this species is known to occur in tropical and subtropical waters (DoEE 2017b). Currently, the movements and distributions of sei whales are unpredictable and not well documented. However, information suggests that sei whales have the same general pattern of migration as most other baleen whales, although timing is later in the season and such high latitudes are not reached (DoEE 2017b).

Based on the cosmopolitan distribution of the species, sei whales may be encountered in low numbers within the Operational area. Individuals of the species may be encountered within the EMBA, although large numbers are unlikely.

Fin Whale (Vulnerable/Migratory)

Fin Whales (*Balaenoptera physalus*) are found in the waters all around Australia and the Australia Antarctic Territory (DoEE 2017b). The Australian Antarctic waters are also thought to be important feeding grounds for fin whales, while feeding has been observed in the Bonney Upwelling area indicating the area to be of importance as a feeding ground for the species (Morrice et al. 2004). No known mating or calving areas are known from Australian waters. Currently, the migration routes and locations of winter breeding grounds for this species are uncertain (DoEE 2017b).

Based on the cosmopolitan distribution of the species, fin whales may be encountered in low numbers within the Operational area.

Bryde's Whale (Migratory)

Bryde's Whales (*Balaenoptera edeni*) are a cosmopolitan species, found in the waters of all Australian states, including both Christmas and the Cocos Islands (DoEE 2017b). Two forms of Bryde's whale are known: the coastal and offshore form. The coastal from appears to be limited to habitat within the 200 m depth isobar, moving along the coast in response to availability of suitable prey (Best et al. 1984); the offshore form is known in deeper water (500 m to 1,000 m).

Ambient noise monitoring conducted in the Southern, Cash-Maple and Oliver permits by JASCO (2012) over a 12-month period between December 2010 and December 2011 recorded whale calls that were attributed to Bryde's whales year-round at all three permits, with no seasonal cycle observed. These data demonstrate that individuals may be encountered within the Operational area.

Orca/Killer Whale (Migratory)

Orcas, or Killer Whales (*Orcinus orca*), are a cosmopolitan species, found in the waters off all Australian states in oceanic, pelagic and neritic regions, in both warm and cold waters. Killer whales are known to make seasonal movements, and are likely to follow regular migratory routes, however little is known about either local or seasonal movement patterns of the species (DoEE 2017b).

Given the lack of known migration routes or areas of significance in the region, the species is not expected to be encountered in either the Operational area.

Spotted Bottlenose Dolphin (Migratory)

The spotted bottlenose dolphin (*Tursiops aduncus*) is generally considered to be a warm water subspecies of the common bottlenose dolphin (*Tursiops truncates*) and known to exist in waters off all Australian states. The spotted bottlenose dolphin appears to be restricted to inshore areas such as bays and estuaries, nearshore waters, open coast environments, and shallow offshore waters including coastal areas around oceanic islands (DoEE 2017b). BIAs for this species are illustrated in Figure3-5.

Due to the distance from the coast and deeper waters of the Operational area, spotted bottlenose dolphins are not expected to occur, particularly given the preference for shallower, coastal waters. Given their cosmopolitan distribution, the species may be encountered within the Operational Area.

3.5.6 Avifauna

The Operational Area PMST report (Appendix D) identified:

- Twelve threatened/migratory; and
- Ten migratory.

A description of avifauna species is provided in Table 3-7.

Numerous species of birds frequent the Timor Sea area or fly through the area on annual migrations. Seabird feeding grounds, roosting and nesting areas are found at the offshore atolls in the wider region, particularly Ashmore Reef. Many species are listed under the Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) or Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). Most seabirds breed at offshore sites, such as Ashmore Reef, Cartier Island and Browse Island, from mid-April to mid-May (Clarke 2010). Peak migration time of migratory shorebirds is between October and December (Clarke 2010). It is expected that some individuals of these species may pass through the Operational area during their annual migrations.

No avifauna migration, resting, foraging or breeding BIAs are present within the Operational area (Figure 3-7). The nearest breeding/roosting site to the Operational Area is Cartier Island approximately 80 km away.

Red Knot (Endangered/Migratory)

The red knot is a migratory shorebird and the species includes five subspecies, including two found in Australia; *Calidris canutus piersmai* and *Calidris canutus rogersi*. It undertakes long distance migrations from breeding grounds in Siberia, where it breeds during the boreal summer, to the southern hemisphere during the austral summer. Both Australia and New Zealand host significant numbers of red knots during their non-breeding period (Bamford et al. 2008). As with other migratory shorebirds, the species occurs in coastal wetland and intertidal sand or mudflats, where they feed on intertidal invertebrates, especially shellfish (Garnet et al. 2011).

They are likely to be found in these habitats throughout the EMBA but is unlikely to occur frequently in the Operational area, aside from individuals occasionally transiting through during migrations, due to the lack of emergent habitat.

Australian Lesser Noddy (Vulnerable)

The Australian lesser noddy (*Anous tenuirostris melanops*) is usually only found around its breeding islands including the Houtman Abrolhos Islands and on Ashmore Reef and Barrow Island in WA (DoEE 2017b). This species may forage out at sea or in seas close to breeding islands and fringing reefs (Johnstone and Storr 1998; Storr et al. 1986; Whittell 1942). Given the distribution of the species and the breeding population at nearby Ashmore Reef and Cartier Island, this species may be present in the Operational area, although only in low numbers. Based on known distribution and the location of rookeries the species is known to occur within the EMBA.

Curlew Sandpiper (Critically Endangered/Migratory)

In Australia, curlew sandpipers (*Calidris ferruginea*) occur around the coasts and are also quite widespread inland. In WA, they are widespread around coastal and subcoastal plains from Cape Arid to south-west Kimberley, albeit rarely encountered in the north-west of the Kimberley region (DoEE 2017b). Curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, as well as around non-tidal swamps, lakes and lagoons near the coast, occurring in both fresh and brackish waters (DoEE 2017b).

Given the offshore location of activities and habitat preferences, the species is unlikely to be encountered within the Operational area other than occasional numbers during migration, although may be present within the EMBA.

Table 3-7: Avifauna Listed EPBC species

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Red Knot (*Calidris canutus*)	E, M	Species or species habitat may occur within area	No	✓ Conservation advice *Calidris canutus* red knot (Threatened Species Scientific Committee, 2016a)	No	**No**
Australian Lesser Noddy (*Anous tenuirostris melanops*)	V	Species or species habitat may occur within area	No	✓ Conservation advice *Anous tenuirostris melanops* Australian lesser noddy (Threatened Species Scientific Committee, 2015e)	No	No
Curlew Sandpiper (*Calidris ferruginea*)	CE, M	Species or species habitat may occur within area	No	✓ Conservation advice *Calidris ferruginea* curlew sandpiper (Threatened Species Scientific Committee, 2015f)	No	No
Eastern Curlew (*Numenius madagascariensis*)	CE, M	Species or species habitat may occur within area	No	✓ Conservation advice *Numenius madagascariensis* eastern curlew (Threatened Species Scientific Committee, 2015g)	No	No

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Abbott's Booby (*Papasula abbotti*)	E, M	Species or species habitat may occur within area	No	✓ Conservation advice *Papasula abbotti* Abbott's booby (Threatened Species Scientific Committee, 2015h)	National Recovery Plan for the Abbott's Booby (Department of the Environment and Heritage 2004)	National Recovery Plan for the Abbott's Booby (Department of the Environment and Heritage 2004)
Common Noddy (*Anous stolidus*)	M	Species or species habitat may occur within area	No		No	✓
Streaked Shearwater (*Calonectris leucomelas*)	M	Species or species habitat may occur within area	No		No	✓
Lesser Frigatebird (*Fregata ariel*)	M	Species or species habitat may occur within area	No		No	✓
Great Frigatebird (*Fregata minor*)	M	Species or species habitat may occur within area	No		No	✓
Common Sandpiper (*Actitis hypoleucos*)	M	Species or species habitat may occur within area	No	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia, 2015c)	No	✓

Common Name (Scientific Name)	EPBC Act Status	Type of presence	BIA within Operational Area	Management		
				Conservation advice	Recovery Plan	Threat Abatement Plan
Sharp-tailed Sandpiper (*Calidris acuminata*)	M	Species or species habitat may occur within area	No	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia, 2015c)	No	✓
Pectoral Sandpiper (*Calidris melanotos*)	M	Species or species habitat may occur within area	No		No	✓

CE = Critically Endangered; E = Endangered; V = Vulnerable; M = Migratory

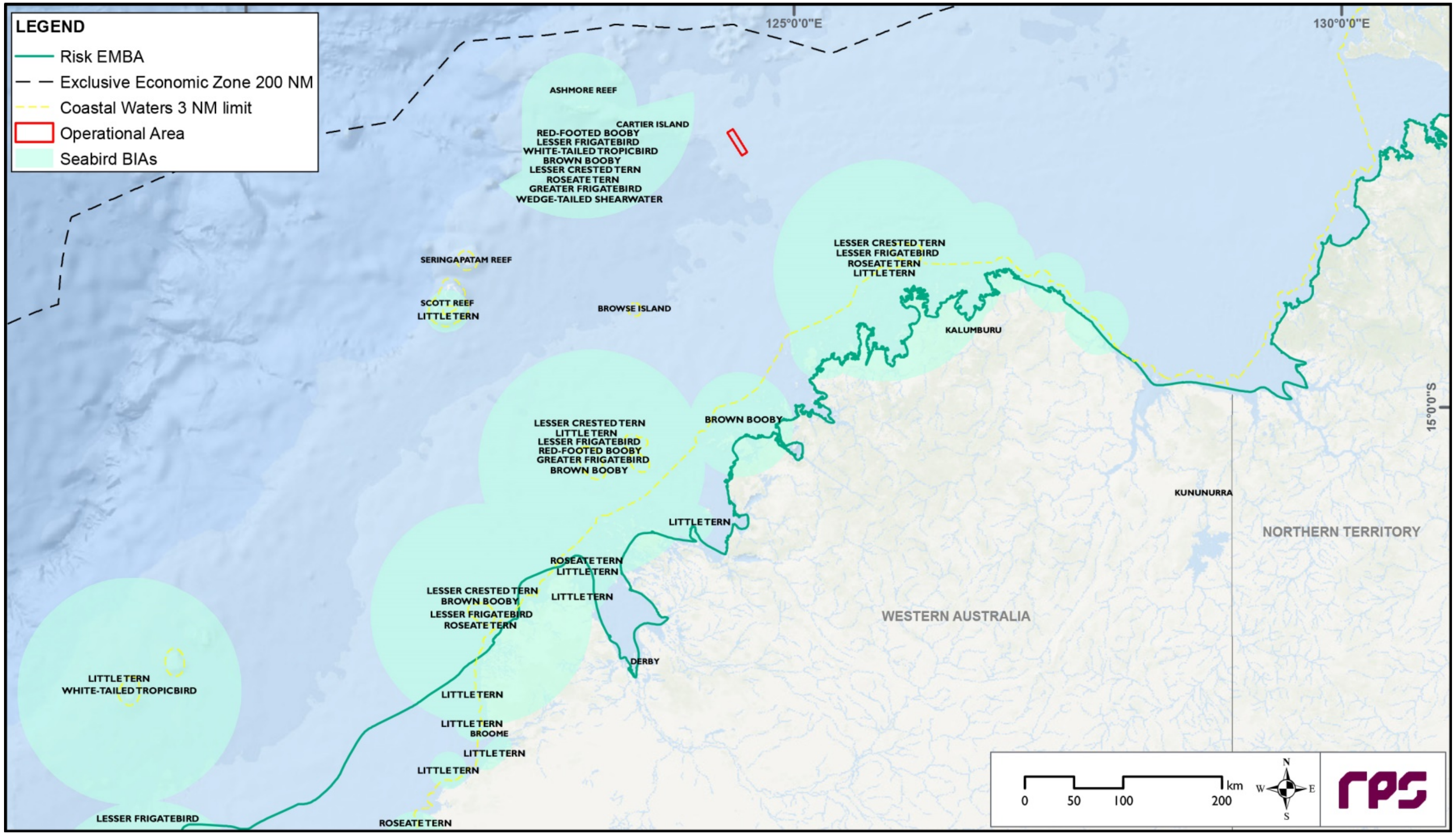


Figure 3-6: Figure Biologically important areas for avifauna

Eastern Curlew (Critically Endangered/Migratory)

Within Australia, the eastern curlew (*Numenius madagascariensis*) has a primarily coastal distribution. They have a continuous distribution from Barrow Island and Dampier Archipelago in WA, through the Kimberley and along the NT, Queensland, and NSW coasts and the islands of Torres Strait. They are patchily distributed elsewhere.

The species nests in the northern hemisphere, from early May to late June and does not breed in Australia. During the non-breeding season in Australia, the eastern curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats (TSSC 2015). Given the offshore location of activities and habitat preferences, the species is unlikely to be encountered within the Operational area other than occasional numbers during migration, although may be present within the EMBA.

Abbott's Booby (Endangered/Migratory)

In Australia, Abbott's booby (*Papasula abbotti*) is only found on Christmas Island, where it nests in tall rainforest trees. It is a pelagic feeding species, spending long periods at sea and often foraging hundreds of kilometres from land (Olsen 2001). Given the offshore location of activities and habitat preferences, the species is may be present foraging within the Operational area and EMBA.

Common Noddy (Migratory)

In Australia, the common noddy (*Anous stolidus*) occurs mainly in oceanic waters off the Queensland coast, although is also known from the north-west and central WA coast. The species is also rarely encountered off the coast of the NT, where only one breeding location of approximately 100-130 birds is documented (DoEE 2017b). During the breeding season, the species usually occurs on, or near islands, on rocky islets and stacks with precipitous cliffs, or on shoals or cays of coral or sand. During the non-breeding period, the species occurs in groups throughout the pelagic zone (DoEE 2017b).

Based on the distribution and habitat preferences the species may be encountered within the Operational area and occurs within the EMBA.

Streaked Shearwater (Migratory)

The streaked shearwater (*Calonectris leucomelas*) is usually found over pelagic waters and is known to breed on the coast and offshore islands mainly around Japan and Korea (Ochi et al 2010). The streaked shearwater migrates south during winter to Australia (Birdlife International 2015). The species does not breed in Australia. Streaked shearwaters are known to forage in areas of high concentrations of subsurface predators (e.g. tuna and dolphins) in tropical oceans during non-breeding periods (Yamamoto et al 2010). Given the distribution of streaked shearwaters, this species may be present in the Operational area, albeit in low numbers, and will occur within the EMBA.

Lesser Frigatebird (Migratory)

The lesser frigatebird (*Fregata ariel*) is considered the most common and widespread frigatebird over Australian seas (Lindsey 1986). They are commonly found in tropical seas, breeding on remote islands (Marchant and Higgins 1990). A BIA has been identified for this species at Ashmore Reef and Cartier Island to highlight breeding and foraging behaviours in the area (DoEE 2017b). The Operational area does not overlap with this BIA (Figure 5-7). Breeding is known to occur between March and September.

Given its distribution and the large breeding population at nearby Ashmore Reef and Cartier Island, this species may be encountered within the Operational area and will be present within the EMBA.

Great Frigatebird (Migratory)

Great frigatebirds (*Fregata minor*) are found in tropical waters globally. A BIA has been identified at Ashmore Reef and Cartier Island for the species to highlight breeding and foraging behaviours in the area (DoEE 2017b). The Operational area does not overlap with this BIA (Figure 5-7). Breeding is known to occur between May to June and in August (DoEE 2017b). Given the distribution of the species and its low population in nearby Ashmore Reef and Cartier Island, this species may be present in the Operational area in low numbers.

Common Sandpiper (Migratory)

The common sandpiper (*Actitis hypoleucos*) is a small, migratory species with a very large range through which it undertakes annual migrations between breeding grounds in the northern hemisphere (Europe and Asia) and non-breeding areas in the Asia-Pacific region (Bamford et al. 2008). The species congregates in large flocks and forages in shallow waters and tidal flats between spring and autumn. Specific critical habitat in Australia has not been identified due to the species' broad distribution (Bamford et al. 2008).

The common sandpiper may be present in coastal wetland and intertidal sand or mudflats throughout the wider EMBA, but is unlikely to occur in the Operational area, aside from individuals occasionally transiting through during migrations, due to the lack of emergent habitat.

Sharp-tailed Sandpiper (Migratory)

The sharp-tailed sandpiper (*Calidris acuminata*) is a migratory wading shorebird and undertakes long distance seasonal migrations between breeding grounds in the northern hemisphere and over-wintering areas in the southern hemisphere (Bamford et al. 2008). The species may occur in Australian between spring and autumn. The species is unlikely to occur within the Operational area due to the lack of suitable habitat but may occur seasonally in coastal wetland and intertidal sand or mudflats throughout the wider EMBA.

Pectoral Sandpiper (Migratory)

The pectoral sandpiper (*Calidris melanotos*) breeds in the northern hemisphere during the boreal summer, before undertaking long distance migrations to feeding grounds in the southern hemisphere (Bamford et al. 2008). The species occurs throughout mainland Australia between spring and autumn. The pectoral sandpiper prefers coastal and near-coastal environments such as wetlands, estuaries and mudflats.

Given the species' preferred habitat the pectoral sand piper is not expected to occur within the Operational area but is expected to occur in suitable habitats within the wider EMBA.

3.6 Social Values

The socioeconomic environmental values and sensitivities (cultural and socio-economic) within the Operational Area, which also include all relevant matters of National Environmental Significance (NES) protected under the EPBC Act, are summarised in Table 3-8.

Table 3-8: Socio-economic Values and Sensitivities within the Operational Area

Value/ Sensitivity	Description	Operational Area Presence
World Heritage Properties	Sites accepted to the World Heritage listing are only inscribed if considered to represent the best examples of the world's cultural and natural heritage. There are no World Heritage properties that intersect with the Operational Area.	None
Shipping	The Operational Area is not located on a major international shipping route. Heavy vessels following the charted Osborn Passage will pass through both permits to the north of the Montara Venture FPSO. Support vessels servicing the nearby infrastructure do pass through the Operational Area (AMSA, 2014) (refer Figure 3-8).	✓
Commercial Fishing	The Northern Demersal Scalefish Fishery (Area 2) has low levels of fishing activity in the vicinity the Operational Area. The following fisheries are permitted, and It is feasible that they may operate in the Operations Area: • JA Northern Shark Fishery (WA) • Mackerel Area 1 (WA) • Western Tuna and Billfish Fishery	Minimal effort
Recreational Fishing	Remoteness of Operational area limits recreational fishing usage.	Limited
Traditional Fishing	Traditional Australian indigenous fishing activities are generally concentrated within 3 nm of the NT/WA coastline (DPIF 2015). Indonesian/Timor Leste indigenous fishing is concentrated in the vicinity of Sahul Bank, Echo Shoals and MoU Box and boats may pass through the Operational area to reach these fishing grounds.	Transit
Defence	No declared defence areas in Operational area.	–
Oil and Gas	Various petroleum exploration and production activities have been undertaken within the Timor Sea, including some within close proximity of the Operational area.	Adjacent
Tourism	No regular tourism activity occurs in the Operational area due to its remoteness.	–
Cultural Heritage	No known sites of shipwrecks or Aboriginal Heritage significance within the Operational area.	–

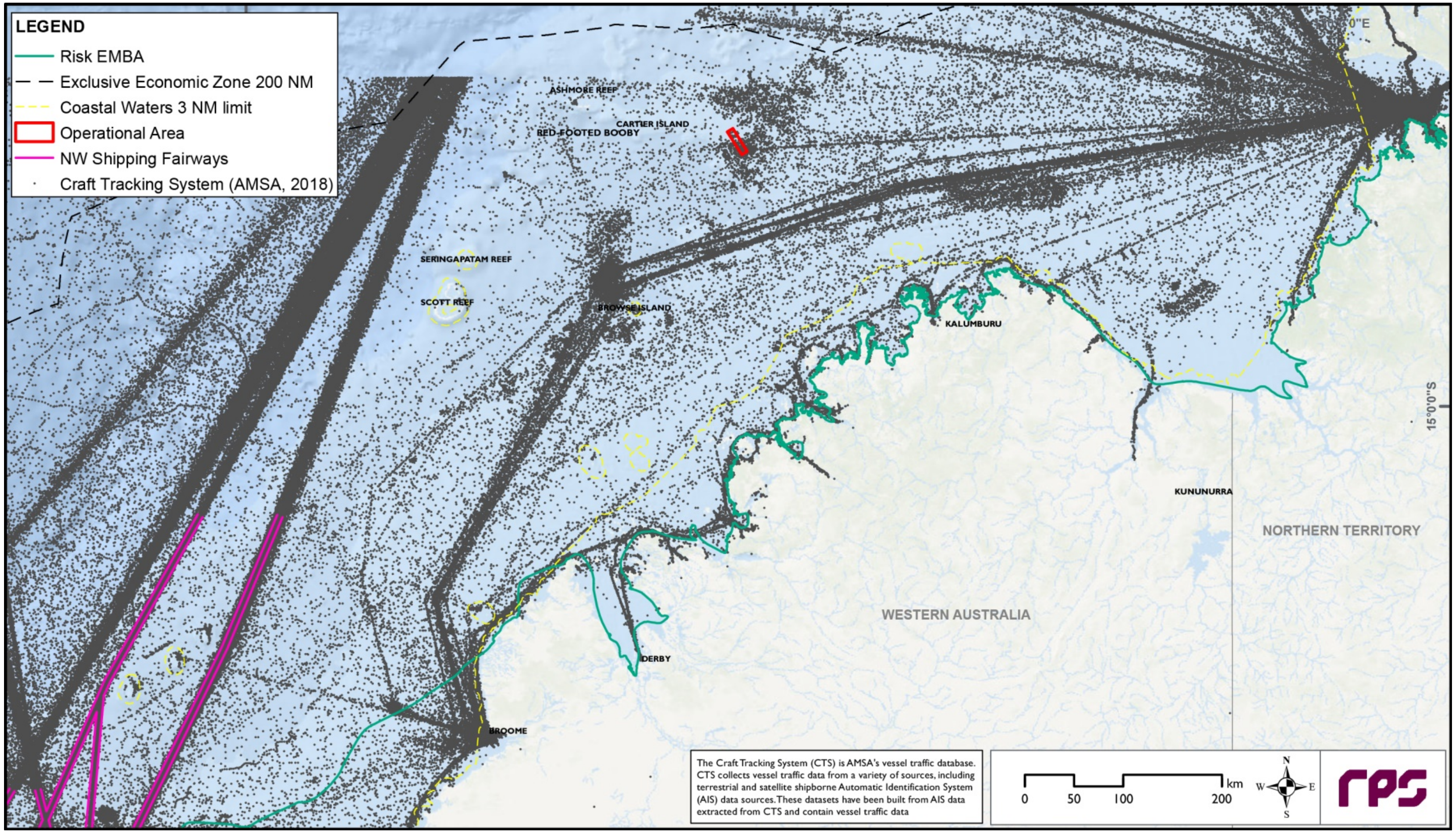


Figure 3-7: Shipping activity within the region

4. CONSULTATION OF RELEVANT PERSONS

Jadestone is required under the OPGGS(E) Regulations 2009 to prepare a strategy for the identification and consultation of relevant persons as part of the process for acceptance by NOPSEMA of this EP.

Jadestone has developed a Consultation Process for Regulatory Approvals (JS-70-PR-I-00034) to assist in addressing this requirement across its approvals (Figure 4-1).

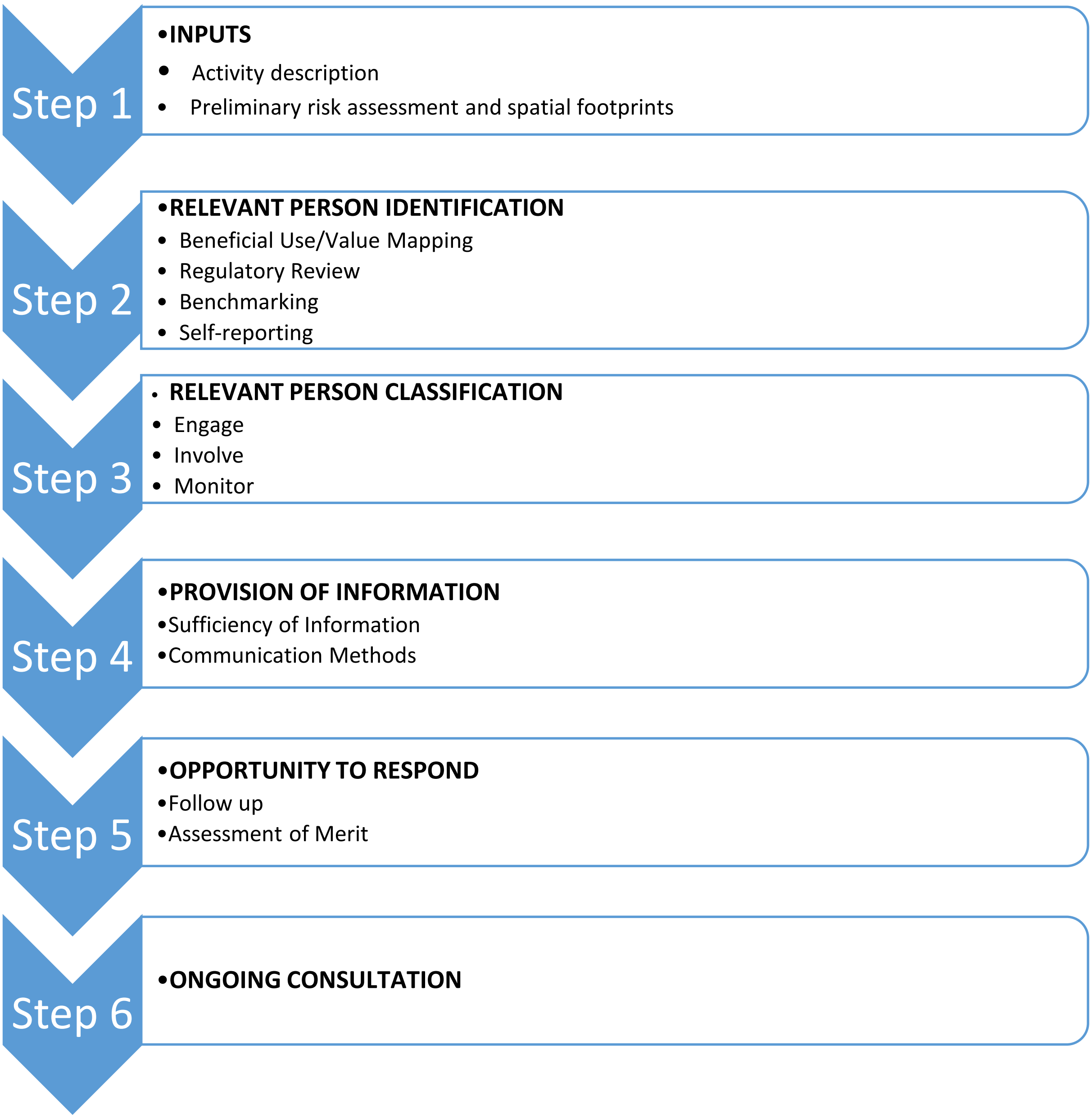


Figure 4-1: JSE Stakeholder Engagement Process

4.1 Definitions

For the purposes of this section the following definitions have been used:

Function	A role in the administration, management or regulation
Activity	A thing that a person or group does or has done under a legal or proprietary right
Interest	A person or organisation having a common concern Commercial or academic pursuit which is regular and observable

4.2 Fulfilment of Regulatory Requirements

The Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 stipulate a number of requirements in relation to consultation associated with an EP (Table 4-1).

Table 4-1: Regulatory Requirements

Regulation	Description	Fulfilment
11A(1)	In the course of preparing an environment plan, or a revision of an environment plan, a titleholder must consult each of the following (a relevant person): (a) each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; (b) each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; (c) the Department of the responsible State Minister, or the responsible Northern Territory Minister; (d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan; (e) any other person or organisation that the titleholder considers relevant.	Section 4.2 of the EP outlines the process (as per JSE standard Stakeholder Engagement Process) that was used to identify relevant persons in each of the 5 groups required under the regulations. A list of the relevant persons can be found in Table 4.2. A log of engagement with each of the relevant persons identified is provided in Appendix C.
11A(2)	For the purpose of the consultation, the titleholder must give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person.	Historical consultation was undertaken by PTEPP during the development of a draft EP prior to the purchase of the Montara facility by JSE. To reduce stakeholder fatigue, JSE built on this consultation. For key stakeholders (particularly government agencies) email and phone discussions between staff were undertaken on specific issues. In addition to this all stakeholders were provided with targeted information sheets (Appendix C).

Regulation	Description	Fulfilment
11A(3)	The titleholder must allow a relevant person a reasonable period for consultation.	At the time of the submission of the EP over two months has been allowed for since the information sheet was distributed.
14(9)	The implementation strategy of the environment plan must provide for appropriate consultation with: (a) Relevant authorities of the Commonwealth, a State or Territory; and (b) Other relevant interested persons or organisations.	As above
16(b)	A report on all consultations between the titleholder and any relevant person, for regulation 11A, that contains: (a) A summary of each response made by a relevant person; (b) An assessment of the merits of any objections or claim about the adverse impact of each activity to which the environment plan relates; (c) A statement of the titleholder's response, or proposed response, if any, to each objection or claim; and (d) A copy of the full text of any response by a relevant person.	a) A log of all engagement undertaken with relevant persons is provided in Appendix L (the separate Sensitive Information Report not published for privacy reasons). b) An assessment of response merits is provided in Table 4-4. c) The assessment of merits provided in Table 4-4 contains JSE's response to any claims. d) Full text of correspondence can be found in Appendix L (the separate Sensitive Information Report not published for privacy reasons).
27	Storage of records: • Records must be stored in a way that makes retrieval reasonably practicable; • Records must be kept for five years; and • Records generated through preparation of the environment plan, demonstrating environmental performance, incidents, emissions and discharges, calibration and maintenance, and in relation to the implementation strategy arrangements must be kept.	The JSE Stakeholder Engagement Process stipulates internal requirements for the storage of records.

4.3 Identification of Relevant Persons

Regulation 11A (1) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 identifies five groups as relevant persons who must be consulted with in the course of preparing an environment plan:

1) each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, 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 environment plan, or the revision of the environment plan, 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 environment plan, or the revision of the environment plan;
5) any other person or organisation that the titleholder considers relevant.

For each consultation process, Jadestone utilises standardised identification methods (in accordance with Consultation Process for Regulatory Approvals JS-70-PR-I-00034.) to compile a list of relevant persons across these categories. For each of the five groups of relevant persons above, four pathways were used to identify contacts:

1. Beneficial Use/Value Mapping: for each use associated with socio-economic or cultural values identified as having the potential to be impacted, identify stakeholders based on function, interest and activity;
2. Regulatory Review: undertake review for Ministers of regulatory portfolios of relevance and for region;
3. Benchmarking: persons identified through benchmarking with other similar in-house or external projects; and
4. Self-reporting: opportunities for self-reporting should be encouraged – e.g. Contact details on Jadestone website and information sheets.

The results of applying this process is summarised in Table 4-2.

Table 4-2: Relevant Persons

Beneficial use/Interest	Relevant activities	Group 1 & 2 Department or Agency (State and Commonwealth)	Group 3 & 4 People or Organisations whose Functions, Activities or Interests affected	Group 5 Any other relevant person JSE consider relevant
Shipping	• Physical presence (Section 6.1)	Australian Hydrographic office (AHO), Australian Maritime Safety Authority (AMSA) Department of Transport	Shipping operators (through AMSA)	Hon. Bill Marmion MLA, Minister for State Development, Transport
	• Release of hydrocarbons (Sections 7.6 and 7.7)	As above	Darwin Port Authority, Kimberley Port Authority (Port of Broome), Pilbara Port Authority	
Commercial Fishing: Commonwealth (including biosecurity)	• Physical presence (Section 6.1) • Introduction of Marine Pests (Section 7.1) • Drilling and cement discharges (Section 6.6 and 6.7)	Australian Fisheries Management Authority (AFMA) Department of Agriculture and Water Resources	Commonwealth Fisheries Association (CFA) Fishing licence holders in Operations area: Western Tuna and Billfish Fishery, Australia Fisheries Trade Association	IMS consultant
	• Release of hydrocarbons (Sections 7.6 and 7.7)	As above	As above Australian Southern Bluefin Tuna Industry Association Northern Prawn Fishery Industry P/L Australian Council of Prawn Fisheries Fishing licence holders in EMBA Southern Bluefin (due to migration)	

Commercial Fishing: State (including biosecurity)	• Physical presence (Section 6.1) • Introduction of Marine Pests (Section 7.1) • Drilling and cement discharges (Section 6.6 and 6.7)	Department of Primary Industries and Regional Development – Fisheries (WA) Department of Primary Industries and Resources (NT)	NT Seafood Council Western Australian Fishing Industry Council (WAFIC) Western Tuna and Billfish Fisheries Australian Fisheries Trade Association Fishing licence holders in operations area • Joint Authority Northern Shark Fishery (WA) • Mackerel Managed Fishery (Area 1) (WA) • Northern Demersal Scalefish Managed Fishery (Area 2) (WA) • Pearl Oyster Fishery Zone 3	Hon Alannah MacTiernan MLC, Minister for Regional Development; Agriculture and Food; Ports; Minister Assisting the Minister for State Development, Jobs and Trade Hon Dave J KELLY BA MLA, Minister for Water; Fisheries; Forestry; Innovation and ICT; Science
	• Release of hydrocarbons (Sections 7.6 and 7.7)	As above	As above Pearl Producers Association Fishing licence holders in EMBA	
Recreational Fishing	• Release of hydrocarbons (Sections 7.6 and 7.7)	Department of Primary Industries and Regional Development - Fisheries (WA) DPIF (NT)	Amateur Fisherman's Association of the NT Recfish West NT Guided Fishing Association Individual recreational fishers	
Subsistence fishing/ Indigenous Fishing	• Physical presence (Section 6.1)	Department of Foreign Affairs and Trade		
	• Release of hydrocarbons (Sections 7.6 and 7.7)	As above	Individual Indonesian/Timor/PNG traditional fishers, Individual Australian Indigenous fishers	

Defence	• Release of hydrocarbons (Sections 7.6 and 7.7)	Department of Defence Australian Border Force (formerly Australian Customs and Border Protection Service)	N/A	
Oil and Gas	• Release of hydrocarbons (Sections 7.6 and 7.7)	NOPSEMA Department of Industry, Innovation and Science Department of Mines, Industry Regulation and Safety (WA) Department of Primary Industry and Resources – Mines, Energy and Fisheries (NT)	Australian Petroleum Production and Exploration Association (APPEA) BHP, Carnarvon Petroleum, Chevron, PTTEP, Finder Pty Ltd, Eni Australia Limited, Quadrant Energy, Murphy Australia Oil Pty Ltd, Sinopec O&G Australia (Puffin) Pty Ltd, Shell Australia Pty Ltd, Bounty Oil and Gas NL, Vermillion Energy	Hon Josh Frydenberg - Minister for Environment & Energy Senator the Hon Matt Canavan - Minister for Resources and Northern Australia Hon Greg Hunt - Minister for Industry, Innovation & Science Bill Johnston Minister for Mines and Petroleum; Energy; Industrial Relations Minister for Mines and Petroleum; Energy; Industrial Relations
Tourism	• Release of hydrocarbons (Sections 7.6 and 7.7)	Department of Jobs, Tourism, Science and Innovation (WA) Department of Tourism and Culture (Parks and Wildlife Commission of the NT)	Tourism NT Tourism Top End Australian Northwest Tourism Tourism Western Australia Kimberley Birdwatching, Kimberley Expeditions	Shire of Wyndham East Kimberley Shire of West Derby/West Kimberley, City of Karratha, Shire of Broome
Cultural/ Indigenous Heritage	• Release of hydrocarbons (Sections 7.6 and 7.7)	National Native Title Tribunal	Tiwi Land Council Northern Land Council (NT) North Australian Indigenous Land and Sea Management Alliance Kimberley Land Council Individuals in coastal communities	

Environment/ Environmental Management	• Release of hydrocarbons (Sections 7.6 and 7.7)	Director of Parks Parks Australia - Australia Marine Parks Department of Environment and Energy Department of Biodiversity, Conservation and Attractions (WA) Department of Water and Environmental Regulation (WA) Department of Environment and Natural Resources (NT) Department of the Chief Minister (NT) Northern Territory EPA	Australian Conservation Foundation WA Conservation Council World Wildlife Fund The Wilderness Society Environs Kimberley International Fund for Animal Welfare Save the Kimberley Australian Marine Conservation Society World Dolphin Conservation Society Australian Conservation Foundation Greenpeace General Public	The Hon Sussan Ley MP, Minister for the Environment, Melissa Price Member for Durack, Chris Tallentire MLA, Member for Gosnells Shadow Minister for Environment
Research	• Release of hydrocarbons (Sections 7.6 and 7.7	CSIRO Western Australian Museum Geoscience Australia	Australian Institute of Marine Science (AIMS)	
Emergency Response	• Release of hydrocarbons (Sections 7.6 and 7.7)	Department of Foreign Affairs and Trade (DFAT) Department of Transport (WA) Department of Infrastructure, Planning and Logistics (NT)		Jacobs Aerotech OSRL AMOSC Hon Francis M LOGAN BA(Hons) MLA, Minister for Emergency Services; Corrective Services

4.4 Relevant Person Classification

Relevant persons were classified according to criteria outlined in the Stakeholder Engagement Process to assist with determining sufficiency of information and level of engagement (Table 4-3). Classification of relevant persons can be found in Appendix C.

Table 4-3: Levels of Engagement

Classification	Engagement Level	Description	Examples of methods
RP1	Inform - invitation for comment	• Interested party but with no activity, function in Operations Area • No risk from Planned Operations - but may have be at risk of impact in event of unplanned event.	• Information sheet sent with overview of operations and approval • Update by email of major milestone
RP2	Inform – action required	• Regulator or Organisation that needs to action information received regarding operations e.g. Update maps, marine notices	• Information sheet sent with overview of operations and approval • Update by email of major milestone • Engage in further correspondence to ensure receipt of information and actioning of item
RP3	Consult	• Relevant person with an interest, activity, function in Operations Area • Potential risk from Planned activities	• Information sheet sent with overview of operations and approval • Update by email of major milestone • Phone calls or face to face meetings to ensure receipt of information and dialogue on any issues.
RP4	Regulator	• Relevant person with regulatory function in potentially affected	• As per regulatory requirements
RP5	Response Organisation	• Primary interest in activity is commercial to assist in response should an unplanned spill occur	• Direct communication (meetings or email) to ascertain capabilities • Contracts

4.4.1 Sufficiency of Information

Jadestone is supportive of ensuring adequate and open information with relevant persons and its investors. The following methods have been used for community engagement:

- Letters / emails: providing updates on key events and milestones (generally in the form of targeted information sheets);
- Meetings: meetings and phone calls with over numerous organisations and individuals to understand requirements and capability regarding the proposed activity and response arrangements;

- Website: Jadestone's website (www.Jadestone.com.au) has been developed to ensure all activities have current and comprehensive information covering location and development plans of its permits, including Montara. The contact details provided on the website allow for self-reporting of interest in activities; and
- Media: Media releases regarding the purchase and key operational milestones have been provided.

The information sheets were developed with sub-regulation 11A(2) and associated guidance in mind to ensure it adequately described the activity – including the risks associated with the activities. As a minimum the following information was provided to all relevant persons:

- Location (permit numbers, latitude/longitude), including a map;
- Description of activity (including duration);
- Description of environment;
- Major risks and impacts to their activity/function/interests;
- How the risks and impacts will be managed and controlled; and
- Contact details.

A fisheries specific information sheet (Appendix C) was developed which included additional specific information, including:

- Fisheries with the potential to be active in the Operational Area; and
- Fisheries specific risk and impact information.

The information provided to the DNP had consideration to the NOPSEMA Petroleum Activities and the Australian Marine Park guidance note, with the supplementary information provided including:

- Name of company or titleholder EP;
- Contact details for a titleholder representative;
- Petroleum activity title number/s;
- Activity overview including type of activity, expected start and completion date of activities;
- A description of the Operational Area; and
- A brief description of any planned activities within AMP.

Where agencies had been engaged with throughout the process of developing the EP or supporting documents (eg.re development of IMS plan), the information sheet was still sent as another formal opportunity to comment in addition to the ongoing engagement. The information provided to these agencies should be considered in the context of all ongoing information provided.

4.4.2 Reasonable Period

Recipients of the information sheet were encouraged to provide comment within a four-week period. Comments provided outside of this time will still be considered and incorporated into the approvals process wherever practicable. If no response was received following this period from Category 1 and some Category 4 stakeholders a reminder was sent indicating if no response was received, then it was considered that no comment was to be provided. For other categories of stakeholder where a response was required direct follow up was undertaken.

The Montara EP includes our emergency response plans. Pursuant to the environment regulations, state and federal government departments and agencies have been, and will continue to be, consulted on response preparedness for an uncontrolled discharge of oil from vessels or the well.

4.5 Assessment of Merit

For all responses received, the merit of each of these responses was assessed. For minor/administrative changes these are noted in the Response log (Appendix L Sensitive Information Report). Assessment of merit for all other responses is found in Table 4-4.

4.6 Sensitive Information

Appendix C has been redacted prior to publishing to preserve the privacy of those persons or organisations consulted with. This can include the removal personal information (as defined by the Privacy Act 1988) and the removal of any information that was provided during consultation where that person has requested for that information not to be published as per OPGGS(E) Regulations sub-regulation 11(A). Jadestone Energy has made reasonable efforts to inform each relevant person consulted that they may request for particular information not to be published during all stages of the consultation.

A separate sensitive information report (Appendix L) containing records of full consultation with relevant persons has not been published due to privacy reasons.

Table 4-4: Responding to merits of objections and claims

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
Australian Maritime Safety Authority	To notify AMSA's JRCC (rccaus@amsa.gov.au, Ph 1800 641 792) 24-48 hrs prior to operations commencing and at cessation of operations	JSE considers these comments have merit and have incorporated these into the EP.	• Item included in implementation section of EP to ensure notification 48 hrs prior to operations commencing and at cessation.
	Australian Hydrographic Office (datacentre@hydro.gov.au) to be contacted no less than 4 working weeks prior to operations commencing for the promulgation of related notices to mariners.	JSE considers these comments have merit and have incorporated these into the EP.	• Item included in implementation section of EP to ensure notification 4 working weeks prior to commencement.
	Suggest where may request vessel traffic plot	Noted	• JSE have requested a vessel traffic plot
Department of Agriculture (Biosecurity/Marine Pests)	The Department of Agriculture manages the regulation of ballast water in Australia and has released a Biofouling Consultation Regulation Impact Statement relating to Australia's proposed mandatory biofouling regulations under the Biosecurity Act 2015, with an anticipated implementation in late 2020.	Noted	• No change to current EP but noted for future EPs
	The Department considers the implementation of an effective biofouling management plan and biofouling record book in line with the International Maritime Organization's 2011 Biofouling guidelines as integral to any vessel proactively minimising biosecurity risk associated with biofouling. An effective plan would address all activities that a vessel would implement to manage its biofouling during normal operation and set out contingency measures used to mitigate risk where the vessel deviates from its usual operational profile (e.g. extended lay-ups). Further information on biofouling management and biosecurity requirements can be found at http://www.marinepests.gov.au/commercial/offshore-	JSE considers these comments have merit and have already addressed these into the EP.	• ALARP assessment of biosecurity risk included in Section 7.1, including management of residual risks. • Vessels mobilised from international waters will have DoA approval and Ballast Management Plans and Ballast Record Books. • A performance standard included in EP that all vessels sourced from outside WA must use the Vessel check process and for this assessment to indicate low/acceptable risk rating.

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
	infrastructure. To comply with Australia's ballast water regulations, all vessels using ballast water must meet the requirements detailed in the Australian Ballast Water Management Requirements. The Department expects that all vessels will comply with the Biosecurity Act 2015 and that this will be detailed within the Environment Plan.		
DMIRS	Send through activity commencement and cessation notifications to petroleum.environment@dmirs.wa.gov.au	JSE considers these comments have merit and have incorporated these into the EP.	• Item included in implementation section of EP to ensure notification
Director of National Parks	Noted that planned activities do not overlap any AMPS and no authorisations required	Noted	• No further action required
	Consider guidance note including ensuring: ○ Identify and manage all impacts and risks to AMP values including ecosystem values to an acceptable level and consider all options to reduce them to ALARP ○ Clearly demonstrate that the activity will not be inconsistent with the management plan	JSE considers these comments have merit	• JSE has developed this EP in accordance with the guidance note and identified and shown how risk to AMPs will be managed
	The North-west Marine Parks Network Management Plan 2018 (management plan) came into effect on 1 July 2018 and provides further information on values for Cartier Island, Ashmore Reef and Kimberley marine parks. Australian marine park values are broadly defined into four categories: natural (including ecosystems), cultural, heritage and socioeconomic. Information on the values for the marine parks is also located on the Australian Marine Parks Science Atlas.	Noted	• JSE has reviewed the North-west Marine Parks Network Management Plan 2018 in the preparation of this EP
	The DNP requests notification to marineparks@environment.gov.au if the EP is approved by NOPSEMA.	JSE considers these comments have merit and have incorporated these into the EP.	• Item included in implementation section of EP to ensure notification

Stakeholder	Stakeholder Concern, Objection or Claim	JSE Assessment of merit	JSE Response
	The DNP should be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24-hour Marine Compliance Duty Officer on 0419 293 465. The notification should include: - titleholder details - time and location of the incident (including name of marine park likely to be affected) - proposed response arrangements as per the Oil Pollution Emergency Plan (e.g. dispersant, containment, etc.) - confirmation of providing access to relevant monitoring and evaluation reports when available; and - contact details for the response coordinator.	JSE considers these comments have merit and have incorporated these into the EP.	• Item included in implementation section of EP to ensure notification
Department of Transport	Ensure that the Department of Transport is consulted as outlined in the Department of Transport Offshore Petroleum Industry Guidance Note – Marine Oil Pollution: Response and Consultation Arrangements (September 2018)	Noted	• JSE has undertaken consultation during the development of this EP in accordance with the guidance note
	Ensure six weeks for review	Noted	• JSE will ensure that DoT has six weeks for review

4.7 Ongoing Consultation

Ongoing consultation activities build upon Jadestone's consultation for the EP. The Stakeholder Engagement Process outlines a standard approach to interacting with relevant persons during the life of the EP, including revision of relevant persons' list and process for dealing with feedback during this period. As part of ongoing consultation Jadestone will undertake activities as shown in Table 4-5.

Table 4-5 Ongoing Consultation Requirements

Activity	Frequency and method	Responsibility
Provisions of updates on activity progress	Annual updates placed on Jadestone's website and email notification to relevant persons, including Commonwealth and WA State government agencies identified as relevant persons.	HSE Manager
Notification of Australian Hydrographic Office	No less than four working weeks prior to operations commencing email AHO (datacentre@hydro.gov.au) for the promulgation of related notices to mariners.	HSE Manager
Notification of AMSA Joint Rescue Coordination Centre (JRCC)	To notify AMSA's JRCC (rccaus@amsa.gov.au, Ph 1800 641 792) 24-48 hrs prior to operations commencing and at cessation of operations with following details regarding the unit: • Name • Call sign • Maritime mobile service identity (MMSI) • Satellite communications details (including INMARSAT-C and satellite telephone • Area of operation • Requested clearance from other vessels	Emergency Response Lead
Notification of DPIRD (Fisheries)	No less than 4 weeks prior to operations commencing notify DPIRD (Fisheries) of actual commencement date and any change to proposal.	HSE Manager
Notification of Director National Parks	Notification to marineparks@environment.gov.au when EP is approved by NOPSEMA	HSE Manager
	No less than 4 weeks prior to operations commencing notify DNP of actual commencement date and any change to proposal.	HSE Manager
DMIRS	Send activity commencement and cessation notifications to petroleum.environment@dmirs.wa.gov.au	HSE Manager
Update to website	Place copy of Jadestone information sheet on Jadestone website	HSE Manager
Provision of broader information relating to Jadestone environmental policy	Website updates as required	HSE Manager

In addition, Jadestone will undertake additional triggered consultation as outlined in Table 4-6. An unplanned loss of well control will have trigger a separate engagement process. Jadestone will use the OPEP to guide response actions and work with supporting response organisations and regulators.

Table 4-6: Triggered Consultation

Trigger	Action	Responsibility
Feedback received from relevant person	Follow standard process outlined the Jadestone Stakeholder Engagement Strategy (Appendix C).	HSE Manager
Suspected Introduced marine species or disease	Report to DPIRD (Fisheries) within 24-hours	HSE Manager
Change to risk profile operations area	Website update Notification to relevant persons Re-engage for consultation if quantum of risk changes significant	HSE Manager
Change to risk profile in EMBA	Notification to government agencies via email to key contact	HSE Manager
Loss of Well Control event	Trigger separate Loss of Well control consultation process. Notification to response agencies and government agencies as per OPEP Attempt to electronically notify all relevant persons within 72 hours of spill Notify AMP Director General of spill response activities within AMP (prior to response activities within a MP) on 0419 293 465. To include titleholder details, time and location of the incident, proposed response arrangements and locations as per the OPEP and contact details for the response coordinator.	IMT Lead
AMP access	Notify AMP Director General of SMP (or other response activities) within AMP 10 days prior to entering (where possible) and at the cessation of activities in AMPs.	IMT Lead
Change to Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 consultative requirements	Review of Stakeholder Engagement Process	HSE Manager
An element of Jadestone's continuous improvement process identifies the procedure needs to be amended	Review of Stakeholder Engagement Process	HSE Manager
Change to infrastructure that affects exclusion zone	Notify the Australian Hydrographic Office of activities and infrastructure for inclusion in Marine Notices	Operations Manager

4.8 Consultation in the event of a Tier 2/3 Oil Spill

In the event of a tier 2/3 hydrocarbon spill, Jadestone will notify all identified relevant persons within 72 hours of the event (refer Table 4-6). In addition, if any scientific monitoring programs (SMPs) are triggered during the spill response the following steps will be undertaken.

1. Step 1: Confirm relevant persons

For the SMP that has been triggered, review relevant persons with a direct interest in either the area monitoring will be undertaken or values that may be affected.

As a minimum, if any SMP is triggered then the following relevant persons will be consulted with:

- Director of National Parks;
- WAFIC (based on WAFIC advice on behalf of individual fishers);
- Indigenous bodies;
- Department of Biodiversity, Conservation and Attractions (WA) and/or Department of Environment and Natural Resources (NT); and
- DPIRD (Fisheries) and/or DPIF (NT).

2. Step 2: Relevant person notification of activation

Prior to SMP activities being undertaken (10 days where possible), email or phone notification to identified SMP relevant persons including:

- Summary of activities/methodology to be undertaken;
- Location of activities;
- Approximate timing of activities; and
- Contact details with invitation for comment.

3. Step 3: Updates

Updates as required while SMP being undertaken.

4. Step 4: Relevant person notification of termination

Ten days prior to the cessation of the SMP activities, notify relevant persons of:

- Proposed date of cessation;
- Summary of results (or date when results will be available and invitation to be provided copy); and
- Contact details with invitation for comment.

5. EVALUATION OF ENVIRONMENTAL IMPACTS AND RISKS

As required by Regulation 13(5) of the OPGGS(E) Regulations, this section of this EP provides an outline of Jadestone Energy's approach to the evaluation of impacts and risks due to the Drilling Activity (Section 5.1), and the outcomes of the impact and risk assessment undertaken (Section 5.6).

5.1 Assessment Method

The environmental impacts and risks associated with the proposed drilling activities for Skua-12 within production license AC/L8 and H6 and H3 within production licence AC/L7 have been assessed using the Jadestone Risk Management Framework (JS-70-PR-F-00009 Rev 1) and methods consistent with HB 203:2012 and AS/NZS ISO 31000:2009.

'Impact' is evaluated in terms of the extent, duration, severity and certainty pertaining to the effect that will or may occur in the environment due a planned event associated with the activity.

'Risk' is evaluated in terms of likelihood and consequence. Likelihood is defined as the probability or frequency of the unplanned event occurring, and consequence, like 'impact', is defined as the extent, duration, severity and certainty pertaining to the effect that will or may occur in the environment due to the event associated with the activity.

The assessment methodology provides a framework to demonstrate:

That the identified impacts and risks are reduced to as low as reasonably practicable (ALARP) (Regulation 10A(b)); and

The impacts and risks are acceptable (Regulation 10A I).

The impact and risk management process is shown in Figure 5-1.

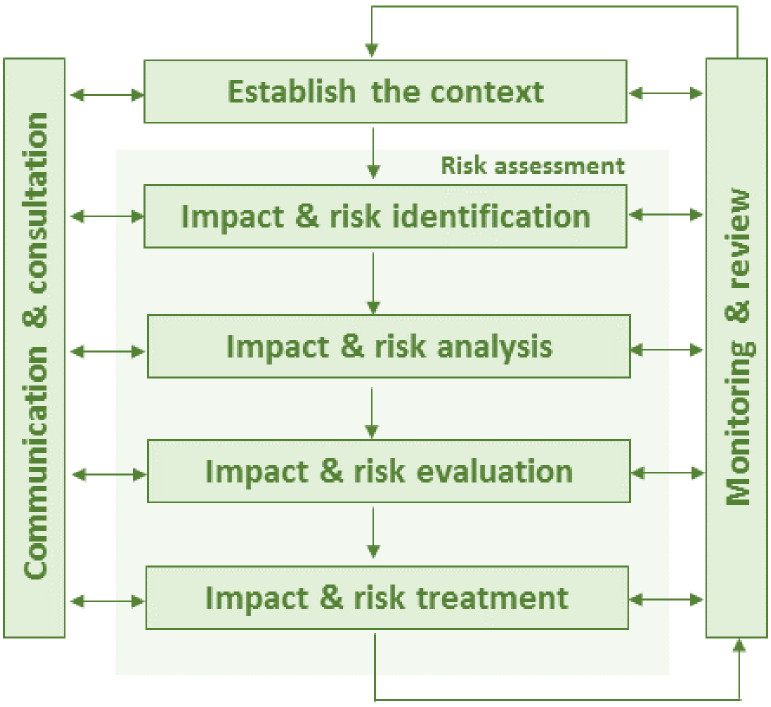


Figure 5-1: Impact and risk evaluation process

Further detail on the steps involved in the impact and risk evaluation process is provided below.

5.2 Risk Assessment

The assessment process evaluates impacts and risks associated with planned and unplanned events that will or have the potential to impact the environment. Impacts and risks are identified through several activities:

Workshopping process attended by a team that includes relevant technical knowledge and experience in the activities being assessed;

Information relating to previous environmental performance relevant to the activity being assessed such as findings of audits and inspections, incident investigations and performance reports;

Consultation with relevant persons; and

Industry related information of exploration and production activities relevant to the activity being assessed.

Analysis of the impacts and risks identified for the activity includes steps intended to treat the impacts and risks to levels that are acceptable and as low as reasonably practicable for the business. The steps are:

Identification of appropriate control measures (preventative and mitigative) to treat likelihood and consequence; and

Determination of the residual impact/risk ratings (Section 5.5).

5.2.1 Identification of control measures

The following framework tools are applied, as appropriate, to assist with identifying control measures:

Legislation, Codes and Standards – identifies the requirements of legislation, codes and standards which are to be complied with for the activity;

Good Industry Practice – identifies further engineering control standards and guidelines which may be applied over and above that required to meet the legislation, codes and standards;

Professional Judgement – uses relevant personnel with the knowledge and experience to identify alternative controls. When formulating control measures for each environmental impact or risk, the 'Hierarchy of Controls' philosophy (see below) is applied. This Hierarchy is used in the industry to minimise or eliminate exposure to impacts and risks;

Risk Based Analysis – assesses the results of probabilistic analyses such as modelling, quantitative risk assessment and/or cost benefit analysis to support the selection of control measures identified during the assessment process;

Company Values – identifies values referenced in Jadestone Energy's HSE Policy; and

Societal Values – identifies the views, concerns and perceptions of relevant persons and addresses their concerns as gathered through the ongoing consultation process.

The Hierarchy of Control philosophy is used by Jadestone Energy to help evaluate potential management controls to ensure alternative reasonable and practicable solutions have not been overlooked:

Elimination – it is preferable to remove the impact or risk altogether;

Substitution – substitute the impact or risk for a lower one;

Engineering control measures – use engineering solutions to prevent or detect the hazard or control the severity of consequences/ impacts;

Administrative control measures – use of procedures, JHA etc. to assess and minimise the environmental impacts or risks of an activity; and

Protective – use of protective equipment (e.g. the use of appropriate containers).

5.2.2 Risk ranking process for unplanned events

Risks are ranked using the Jadestone Qualitative Risk Matrix (Table 5-1). Environmental ranking of a measure between **Low** to **Extreme** is determined by evaluating the likelihood of the unplanned event occurring, and evaluation the expected severity of the consequence with standard expected control measures in place.

Table 5-1: Jadestone Qualitative Risk Matrix

Rating		Consequence				
		Negligible	**Minor**	**Moderate**	**Major**	**Critical**
Likelihood	**Expected**	Medium	Medium	High	Extreme	Extreme
	Probable	Medium	Medium	Medium	High	Extreme
	Likely	Low	Medium	Medium	Medium	High
	Unlikely	Low	Low	Medium	Medium	Medium
	Rare	Low	Low	Low	Medium	Medium

Consequence levels for unplanned events are assigned based on the expected extent of area that may be affected, the duration of effect and the severity of the effect. A consequence level of **Negligible** to **Critical** may be assigned (Table 5-2).

Table 5-2: Definition of consequence level

Consequence	Consequence description	Socio-economic
5. Critical	Massive effect; recovery in decades; ecosystem collapse	Extensive damage International impact
4. Major	Major effect; recovery in 1 to 2 years; impact to population	Major damage National reputation impact
3. Moderate	Local effect; recovery in months to a year; impact to localised community	Local damage Considerable reputation impact
2. Minor	Minor effect; recovery in weeks to months; death of individuals	Minor damage Limited reputation impact
1. Negligible	Slight effect; recovery in days to weeks; injury to organism	Slight damage Slight reputation impact

Likelihood levels for unplanned events are assigned based on preceding performance in relation to the specific activity, within the region or in industry. A likelihood level of **Rare** to **Expected** may be assigned to unplanned events (Table 5-3).

Table 5-3: Definition of likelihood levels

Likelihood	
5. Expected	Happens several times a month in similar exploration and production operations
4. Probable	Happens several times a year in similar exploration and production operations
3. Likely	Event has occurred in similar exploration and production operations
2. Unlikely	Heard of in the exploration and production industry
1. Rare	Never heard of in the exploration and production industry

Once assessed and treated, an assessment as to whether the risks recorded can be demonstrated as being acceptable and ALARP is made. The processes for determining if risks and impacts have been reduced to ALARP and acceptable levels are described below.

5.3 Impact Assessment

Environmental impacts that will occur as a result of planned activities may cover a wider range of issues, multiple species, persistence, reversibility, resilience, cumulative effects and variation in severity. The degree of impact and the corresponding level of acceptability is assessed against several guiding principles:

Principles of ecologically sustainable development (ESD);

Conservation and management advice;

Stakeholder feedback;

Reputational ramifications;

Environmental context; and

Jadestone's HSE Policy and Management System.

The application of the guiding principles within the acceptability matrix are outlined in Table 5-4.

The following process has been applied to demonstrate acceptability in the reduction of planned impacts:

GREEN residual impacts are Tolerable, if they meet management requirements, stakeholder requirements, environmental context, and the Jadestone Energy HSE Policy and management system requirements; and

ORANGE residual impacts are Intolerable and therefore unacceptable. Planned impacts with this rating will require further investigation and mitigation to reduce them to a lower and acceptable level. If after further investigation the impact remains in the unacceptable category, the impact requires appropriate business sign-off to accept the impact.

A reduction of impacts to as low as reasonably practicable (ALARP) follows the process described in Section 5.5.

5.4 Demonstration of Acceptability

An acceptable level of risk of an unplanned event occurring must be scored with a low or medium rating. Risks receiving a score of high (orange) or extreme (red) risk ratings in Table 5-4 are unacceptable. For those risks found to have an unacceptable rating, a return to the planning process for the activity is required to determine if an alternative approach to undertaking the activity can be identified.

Table 5-4: Jadestone Energy's acceptability matrix

Guiding principles		Impact level				
		1	**2**	**3**	**4**	**5**
A	**Principles of ESD**	Discharges/ emissions have slight effect – recovery in days to weeks	Discharges/ emissions have minor effect – recovery in weeks to months	Discharges/ emissions have local effect – recovery in months to a year	Discharges emissions have major effect – recovery in multiple years	Discharges emissions have catastrophic effect – recovery in decades
B	**Conservation and management advice**	Activity does not contact/ interact with sensitivities protected by conservation and management advice	Activity Triggered and adopts conservation and management advice of affected sensitivities	Activity must be modified to uphold conservation and management requirements of affected sensitivities	Activity as planned cannot uphold conservation and management requirements of affected sensitivities	Activity as planned will contravene conservation and management requirements of affected sensitivities
C	**Stakeholders**	No issues raised by stakeholders	Concern/ query received by stakeholders due to activity	Delay in commencement of activity due to stakeholder consultation	Modification of planned activity to achieve negotiated outcome	Executive involvement in resolving stakeholder concerns
D	**Reputation**	Slight impact – no media coverage	Limited impact – State media coverage	Considerable impact – national coverage	National impact – persistent national coverage	International impact – international coverage
E	**Environmental context**	Slight effect – recovery in days to weeks	Minor effect – recovery in weeks to months	Local effect – recovery in months to a year	Major effect – recovery in multiple years	Catastrophic effect – recovery in decades
F	**Policy and Management System compliance**	Proposed activity complies with JSE HSE Policy and Management System	Parts of the activity will not align with JSE HSE Policy and Management System	Proposed activity must be modified to align with JSE HSE Policy and Management System	Proposed activity cannot uphold intent of JSE HSE Policy and Management System	Proposed activity does not comply with JSE HSE Policy and Management System

5.5 Demonstration of as Low as Reasonably Practicable (ALARP)

Regulation 10A(b) of the Environment Regulations requires a demonstration that risks are reduced to 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 principal arises from the fact that infinite time, effort and money could be spent attempting to reduce a risk to zero. An iterative evaluation process is employed until such time as any further reduction in the residual ranking is not reasonably practicable to implement. Following identification of the residual ranking, the ALARP principle is applied:

Where the residual rank is **LOW** as:

- Good industry practice or comparable standards have been applied to control the risk, because any further effort towards reduction is not reasonably practicable without sacrifices grossly disproportionate to the benefit gained.

Where the residual rank is **MEDIUM**:

- Good industry practice is applied for the impact or risk; and
- Alternatives have been identified and the control measures selected to reduce the risks to ALARP. This may require assessment of company and industry benchmarking, review of local and international codes and standards, consultation with stakeholders, etc. to demonstrate that alternatives have been considered, and reasons for adoption/rejection provided.

Where the residual rank is **HIGH** or **EXTREME,** the risk is not considered to be acceptable and the activity cannot continue as described. Further control measures must be applied such that an acceptable risk is demonstrated; and the residual risk is reduced to 'Medium' or lower as described above. The activity should not be carried out if the residual risk remains 'High or Extreme'.

The process of evaluating the reduction of risks to ALARP is illustrated in Figure 5-2.

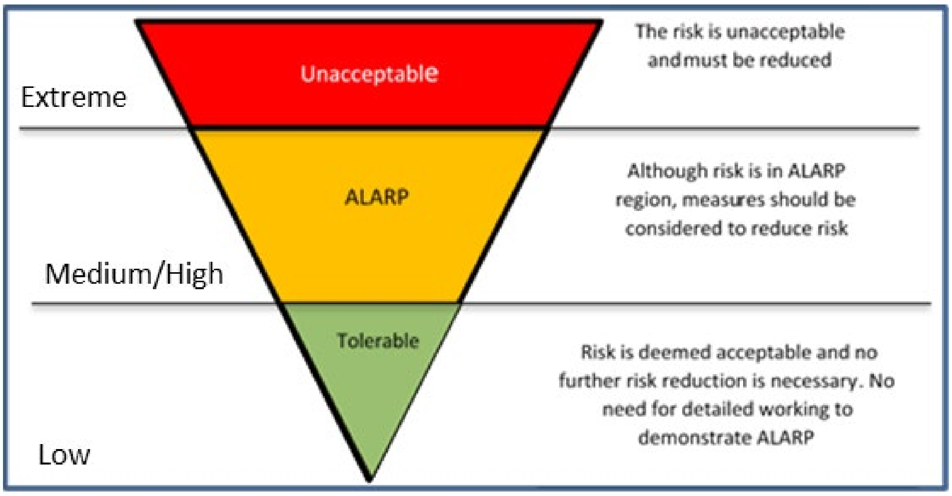


Figure 5-2: ALARP triangle

5.6 Evaluation Summary

An impact and risk assessment workshop was conducted by Jadestone Energy on the 18st of September 2019 (drilling impacts and risks) to generate a register to reflect the Jadestone Energy Impact and Risk Management Framework (JS-70-PR-F-00009). The assessment was undertaken by a multidisciplinary team with sufficient breadth of knowledge, training and experience to reasonably assure that risks and impacts were identified and assessed. The assessment team included management, maintenance, operations, emergency response and environmental personnel.

The assessment process undertaken by Jadestone Energy in September 2019 for Drilling Program activities identified eight planned aspects and six unplanned hazards and their associated environmental impacts and risks that will or may occur during the activities.

The output of the assessment process is documented in the Drilling Activities 2020 Impact and Risk Register and summarised in Table 5-5 .

Table 5-5: Summary of the environmental impact and risk assessment rankings for aspects and hazards associated with planned activities and unplanned events during the Drilling Activities

Aspect/Hazard	Pre-treatment Assessment	Residual Assessment
Planned activities		
1. Physical presence – other users, marine fauna, seabed disturbance	Acceptable	Acceptable
2. Light emissions	Acceptable	Acceptable
3. Noise emissions	Acceptable	Acceptable
4. Atmospheric emissions	Acceptable	Acceptable
5. Operational discharges	Acceptable	Acceptable
6. Drilling discharges	Acceptable	Acceptable
7. Cement discharges	Acceptable	Acceptable
8. Spill response activities	Acceptable	Acceptable
Unplanned events		
1. Marine pest introduction	Medium	Medium
2. Interaction with fauna	Low	Low
3. Unplanned release of solids	Medium	Medium
4. Unplanned release of (non-hydrocarbon) liquids	Low	Low
5. Worst case crude oil spill	Medium	Medium
6. Worst case spill diesel	Low	Low

5.7 Risk Assessment Approach for Worst-case Hydrocarbon Spill Response

The risk assessment approach for the worst-case hydrocarbon spill response requirements follows the risk assessment process as described above, with additional steps and considerations to determine an environmentally acceptable oil spill response strategy and an ALARP level of response preparedness:

1. Determine threshold concentrations to be used in oil spill modelling;

2. Determine the environment that may be affected (EMBA);
3. Identify sensitive receptors;
4. Determine priority receptors; and
5. ALARP and acceptability evaluation for spill response activities.

5.7.1 Determine Oil Spill Modelling Thresholds

Threshold concentrations for each of the hydrocarbon component types (floating oil, entrained oil and dissolved aromatic hydrocarbons) are specified as inputs for the model to determine what contact is recorded for each hydrocarbon type and the receptor/location, to ensure that recorded contacts are assessed at environmentally meaningful concentrations. Meaningful concentrations are those concentrations at which environmental (or biological) impacts may occur, and at which societal values (e.g. visual aesthetics, economics) may be impacted.

The determination of environmentally meaningful impact thresholds is complex since the degree of impact will depend on the sensitivity of the value, the duration of the contact (exposure) and the toxicity of the hydrocarbon mixture making the contact. The chemical and physical properties of a hydrocarbon change over time due to weathering processes altering the composition. To ensure conservatism in defining the EMBA and the subsequent impact/risk assessment, the threshold concentrations applied to the model are based on the most sensitive environmental resources that may be exposed, the longest likely exposure times and on toxicity information for the hydrocarbon. Impact pathways and impact threshold concentrations are detailed in Appendix F.

5.7.2 Determine the RISK EMBA

The RISK EMBA for hydrocarbon concentration thresholds for the worst-case spill scenario for this EP is shown in Section 7.6 and described in Appendix B). These contact concentrations are used to evaluate impacts and receptors at risk from the worst-case credible spill scenario, and to inform spill response preparedness and planning as they are the most conservative, environmentally meaningful, impact thresholds for oil. A detailed description of the worst-case credible spill scenario resulting in the RISK EMBA is provided in Section 7.5**.**

5.7.3 Sensitive Receptor Identification

Jadestone Energy has generated spatial layers of known environmental and socio-economic values within the marine and coastal environment in WA State, Northern Territory, Commonwealth and adjacent international jurisdictions, to identify sensitive receptors (locations with highest environmental and/ or socio-economic values relative to other locations). The RISK EMBA is overlaid as a boundary to identify the sensitive receptors that exist within.

Sensitive receptor assessment considers:

<u>Protected Area Status</u>: used as an indicator of the biodiversity values contained within that area e.g. World Heritage Areas, Ramsar sites and Marine Protected Areas;

<u>Biologically Important Areas (BIA) of Listed Threatened and Migratory Species</u>: these are spatially defined areas where aggregations of individuals of a species are known to display biologically important behaviour such as breeding, feeding, resting or migratory;

<u>Social values</u>: socio-economic and heritage features (e.g. commercial fishing, recreational fishing, amenities and aquaculture);

<u>Economic values</u>: recreational and commercial fishing areas;

Listed species status and predominant habitats (surface versus subsurface): critically endangered/ endangered species, listed species, surface species (e.g. reptiles and birds) and subsurface species (e.g. mammals, sharks and fish); and

Recovery Plans, Conservation Advice for threatened species.

Once the sensitive receptors within the RISK EMBA have been identified, the potential oil pollution risks are described and evaluated (refer Sections 7.6 and 7.7). In addition, the environmental risks from implementing spill response activities are described and evaluated.

Sensitive receptors are further evaluated by considering what values are contained within them when determining appropriate spill response strategies (refer Section 7.5). This informs the Oil Pollution Emergency Plan (OPEP) and guides spill response preparedness and planning.

The next step is to determine those sensitive receptors within the RISK EMBA that are considered the highest risk from the worst-case credible oil spill scenario and are common across ALL modelled scenarios and seasons, that is, the priority receptors.

5.7.4 Priority Receptors

It is important to note that in the event of a single worst-case hydrocarbon spill, not all sensitive receptors and areas within the RISK EMBA will be contacted at the same time or at all. Instead, the RISK EMBA is a collation of numerous possible scenarios (generally 100 or more) to develop the areas for focus in response preparedness and strategic planning. As such, only a portion would be contacted during a spill event.

It is best practice to develop spill response strategies for those areas most likely to be contacted in a single maximum credible worst-case spill. To be able to develop these strategies, the sensitive receptors in the RISK EMBA and their vulnerability to a hydrocarbon event (considering nature and scale of spill) need to be understood. A critical first step is to identify these areas – a concept termed here as 'priority receptors'. The selection of priority receptors is based on stochastic modelling of multiple hydrocarbon spills.

Defining priority receptors determines the scale and needs of the oil spill response strategy. Thus, priority receptors (as a subset of all the sensitive receptors present within the full extent of the RISK EMBA) specific to a particular spill are selected using the following criteria:

Sensitive receptor within RISK EMBA; AND

>5% probability of shoreline contact based on modelling results; OR

Has the largest volume of floating oil shoreline contact; OR

Has the shortest timeframe to floating oil shoreline contact; OR

Vulnerability to impact from hydrocarbons – e.g. mangroves are more vulnerable than intertidal rock pavement; known turtle nesting beaches are vulnerable during nesting periods[1]; AND

Any other area of interest within the RISK EMBA including areas that have a high social value or are a concern raised through stakeholder consultation (refer Section 4).

It is logical and best practice to focus spill response planning and strategies on those locations most likely to be contacted in the credible worst-case oil spill scenario; that is, the scenario that represents the highest risk across all modelled scenarios covering any season, rather than attempt to cover the full spatial extent of the

[1] IPIECA, the global oil and gas industry association for environmental and social issues, the International Maritime Organisation (IMO) and International Association of Oil and Gas Producers (OGP) developed a guidance document for 'Sensitivity mapping for oil spill response' IPIECA/IMO/OPG (2012). This document was used as a reference and basis for the sensitivity of habitats vulnerability assessment.

RISK EMBA. This allows for flexibility in response planning as plans are developed for environmental resources at greatest risk of being contacted by an oil spill and can be adapted for any scenario that occurs.

The evaluation of priority receptors is based upon stochastic modelling of multiple hydrocarbon spills. The focus for spill response planning and preparedness is based upon the level of risk (probability of contact, vulnerability to hydrocarbons, time to contact and volume/concentration of loading). Response Plans are based on the nature and scale of the worst-case modelled hydrocarbon event for each Protection Priority, which includes estimation of shoreline loading volume and time to contact without consideration of response strategies interventions, which are provided in the OPEP.

For the purposes of spill response preparedness strategies, it is not necessary for all priority receptors to have specific operational response plans in place. For example, wholly submerged priority receptors may only be contacted by entrained oil, and the response will largely be the implementation of scientific monitoring to assess impact and recovery. Priority receptors with emergent features can have response actions prepared.

5.7.5 ALARP and Acceptability Evaluation for Spill Response

Jadestone Energy applies a robust and systematic process to ensure that credible spill scenarios are adequately evaluated, to promote a clear link between the nature and scale and the priority receptors, and, to ensure that effective control measures exist to mitigate environmental risks and impacts to a level that is ALARP and acceptable. This process is depicted in Figure 5-3.

The process promotes a clear link between the nature and scale of the maximum credible worst-case spill scenario and the identified priority receptors to ensure that selected response strategies are appropriate and demonstrated to be effective and adequate.

As part of the risk assessment process, the spill response strategies selected are evaluated for their environmental impact (Figure 5-4).

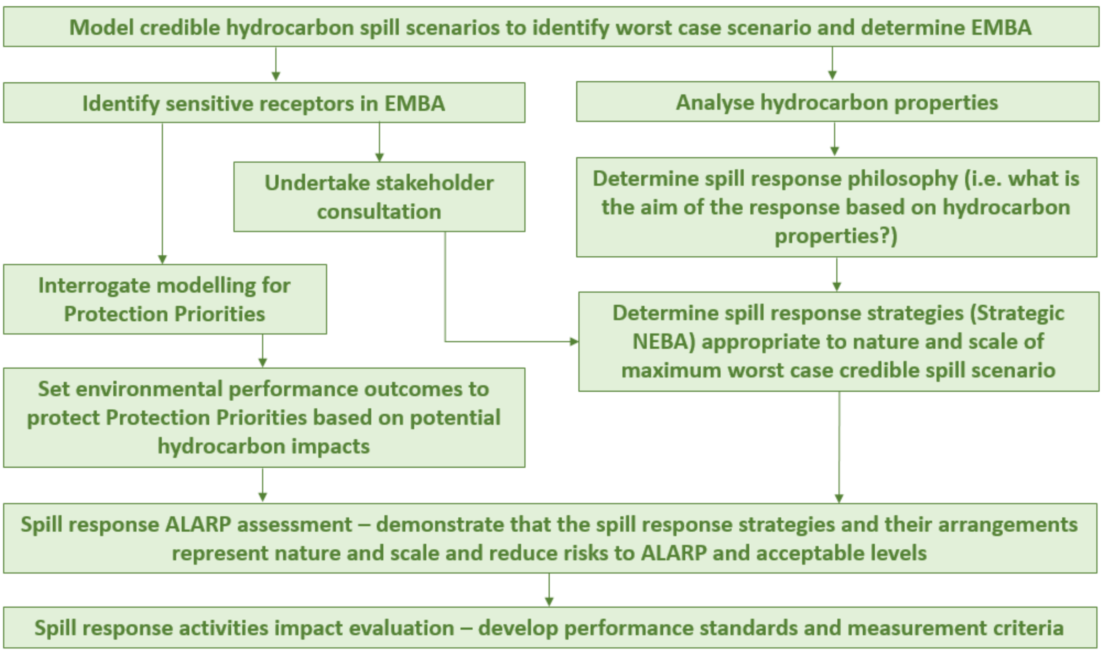


Figure 5-3: Spill scenario evaluation and ALARP determination process

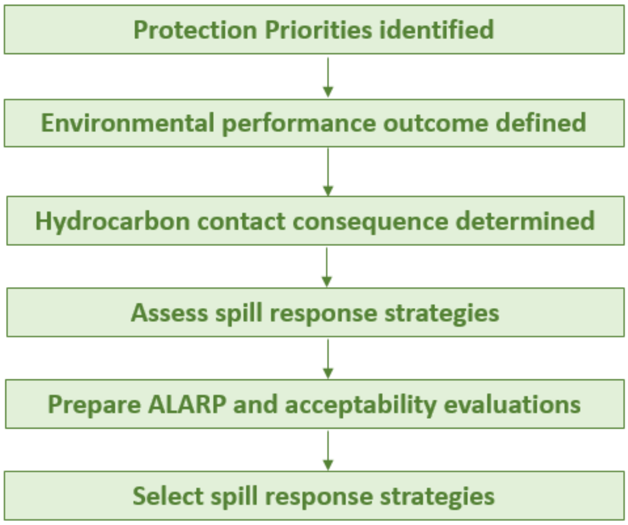


Figure 5-4: Spill control analysis and ALARP determination process

6. ASSESSMENT – PLANNED ACTIVITIES

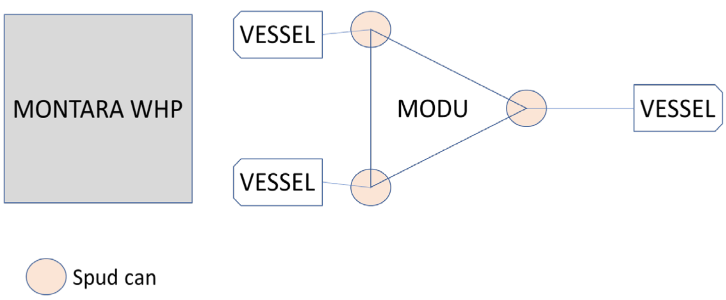
Note. In the following tables the OIM refers to the MODU OIM unless otherwise stated.

6.1 Physical Presence

6.1.1 Description of aspect

Physical presence

The MODU will be towed to site by support vessels. The legs may be lowered to the seabed (‘soft pinned’, i.e. not weighted down but just touching the seabed) in a standing off location before being towed (without touching the seabed) to the predetermined drilling position. It then becomes a static facility standing on the sea floor for the duration of the drilling at that site. The MODU is fixed to the seabed by three supporting legs, each with a base plate (spud can, typically ~18 m diameter) and due to the heavy weights applied penetrate the seabed surface. Support vessels are used to supply the MODU on a regular basis, with vessels transiting every few days to Darwin. A 500 m Petroleum Safety Zone (PSZ) is present around the MODU to ensure restricted and controlled vessel access within close proximity of the facilities. A support vessel remains on location (just outside the 500 m MODU safety exclusion zone unless working alongside the MODU) at all times during drilling activities.



The maximum possible area of undisturbed seabed that may be affected by positioning of the MODU and anchoring of support vessels is summarised below.

Activity	Aspect	Area
Soft pin of MODU	3 spud cans (~260 m^2 each)	780 m^2
Final position of MODU (H6/H3)	Disturbed site at WHP	N/A
Final position of MODU (Skua-10)	Disturbed site at Skua-10	N/A
Final position of MODU (Skua-12)	3 spud cans (~260 m^2 each)	780 m^2
Total area		**1,560 m^2**

The physical presence of the MODU, vessels and PSZ result in the preclusion of other users including commercial and recreational fishers, and commercial shipping traffic, to use the area for their purposes.

The physical presence of infrastructure may alter marine fauna behaviour such as avoidance or attraction. The spud cans compact benthic communities by direct contact with a temporary increase in turbidity due to seabed disturbance. The area alongside the WHP has previously been disturbed (i.e. site of MODU during H3 and H6 activities), as has the seabed at Skua-10, while the MODU site during Skua-12 activities is undisturbed.

No vessels anchor within the Operational Area unless in emergency.

Helicopters operating at low altitude during ascent from and descent to the helidecks also have the potential to disrupt the behaviour of marine fauna due to the effects of noise. Avoidance behaviours in response to vessel and helicopter noise are assessed separately in Section 6.3.

6.1.2 Impacts

Sensitive Receptor	Impact description
Social receptors	
Fishing Shipping	Interaction between the MODU, support vessels and other marine users is expected to be minimal due to the remote location and low fishing effort expended within the Operational Area. In the immediate vicinity, the greater Montara facilities and PSZs have been established and effective since 2012, so this additional PSZ is not new, nor large (especially when alongside the existing wellhead platform which already has an PSZ gazetted around it). Any overlap with active fisheries is relatively small, with only the Northern Demersal Scalefish Managed Fishery having recent catch returns for the Operational Area or its immediate vicinity. The PSZ represents a very small part of the Northern Demersal Scalefish Managed Fishery licenced area, with numerous alternatives available. There is the potential for interactions between fishing activities and support vessels. The temporary presence of the MODU and 500 m PSZ exclusion area, and the movement of support vessels, present obstacles for shipping traffic in the region and are potential navigational hazards and a collision. The Operational Area is located northwest of the nearest designated shipping route with heavy vessels utilising the Osborne Passage in the northern part of the permit areas, however it is not anticipated there will be high commercial shipping traffic in the Operational Area or immediate surrounds (refer to Section 3.6 and Figure 3-8 for details on commercial shipping, including designated shipping routes) (AMSA, 2012). Any detour by shipping traffic that may occur is considered negligible in comparison to the area available for vessels to navigate through. As such impacts to other users are considered ***negligible***.
Environmental receptors	
Seabirds, cetaceans	Fauna most susceptible to impacts from the temporary physical presence include birds, and cetaceans. Migratory species such as seabirds may experience localised and short-term effects through behavioural changes; such as resting or roosting on the MODU or changed feeding patterns in nearby waters in response to other factors such as attraction of fish to the infrastructure (Verhejen, 1985; Weise et al. 2001) with subsequent short-term positive effects. This is predominantly attributed to the observation that structures in deeper water environments tend to aggregate marine life at all trophic levels, creating food sources and shelter for seabirds (Surman, 2002). Behavioural changes could affect the size and composition of the seabird community in the local area. Birds striking infrastructure, causing injury/mortality, may cause a minor disruption to a small proportion of the population. The only known biologically important areas (BIAs) that overlap the Operational Area are the most northern part of the Whale shark foraging BIA as described in **Section 3**. However, only occasional individuals are expected to traverse the area as there are no whale shark aggregations (such as the Ningaloo Reef aggregation) in the region and Pygmy blue whales are typically solitary animals. Both species may occur year-round. Slight deviations by migrating marine fauna including whale sharks and pygmy blue whales, to avoid the MODU may be required, however this impact is considered negligible given the large navigable area available and the relatively small Operational Area. Impacts to marine fauna are considered ***negligible***.

Sensitive Receptor	Impact description
Benthic communities	The soft pinning process may impact a highly-localised area through habitat degradation and compaction. The Operational Area is distant from key habitats of ecological importance such as coral reefs or shoals (detailed in Section 3), the nearest being Goeree and Vulcan Shoals located approximately 28 km to the southwest. Such habitats will therefore not be disturbed by jack up leg or soft pinning activities. A seabed survey is undertaken 3 to 6 months prior to placing the MODU to confirm the absence of large reefs or structures where the MODU will be placed. This ensures multiple attempts are not required to secure the MODU. There are no sensitive or unique marine habitats in the area and the diversity and coverage of epibenthos is low (ERM 2011). Benthic communities are expected to rapidly recolonise any damaged areas once the MODU has left the site (Currie and Isaac, 2004), with scars from the jack up legs typically recolonised by benthic organisms over a period of 2to 3 years. Given the small footprint of the MODU spud cans, and the widespread distribution and abundance of benthic communities within the surveyed areas and the NW Marine Bioregion, the consequence to benthic communities will be highly localised, negligible, and reversible change to a very small proportion of the of the overall benthos***.*** The presence of subsea infrastructure has the potential to act as artificial habitat or hard substrate for the settlement of marine organisms that would not otherwise be successful in colonising the area. Given the short duration of the MODU being stationary, this is not deemed likely to any extent. Impacts to benthic communities are considered ***minor***.

Consequence	Ranking
Minor	Acceptable

6.1.3 Environmental performance

Aspect		Physical presence		
Performance outcome		**Recreational and commercial fishers, and shipping traffic, are aware of exclusion and cautionary areas and are not significantly disrupted. Seabed disturbance limited to planned activities and defined locations**		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
001	MODU and vessels navigational and communication equipment installed, maintained and operated in alignment with AMSA requirements	The MODU when alongside the WHP will be alongside facilities already charted on Australian Hydrographic Office (AHO) nautical charts with gazetted PSZ. A new PSZ will be temporarily gazetted around other MODU locations	AHS Chart Communications with AHS	OIM
002		Navigation and communication equipment on the MODU and vessels comply with Safety of Life at Sea (SOLAS) requirements	PMS records show evidence of fully functional navigation and communication equipment maintenance	OIM
003		ARPA with integrated AIS system are located on the MODU and vessels	CCR panel.	OIM
004		A Marine VHF Radio is located and functioning in the MODU and WHP central control room and on all vessels	CMMS, PMS and assurance through daily use	OIM
005	Adherence to MODU Move Procedures	Adherence to MODU Move Procedures to minimise disturbance to the seabed via planned and controlled positioning of the spud cans	Records show the MODU movements align with the activity specific MODU Move Procedures	OIM
006	Jadestone Energy Consultation Process for Regulatory Approvals JS-70-PR-I-00034 details consultation requirements to	Consultation undertaken with relevant stakeholders as described in Section 4. Other users who may be present in the area will be advised of drilling activities through: • Pre-mobilisation consultation;	Stakeholder communication records • Records confirm that AHS have received notification of activity commencement prior to mobilisation and following demobilisation of the MODU.	Drilling Manager

Aspect		Physical presence		
Performance outcome		**Recreational and commercial fishers, and shipping traffic, are aware of exclusion and cautionary areas and are not significantly disrupted. Seabed disturbance limited to planned activities and defined locations**		
ID	**Management control**	**Performance standard**	**Measurement criteria**	**Responsible**
	ensure other marine users are aware of the activity	• Notice to Mariners issued by the AHS prior to mobilisation and following demobilisation; and • Cautionary areas delineation on Admiralty Chart.	• Records confirm that Cautionary area is delineated on Admiralty Chart	
007		Rights of commercial fishers to operate in the Cautionary Area (as delineated on Admiralty charts) will be communicated to relevant MODU and supply vessel personnel.	MODU and supply vessel induction records include awareness of Rights for commercial fishers.	Country Manager

6.1.4 ALARP assessment

Based on the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to reduce the imposition due to the physical presence of the MODU and support vessels to activities undertaken by relevant persons, as well as impacts to seabed. Additional controls considered but rejected are detailed below. The potential impacts are considered Acceptable (negligible to minor impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Reduce number or remove vessel and helicopter use or reduce use during key sensitive periods	Isolation	No	No	Reducing or removing vessel and helicopter activities during known migration periods of marine fauna is not a viable option as these activities are necessary for the safe and efficient operation of the facility. The Operational Area is located outside of intensive shipping fairways and is not positioned in highly prized fishing habitat.
Additional activity specific navigational or communications requirements	Administrative	No	No	The navigational management and monitoring measures in place are industry standard and internationally accepted measures to minimise the potential for interference with, or collision between, vessels. Frequent and informative communication with relevant persons regarding activities associated with the MODU and vessels are undertaken. Additional procedures would provide no further benefit.
Additional support vessels on location to inform third party vessels in the vicinity of the facility	Engineering	No	No	The additional cost of 24/7 vessel presence in field is considered grossly disproportionate to the benefit gained given the facility is marked on hydrographic charts and is visible above water. The radio room on the MODU is manned 24/7 allowing contact to be made with 3rd part vessels in the vicinity as required. If radio from MODU or support vessels cannot raise the vessel, calls are made to the Home Affairs Office for their control.

6.1.5 Acceptability assessment

The potential impacts of physical presence from the MODU and vessels during drilling activities are considered 'Acceptable' in accordance with **Section 5**, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and the environmental consequence is considered negligible.	
Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.

Social acceptability	Stakeholder consultation has been undertaken (Section 4), and no stakeholder concerns have been raised with regards to physical presence as denoted by the PSZ and preclusions within it. Impacts beyond temporary exclusion of areas local to the activity are not predicted.
Environmental context	While the MODU presents a restricted zone to other users, the impact and risk assessment process indicates that the area of restriction is localised and occurs at a location that is not likely to result in significant penalties to the activities of relevant persons currently active in the area. The site around the WHP and Skua-10 is already disturbed, while that around Skua-12 is not. The area of seabed impacted by the placing of the spudcans is negligible in size, with recovery predicted through local recruitment from adjacent unimpacted areas. Previous surveys in the area show soft sandy sediments with sparse benthic communities typical of the greater NW Bioregion. Impacts to protected species are negligible with no permanent or population effects, given the large navigable area available and the relatively small Operational Area. The disturbed seabed is negligible in comparison to the vast size of soft substrata habitats spanning the North-West Marine Bioregion. The potential impact is considered acceptable after consideration of: • Potential impact pathways: the pathways and consequences from the temporary localized presence of MODU and vessels are assessed in Section 6.1.1; • Preservation of critical habitats: localised disturbance is remote from Protected Areas; • Assessment of key threats as described in species and Area Management/ Recovery plans: see below under 'Conservation and Management Advice'; • Consideration of North-West Bioregional Plan: no impacts beyond 'negligible' (localized disturbance) predicted from the physical presence of the MODU or vessels to KEFs, shipwrecks/ other heritage places or protected species that are listed as values within the NW Bioregional Plan; and • Principles of ecologically sustainable development: impacts are fully recoverable, biological diversity and ecological integrity are not impacted.
Conservation and management advice	No management plans identified physical presence as described above as being a threat to marine fauna or habitats. Jadestone Energy has had regard to the representative values of the protected areas within the EMBAs, and the respective management plans and other published information. Impacts from physical presence will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.2 Light emissions

6.2.1 Description of aspect

Artificial light	During periods of reduced visibility over the 150-day drilling program, navigational and safety lighting on the MODU and support vessels will generate light emissions that may potentially affect marine fauna behaviour. Lighting typically consists of bright white (metal halide, halogen, fluorescent) lights attenuating with distance. Direct light spill on surface waters will be limited to the area directly adjacent to the facility and support vessels as they operate within the Operational Area.

6.2.2 Impacts

Artificial lighting has the potential to affect marine fauna that use visual cues for orientation, navigation, or other purposes, resulting in behavioural responses which can alter foraging and breeding activity in marine reptiles, seabirds, fish and dolphins, create competitive advantage to some species and reduce reproductive success and/ or survival in others.

Potential impacts to marine fauna from artificial lighting associated with the drilling program are:

- Disorientation, attraction or repulsion; and
- Disruption to natural behavioural patterns and cycles.
- These potential impacts are dependent on:
- Density and wavelength of the light and the extent to which light spills into areas that are significant for breeding and foraging;
- Timing of overspill relative to breeding and foraging activity; and
- Sensitivity and resilience of the fauna populations that are affected.

Sensitive Receptor	Impact description
Plankton; Fish, Sharks and Rays	The response of fish to light emissions varies according to species and habitat. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al. 2001). Lindquist et al. (2005) concluded from a study that artificial lighting resulted in an increased abundance of clupeids (herring and sardines) and engraulids (anchovies); these species are known to be highly photopositive. Shaw et al. (2002), in a similar light trap study, noted that juvenile tuna (Scombridae) and jack (Carangidae), which are highly predatory, may have been preying upon higher than usual concentrations of zooplankton that were attracted to a vessels light field. There is a potential for individuals to be impacted by light emissions from lighting. However, as the Operational Area does not contain any significant feeding, breeding or aggregation areas for fish it is more likely there will individuals traversing the area then large groups of species. Light associated with the drilling will affect a small portion of the vast biologically important foraging area for whale sharks. However, impacts at a population level are not expected. Light impacts to plankton, fish, sharks (including whale sharks) are considered ***negligible.***
Marine reptiles	Turtles are known to use a variety of cues for navigation when in the water. However, light is not thought to be an important cue for adults, although adults are considered to have a preference for non-illuminated beaches (EPA 2010). The most significant risk posed to marine turtles from artificial lighting is the potential disorientation of hatchlings following their emergence from nests. Hatchlings use the light of the oceanic horizon to orientate themselves towards the sea when making their way into the water for the first time; the oceanic horizon is almost always brighter than the elevated landward horizon (EPA 2010). Hatchling behaviour may therefore be affected when exposed to an artificial light source at certain intensities and distributions, potentially leading to disorientation when attempting to migrate to the ocean. The diffuse glow from light sources can cause disorientation to hatchlings up to 4.8 km from the light source (Limpus, 2006, in EPA, 2006). The closest turtle nesting habitat to the Operational Area is significantly beyond this distance as Cartier Island is approximately 84 km north-west of the FPSO. The nearest BIA boundary for marine reptiles (green turtle) is 64 km west of the Operational area. As a result, impacts to adults and hatchlings are expected to be ***negligible***.

Sensitive Receptor	Impact description	
	Due to the paucity of information, the direct effect of artificial light on sea snakes is largely unknown. Sea snakes may experience indirect effects such as changes in predator-prey relationships and disorientation, attraction or repulsion may occur. Sea snakes are thought to occur more commonly on reef habitats that are not present in the Operational Area. It is recognised that some pelagic sea snake individuals may occur and be attracted to the light from the MODU and vessels. However, while such individuals may come to investigate the light source it is considered unlikely that they will stay within the area. As such impacts to sea snakes are considered ***negligible.***	
Seabirds	It is broadly accepted that seabirds do aggregate around offshore production facilities in above average numbers (Verhejen, 1985; Weise et al., 2001). This is predominantly attributed to the observation that structures in deeper water environments tend to aggregate marine life at all trophic levels, creating food sources and shelter for seabirds (Surman, 2002). The light from the MODU and vessels may also provide enhanced capability for seabirds to forage at night (BHPB, 2005). Studies in the North Sea indicate that migratory birds are attracted to lights on offshore platforms when travelling within a radius of 3–5 km from the light source. Outside this area their migratory path will be unaffected (Marquenie et al., 2008). Given that the Operational Area is outside a flyway, and the nearest migratory bird breeding/ roosting site is Cartier Island which is located approximately 80+ km north-west of the locations only a small number of seabirds are expected to be affected by artificial light emissions whilst in transit, any behavioural disturbances such as disorientation and attraction would be a *Slight effect; recovery in days to week*. As such impacts to seabirds are considered ***negligible.***	
Other species	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 from the MODU and vessels is not considered to have an impact on marine mammal behaviour.	
Consequence		**Ranking**
Negligible		Acceptable

6.2.3 Environmental performance

Aspect		Light emissions		
Performance outcome		**Activity lighting managed in accordance with OHS requirements**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
008	MODU and vessel navigation aids and equipment meet regulatory and safety requirements by aligning with AMSA	Marine Navigational lights are positioned on infrastructure such that at least one light is visible to a vessel approaching from any direction.	PMS confirms navigational equipment is maintained to regulatory and safety standards	OIM

6.2.4 ALARP assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk of light emissions to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are 'tolerable' as they are within the green category (negligible impacts). No further controls are required (see below) and therefore ALARP has been demonstrated.

Rejected Control	Hierarchy	Practicable	Cost Effective	Justification
All activities completed in daylight hours only	Eliminate	No	No	Daylight operations only considered to introduce unnecessary cost (i.e. 12 vs 24-hour ops.), whilst delivering little/ no environmental benefit. Drilling cannot be shut down on a daily basis, and there would be a >100% increase in time taken to complete the activities resulting in significant costs and introduction of risk particularly while drilling the hydrocarbon bearing zone. Light from the MODU and vessels will not illuminate beaches where receptors (including turtle hatchlings) sensitive to light emissions are present.
Replace external lights or reduce the lighting	Substitute	No	No	Lights are required to create illumination levels needed for safe working, emergencies and navigational requirements. No additional cost but introduces unacceptable safety risks to personnel and vessels. Little benefit given relatively low numbers of turtles and seabirds in Operational Area and surrounding waters.
Add filters to lights or re-design placement/ positioning	Engineering	No	No	Lighting has been positioned such that maximum illumination of work surfaces within asset structures is achieved. Costly and considered grossly disproportionate to any gain when considering the distances that the Operational Area is from turtle or seabird nesting areas.
Reduce usage of lighting in peak sensitive receptor windows	Isolation	No	N/a	To ensure lighting meets health and safety requirements, lighting is required throughout the day/ night for the duration of the activities. To isolate usage such that lights were not used during sensitive receptor windows would create a non-conformance with health and safety requirements.
None identified	Administrative	N/a	Na/a	N/a

6.2.5 Acceptability assessment

The potential impacts due to light emissions are considered acceptable in accordance with Section 5, based on the acceptability criteria outlined below. No control measures are proposed as a reduction below maintenance of light levels in accordance with health and safety regulations would compromise personnel health and safety, and the environmental consequence is considered negligible.

Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.

Stakeholders & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from lighting on sensitive receptors.
Environmental context & ESD	While there is direct light spill to sea surface immediately around the MODU and support vessels, the impact and risk assessment process indicates that the light spill will not cause significant effects to adult turtles or birds that may transit the Operational Area. The potential impact is considered acceptable after consideration of: • Potential impact pathways; • Preservation of critical habitats; • Assessment of key threats as described in species and Area Management / Recovery plans; • Consideration of North-West Bioregional Plan; and • Principles of ecologically sustainable development (ESD).
Conservation and management advice	Light is identified in the National recovery plan for Turtles (2017) as a threat to turtles on nesting beaches only. There will be no light spill on nesting beaches and therefore the activity is considered to be conducted in a manner that is consistent with the Recovery Plan. Jadestone has had regard to the representative values of the protected areas within the EMBA, and the respective management plans and other published information. Impacts from light emissions will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.3 Noise Emissions

6.3.1 Description of aspect

Noise emissions	Throughout the 150-day drilling program, low intensity underwater noise of a continuous nature will be emitted from the drilling MODU and support vessels. Noise will be generated during drilling activities from a number of sources, in particular, vessel engine rotation of propellers, by the bit, drill string and associated equipment and by machinery operated on the decks and working areas of the drilling MODU and supply vessels. Marine operations conducted on the decks and working areas of the vessel introduce strong sounds of varying characteristics into the water column, largely at low frequencies. Noise produced from active drill MODUs is predominantly below 2 kHz, with peak frequencies below 500 Hz. A range of broadband source values (157 - 162 dB re 1 µPa) with various tones have been quoted for drill MODUs (Hannay et al. 2004; McCauley 1998). These levels are expected to decrease rapidly moving from the source. For example, measurements of radiated underwater noise from an exploration drilling MODU in the Timor Sea reported noise levels from drilling operations to be 117 dB re 1 µPa at 125 m and 115 dB re 1 µPa at 405 m from the MODU (McCauley, 1998). Vessel noise varies with the size, speed, and engine type and the activity being undertaken. The loudest noise level from support vessels are during MODU loading and unloading activities where thrusters are used to maintain position. Noise levels for a range of vessels have been measured at 164-182 dB re µPa at 1 m (Wyatt 2008). Similar to the MODU, vessel noise is expected to decrease rapidly from the source. The extent of helicopter noise impacts is limited to take off and landing at the facilities as they do not fly close to the ocean surface (typical cruising height of between approximately 1,000 to 1,400 m). The main acoustic source associated with helicopters is the impulsive noise from the main rotor and high-speed impulsive noise related to trans-sonic effects on the advancing blade. Dominant tones in noise spectra from helicopters and fixed wing aircraft are generally below 500 Hz (McCauley, 1994). Other tones associated with the main and tail rotors and other engine noise can result in a larger number of tones at various frequencies (BHPB, 2005).

	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 level underwater depends on source altitude and lateral distance, 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 greater than 13° from vertical, much of the sound is reflected and does not penetrate 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 (BHPB, 2005). A summary of anthropogenic noise sources associated with the drilling activities, and natural underwater noise sources, are provided in Table 6-1 below. No vertical seismic profiling or side scan sonar will be used during the Drilling Activities.

Table 6-1: Summary of anthropogenic and natural underwater noise sources

Source	Sound Intensity (dB re 1 µPa)	Dominant Frequency (Hz)
Natural Noises		
Ambient sea sound [1, 2]	80 – 120	Varied
Undersea earthquake [2]	272	50
Seafloor volcanic eruption [2]	255+	Varied
Lightning strike on sea surface [2]	250	Varied
Breaching whale [2]	200	10-100
Bottlenose dolphin click [2]	Up to 229	Up to 120,000
Humpback whales (tail fluke, fin slaps) [3]	192	30 – 1,200
Humpback whale song [4]	179	50 – 10,000
Sperm whale clicks [2]	Up to 235	100 – 30,000
Blue whale vocalisations [2]	190	12 – 400
Anthropogenic Noise Sources Expected from the MDP		
FPSO noise (production operations) [5, 6]	170-185 dB re 1µPa@1 m (route-mean-square sound pressure level; SPL)	Non-impulsive, predominantly low frequency (<500 Hz).
WHP noise (fixed platform production noise) [5, 7]	129-196 dB re 1µPa@1 m (SPL)	Non-impulsive, predominantly low frequency (<500 Hz).
Wellheads and flowlines [8, 9]	Approx. 159 dB re 1 µPa @1 m (SPL)	Non-impulsive, predominantly between 100 Hz and 2.5 kHz.
Support vessels (<100 m length) [5]	150 – 189 (SPL), depending on size, age, speed and engine characteristics	Non-impulsive, modulated by propeller cavitation and dynamic positioning. Tonal and broadband noise up to 100 kHz, dominant at low frequency (50-150 Hz).
Tankers (>100 m length) [5]	175 – 190 (SPL), depending on size, age, speed and engine characteristics	Non-impulsive, modulated by propeller cavitation. Tonal and broadband noise up to 10 kHz,

Source	Sound Intensity (dB re 1 µPa)	Dominant Frequency (Hz)
		dominant at low frequency (<100 Hz).
Helicopter flyover [5, 9]	Depends on type and size of helicopter and height above sea level. E.g. from 101 to 109 dB re 1 uPa measured at 3 m water depth for a helicopter at altitudes of 610 m and 152 m respectively.	Most acoustic energy is low frequency (<500 Hz).
Active MODU – within AC/L7 and AC/L8		
Drilling MODU in Timor Sea (McCauley 1998)	157 - 162 dB re 1 µPa, with rapid decreasing intensity of 117 dB re 1 µPa at 125 m and 115 dB re 1 µPa at 405 m from the MODU	Peak frequencies below 500 Hz

6.3.2 Impacts

Potential impacts to marine fauna due to noise and vibration in the underwater environment may occur, and can result in a range of responses including (Richardson *et a*l., 1995; Southall *et a*l., 2007):

- Injury to hearing or other organs: hearing loss may be temporary (temporary threshold shift (TTS)) or permanent (permanent threshold shift (PTS));
- Masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey); and
- Disturbance leading to behavioural changes or displacement of fauna. The occurrence and intensity of disturbance is highly variable and depends on a range of factors relating to the animal and situation.

EPBC Act listed and threatened migratory species that may be present near the activities include whales migrating through the operational area, whale sharks and turtles. Noise is identified as a threat within the conservation advice or recovery plan for a number of the EPBC species that may occur in the operational area.

Sensitive Receptor	Impact description
Marine Mammals	Whales are low-frequency hearing cetaceans with an estimated functional hearing frequency range of 7–22 kHz (Southall *et. al.*2007). The thresholds of recommended root square mean sound pressure level (ms SPL) that could result in behavioural response for cetaceans is expected to be: 120 dB (ms SPL) for continuous noise sources; and 160 dB RMS SPL for impulsive noise sources. More permanent injury would be expected to occur at 230 dB re 1 µPa (peak) (Parvin et al., 2007, Gomez *et al.* 2016). Behavioural responses to noise are highly variable and context-specific; higher received levels are not always associated with stronger behavioural responses (Southall *et al.* 2007; Gomez *et al.* 2016). Different individuals or groups may respond differently depending on their behaviours and motivation at the time (e.g. foraging, socializing, reproduction) and sudden exposure to noise may

Sensitive Receptor	Impact description
	also result in more apparent responses than more gradual exposures (Gomez *et al.* 2016). Cetaceans approaching the MODU will be gradually exposed to increasing noise levels and, therefore, animals will not be startled by sudden or loud noises and behavioural responses are expected to be limited. Based on these findings however, it is reasonable to expect that significant behavioural responses such as avoidance are more likely to occur in closer proximity to the sound source and in response to higher sound levels. There is the potential for some cetaceans to display some level of avoidance when in close proximity to the facilities and vessels. Sound levels are expected to approach ambient levels over several kilometres. Reactions of whales to circling aircraft (fixed wing or helicopter) are sometimes conspicuous if the aircraft is below an altitude of approximately 300 m, uncommon at 460 m and generally undetectable at 600 m plus (NMFS, 2001). Baleen whales sometimes dive or turn away during overflights, but sensitivity seems to vary depending on the activity of the animals. The effects on whales appear to be transient, and occasional overflights are not thought to have long-term consequences to cetaceans (NMFS, 2001). Observations by Richardson and Malme (1993) indicate that, for bowhead whales, most individuals are unlikely to react significantly to occasional low-flying single helicopter passes ferrying personnel and equipment to offshore operations at altitudes above 150 m. Leatherwood et al. (1982) observed that minke whales responded to helicopters at an altitude of 230 m by changing course or slowly diving. Although there are likely to be transient whales passing through the Operational Area (refer Section 3), it does not contain any significant feeding, breeding or aggregation areas for marine mammals. The nearest BIA for cetaceans is the pygmy blue whale migration BIA, which is located 63 km from the nearest Operational Area and is therefore not expected to be impacted by noise from the MODU or vessels. Impacts to cetaceans from underwater noise generated by drilling activities is considered ***negligible.***
Marine reptiles	The auditory sensitivity of marine turtles is reported to be centred in the 400–1,000 Hz range, with a rapid drop-off in noise perception on either side of this range (Richardson *et al.* 1995). Turtles have been shown to respond to low frequency sound, with indications that they have the highest hearing sensitivity in the frequency range between 100 – 700 Hz (Bartol and Musick, 2003). Reported responses of turtles to high levels of anthropogenic noise include increased swimming activity and erratic swimming patterns (McCauley et al., 2002). No absolute thresholds are known for the sensitivity of turtles to underwater noise, or the levels required causing pathological damage. However, Popper *et al.* (2014), a working group of leading experts, suggested that behavioural responses which are less sensitive to noise than cetaceans, are more likely to occur within tens or hundreds of metres from vessels and other continuous/ non-impulsive noise sources. The Operational Area does not intersect any known inter-nesting areas and is 92 km from nearest BIA and key nesting sites (Cartier Island). As such, it is more likely that a transient individual might be affected by noise. However, any impacts are expected to be limited to behavioural impacts, with recovery in days to weeks (***negligible***). Sea snakes may also be affected by noise, although as they generally associated with reef systems including at submerged shoals (the closest are approximately 30 km away from the operational area), it is considered unlikely they will frequent the Operational Area.
Fish, Sharks and Rays	Fish sensitivity and resilience to underwater noise varies greatly depending on the species, hearing capability, habits, proximity to the noise source, and the timing of the noise (i.e. the noise may occur during a critical part of the fish's lifecycle; McCauley and Salgado-Kent, 2008). Most marine fish are hearing generalists (Amoser and Ladich, 2005) with relatively poor hearing. Hearing generalists are not as sensitive to noise and vibration as hearing specialists, which have

Sensitive Receptor	Impact description
	developed hearing specialisations and can be particularly vulnerable to intense sound vibrations because many possess an air-filled swim bladder (Gordon et al. 2004). Popper et al. (2014), a working group of leading experts, suggested that behavioural responses in fish, which are less sensitive to noise than cetaceans, are more likely to occur within tens or hundreds of metres from vessels and other continuous/ non-impulsive noise sources. While fish may show an initial behavioural response, fish are known to quickly habituate to continuous noise sources (Smith et al. 2004; Wysocki et al. 2006; Spiga et al. 2012; Nichols et al. 2015; Johansson et al. 2016; Holmes et al. 2017). In particular, many fish species are known to aggregate around the foundations of oil and gas platforms and subsea structures, despite operational noise. Therefore, behavioural impacts to turtles and fish are expected to be limited and highly localised. There are also no known key feeding/ breeding areas occur within the Operational Area, however fish will likely transit the area. Scientific literature indicates that behavioural affects due to artificial noise may include changes to schooling behaviour and avoidance of noise sources. A number of shark species may also occur in the region, including the EPBC Act listed whale shark as a BIA overlaps the area. Elasmobranchs (rays, skates, sharks) rely on low frequency sound to locate prey (Myrberg 1978). The large hearing structure of the whale shark will be most responsive to long-wave, low-frequency sound (Myberg 2001) in the range of 20 and 800 Hz. Elasmobranchs do not have swim bladders and are not typical hearing specialists (Baldridge 1970). As such any impacts to fish, sharks or rays are expected to be ***negligible.***
Seabirds	Birds generally hear at a narrower frequency range than mammals, with best hearing at frequencies between 1 and 5 kHz (Dooling & Popper 2007). However, there is little information available specific to seabird and shorebird hearing and thresholds for disturbance. It is not expected that noise generated from the MODU or support vessels will greatly affect seabirds and shorebirds that may overfly or land on the facility. Therefore, any impacts are expected to be limited to behavioural impacts, with recovery in days to weeks (***negligible***).

Consequence	Ranking
Negligible	Acceptable

6.3.3 Environmental performance

Aspect		Noise emissions		
Performance outcome		**Controls implemented to minimise potential harmful impacts to marine fauna from noise**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
009	Support vessels will comply with EPBC Regulations 8.05 and 8.06 as per Montara Marine Facility Operating Manual (MV-90-PR-H-00001)	Support Vessel Masters will comply with relevant parts of EPBC Regulation (2000): Reg. 8.05 & 8.06 respectively, where safe to do so: Within the caution zone for a cetacean (including a calf) (within 300 m of a cetacean), the Vessel Master must operate the vessel at a constant speed of less than 6 knots and minimise noise; and If a calf appears within an area that means the vessel is then within the caution zone of the calf, the Vessel Master must immediately stop the vessel and turn off the vessel's engines or disengage the gears or withdraw the vessel from the caution zone at a constant speed of less than 6 knots.	Vessel Masters provided and required to operate in accordance with the Montara Marine Facility Operating Manual (MV-90-PR-H-00001) – Sign-off sheet for completed by Vessel Master. Incident reports record non-compliances with EPBC Regulations 2000 - Part 8 Division 8.1 (interacting with cetaceans)	Logistics Lead
010	Helicopters will comply with EPBC Regulations 8.07 as per Jadestone's Aviation Operations Procedure (MV-90-PR-G-00004)	Helicopters will comply with the following elements of EPBC Regulations 2000 Regulation 8.07, except during take-off/ landing, during an emergency or when action is required to maintain safe operations: A helicopter will not operate at a height lower than 1,650 ft or within a horizontal radius of 500 m of a cetacean; and A helicopter will not deliberately approach a cetacean from head-on. Helicopter operators are required to report any instances where these standards are breached, and any event involving injury to or death of marine fauna due to helicopter operations.	Helicopter Contractor's provided Jadestone's Aviation Operations Procedure (MV-90-PR-G-00004) Incident reports record non-compliances with EPBC Regulations 2000 – Part 8 Division 8.1 (interacting with cetaceans)	Logistics Lead
011	Safety Case requires MODU machinery is certified and maintained	MODU machinery is maintained in accordance with Safety Case maintenance and is conducted in accordance with PMS.	PMS shows maintenance has been completed as scheduled	OIM

6.3.4 ALARP assessment

Based on the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage the impact and risk of noise due to operation of MODU, machinery, vessels and helicopters to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Acceptable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected Control	Hierarchy	Practicable	Cost-effective	Justification
Remove machinery that emits noise	Eliminate	No	N/a	Noise from the MODU, vessels, ROVs, helicopters and machinery cannot be eliminated. Without these assets, the activities cannot be undertaken.
Replace machinery that emits noise with quieter machinery	Substitute	No	No	All equipment as listed is required; no opportunities for substitution were identified.
Provide additional muffling on machinery, or design to reduce noise emissions	Engineering	No	No	Machinery is generally designed with human health hearing requirements taken into consideration, reducing operating noise to as low as efficiently and cost effectively as possible.
Do not operate noisy machinery in areas of sensitivity	Isolation	No	N/a	The activities are located at distance from sensitive receptors and the coastline. Other fauna in the vicinity may experience short term behavioural effects only.
Additional activity specific noise emissions procedures for assets	Administrative	No	No	Through the application of EPBC Regulation 8 for helicopter and vessel marine fauna interaction procedures, and application of machinery maintenance, potential impacts are reduced. No further procedures are considered necessary.

6.3.5 Acceptability assessment

The impacts due to machinery, MODU, helicopter and vessel noise are considered acceptable in accordance with **Section 5**, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and the environmental consequence is considered negligible.

Policy & management system compliance	Key Jadestone management system controls include EPBC Regulations (2000) pertaining to vessel and helicopter operations. Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the proposed drilling activities.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from noise on sensitive receptors.
Environmental context & ESD	While there are noise emissions expected, the impact and risk assessment process indicate that noise will not result in death, injury or significant behavioral effects to marine fauna The potential impact is considered acceptable after consideration of:

	• Potential impact pathways: the pathways and consequences from the temporary localised drilling and engine sources from the MODU and vessels are assessed in Section 6.3.2; • Preservation of critical habitats: remote from Protected Areas or aggregations of noise sensitive receptors; • Assessment of key threats as described in species and Area Management/Recovery plans: See 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: vessel and offshore mining noise is regarded 'of potential concern' to multiple conservation values (see Section 6.3.2). As such, minimisation through maintenance and avoidance through application of EPBC Act Reg 8.05 and 8.06 are aligned with the objectives of the Plan; and • Principles of ecologically sustainable development (ESD): no impacts from noise sources beyond' negligible' to biological diversity or ecological integrity, no irreversible damage.
Conservation and management advice	Noise interference is identified as a threat in: • The Recovery Plan for Marine Turtles in Australia (2003) • Approved Conservation Advice for M. novaeangliae (Humpback Whale) (2015) • The Conservation Management Plan (Recovery Plan) for the Blue Whale (B. musculus) (DoE 2015) The Operational Area does not overlap with any turtle or whale BIAs or migratory pathways. Jadestone has had regard to the representative values of the protected areas within the EMBA, and the respective management plans and other published information. Impacts from noise will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable. EPBC Regulation 8 and the Australian National Guidelines for Whale and Dolphin Watching 2005 (DEH 2006) set the requirements for vessels interacting with cetaceans. Commercial vessel noise is identified as a risk in the 'Whale shark management with particular reference to Ningaloo Marine Park' (2013). The Operational Area overlaps a small portion of the Whale shark foraging BIA where aggregations are not as dense or sustained as the Ningaloo Marine Park and the open ocean location does not restrain migratory routes.

6.4 Atmospheric Emissions

6.4.1 Description of aspect

Emissions	The main sources of atmospheric emissions during operational activities are: • Power generation for machinery and vessel operations; and • Emissions related to the well activities, in particular bleed down of annuli during workovers; and • Emergency conditions. The use of fuel (specifically marine-grade diesel) to power vessel engines, generators and mobile and fixed plant and equipment will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and non-GHG such as sulphur oxides (SO_x) and nitrous oxides (NO_x). Trapped gases will be released to atmosphere during the well activities (Section 2.8).

During workover activities on H3 and Skua-10, the A and B annuli of the well will be bled down of gas through displacement with a brine. The brine in the well becomes one of the well barriers for the activity. Gas volumes expected to be vented during the bleed down process are summarised in Table 6-2. The volume estimates are based on existing or planned pressure measurements and well design. This may or may not apply to H3 depending on when gas lift operations commence.

Table 6-2: Gas volumes vented during bleed down process

Annulus	Existing or planned pressure	Gas volume
A	780 psi	92,000 standard cubic feet
B	1,378 psi	110,000 standard cubic feet

6.4.2 Impacts

Sensitive Receptor	Impact description
Air quality	Emissions can reduce air quality in the immediate vicinity of the MODU or vessels present in the Operational Area. The emissions will under normal circumstances quickly dissipate into the surrounding atmosphere. As such impacts to air emissions are considered ***negligible***.
Birds	A reduction in air quality may have a temporary effect on transient bird species passing through the Operational Area. No avifauna BIAs overlap the Operational Area (**Section 3**), however, eleven threatened and/or migratory seabirds were identified as potentially transiting, occurring within, or having habitat potentially occurring within the greater region. These species may be impacted by deterioration in air quality if they are transiting the immediate area of the MODU and vessel exhaust release points. Symptoms of exposure could include irritation of eyes and respiratory tissues or breathing difficulties. Given that the Operational Area is outside a flyway, and the nearest migratory bird breeding/ roosting site is Cartier Island approximately 92 km north-west of the Operational Area, only a small number of seabirds are expected to be affected by a reduction in air quality whilst in transit, any behavioural disturbances such as alteration of flight path would be a Slight effect; recovery in days to week. There are no known air quality standards or guidelines specifically for avifauna. However, if avifauna are exposed, it is expected they would only be exposed to changes in air quality for an extremely short period. Chronic exposures are not considered credible given that avifauna would be transiting through the area. As such impacts to seabirds are considered ***negligible***.
Social receptors	As the Operational Area sits in offshore waters, the combustion of fuels in such remote locations will not impact on air quality in coastal towns or other sensitive locations. No impacts are therefore expected ***negligible***.

Consequence	Ranking
Negligible	Acceptable

6.4.3 Environmental performance

Aspect		**Atmospheric emissions**		
Performance outcome		**No unplanned emissions to the atmosphere; Emissions to air meet regulatory requirements**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
012	MODU Safety Case requires equipment certification and maintenance	All engines, compressors and machinery on the MODU are maintained via the PMS	Pre-start inspection shows maintenance has been satisfactorily completed as scheduled	Drilling Manager
013	Production flowline	Where possible, emissions will be directed to the Montara Venture topside production infrastructure for processing.	Daily drilling report	Drilling Manager
014	MODU poor boy degasser	Emissions will be directed to the MODU and be vented to atmosphere at the top of the derrick via the BOP, choke line, choke manifold and the poor boy degasser.	Daily drilling report	MODU OIM

6.4.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage atmospheric emissions from production and operations equipment, as well as vessels to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
All equipment producing emissions is removed	Eliminate, Engineering	No	N/a	Atmospheric emissions from drilling and operating equipment including vessels and helicopters is required to undertake the Activity. Equipment cannot be removed completely. Risk and impact reduction are achieved through planned maintenance ensuring clean and efficient running of engines.
All emissions producing equipment is substituted for equipment that does not produce emissions	Substitute	No	N/a	All equipment as listed is required; no opportunities for substitution were identified.
None identified	Isolation	N/a	N/a	The Activity is located at distance from sensitive receptors and the coastline.
None identified	Administrative	N/a	N/a	Compliance with relevant and appropriate MARPOL requirements

6.4.5 Acceptability assessment

The potential impacts of atmospheric emissions are considered acceptable in accordance with Section 5, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes, and the environmental consequence is considered negligible.

Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for the activities.
Laws, standards and Industry best practice	Compliance with relevant and appropriate MARPOL requirements. The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to meeting the requirements of all laws and regulations, and meeting industry's objective to maintain a social license to operate. In accordance with APPEA objectives, appropriate systems are in place to minimise impacts, manage complaints, document consultation and communicate with stakeholders.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from atmospheric emissions on sensitive receptors. The Activity is located at distance from aggregations of sensitive receptors and the coastal communities.
Environmental context & ESD	While there are atmospheric emissions to the airshed immediately around the facility and vessels, the impact and risk assessment process indicates that emissions will not result in significant effects to the environment or receptors. The potential impact is considered acceptable after consideration of:

	• Potential impact pathways: Section 6.4.2 assesses the pathways and consequences of the localised degradation of air quality potentially impacting transiting migratory shorebirds and protected seabirds; • Preservation of critical habitats: remote from Protected Areas and aggregations of sensitive receptors; • Assessment of key threats as described in species and Area Management/ Recovery plans: see Conservation and Management Plans' below; • Consideration of North-West Bioregional Plan: no specific actions noted regarding offshore air emissions but contributions to the global GHG inventory resulting in ocean acidification are noted. As such, minimisation of inefficient engine exhaust gases though timely PMS is aligned with the NW Bioregional objectives; and • Principles of ecologically sustainable development ESD: no impacts from air emissions beyond 'negligible' to biological diversity or ecological integrity.
Conservation and management Plans	No Management Plans identified air emissions such as those described above as being a threat to marine fauna or habitats. Jadestone has had regard to the representative values of the protected areas within the EMBA, and the respective management plans and other published information. Impacts from atmospheric emissions will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.5 Operational Discharges

6.5.1 Description of aspect

Liquid discharges	Liquid discharges generated from the MODU and vessels and routinely discharged to the marine environment include: • Slops water (deck drainage, bilge water, tank washing); • Cooling water; • Desalination brine; and • Sewage, greywater and putrescible waste. A summary of each waste type is provided below. <u>Deck drainage and bilge water</u> Deck drainage from the MODU and support vessels consists primarily of stormwater and deck wash-down water. It may include low levels of detergents, oil and grease, spilt chemicals, used machinery chemicals and general dirt from the deck. The volume of drainage likely to be generated is difficult to determine with accuracy as it depends on the rainfall and frequency of deck washing. Oily water from bilges will be collected and treated via an oil-water separator in accordance with MARPOL requirements (<15 mg/L (v) oil-in-water). Once separated, the oil and grease will be stored in suitable containers ahead of transfer ashore for recycling and the treated water discharged to ocean. <u>Cooling Water and Desalination Brine</u> Seawater will be pumped aboard the MODU and vessels, circulated through various process and marine heat exchangers prior to discharge back into the ocean at a temperature higher than ambient seawater. The seawater is typically treated with biocides then directed to sea chests, pump caissons etc to prevent blockage of marine growth inside pipes and exchangers.

	Freshwater is produced on board the MODU and vessels via desalination. The freshwater makers on board the comparative facilities (for example, *Montara Venture* FPSO) result in discharge of maximum 40 tonnes per day of brine of 50.5ºC and a maximum salinity of 38.5 ppm. As a comparative study, the Montara FPSO was assessed by GEMS (2003). The potential behaviour of cooling water discharge from the Montara FPSO during production using wind and tidal driven currents during the dominant seasons (winter and summer). The report concluded that the zone of impact associated with temperature impact from the discharge of cooling water is predicted to be extremely limited in extent with the plume mixing to within 2ºC of the ambient temperature within 40 m from the point of discharge. A water quality monitoring program conducted in 2017 (Jacobs 2017) confirmed at 100 m from the point of discharge, the discharge was not greater than 3°C above the ambient water temperature. Sewage, Grey water and Food waste All sewage (including grey water) generated onboard the MODU and support vessels is discharged through an inline macerator to comminute solids to a diameter of less than 25 mm. Tertiary treated wastewater on the MODU is discharged directly to the ocean via a sewage treatment plant (STP). With the maximum persons on board (POB) of the MODU being typically a maximum of 112 personnel (with a lower average number typically on board), the volume of treated sewage and greywater is conservatively estimated to be <67 m^3/d (based on 0.6 m^3/person/d) and putrescible waste of 112 kg/d (based on 1 kg/person/d). These quantities are derived from existing Jadestone Montara Operations estimates. Given the MODU is manned on a continuous basis, discharges of treated sewage, greywater and putrescible food waste is expected to occur daily throughout the drilling activities. In addition to the MODU, support vessels routinely discharge sewage and greywater and putrescible wastes. Given the lower POB of vessels and the intermittent nature of support activities, overall discharge volumes and frequencies are less than that from the MODU.

6.5.2 Impacts

Sensitive Receptor	Impact description
Water Quality	The impacts associated with the discharge of liquids to the marine environment include a potential change to ambient water quality within the direct vicinity of the MODU and support vessels through chemical loading, increased water temperature, eutrophication, and change in salinity. Deck drainage and bilge water The potential impact associated with the discharge of treated deck drainage and bilge water is a change to ambient water quality through chemical loading within the direct vicinity of the operational facilities and support vessels. If not properly managed, the discharge of oily water has the potential to create an oil sheen on surface waters and a temporary localised decline in water quality. Dispersion and biodegradation of potentially contaminated oily water drainage is expected to be rapid and highly localised resulting in no long-term or adverse effects on water quality and the consequence was assessed as ***negligible***. Cooling water and desalination brine Cooling water discharges to the marine environment will result in a localised and temporary increase in the ambient water temperature of approximately 10ºC. Once discharged into the ocean, the cooling water will initially be subject to mixing due to ocean turbulence and some heat will be transferred to the surrounding waters. The plume will then disperse and rise to the ocean surface, where further loss of heat and dilution will occur (Black et al. 1994). The volume of water discharged will be small compared to the receiving waters, the environmental effects of the elevated temperature of discharged waters is therefore predicted to be insignificant due to the large buffering

Sensitive Receptor	Impact description
	capacity of the ocean. The plume will quickly lose heat and water in only a small area around the outfall will have a substantially elevated temperature (Black et al. 1994). The consequence was assessed as localised with full recovery predicted at the end of the Program, hence ranked ***negligible***. Residual brine typically has a salinity of 40,000 ppm in comparison to seawater which has a salinity of 35,000 ppm. Any increase in salinity within the receiving environment as a result of desalination brine discharges is expected to be limited to the immediate point of discharge. As brine is of greater density than seawater and it is expected to sink and rapidly disperse in the currents. The consequence was assessed as localised with full recovery predicted in the short-term following completion of the Program, hence ranked ***negligible***. <u>Sewage, grey water and putrescible waste</u> The potential impact associated with the routine discharge of sewage, grey water and putrescible waste on water quality is changes to ambient water quality and BOD levels from nutrient loading within the direct vicinity of the MODU and support vessels. The discharges of treated sewage and grey water result in localised increases in nutrient concentrations, generate an increase in bacterial activity and associated Biological Oxygen Demand (BOD) in receiving waters and may promote localised elevated levels of phytoplankton due to nutrient inputs. However, the open water conditions and swift currents of the receiving environment will dilute the discharge and prevent environmentally significant reductions of oxygen levels in the water column (Somerville et al. 1987, cited in Swan et al. 1994). The consequence was assessed as localised with full recovery predicted in the short term at the end of the Program, hence ranked negligible. The consequence of operational discharges to the water quality are considered to be ***negligible*** given the low toxicity of the discharges and expected dilution within the open water.
Marine fauna: cetaceans, turtles, fish, sharks, rays, seabirds	Changes in water quality as a result of liquid discharges can lead to impacts on fauna including: • Potential chemical toxicity to marine species within the direct vicinity of the MODU and support vessels; • Potential behavioral change in marine species; • Chemical effects to marine fauna; • Alteration of physiological processes of exposed biota; • Bio-stimulation of planktonic communities; • Biological exposure to pathogens; and • Deposition and accumulation of solids/ particulates leading to a change in sediment quality. <u>Deck drainage and bilge water</u> The potential impact associated with the discharge of treated deck drainage and bilge water is chemical toxicity to marine species within the direct vicinity of the MODU and support vessels. If not properly managed, the discharge of oily water has the potential to create an oil sheen on surface waters and a temporary localised decline in water quality and toxic effects to marine fauna. Toxicity to marine organisms would be from small amounts of dissolved hydrocarbons in the oily water drainage after treatment. Given that oil and grease residues in oily water drainage will be in low concentrations, the potential for impact is low and would be further reduced due to the strong tidal movements experienced in the region and the naturally turbid environment. Dispersion and biodegradation of potentially contaminated oily water drainage is expected to be rapid and highly localised resulting in no long-term or adverse effects on marine ecology. The consequence was assessed as ***negligible***. <u>Cooling water and desalination brine</u>

Sensitive Receptor	Impact description
	Discharge of cooling water has the potential to cause changes in marine ecology through elevated temperatures, as well as the presence of anti-fouling biocides with trace chemical concentrations of copper and aluminium ions being discharged. These small amounts of biocides will disperse rapidly on discharge to concentrations below levels of environmental concern to marine biota especially demersal fauna. When discharged to the sea surface, cooling water will initially be exposed to the atmosphere and subsequently air-cooled. Upon reaching sea surface cooling water will then be subjected to turbulent mixing and some transfer of heat to surrounding waters. The plume will disperse mainly within surface waters being thermally buoyant, primarily in the direction of prevailing tidal currents (northwest–southeast). A water quality monitoring program conducted in 2017 (Jacobs 2017) confirmed at 100 m from the point of discharge, there has not been greater than 3°C above the ambient water temperature. Most marine species are able to tolerate short-term fluctuations in salinity in the order of 20–30% (Walker and McComb 1990), and it is expected that most pelagic species would be able to tolerate short-term exposure to the slight increase in salinity caused by the discharged brine. Given the relatively low volume of discharge, low increase in salinity and deep, open water surrounding the operational area, impacts on fauna from increased salinity in the Operational Area is expected to be ***negligible***. Fish and plankton are likely to be at greatest risk from cooling water discharge impacts since they are most likely to be attracted to the discharge location (fish) or entrained within the discharge plume (plankton). Fish and plankton are relatively small organisms that may experience increased body temperature and altered physiological processes (e.g. increased respiration rate and oxygen demand). However, given that the area of raised water temperature will be highly localised and within the range of temperature on the North-West Bioregion, significant impacts on a larger ecosystem or population levels to fish or plankton are not expected to occur. Given the hydro-dynamically active open water environment surrounding the Drilling Activities, it is expected that the surface discharges of cooling water and desalination brine would rapidly disperse, cool and dilute in the surrounding waters, therefore temperature, biocides and increased salinity loading leading to changes to water quality or behavioural changes in marine species would be ***negligible***. Only receptors in close proximity to the discharge point have the potential to be impacted with full recovery predicted within weeks. <u>Sewage and greywater and putrescible food waste</u> The potential impact associated with the routine discharge of sewage and grey water and putrescible food waste is changes to water quality resulting in a change in BOD and behavioural responses of marine fauna to discharges as an alternative food source. As cited within NERA (2017), any potential change in phytoplankton or zooplankton abundance and composition is expected to be localised, typically returning to background conditions within tens to a few hundred metres of the discharge location (e.g. Abdellatif 1993; Axelrad et al. 1981; Parnell, 2003). Effects on environmental receptors further up the food chain, namely, fish, reptiles, birds and cetaceans are therefore not expected beyond the immediate vicinity of the discharge in deep open waters. Some fish and oceanic seabirds may be attracted to the MODU and support vessels by the discharge of sewage. This attraction may be either direct, in response to increased food availability, or secondary, as a result of prey species being attracted to the area. Given the small quantities and intermittent nature of disposal however, any attraction is likely to be temporary and is not expected to result in adverse impacts at an ecosystem or population level and impacts ranked ***negligible***. <u>Summary</u> No important foraging or nesting BIA for marine turtles, fish or marine mammals overlaps the Operational Area. While the northern boundary of the Whale shark foraging BIA does overlap

Sensitive Receptor	Impact description
	providing potential for whale sharks to be present, their presence is expected to be limited to transiting individuals, due to the size of the whale shark foraging BIA. Impacts overall to marine fauna are expected to be short term with rapid recovery and the consequence of operational discharges was assessed as ***negligible.***

Consequence	Ranking
Negligible	Acceptable

6.5.3 Environmental performance

Aspect		Operational discharges		
Performance outcome		No unplanned operational discharges within the Operational Area; Operational discharges to sea are in accordance with legislative requirements		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
	Deck drainage and bilge water			
015	Oily water filtering and monitoring equipment fitted and maintained	If required under MARPOL, support vessels have oily water filtering and monitoring equipment that is compliant (e.g. discharges oily water with OIW <15 mg/L) and surveyed/ maintained as per MARPOL	Maintenance records or a pre-mobilisation inspection report (e.g. OCIMF OVID, IMCA CMID, ISM inspection) IOPP certificate	OIM Vessel Master
016	Oily sludge is contained	Oily residue (sludge) is not discharged to sea but is contained and transferred to shore for disposal.	Oil Record Book	OIM Vessel Master
017	MODU closed drain system and slops tank	No open drains to the sea confirmed in pre-start audit.	Pre-start audit report	OIM
	Cooling water			
018	Water cooled equipment on MODU is maintained in accordance with the PMS	Water cooled equipment/ machinery and heat exchangers maintained in accordance with the PMS	Pre-start inspection shows maintenance is scheduled and completed	OIM
	Desalination brine			
019	Potable water systems are maintained	Potable water systems maintained in accordance with PMS	Pre-start inspection shows maintenance is scheduled and completed	OIM
	Sewage and greywater			

Aspect		Operational discharges		
Performance outcome		**No unplanned operational discharges within the Operational Area; Operational discharges to sea are in accordance with legislative requirements**		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
020	MODU and vessels >400 t STP meets operational needs and is operated in line with MARPOL requirements	Pursuant to MARPOL, MODU and vessels have a current International Sewage Pollution Prevention (ISPP) Certificate or equivalent which confirms that required measures to reduce impacts from sewage disposal are in place	Valid ISPP Certificate	OIM Vessel Master
	Putrescible waste			
021	Garbage record book maintained	MODU and vessels' garbage record book maintained to record quantities of food waste in accordance with MARPOL	Garbage Record Book	OIM Vessel Master

6.5.4 ALARP assessment

Based on the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage liquid waste discharges from the MODU and support vessels to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Acceptable as per Section 5. No further controls are required and therefore ALARP has been demonstrated.				
Rejected control	**Hierarchy**	**Practicable**	**Cost effective**	**Justification**
Wastes stored onboard and transferred to shore for onshore treatment and disposal	Eliminate	No	No	Transfers increase the risks of spills/ leaks and safety risks to personnel during transfer operations. Costs associated with complete reengineering such that wastes contained onboard and disposed of onshore, onshore treatment and disposal costs and increase in fuel consumption due to multiple vessel transfers would be disproportionate to the environmental benefit gained given the rapid dilution in offshore water and low potential impact from discharges.
Re-engineer equipment to retain wastes onboard	Engineering	No	No	Costs associated with complete reengineering such that wastes contained onboard and disposed of onshore would be disproportionate to the environmental benefit gained. There is not enough space on board the MODU or vessels to have storage tanks for all the waste produced prior to transferring to a vessel for onshore treatment and disposal. Substantial additional costs for re-engineering is grossly disproportionate to the benefit gained.
N/a	Isolation	N/a	N/a	The activity is located at distance from sensitive receptors and the coastline and no significant impacts on receptors are predicted.
N/a	Administrative	N/a	N/a	Maintenance management system implemented, compliance with relevant and appropriate MARPOL requirements and certified equipment ensure discharges meet regulatory requirements.

6.5.5 Acceptability assessment

The potential impacts of liquid waste discharges are considered acceptable in accordance with Section 5, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes and the environmental consequence is considered negligible.	
Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from liquid waste discharges on sensitive receptors.
Legislation & Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to having appropriate management measures in place to minimise impacts and all wastes are disposed of or recycled at appropriate facilities in accordance with legislative requirements and agreed procedures.

	Maintenance management system implemented, compliance with relevant MARPOL requirements and certified equipment ensure discharges meet regulatory requirements and are acceptable with standards used globally.
Environmental context & ESD	The activity is located at distance from sensitive receptors and the coastline and no significant impacts on receptors are predicted. While there are liquid waste discharges to sea surface immediately around the MODU and vessels, the impact and risk assessment process indicates that discharges will not result in significant effects to marine fauna. The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 6.5.1 and 6.5.2 assess the pathways and consequences of localized and degradation of water quality to the marine ecosystem; • Preservation of critical habitats: no impacts on Protected Areas or aggregations of sensitive receptors; • Assessment of key threats as described in species and Area Management/ Recovery plans: see Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The Plan considers vessel and MODU marine discharges and effluents (with associated temperature, BOD and turbidity impacts) as potential concern to various KEFs (Seringapatam Reef and Commonwealth waters in Scott Reef complex, Rowley Shoals and Ningaloo Reef). No KEFs are impacted from H6 and Skua-12 drilling operational discharges. Avifauna, dolphin, turtle, sea snakes, shark, and dugong are also mentioned in the NW Bioregional Plan but no BIA are predicted to be affected by the MODU or vessel discharges above 'negligible'; and • Principles of ecologically sustainable development ESD: there are no impacts from operational discharges to biological diversity or ecological integrity and no irreversible damage with full recovery in the short term predicted.
Conservation and management advice	No Management Plans identified operational discharges such as those described above as being a threat to marine fauna or habitats Jadestone has had regard to the representative values of the protected areas within the EMBA, and the respective management plans and other published information. Impacts from liquid discharges will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.6 Drilling Discharges

6.6.1 Description of aspect

Drilling discharges	Jadestone Energy proposes to drill the H6 and Skua-12 wells exclusively with water-based drill fluids (WBM). An estimated 478 m^3 and 464 m^3 of drill cuttings from H6 and Skua-12, respectively, is expected to be discharged to the ocean. Residual WBM will be discharged from the MODU mud tanks at the end of the drilling activities. The anticipated maximum volume of WBM discharged during the program is 3,496 m^3. The WBM proposed consists of approximately 80–90% fresh or saline water, with the remaining 10–20% comprising drilling fluid additives that are generally inert or readily biodegradable organic polymers. Small quantities of select chemical additives will also be used to control borehole stability and to improve drilling performance and reliability. These chemical additives include viscosifiers, fluid loss additives, weighting agents (including barite), corrosion control, alkalinity control and engineered bridging materials. During the workovers (H3 and Skua 10) and completions (Skua 12 and H6) an estimated maximum

	6,000 m³ of brine (30,000 – 40,000 ppm salt solution) will be discharged to the ocean. This brine may contain small quantities of chemicals used to clean the wellbore (surfactants) or prevent corrosion (inhibitors) and control microbial growth (biocides). In addition to drilling fluids that will be discharged to the marine environment, cuttings will also be discharged to the ocean. The volume of cuttings to be discharged during each drilling activity is determined by the hole size (diameter) and interval length.

H6 Drilling Discharges

The type of mud used in the various sections, corresponding hole diameters, volume of cuttings discharged, and volume of water-based mud discharged is listed in **Table 6-2**. 30 m^3 of cuttings will discharged at 78 m water depth and the rest of the cuttings (448 m^3) and muds (2,596 m^3) at 1 m below sea surface.

Table 6-3: H6 well profile and cuttings and mud discharge volumes

Well Section	Mud Type	Hole diameter	Shoe Depth	Length	Cuttings discharged	WBM discharged
		inches	f/ ML	m	m^3	m^3
Conductor Hole	SW & Bentonite Sweeps	26”		40	30	n/a
Surface Hole	WBM (Gel /Polymer)	17½”	1,688	1,515	282	950
Contingency sidetrack	WBM (Gel /Polymer)	17½”	1,688	1,515	282	n/a
Intermediate Hole	WBM (KCL/PHPA/Polyamine)	12¼”	2,412	731	69	500
Production Hole	WBM (KCL/PHPA/Polyamine)	8½”	4,365	1,810	73	720
Reservoir hole	WBM (NACL / Polymer / $CaCO_3$)	6⅛”	5,240	1,010	24	426
Total					**760 m^3**	**2,596 m^3**

Skua-12 Drilling Discharges

The type of mud used in the various sections, corresponding hole diameters, volume of cuttings discharged, and volume of water-based mud discharged is listed in **Table 6-4**. 360 m^3 cuttings will be discharged at 80 m water depth, while the remainder of the cuttings (464 m^3) and muds (900 m^3) will be discharged 1 m below sea surface.

Table 6-4: Skua-12 well profile and cuttings and mud discharge volumes

Well Section	Mud Type	Hole diameter	Shoe Depth	Length	Cuttings discharged	WBM discharged
		inches	f/ ML	m	m^3	m^3
Conductor hole	SW & Bentonite Sweeps	36”	154	40	53	NA
Surface hole	WBM (Gel/Polymer)	17½”	1,720	1,580	307	350
Contingency sidetrack	WBM (Gel/Polymer)	17½”	1,720	1,580	307	n/a
Production Hole	WBM (KCl/PHPA/Polyamine)	12¼”	2,500	770	74	300
Reservoir hole	WBM (NaCl, Polymer, $CaCO_3$)	8½”	3,215	720	30	250
Total					**771 m^3**	**900 m^3**

Well & drilling activities

In managing the stability of the well during drilling activities, pressure balance during drilling and workover, and clean up requirements associated with the activities will result in the fluids listed in Table 6-5 being discharged to the marine environment.

Table 6-5: Completion fluid discharges

Completion fluid type	**Volume discharged Skua 12 (m^3)**	**Volume discharged Skua 10 (m^3)**	**Volume discharged H3 (m^3)**	**Surfactant Volume discharged H6 (m^3)**
Brine with 10% surfactant	120	120	120	120
Xanthan Gum biopolymer viscous pills	120	120	120	120
Completion brine – dosed with biocide, oxygen scavenger, corrosion inhibitor and caustic.	1,500	1,500	1,500	1,500

Any brine returned from a well with an oil in water content greater than 15 ppm will be transferred to the and processed before discharge. If the oil in water content is less than 15 ppm the brine will be discharged direct to the sea. The discharged brine will contain corrosion inhibitor and biocide.

6.6.2 Impacts

Sensitive Receptor	**Impact description**
Seafloor - benthic communities and benthic fauna	International Association of Oil and Gas Producers (IOGP) Report 543 *'Environmental fates and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations'* (2016) reports the following summary of drill cuttings fates, based on numerous field studies, that can be used to identify a conservative extent of cuttings discharge accumulation on the seabed: • Cuttings were detected visually or as elevated barium concentrations in sediments within 10 to 150 m of the discharge. Maximum height of the cuttings pile usually is less than 50 cm; and • WBDF cuttings discharged near the sea surface tend to accumulate on the seafloor down current from the discharge at distances of about 0.1 to 1 km, or occasionally more in deep water in excess of 300 m depth. Numerous additional studies support this report and its findings of a conservative maximum extent of deposition in shallower waters of 1 km by indicating that biological effects from seabed communities associated with the deposition of cuttings are limited to ~500 m from a well site (Davies et al 1994; Daniels, C.B. 1998; Limia, J.M. 1996; Oliver et al 1999; Terrens *et al.*1998*)*. Based on this review of current available literature it is considered that a cuttings pile spreading out to an extent of 1 km from the drill site, at a depth of approximately 50 cm, was a conservative extent for this drilling activity given it is in shallow water of less than 300 m depth (77 to 80 m). The following case studies on impacts of WBM on soft sediment and benthic fauna were considered: • For Apache's East Spar development, the area of impact from WBM discharges was not more than 100 m from the drill site and short lived (recovery in less than 18 months) (Sinclair Knight Merz 1996, 1997; Kinhill 1997); • Benthic monitoring at the Stag production platform on the NWS 60 km from Dampier indicated that drilling-induced impacts had less of an influence on infaunal assemblages through time than small spatial scale natural variability (Kinhill 1998; CSIRO 2001; IRC 2001). Two years after the

Sensitive Receptor	Impact description
	initial production well drilling, the distribution of drill cuttings was mostly restricted to within 50 m of the platform, with minor traces out to 1,000 m; and • Cuttings mounds lay approximately 2 m high were found surrounding the Kitan-1 well head in the Timor Sea in approximately 312 m of water (Eni, 2008). 330 m^3 of cuttings were discharged during riserless drilling and 78 m^3 following riser installation. Cuttings mounds of 5 m x 5 m to the North, 2 m x 5 m to the west and 2 m x 4 m to the southeast were identified, all within 2 m of the wellhead. Hermit crabs and fish were observed at these locations suggesting that smothering impacts were localised (Eni, 2008). **Physical alteration to benthic communities through smothering** Hinwood *et al.* (1994) explains that the main environmental disturbance from discharging drilling cuttings and fluids is associated with the smothering and burial of sessile benthic and epibenthic fauna. Impacts are generally localised (100–250 m from drill site) and short-lived (<24 months). The smothering effects of sedimentation depend on the mobility of benthic fauna and the rate of cuttings deposition (Kjeilen-Eilertsen et al 2004). Generally, most species present in high-energy environments are well adapted to changes in substrate, especially species with burying behaviour, experience little effect from sediment deposition (Bijkerek 1988 cited in Kjeilen-Eilertsen et al 2004). Threshold points for benthic fauna tolerance to sedimentation as Threshold points for benthic fauna tolerance to sedimentation as it depends on the species and sediment type. For instance, epibenthic fauna are generally unable to escape more than a 1 cm burial depth, whereas infauna, which are adapted to be covered with sediment, may escape from burial to 10 cm depth or more (Bellchambers and Richardson 1995). Kjeilen-Eilertsen et al. (2004] compiled a list of sediment burial threshold levels for different benthic species that have been studied. These burial thresholds ranged from 1 to >50 cm, depending upon taxon and their size and mobility. These data are almost exclusively from shallow-water studies and taxa and are largely based on laboratory experimentation associated with dredged material disposal. It has been found that the 50% hazardous level for burial of deepwater benthic fauna was at a depth of 5.4 cm (Smit et al 2008). In summarizing burial depths and potential harm to benthic macrofauna due to deposition of drilling fluids and cuttings, Smit et al. (2008] established a more conservative threshold depth of 0.65 cm (6.5 mm of deposited sediment below which would be the Predicted No Effect Concentration (PNEC). Therefore, deposits greater than 0.65 cm deep would be needed before benthic mortality occurred. This indicates there is the potential for smothering impacts to result in benthic mortality over an area of ~1.5 km^2 (based on cutting piles with a 1 km radius) around the drill site. However, any disturbance is expected to be limited to soft sediment infauna communities. Because these communities are known to recover over a longer period of time (Jones et al., 2012), the potential impacts associated with this program are considered to be limited to localised long-term degradation of habitat. **Potential sediment chemical toxicity** Barite is not considered harmful when used in accordance with recommended workplace precautions, with disposal considered environmentally acceptable in almost all geographic areas (Bruton et al, 2006). The industry has recognised that discharges of heavy metals may cause environmental damage and potentially human health problems. Due to the allowable and significant discharge of barite-laden drilling fluids, most countries' regulatory bodies set maximum allowable levels of heavy metals in barite such as a mercury (Hg) and cadmium (Cd), and some are considering regulating lead (Pb) content. The U.S. Environmental Protection Agency limits mercury at no greater than 1 mg/kg and

Sensitive Receptor	Impact description
	cadmium at no more than 3 mg/kg and considers heavy metal content below these limits not to impose a significant environmental threat. Based upon the evaluation that there is the potential for biological impacts within conservatively 1 km of the well location, it is expected that these discharges would result in toxicity impacts to benthic infauna. However, benthic infauna within soft sediment communities are not considered to be restricted to the Operational Area and are well represented in the wider region. In summary, because benthic fauna and communities are known to recover over a longer period of time (months to years), the potential impacts associated with this program is considered to be limited to localised long-term degradation of habitat. Based on past surveys of the region, given the sparsity of benthic communities surrounding the H6 and Skua-12 well locations, and given the discharge volume is expected is relatively small, and that cuttings piles from the top-hole section are likely to remain close to the well centre for an extended period, it is considered credible that there be some smothering and toxicity impacts affect a localised benthic community but recovery is expected within a few years. Impacts are ranked ***moderate*** (*impacts to localised communities*).
Marine Fauna Mammals, reptiles, whale sharks, sharks, sawfish & rays, listed fish species	The potential for toxicity effects to fish and pelagic organisms, including larvae, due to impacts to water quality will be limited due to the use of WBM with a rating of non-toxic, slightly toxic or low toxicity, therefore the consequence to marine fauna is considered in the context of a sub-lethal, localised nuisance to individual or small populations of marine fauna. Also, given that fish and pelagic organisms are mobile and would have a temporary, transient exposure to the plume, the potential for toxicity effects to occur is considered negligible. Turbidity impacts are also likely to be minimal. Thus, there is the potential for localised, short-term impact on species for both toxicity or turbidity in the water column. Given the tendency for drill cutting and fluid discharged to the seabed to settle rapidly, and the discharge of drill cuttings with residual fluid within the area and the temporary degradation in water quality in the upper water column would rapidly dilute and disperse to below levels that could elicit a toxic response, impact level to marine fauna is ranked ***minor*** - local effects with recovery in weeks to months.
Avifauna	Diving seabirds could be exposed to increased turbidity and prey contamination. However, such impacts are not predicted at population levels given no BIA within the area exposed to the plumes. The discharge of drill fluids and cuttings poses low risks to avifauna, therefore, there impacts are ranked ***negligible***.
Commercial fisheries Commonwealth – managed State/ Territory – managed	The potential for toxicity effects to commercially valuable fish, including larvae, due to impacts to water quality will be limited due to the use of WBM (worst case- NADF) with a rating of non-toxic, slightly toxic or low toxicity, therefore the consequence to commercial fisheries is considered in the context of a sub-lethal, localised nuisance to individual or small populations of fish and not the fishery in entirety. Also, given that fish are mobile and would have a temporary, transient exposure to the plume, the potential for toxicity effects to occur is considered negligible. Turbidity impacts are also likely to be minimal. Thus, there is the potential for localised, short-term impact on fisheries for both toxicity and turbidity in water column. It is recognised that the offshore waters around the Drilling Activities are within broad spawning areas for commercial fish species including the red emperor and goldband snapper (Section 3). However, given the wide area over which spawning may occur, the extended length of spawning periods and that discharges will be localised and readily diluted and dispersed, the potential for impacts to larval fish and other planktonic communities is limited and will not occur at a population level. Full recovery of plankton (i.e. food chain impacts) is predicted within weeks to months due to

Sensitive Receptor	Impact description
	the quick biological life spans of plankton and recruitment from unimpacted areas within the tidal changes. Thus, potential impacts to commercial fisheries are ranked ***minor*****.**

Consequence	**Ranking**
Moderate	Acceptable

6.6.3 Environmental performance

Aspect		Drilling discharges		
Performance outcome		**No unplanned chemical discharges within the Operational Area**		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
021	Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033)	Drilling chemicals discharged to the ocean are Gold/ Silver/ D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a complete risk assessment so that only environmentally acceptable products are used	Chemical Risk Assessment completed form	Drilling Superintendent
022	Cuttings management system is installed and functional to ensure discharges overboard are minimised and maximum volumes available for re-use	Cuttings returned to the MODU are treated through the onboard cuttings management system to reduce the concentration of drilling mud on cuttings prior to discharge	Surface losses as reported on the daily mud report	Drilling Superintendent
023		Shaker screens inspected daily during drilling operations to ensure shaker screens are operating as intended	Surface losses as reported on the daily mud report	Drilling Superintendent
024	MODU oily water separator	If brine discharges have an oil in water content greater than 15 ppm, discharge stream will be diverted to the MODU for treatment prior to overboard discharge	Operational discharges from the MODU have an oil in water content less than 15 ppm	MODU OIM
025	Inventory control work instructions are followed to ensure impacts do not exceed those forecast	Only water-based mud, brine and drilling water will be diverted overboard.	Daily Report	Mud Engineer
026		The volume of drill cuttings discharged to the seabed will not exceed those volumes defined in the EP	Daily Report	Drilling Superintendent

Aspect		Drilling discharges		
Performance outcome		**No unplanned chemical discharges within the Operational Area**		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
027		Barite does not exceed concentrations of the following metals: Mercury – maximum 1 mg/kg dry weight; Cadmium – maximum 3 mg/kg dry weight Lead - maximum 1000 mg/kg dry weight	Purchase records confirm that the stock barite in drilling fluids do not exceed maximum concentrations	Drilling Superintendent

6.6.4 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage cuttings and WBM discharges from the MODU to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Acceptable (refer Section 5). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Collection of cuttings returns with residual WBM for onshore treatment/ disposal (i.e. no offshore discharge)	Elimination (of offshore impacts)	No	No	The option of onshore disposal has been evaluated considering: • Additional fuel consumption (and associated emissions) required by support vessels for transport; • Additional risk exposure to workers due to increased handling and loading activities; • Additional road transport and onshore landfill pressure; • Additional financial cost of approximately $2M AUD; • By contrast, offshore discharge will result in only limited and short-term impact to marine benthos given the no-low toxicity of drill fluids; and • No additional safety risk to personnel. Given the relatively low potential environmental impact associated with offshore cuttings disposal, the elevated risk to personnel safety and the significant additional financial cost associated with backloading cuttings to onshore landfill facilities, Jadestone does not consider this option to be reasonably practicable.
Undertake drilling activity in alternate season to potentially further reduce exposure to marine fauna from drill fluids and cuttings	Substitution	Yes	No	Drilling activity timing can be any time of the year. As the impacts are localised and no significant impacts predicted to marine fauna/habitats or socio- economic receptors, any restriction on timing results in an unacceptable cost for little environmental benefit. No delay in the timing of this drilling activity is important to allow the H6 and Skua-12 wells to be brought on-line, in a timeframe that supports the ongoing production requirements and economic viability of the Montara and Skua Fields. Given the considerations above, any restriction on activity timing would not be considered reasonably practicable and would not achieve any significant environmental benefit by being seasonally specific.

Alteration of well design to facilitate slim-hole drilling thereby reducing fluid use and cuttings volumes	Engineering	No	No	Jadestone have considered reducing the overall bore size of the H6 and Skua-12 wells, however, given this is a proposed production well a slim-hole design would not be large enough to facilitate well completion. Therefore, Jadestone do not consider well design alterations reasonably practicable.
Installation of a riserless mud-recovery system to enable WBM and cuttings to be returned to surface thereby reducing discharges	Engineering	No	No	The use of an RMR system while drilling H6 is not possible due to the positioning of the MODU against the WHP, impeding access to the conductor guides that would used by the equipment. The use of an RMR at Skua-12 is not feasible as the equipment footprint is too large for a jackup. The cost for using an RMR is disproportionate to the benefit.

6.6.5 Acceptability assessment

The impacts of drilling discharges are considered acceptable in accordance with Section 5, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes and the environmental consequence is considered negligible.	
Policy & management system compliance	With a commitment to using only low toxicity fluids additives during the activities, as well as Jadestone's mitigation and management measures – including design of the well to minimise volumes of cuttings generated and mud/ cuttings – a reduced environmental impact footprint is achieved. Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised with regards to impacts from drilling discharges on sensitive receptors.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to offshore drilling activities. Jadestone Energy apply 'Industry Best practice" in relation to assessment of chemicals for offshore discharge in alignment with guidance provided by the Centre for Environment, Fisheries and Aquaculture Science (Cefas). Cefas administer the Offshore Chemical Notification Scheme (OCNS) and apply the Chemical Hazard and Risk Management (CHARM) model to rank offshore chemicals: https://www.cefas.co.uk/. The Jadestone Chemical selection procedure uses this to preferably select lower toxicity chemicals. World Bank Group - Environmental, Health, and Safety Guidelines Offshore Oil and Gas Development - Drilling Fluids and Drilled Cuttings Guidance Number 53 requires that the direct loss system is to be considered an interim solution for the first drilling phase and applied only when the chemical content is low and water-based drilling mud is used. Environmental, Health, and Safety Guidelines Offshore Oil and Gas Development - Drilling Fluids and Drilled Cuttings Guidance Number 59 requires that operators carefully select

	drilling fluid additives, considering their concentration, toxicity, bioavailability, and bioaccumulation potential. Environmental, Health, and Safety Guidelines Offshore Oil and Gas Development – Emissions and Effluent Guideline Number 134 (Table-1) presents effluent guidelines for offshore oil and gas development. Guideline values for process effluents in this sector are indicative of good international industry practice, as reflected in the relevant standards of countries with recognized regulatory frameworks: • Hg: max 1 mg/kg dry weight in stock barite; and • Cd: max 3 mg/kg dry weight in stock barite Environmental, Health, and Safety Guidelines Offshore Oil and Gas Development - Drilling Fluids and Drilled Cuttings Guidance Number 59 requires that operators use high-efficiency solids removal and treatment equipment to reduce and minimise the amount of residual fluid on drilled cuttings. The industry-standard cuttings treatment technology comprises shakers, cuttings dryers, and centrifuges. Shakers separate fluids from solids, thus reducing the overall volume of adhered drilling fluids discharged – as applicable to WBM.
Environmental context & ESD	The environment around the H6 and Skua-12 wells is well understood and described in **Section 3** of the EP. Further, a detailed risk assessment has been undertaken to evaluate the potential impacts and risks of this activity's particular values and sensitivities within the vicinity of the drilling and wider operational EMBA. A conservative extent of impact has been used for the activity based on recent available literature. The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 6.6.2 assesses the pathways and consequences of localised impacts to the immediate wellhead seabed and temporary degradation of water quality; • Preservation of critical habitats: no impacts on Protected Areas or aggregation of sensitive receptors; • Assessment of key threats as described in species and Area Management/ Recovery plans: see Conservation and Management Advise' below; • Consideration of North-West Bioregional Plan: The Plan considers drilling cuttings and muds as potential concern to KEFs – specifically Seringapatam Reef and Commonwealth waters in Scott Reef complex, Rowley Shoals and Ningaloo Reef) - none of which are impacted from H6 and Skua-12 drilling discharges; and • Principles of ecologically sustainable development ESD: no impacts from drilling cuttings and muds beyond 'negligible' to population levels hence biological diversity or ecological integrity, no irreversible damage.
Conservation and management advice	No Management Plans identified operational discharges such as those described above as being a threat to marine fauna or habitats. Jadestone has had regard to the representative values of the protected areas within the EMBA, and the respective management plans and other published information. Impacts from drilling discharges will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.7 Cement Discharges

6.7.1 Description of aspect

Discharge of cement

Cement is mixed on board the drilling MODU and used to secure the casings in place to ensure well integrity. Excess cement as per the drilling program will be used in all well bore sections and abandonment plugs to account for potential wash outs, over gauge hole and small seepage losses into the formation.

Cement volumes used in the H6 and Skua-12 well are estimated to be approximately 58 m^3. At the end of each cement job approximately 1 m^3 of dry cement may be blown overboard from the hopper. In addition, approximately 1 to 3 m^3 of cement slurry will be discharged as a result of cleaning cement pump and lines. This discharge is released at the sea and will disperse within the water column.

Activity	Cement volume m^3	Release location
H6	20 (extruded)	Seabed
	3 (mixed)	Sea surface
	1 (dry)	Sea surface
Skua-12	30 (extruded)	Seabed
	3 (mixed)	Sea surface
	1 (dry)	Sea surface
Total	58 m^3	

There are potential environmental impacts relating to the toxicity of the cement and cement additives. A number of additives with different chemical functions are required (e.g. defoaming agents, dispersants and fluid loss control additives).

6.7.2 Impacts

Sensitive Receptor	Impact description
Water column marine fauna Marine Mammals Marine Reptiles Whale Sharks Sharks, Sawfish & Rays Listed Fish Species	The potential for toxicity effects to fish and pelagic organisms due to impacts to water quality will be limited due to the use of cement additives with a rating of non-toxic, slightly toxic or low toxicity, as per the Jadestone Chemical Selection and Evaluation and Approval Procedure Furthermore, effects will be limited to a small number of individuals within the immediate vicinity of the discharge location given the minor quantities involved, the expected localised mixing zone and high level of dilution into the open water marine environment of the MDP area. Given the small discharge volumes, localised mixing zone and the mobile nature of fish and pelagic organisms, exposure is expected to be temporary and transient and consequences are ranked ***negligible***.
Avifauna	The discharge of cement within the MDP area poses no hazard to avifauna, therefore, there is no potential for an impact to occur.

Sensitive Receptor	Impact description
Benthic Communities	The absence of sensitive benthic communities in the vicinity of the well should result in limited impacts to benthic communities as a result of smothering or toxicity effects from cement discharges. Any smothering or toxic effects to benthic communities or habitats from cement additives will be highly localised to around the well head and recovery by recruitment of new colonising organisms and migration from adjacent undisturbed seabed area is expected to commence shortly after drilling finishes (Neff, 2005; IOGP, 2016). The closest shoals are located approximately 28 km south west of the Drilling Activities (Goeree and Vulcan Shoals) and therefore due to the localised nature of the cement discharges, no impacts are anticipated at the shoals. Due to the restitution time for communities to recover, the limited discharge volumes at the seabed of excess cement and localised extent of potential smothering or toxicity effects, impact level for benthic communities is ranked ***moderate***.
Protected areas, heritage places, tourism, recreation, Petroleum Exploration and Production, Ports and Commercial Shipping, Traditional and subsistence Fisheries or Commercial Fisheries	The plume of cement during Drilling Activities is so localised and water quality impacts of such short term, that the release of cement poses no hazard to these receptors, therefore, there is no potential for impacts to occur.

Consequence	Ranking
Moderate	Acceptable

6.7.3 Environmental performance

Aspect		Cement discharges		
Performance outcome		No discharge of high-risk profile chemicals to the marine environment		
ID	**Management controls**	**Performance standard**	**Measurement criteria**	**Responsibility**
028	Selection of chemicals discharged to the ocean is aligned with the Jadestone Chemical Selection and Evaluation and Approval Procedure	Chemicals used are Gold/Silver/D or E rated through OCNS, or PLONOR substances listed by OSPAR, or have a complete risk assessment so that only environmentally acceptable products are used	Completed Chemical Risk Assessment form confirms drilling mud is ranked 'acceptable'	Drilling Manager
029	Actual volumes of cement discharged match do not exceed forecast volumes stated in the well design and constituents are as forecast in the well design	The volume and constituents of cement discharged to the seabed and sea surface will be limited to that predicted by the well design	Daily report	Drilling Superintendent

6.7.4 ALARP Assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage cement discharges from the MODU to ALARP. Additional controls considered but rejected are detailed below. The potential impacts are considered Tolerable as they are within the green category (negligible impacts). No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Return excess cement to shore for re-use and disposal	Elimination of offshore impacts	No	No	The option of onshore disposal has been evaluated giving consideration to: • Additional fuel consumption (and associated emissions) required by support vessels for transport; • Additional risk exposure to workers due to increased handling and loading activities; • Additional road transport and onshore landfill pressure; • Additional financial cost; • Product often by nature hardened and hence off spec so has no on-sell value; and • Use of limited landfill for unwanted product • The vessels bulk systems running at a higher pressure than shore-based facilities, therefore creating a safety concern. By contrast, offshore discharge will result in: • Only limited and short-term impact to marine benthos given the no-low toxicity of cement; • No onshore disposal impacts; and • No additional safety risk to personnel. Given the relatively low potential environmental impact associated with offshore cuttings disposal, the elevated risk to personnel safety and the significant additional financial cost associated with backloading cuttings to onshore landfill facilities, Jadestone do not consider this option to be reasonably practicable.
Minimise excess cement	Engineering	No	No	Excess cement is required for safety purposes and is a calculated volume to ensure well integrity. Given the low impact of generating a slight excess of cement (rather than underestimating excess volumes and requiring additional loads delivered) Jadestone do not consider this option to be reasonably practicable.

6.7.5 Acceptability assessment

The potential impacts of liquid waste discharges are considered acceptable in accordance with Section 5, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes and the environmental consequence is considered negligible.

Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholders & reputation	Stakeholder consultation has been undertaken (see Section 3), and no stakeholder concerns have been raised with regards to impacts from cement discharges on sensitive receptors.
Industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to reducing impacts to benthic communities to ALARP through undertaking appropriate measures to reduce the footprint and monitoring and recording discharge characteristics
Environmental context & ESD	The environment around the H6 and Skua-12 wells is well understood and described in Section 4 of the EP. Furthermore, a detailed risk assessment has been undertaken to evaluate the potential impacts of this activity's particular values and sensitivities within the vicinity of the drilling and wider EMBA. A conservative extent of impact has been used for the activity based on recent available literature. The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 6.7.1 and 6.7.2 assess the pathways and consequences of the localised impacts to seabed around the wellhead from smothering and the temporary degradation of water quality through turbidity and toxicity; • Preservation of critical habitats: the location is remote from Protected Areas or aggregations of sensitive receptors; • Assessment of key threats as described in species and Area Management/ Recovery plans: see 'Conservation and Management Advise' below; • Consideration of North-West Bioregional Plan: Habitat modification from construction and installation of facilities is noted as a 'potential concern' to the NW Marine Bioregion in general and specifically the KEF -Seringapatam Reef and Commonwealth waters in the Scott Reef complex. As the location of this KEF is remote from H6 and Skua-12 cement discharges, and discharges are managed to ensure low toxicity and short duration, this EP is aligned with the objectives of the NW Bioregional Plan; and • Principles of ecologically sustainable development ESD: no impacts from cement discharges beyond 'negligible' to biological diversity or ecological integrity, no irreversible damage
Conservation and management advice	No Management Plans identified drill cuttings and fluid discharges such as those described above as being a threat to marine fauna or habitats Jadestone Energy has had regard to the representative values of the protected areas within the EMBAs, and the respective management plans and other published information. Impacts from cuttings and fluid discharges will have a negligible impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

6.8 Spill Response Activities

6.8.1 Description of aspect

Spill Response	In the event of a hydrocarbon spill, contingency spill response activities will be undertaken to reduce the level of impact to sensitive receptors within the environment. In summary, the response activities include: • Source control; • Monitoring, evaluation and surveillance;

	• Protection and deflection;
	• Containment and recovery;
	• Shoreline clean-up;
	• Dispersant application;
	• Oiled wildlife response; and
	• Scientific monitoring.
	The WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (MV-70-PLN-G-00001) (the OPEP) provides further detail on how these strategies will be implemented.
	While the aim of undertaking these spill response activities is to reduce environmental impacts from the spill, there is the potential for these activities to create additional impacts or to exacerbate existing oil spill impacts. Poorly selected or implemented spill response activities may therefore do more environmental harm than good.
	Spill response activities will involve:
	• The use of vessels which are required at a minimum to display navigational lighting. Vessels may operate near shoreline areas during spill response activities;
	• Spill response activities may also involve onshore operations including the use of vehicles and temporary camps which may require lighting;
	• The use of aircraft and vessels which will generate noise both offshore and in proximity to sensitive receptors in coastal areas;
	• The use of equipment on coastal areas during clean-up of shorelines (e.g. pumps);
	• The use of fuels to power vessel engines, generators and mobile equipment that will result in emissions of greenhouse gases (GHG) 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);
	• Operational discharges including those routine discharges (Section 6.5) from vessels and MODU used during spill response. In addition, there are specific spill response discharges and waste creation that may occur, including:
	  ○ Cleaning of oily equipment/vessels;
	  ○ Flushing water for the cleaning of shoreline habitats;
	  ○ Sewage/putrescible and municipal waste on vessels; and
	  ○ Creation, storage and transport of oily and contaminated waste.
	• Dispersant operations;
	• Movement and operation of vessels, personnel and equipment on the shoreline areas including the marine/ coastal habitats and fauna, which may include those habitats and fauna within protected areas; and
	• Oiled wildlife response activities may involve deliberate disturbance (hazing), capture, handling, cleaning, rehabilitation and release of wildlife.

6.8.2 Impacts

The key environmental impacts associated with the potential spill response strategies are provided together with a description of associated potential impacts to sensitive receptors. Some of these hazards are unique to spill response (e.g. shoreline clean-up, oiled wildlife response). Some hazards common to the operations have also been detailed and re-evaluated on the basis that the environment within which spill response activities take place may be of higher sensitivity than the environment within which the H6 and Skua-12 Drilling Activities occurs.

Table 6-6: Impact assessment of spill response activities

Sensitive Receptor	Impact description
Light	The receptors considered most sensitive to lighting from vessel and shoreline operations are seabirds/ shorebirds and marine turtles. Emerging turtle hatchlings on the beaches are particularly sensitive to light spill, however, the potential impact is considered negligible as stated below. Section 6.2 provides further detail on the nature of light impacts to fish, birds and marine turtles. Following restrictions on night-time operations by spill response vessels, which will demobilise to mooring areas offshore with safety lighting only, light impacts from vessels are considered to be ***Negligible***. The positioning of temporary camps will be done in consultation with DBaC and any camp lighting will be restricted to minimum directional lighting that will reduce fauna disturbance. Following these controls, the consequence of shoreline lighting is considered ***Negligible***. These species are likely to be values of the protected area they occur in, and the impact to the protected area from light is also considered ***Negligible***. Response activities may occur within the highly sensitive locations of Ashmore, Cartier, (priority receptors) response activities related light impacts to the key values within the applicable Management Plans are also expected to be ***Negligible*** due reasons described above.
Noise	The receptor considered most sensitive to vessel noise disturbance are cetaceans. The humpback whale and Pygmy blue whale (distribution) BIAs overlaps the EMBA and species may be vulnerable during their peak activity season (July–October; April - Aug) as they migrate north/ south through the EMBAs (Section 4). Control measures, by means of compliance to Part 8 of EPBC Regulations, will reduce potential impacts from response activities within this area during whale activity seasons. Given the activity will only introduce vessel engine noise, the consequence is considered consistent with noise impacts from activities (***Negligible***). Section 6.3 provides further detail on these impacts from vessels. With respect to noise from onshore operations (mobile equipment and vehicles), nesting, roosting or feeding birds are considered the most sensitive to noise, in particular, shorebirds aggregating at Tiwi and Indonesian coast lines. However, the equipment used is not considered to have excessive sound levels and following consultation with DoT and DBCA on the location of temporary camp areas, the consequence to birds from noise is expected to be ***Negligible*.** These species are likely to be values of the protected area they occur in, and the impact to the protected area from noise is also considered ***Negligible***.
Atmospheric	Atmospheric emissions from spill response equipment such as the use of mobile equipment, vessels and vehicles may result in a temporary, localised reduction of air quality in the environment immediately surrounding the emission points. Atmospheric emissions from spill response equipment will be localised and impacts to even the most sensitive fauna, such as birds, are expected to be ***Negligible***.
Operational discharges	Operational discharges from vessels may create a localised and temporary reduction in marine water quality, which has the potential to impact shallow coastal habitats in particular. However, following the adoption of regulatory requirements for vessel discharges, which prevent discharges close to shorelines, discharges will have a ***Negligible*** impact. Furthermore, washing of vessels and equipment will take place only in defined offshore hot zones preventing impacts to shallow coastal habitats. Onshore, the use of flushing water has the potential to damage sensitive shoreline and intertidal habitats, e.g. mangroves, however low pressure flushing only will be used, preventing further damage to habitats or erosion of sediments. For sensitive habitats, the deployment of booms will

Sensitive Receptor	Impact description
	be considered to retain flushed hydrocarbons, if this presents a net benefit. Following these controls, the use of flushing to clean shorelines and intertidal habitats is seen to have a ***Negligible*** additional impact. The cleaning of contaminated vehicles and equipment onshore has the potential to spread oily waste and damage habitats if not contained. Decontamination units will be used during the spill response thus containing waste and preventing any secondary contamination. The consequence of cleaning discharges is therefore ranked as ***Negligible***. Sewage, putrescible and municipal waste generated onshore will be stored disposed of at approved locations. There will be no discharges of this waste to the marine or coastal environment and the likelihood of an unplanned discharge is considered Unlikely following those controls provided. If those controls failed, and secondary contamination or loss of municipal waste occurred the additional consequence to coastal habitat has been assessed as Minor. The risk ranking for an unlikely event with a ***Minor*** consequence is ***Low***. The response activities may occur within the Protected Areas, response activities related discharge impacts to the key values within the Protected Area also expected to be ***Negligible***, with low risk of any unplanned releases.
Physical presence	**Physical presence of nearshore response vessels and spill equipment** The use of vessels and nearshore booms has the potential to disturb benthic habitats including sensitive habitats in coastal waters such as corals, seagrass, macroalgae and mangroves. A review of shoreline and shallow water habitats, and bathymetry, and the establishment of demarcated areas for access and anchoring will reduce the level of impact to ***Negligible***. **Onshore vehicle movements, equipment use and camp set-up** The use and movement of vehicles, equipment and personnel during shoreline response activities has the potential to disturb coastal habitats such as dune vegetation, samphire and mangroves, and important habitats of threatened and migratory fauna including nests of turtles and birds and bird roosting areas. A clean-up can also involve physical removal of substrates that could cause impact habitats, fauna and alter coastal hydrodynamics. As with vessel use, an assessment of appropriate vehicles and equipment to reduce habitat damage, along with the establishment of access routes/demarcation zones, and operational restrictions on equipment/ vehicles use will limit sensitive habitat damage and damage to important fauna areas. The establishment of temporary camp areas will be done with consultation to DoT, DBCA and with a Heritage Advisor if access is sought to culturally significant areas. Following these controls, the overall resultant consequence to the physical environment and habitat is assessed as Minor, indicating that there may be a detectable reduction in habitat area from response activities (as separate from spill impacts), but recovery will be relatively rapid once spill response activities cease. As with all spill response activities this disturbance will only occur if there is a net benefit to accessing and cleaning shoreline areas. **Wildlife response** The main direct disturbance to fauna would be the hazing, capture, handling, transportation, cleaning and release of wildlife susceptible to oiling impacts, such as birds and marine turtles. This would only be done if this intervention were to deliver a net benefit to the species but may result in a Minor consequence following close adherence to the WA and NT Oiled Wildlife Response Plans and the Kimberley Region Oiled Wildlife Response Plan. **Physical disturbance in protected areas** These habitats/environments are likely to be values of the protected area they occur in, and the impact to the protected area from physical disturbance is considered ***Minor***.

Sensitive Receptor	Impact description
Invasive Marine Pests-IMP	The mobilisation of vessels, vehicles and equipment into sensitive nearshore and coastal habitats brings the potential for non-indigenous and potentially invasive species, either attached as biofouling, in the case of vessels or as seeds/plant propagules or invasive fauna within equipment and vehicles. The release of such species is an unplanned event which is considered to have a likelihood of Unlikely following vessel risk assessments (on all international and interstate Australian vessels) and pre-cleaning and quarantine inspections of onshore equipment. The consequence of an outbreak of an invasive marine pest is considered Major in the nearshore/ coastal environment, which is more conducive to establishment of invasive marine pests than deeper offshore waters. Given the Unlikely likelihood, the overall Risk Ranking is ***Medium***.
Disturbance to other users	The use of vessels in the nearshore and offshore environment and spill response activities at shoreline locations, and within townships, may exclude general public (community villages) and industry use. It should be noted that this is distinct from the socio-economic impact of a spill itself which would have a far greater detrimental impact to industry and recreation. Following the controls outlined, it is considered that the additional impact of spill response activities on affected industries would be ranked ***Minor***.
Dispersants	While the aim of chemical dispersants is to provide a net benefit to the environment, the use of dispersants has the potential to increase exposure to habitats under the sea surface, including coral, seagrass and macroalgae, and to marine fauna (particularly fish and invertebrates) by increasing entrained oil concentration. These receptors are generally located in shallow coastal areas of the mainland and offshore islands. Increased entrained and aromatic hydrocarbon concentration can contact marine fauna, and are most likely to be encountered by plankton, benthic filter feeding invertebrates, fish and sharks. Fish and sharks include threatened/ migratory species, which may ingest oil or uptake toxic compounds across gill structures. As a result of increased exposure to marine fauna and subtidal habitats, socio-economic impacts may be felt through industries such as tourism and commercial fishing. During a response, the area over which entrained oil will increase will be a function of the area treated with aerial dispersants. The increase in entrained oil concentration will be short term (minutes to hours) as the floating oil moves into the water column after which dispersion of the entrained oil will see concentrations decrease. A description of the potential impacts from entrained oil and aromatic hydrocarbons from a maximum credible worst-case spill is provided in Section 7.6. Jadestone provided detailed assay information of Montara crude oil (Leeder 2013) to RPS to commission a report (RPS, 2018), to assess whether the application of chemical dispersants reduced the probability of contact to shorelines. Key findings of this report include a reduction in the predicted probabilities for shoreline contact by 40% total volume ashore, and greater prediction times to sensitive locations following application of chemical dispersant. These key findings support the use of chemical dispersants on Montara crude as they have potential to reduce hydrocarbon contact with sensitive locations and increase the time of the hydrocarbon contact to shorelines, thus giving time for other response strategies to take effect and further reduce impacts. Table 6-6 provides a summary evaluation of the selected strategies performance outcomes and controls, and the benefit that will be provided in applying this strategy.

6.8.3 Environmental performance

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
Overall spill response				
030	WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (TM-50-PLN-I-00001) provides for NEBA, notifications and consultation requirements to ensure net environmental benefit from response	NEBA undertaken every operational period and considered in development of following period Incident Action Plan.	Incident log	IMT Leader
031		OPEP activated as per OPEP notification table		
032		DoT and DBCA consulted with on location of shoreline operations location(s).		
033	Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008) procedure details IMT Core team members, resource pool and responsibilities	Jadestone IMT comply with Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)		
Light emissions				
034	WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (TM-50-PLN-I-00001)) provides for task description for response activities to manage lighting during spill response	Nearshore booming and skimming operations conducted during daylight hours only.	Incident log	IMT Leader
035		Vessels to maintain minimal lighting required for safety and navigation requirements		
Noise				
036	Vessels align with Montara Marine Facility Manual (MV-90-PR-H-00001) details vessel and helicopter operating requirements to reduce interactions with cetaceans	Spill response vessels and aircraft comply with EPBC Act Regulation 8 (cetacean interaction). Performance requirements as per Section 6.3	Incident log	IMT Leader
Atmospheric emissions				

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
037	International Air Pollution Prevention (IAPP) Certificate valid to certify measures are in place to reduce air emissions	If required under MARPOL, vessels have a current IAPP Certificate.	IAPP or vessel inspection document	IMT Leader
Operational discharges and waste				
038	Vessels comply with MARPOL and Protected Area sewage disposal requirements	Vessel sewage disposal will meet MARPOL Annex IV requirements. If vessel activities occur within protected areas, discharges will meet marine park management plan requirements and the DoT sewage strategy[2]	Vessel checklist or other confirmation from vessel master that requirements will be met	IMT Leader
039	Vessels comply with MARPOL requirements for oily water (bilge) discharges	Vessel oily water disposal will meet MARPOL Annex I requirements.		
040	WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (TM-50-PLN-I-00001) details controls in place to manage oily water during shoreline flushing	Oily water collected during offshore containment and recovery to be decanted behind boom.	Incident log	
041		DoT/ AMSA approval prior to decanting oily water back to marine environment.		
042		Offshore Equipment wash-down confined to hotzone.		
043		Onshore equipment wash-down occurs in a decontamination area	Incident log	IMT Leader
044		Low pressure high volume is used for shoreline habitat flushing		

2 http://www.transport.wa.gov.au/mediaFiles/marine/MAC-IS-SewageStrategy.pdf

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
045		Seawater at ambient temperature is used for shoreline flushing.		
046		Booms are used for containment of shoreline flushing liquids if contaminated flushing has potential to cause secondary impacts in excess of oil dispersion into ocean.		
047	Jadestone's Waste Management Plan – Oil Spill Response Support (JS-70-PR-I-00037) details requirements and capability for waste treatment in the event of a spill	All waste associated with oil spill response activity transported and disposed of in accordance with Environmental Protection (Controlled Waste) Regulations 2004, EP Act 1986 and associated regulations	Waste tracking records	Logistics Lead
048		All waste associated with oiled wildlife facilities captured and disposed of in accordance with the NTOWRP, WAOWRP and KOWRP	Incident log	
049		Compliance with local government municipal waste requirements	Waste consignment records	
050		Onsite inductions include municipal waste requirements (how to manage domestic waste).	Incident log	
051		Reduce/ Reuse/ Recycle assessment of collected waste conducted by waste contractor.		
052	DoT OSCP 2015 Waste Management Sub-Plan Guidance informs waste management plans	DoT OSCP 2015 Waste Management Sub-Plan Guidance considered as part of Jadestone's Waste Management Plan – Oil Spill Response Support (JS-70-PR-I-00037)		IMT Leader

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
Physical presence and disturbance				
053	WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (TM-50-PLN-I-00001)) details appropriate equipment and sites for response selected during spill response activities to minimise potential impacts from vessel/equipment presence	Shallow draft vessels are used for shoreline and nearshore operations	Vessel specification documented in IAP	IMT Leader
054		A shoreline/ nearshore habitat/ bathymetry assessment is conducted prior to nearshore activities	Incident log	
055		Maintenance and inspection personnel are assigned to boom sets to ensure operational ability maintained		
056		Vehicles are appropriate to shoreline conditions.		
057		Demarcation zones to be established for shoreline operations involving vehicle and personnel movement considering vegetation, bird nesting/roosting areas and turtle nesting timeframes		
058		Access plans for shoreline operations will prioritise use of existing roads and tracks		
059		Terrestrial vehicle and equipment deployment via landing barges where there is no existing track access		
060		A Specialist Advisor is consulted if shoreline operations overlap with areas of cultural or heritage significance.		
061		Vehicles and equipment are verified as clean and invasive species free prior to deployment to site		

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
062	Vessels IMS management aligns with Montara Marine Facility Manual (MV-90-PR-H-00001) which provides IMS prevention requirements	Vessel Contractors are required to conduct an IMS risk assessment for support vessel(s) that have been sourced from outside Western Australia using the WA Department of Fisheries Vessel Check process, and for this assessment to indicate low / acceptable risk	Vessel Check completed by Vessel Operator.	
063		Ballast water management plan review requirement for interstate and international vessels	Ballast Water Management Plan	
Oiled Wildlife Response				
064	WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (TM-50-PLN-I-00001) provides linkage to NTOWRP, WAOWRP and KOWRP	OWR undertaken in accordance with the NT and WA Oiled Wildlife Response Plans and the Regional Oiled Wildlife Response Plans	Incident log	IMT Leader
Chemical dispersant application				
065	Prioritise the use of dispersants that are listed as approved on the Register of Oil Spill Control Agents (OSCA) - National Plan for Maritime Environmental Emergencies	Dispersants listed as approved on the Register of Oil Spill Control Agents (OSCA) - National Plan for Maritime Environmental Emergencies shall be used prior to any other dispersant being considered for use	Incident log	IMT Leader
066	Chemical dispersant selected in accordance with Jadestone's Chemical Selection Evaluation and Approval Procedure (JS-70-PR-I-00033)	Chemical dispersant to be applied is selected after having undergone a risk assessment by Jadestone. The evaluation must find the chemical dispersant acceptable for use prior to application	Incident log	IMT Leader
067		Operational monitoring of chemical dispersant efficacy to be undertaken throughout dispersant application		

Hazard		**Oil Spill Response Activities**		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
068	WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (TM-50-PLN-I-00001) provides chemical dispersant application requirements	Chemical dispersant application capability assessed by the NEBA during the IAP process prior to decision to apply		
069		Selection of correct equipment for chemical dispersant application prior to application		
070		Geographic location for chemical dispersant application assessed in the NEBA during the IAP process		
071		At no time, can chemical dispersant be applied: • In waters shallower than 20 m (LAT); • Within 10 km of water shallower than 20 m; • Within restricted zones for offshore facilities; • Within an AMP boundary or its buffer; • Within State Waters unless approved by the HMA.	Incident log	IMT Leader
Disruption to other users of marine and coastal area and townships				
072	Consultation undertaken in accordance with Jadestone Energy Consultation of Relevant Persons Procedure (JS-70-PR-I-00034) prior to deployment in populated areas	Consultation is undertaken with relevant stakeholders prior to deployment of resources to townships and marine/coastal areas	Consultation records	IMT Leader
073	Localised Risk Management Assessment undertaken to minimise potential impacts on populated areas	A Risk Management Assessment is undertaken prior to large scale deployment to populated areas	Risk Management Assessment	

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
Spill response preparedness				
074	Contracts valid and maintained in accordance with Jadestone Energy Contractor Management Framework (JS-90-PR-G-00002) to ensure access to competent personnel and appropriate equipment	Contracts for the supply of personnel and materials in place and current with competent service providers and suppliers	Contractor assessment records	Supply Chain Management
075	AMOSC MSC/ AMSA MOU/ OSRL MSC valid for life of the EP	AMOSC & OSRL memberships allowing access to mutual aid arrangements for spill response crew and equipment via a Master Services Contracts (MSC) for life of EP AMSA MOU (access to NRT and resources) for life of EP	Current AMOSC & OSRL memberships and MSCs AMSA MOU valid for 5 years from 2017	General Manager
076	Response personnel competent and trained in accordance with Jadestone Energy Training and Competency Management System (JS-60-PR-Q-0014) and WHP & Subsea Fields AC/L7 & AC/L8 Drilling Program 2020 OPEP (TM-50-PLN-I-00001) for life of EP	Assessment of proposed/ rostered response personnel as being competent and trained according to the requirements of response roles defined in Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)	Response personnel competency and training records	HR Manager
077	Spill response exercise and training completed in accordance with Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008) to maintain spill preparedness readiness of Jadestone for life of EP	Training and exercising current and completed as required by the Incident Management Team Response Plan and OSRA (GF-70-PLN-I-00037)	Exercise schedule Exercising close out reports Training records	Emergency Response Lead
078	OPEP maintained to ensure spill response is appropriate to nature and scale of risk for life of EP	Spill response planning and preparedness are aligned with nature and scale of risk of this EP	Review confirms drilling risks are aligned with the OPEP	Drilling Manager

Hazard		Oil Spill Response Activities		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
079	MODU and vessels SOPEP are valid and tested to ensure ability to respond to spills as required by MARPOL	In line with MARPOL Annex 1, support vessels over 400 gross tonnage will have a current Shipboard Oil Pollution Emergency Plan (SOPEP)/ Shipboard Marine Pollution Emergency Plan (SMPEP) and International Oil Pollution Prevention (IOPP) certificate	Exercise reports SMPEP/ SOPEP	OIM Vessel Masters
080		MODU spill exercises are conducted monthly		
081	Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008) maintained to ensure ability to respond to spills by Jadestone	Provides current information for Jadestone spill response resources and matches risk as defined in the EP	Annual Performance Report	Emergency Response Lead
082	Personnel aware of roles and responsibilities in the event of a response in accordance with Montara Incident Response Plan (MV-70-PLN-F-00001)	Instructs offshore response roles and responsibilities and training requirements.	Exercise records Training and induction records	Emergency Response Lead
083	Blowout Contingency Plan (JS-70-PLN-D-00001) in place one month prior to drilling commencing	Blowout Contingency Plan in place that address loss of well containment actions as defined in the EP that minimise risk to personnel and reduce environmental impact	Blowout Contingency Plan	Drilling Manager
084	AMOSC Subsea First Response Toolkit (SRFT) membership is in place for the life of the EP, including appropriate insurance and an Operations, Training and Advice (OTA) Agreement with Oceaneering	Maintain AMOSC SRFT membership, appropriate insurance and an OTA Agreement with Oceaneering which allows access to equipment, dispersant stocks and technical support for subsea dispersant application	Current SRFT membership, insurance and OTA Agreement records	Country Manager
085	ROV support in place for SFRT activity	Contract in place to provide ROV services for SFRT	Current contract in place	Supply Chain Management

Hazard		**Oil Spill Response Activities**		
Performance Outcome		**Spill response has an overall net environmental benefit**		
ID	**Management Controls**	**Performance Standard**	**Measurement Criteria**	**Responsibility**
086	Labour hire contract in place for life of EP to source labour for	Labour hire contract in place to provide access to personnel	Labour hire contract	HR Manager
087	Vessel availability for SFRT deployment is monitored monthly via Jadestone's nominated vessel broker for life of EP	Monitor the availability of vessels that are suitable for deployment of the SRFT for life of EP	Monthly Monitoring reports	Logistics Lead
088	Maintain contract with Jadestone's Waste Management Contractor for life of the EP	Waste management contract is maintained which enables access to waste storage facilities and waste transport	Contractor assessment records	Logistics Lead
089	Monitor external drilling programs for MODU availability for life of EP	Jadestone to have a process for monitoring external drilling programs for MODU availability	Monthly Monitoring reports	Logistics Lead
090	Monitor status of Registered Operators with Approved Safety cases for MODUs for life of EP	Jadestone have a process for monitoring the status of Registered Operators with Approved Safety cases for MODUs	Monthly Monitoring reports	Logistics Lead
091	Contract and Equipment Access Agreement with Wild Well Control (WWC) for life of EP	Contract and Equipment Access Agreement with WWC are maintained providing technical support and equipment	Contract and Equipment Access Agreement with WWC	Supply Chain Management
092	APPEA MOU for mutual assistance to facilitate and expedite the mobilisation of a relief well for life of EP	APPEA MoU for mutual assistance for relief well drilling	Records demonstrate Jadestone is a signatory of the APPEA MoU for Mutual Assistance	Country Manager
093	Vessel availability for containment and recovery activity is monitored monthly via Jadestone's nominated vessel broker	Monitor the availability of vessels that are suitable for deployment of the Containment and Recovery strategy as defined in the OPEP	Monthly monitoring reports	Supply Chain Management

6.8.4 ALARP assessment

The purpose of implementing spill response activities is to reduce the severity of impacts from an oil spill to the environment. However, if the strategies do more harm than good (i.e. they are not having a net environmental benefit) then the spill response is not ALARP. The key process in determining if the strategies employed are having a net benefit is the net environmental benefit analysis (NEBA). A NEBA is conducted for each operational period during a response to ensure the best strategies are being implemented and the ALARP principle is regularly tested (refer to the OPEP for further detail). The strategic NEBA has been conducted for chemical dispersant operations (refer to the OPEP) indicates an overall positive effect, based on reduced shoreline loading of oil and spatial extent of floating oil above the impact threshold.

It is best practice to ensure all possible response strategies have been evaluated and, if there is the potential to produce a net environmental benefit, to have them in the toolbox ready for implementation if determined feasible for the scenario (IPIECA (2015). Contingency planning for oil spill on water: Good practice guidelines for the development of an effective spill response capability).

For each of the environmental hazards associated with spill response strategies an ALARP evaluation was conducted as part of the hazard identification workshop (HAZID). A number of controls were identified as industry and/ or Jadestone standard controls that will be considered during a spill response while additional controls were evaluated and either accepted or rejected on the basis of the ALARP principal, i.e. a decision was based on whether the additional control would have a cost/effort disproportionate to the level of impact reduction it would provide. Results of the evaluation are shown in Table 6-6**.**

Note that some of the potential impacts to fauna from spill response activities can be beneficial in the prevention of oiling by acting as deterrents. For example, if shoreline operations are being undertaken at a turtle nesting or bird breeding site, fauna may avoid the location as disturbed by noise or people and thereby not be oiled.

Table 6-7: ALARP for spill response activities

Strategy	Description	Environmental Benefits	Decision
Source control	Implementation of the MODU SOPEP	Reduce the volume of oil entering the marine environment	Adopt
	Implementation of Emergency Pipeline Repair Plan (GF-09-PLN-L-00039)	Reduce the volume of oil entering the marine environment	Adopt
	Implementation of Blowout Contingency Plan (JS-70-PLN-D-00001)	Reduce the volume of oil entering the marine environment	Adopt
Subsea dispersants	Subsea dispersants are applied close to the release point with the objective of minimising the amount of oil from reaching the sea surface. This technique helps to break up the oil droplets so that they are dispersed, diluted and biodegraded more rapidly in the water column, and is beneficial in reducing the amount of volatile organic compounds at the sea surface in the vicinity of the well site.	This strategy is only suitable for a loss of well control release. Subsea dispersant application can reduce the amount of surface hydrocarbons drifting towards sensitive receptors, by increasing the availability of oil droplets for biodegradation. Subsea dispersant typically requires smaller volumes of dispersant to treat the oil as compared to surface dispersant application, resulting in lower volumes of dispersant being applied to treat the spill. Subsea dispersant application will only be undertaken when there is a net environmental benefit. Applicability of chemical dispersant is limited to the conditions, locations and circumstances described in the OPEP.	Adopt
Operational Monitoring	Surveillance actions are used to monitor and evaluate the trajectory and fate of the released hydrocarbon, to determine the effectiveness of response strategies and to identify and report on any potential/actual contacts to flora, fauna, or any other sensitive receptor that occurs. Surveillance results are used to assist in escalating or de-escalating response strategies as required.	There are various measures (vessel/ aerial surveillance, tracking buoys, oil spill modelling, fluorometry, SCAT) within this response strategy which may be suitable. Their use, in combination or individually, will be determined based on the spill distribution as well as other considerations such as access to locations, environmental and metocean conditions. This strategy is a primary response to ensure that there is sufficient information to gain situational awareness and make informed decisions on response planning, execution and termination.	Adopt
Surface chemical dispersion	Chemical dispersant is applied to break down the hydrocarbons and allow/enhance dispersion into the	Surface chemical dispersant may be viable, either by vessel or plane, or subsea. Evidence from the Montara oil spill in 2009 from AMSA reported that 'based on experienced personnel during the response the use of dispersant was highly effective in assisting the natural process of biodegradation and minimising the risk of oil impacts	Adopt

Strategy	Description	Environmental Benefits	Decision
	water column, thereby preventing/reducing potential shoreline contact and increasing biodegradation.	on reefs and shorelines' (Refer Appendix 4 of the OPEP). If there is a weather condition that prevents the application of dispersant (which is unusual for the environment around the Montara facilities), this creates dispersion. The Oil Spill Modelling Report (RPS 2018) output for Montara oil comparing dispersant and non-dispersant models indicated shoreline oil loading to be reduced by up to 40% when applied to oil thickness of 100 $g/^2$, up to 56% when applied to oil thickness of 50 g/m^2 and up to 58% when applied to oil thickness of 16 g/m^2. Chemical dispersants applied at sea surface can reduce the amount of floating oil but increase the oil concentrations in the water column, thereby increasing the risk of exposure to organisms that live in the water column. Diesel is not considered a persistent hydrocarbon and has high natural dispersion rates in the marine environment. Chemical dispersant application is not recommended as a beneficial option for Diesel as it has a low probability of increasing the dispersal rate of the spill while introducing more chemicals to the marine environment. Entrained oil concentrations are not constant; they are subject to frequent fluctuations due to metocean influences, mobility of receptors and the dilution of the dispersed oil by the sea. Subsequent potential contact to organisms in the water column and nearshore marine habitats is infrequent, of varying concentration, duration and consequence. The majority of potentially contacted shorelines are mangroves and tidal flats subjected to very high tidal influences, which make shoreline response infeasible, cause more damage than not responding or unsafe. Therefore, Jadestone consider that any potential shoreline loading reduction is more beneficial than the potential impact to organisms from entrained oil and this strategy is deemed to be a primary strategy. Chemical dispersion will only be undertaken when there is a net environmental benefit. Applicability of chemical dispersant is limited to the conditions, locations and circumstances described in the OPEP.	
Physical dispersion	Physical dispersion is undertaken by running vessels through the hydrocarbon plume and using the turbulence developed by the propellers or hydro-blasting from vessel	In general, this strategy is considered an opportunistic strategy; used on targeted, small, breakaway areas, especially patches close to shorelines. Given that oil is expected to emulsify by the time it approaches shorelines, and chemical dispersant	Reject

Strategy	Description	Environmental Benefits	Decision
	hydrants to break up the slick. Once dispersed in the water column in the form of smaller droplet sizes, biodegradation processes are enhanced.	application would be preferred as a means of dispersing bulk oil; this strategy has limited effectiveness and is not considered to be a strategy requiring further planning and associated control measures.	
Containment and recovery	Containment and recovery of hydrocarbons can offer a preventive form of protection to sensitive receptors. Skimmers (mechanical) and booms will be used at sea. This strategy is only effective in calm conditions.	For a spill of Montara or Skua crude oil, this is the preferred way to remove hydrocarbons from the water surface before the risk of contacting shorelines/ sensitive receptors. Given the fast spreading nature of diesel, and the expected moderate to high sea states of the area causing the slick to break up and disperse, this response is not considered to be effective in reducing the net environmental impacts of a diesel spill. The ability to contain and recover spreading diesel on the ocean water surface is extremely limited due the very low viscosity of the fuel. Containment and recovery may be applicable once evaporation of highly volatile components has occurred. Based on the crude oil assays, a solidified residual is expected which can be collected using containment and recovery methods. Given that shoreline booming and shoreline clean-up are expected to be difficult across some locations within the RISK EMBA, this strategy is considered a primary strategy in the overall spill response.	Adopt
Protection and deflection	Protection and deflection activities involve the use of booms to: • Protect sensitive receptors; • Deflect spills away from sensitive receptors or shorelines; or • Deflect spills to an area that provides increased opportunity for recovery activities. • This strategy is typically not effective in areas experiencing large tidal variations and associated currents.	Anchoring of booms may result in additional damage to the subsurface environment (coral reef) surrounding most offshore islands. Booms themselves would also move around on the coral intertidal reef during periods of lower tides, potentially resulting in physical damage to the benthos of the reef platform. Due to the types of shorelines that may be impacted (i.e. remote, high tidal - high energy beaches/intertidal reef platforms), protect and deflect would under most circumstances, not be considered to result in a net environmental benefit. The use of vessels to deploy booming may be feasible to protect priority locations. If a tangible, positive outcome could be demonstrated a protect and deflect operation may be possible. Consequently, this strategy may not be applicable across all shorelines identified as being contacted by oil but is considered a secondary strategy for targeted use.	Adopt

Strategy	Description	Environmental Benefits	Decision
Shoreline clean-up	During a spill response, clean-up of the oiled shorelines will be implemented using suitable methods, provided it will be beneficial to the environment based on the NEBA performed on the affected areas based on actual site conditions.	Contacted shorelines will be assessed for their shoreline clean-up potential. The selection of the most appropriate clean-up techniques requires a rapid evaluation of the degree and type of contamination, together with the length, nature and accessibility of the affected coastline. This response has the potential to cause secondary disturbance associated with the clean-up, so applicability of the strategy is based on aerial surveillance reconnaissance, shoreline assessments and NEBA in the shoreline clean-up assessment. Diesel is relatively non-adhesive and will not form a thick adhesive barrier on a shoreline (Fingas 2012). The clean-up of diesel spills from a beach or shoreline is likely to be difficult, generating high volumes of waste in comparison to the oil recovered, and therefore not recommended. Consequently, this strategy may not be applicable across all shorelines identified as being oiled but is considered a secondary strategy for targeted use.	Adopt
Oiled wildlife response (OWR)	Responding to an oiled wildlife incident will involve an attempt to prevent wildlife from becoming oiled and/or the treatment of animals that do become oiled.	Within the RISK EMBA, areas with importance for wildlife have been identified to be threatened by the oil spill and mobilisation of a wildlife response will likely be necessary. Mobilisation of experts, trained work forces, facilities and equipment will then be needed. Wildlife response activities may take place at sea, on shorelines and in specialised facilities further inland. Options for wildlife management are considered and a strategy determined guided by the WA and NT Oiled Wildlife Response Plan and relevant regional plans.	Adopt
In-situ burning	In situ burning is a technique sometimes used in responding to an oil spill. In situ burning involves the controlled burning of oil that has spilled (from a vessel or a facility), at the location of the spill. The oil must be amenable to lighting e.g. unweathered, high lighter oil fractions and not prone to emulsification. When conditions are favourable and conducted properly, in situ burning will reduce the amount of oil on water.	Operational and oil constraints expected during a spill from the Drilling Activities suggest in-situ burning is not feasible. For in-situ burning to be undertaken, oil must be thicker than 1-2 mm but diesel and Montara and Skua crude oil tend to have high evaporation rate and spread into thin films rapidly. Due to operational constraints and the expected hydrocarbon not being suitable for in-situ burning, this response strategy is deemed inapplicable for the Drilling Activities.	Reject

Strategy	Description	Environmental Benefits	Decision
Scientific Monitoring	This is the main tool for determining the extent, severity and persistence of environmental impacts from an oil spill and allows operators to determine whether their environmental protection outcomes have been met (via scientific monitoring activities). This strategy also evaluates recovery from the spill.	Scientific monitoring is especially beneficial for monitoring entrained and dissolved oil impacts as response strategies are generally targeted to manage the surface oil impacts.	Adopt

6.8.5 Acceptability assessment

<table>
<tr><td colspan="2">The potential impacts of spill response activities are considered 'Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.</td></tr>
<tr><td>Policy & management system compliance</td><td>Jadestone's HSE Policy objectives are met. Section 8 and the OPEP demonstrate that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity including spill response arrangements.</td></tr>
<tr><td>Stakeholders & reputation</td><td>Stakeholder consultation has been undertaken (Section 3), and no stakeholder concerns have been raised with regards to spill response activities. Consultation included engagement with the State and National response agencies of DoT and AMSA, nearby operators, AMOSC, as well as commercial and recreational fishing industry bodies and fishers. No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons.

During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA, DER) will occur and thus there will be ongoing consultation with relevant persons during response operations.</td></tr>
<tr><td>Environmental context & ESD</td><td>The worst-case credible spill scenario for the drilling activities is a loss of well control at H6 resulting in a spill of 234,682 m^3 over 77 days. The area over which the oil travels (>1 g/m^2) is between roughly 84°E in the west, and 140°E (Arnhem Land) to the east. The oil is primarily floating and sensitive receptors at risk include seabirds, shorebirds, marine fauna and coastal habitats.

While some response strategies (e.g. application of chemical dispersants and booming operations) may pose additional risk to sensitive receptors, to not implement response activities would likely result in greater negative impact to the receiving environment and a longer recovery period. Response activities are undertaken in accordance with controls which reduce and/or prevent additional risks.

The mutual interests of responding and protecting sensitive receptors from further impact due to response activities is managed through the use of a net environmental benefit analysis during response strategy planning in preparedness arrangements as well as during a response.

The potential impact is considered acceptable after consideration of:
• Potential impact pathways: pathways and proposed management are described under individual activities and aspects in Section 6.8.2;
• Preservation of critical habitats: described under individual Tactical Response Plans, and ALARP measures considered (Section 6.8.4) to ensure response activities do not increase the risks to critical habitats from spills;
• Assessment of key threats as described in species and Area Management /Recovery plan: see 'Conservation and Management Advise' below;
• Consideration of North-West Bioregional Plan: no specific discussion of spill response activities but impacts such as light, noise, vessel discharges, collision with fauna etc are discussed individually under the planned aspects above. The toxicity to marine life from dispersants is noted. As such, the proposed management control to minimise impacts under this EP, are aligned with the objectives of the NW Bioregional Plan; and
• Principles of ecologically sustainable development ESD: Operational NEBA assessments ensure the environmental impacts are neutral or positive; thus, potential impacts to biodiversity and ecosystem integrity minimised.</td></tr>
</table>

Conservation and management advice	Jadestone Energy will have regard to the representative values of the reserves and other information published and endeavor to ensure that priority is given to the social and ecological objectives and values, of any AMPs, or state marine parks impacted by spill response activities to ensure that the objectives of the management plans are not contravened (Appendix B). Noting 'Emergency response' is permitted in all AMPs and State marine parks. Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with activities authorised under the OPGGS Act may be conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. The Management Plans for EPBC protected species that identify light, noise and other risks through Sections 6.1 – 6.8 apply here. The 'Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species' will be applied/used as guidance in the event of an oil spill.

7. UNPLANNED RISKS

This section of the EP describes the potential risks and environmental impacts from accidental events that may arise during the Drilling Activities and associated mitigation and management measures that will be implemented to reduce risks and impacts to as low as reasonably practicable and acceptable levels.

The environmental risk assessment process identified five accidental environmental risks. The pre-treatment and residual risk rankings are summarised in Table 7-1 and presented in detail throughout this section.

Table 7-1: Summary of the environmental risk assessment ranking for accidental events

Hazard	Pre-treatment Ranking	Residual Ranking
Marine pest introduction and establishment	Medium	Medium
Interaction with fauna	Low	Low
Unplanned release of solids overboard	Medium	Medium
Unplanned release of non-hydrocarbon liquids	Low	Low
Unplanned release of crude oil	Medium	Medium
Unplanned release of diesel	Low	Low

7.1 Marine Pest Introduction

7.1.1 Description of hazard

Invasive Marine Pests (IMP)	Biofouling on immersed surfaces (e.g. ship hulls), floating/ immersible equipment and within internal seawater circulation systems, as well as ballast water, are potential pathways for invasive marine pests (IMPs) to translocate on support vessels and the MODU. Excluding tows between the MODU locations, the MODU will be a stationary facility within the Operational Area, located further than 12 NM from the nearest land and in water depths of approximately 70 to 80 m. Prior to arriving in Australian waters, the MODU will be required to exchange ballast waters in an open sea area. There is the potential for support vessels to transfer IMPs from international waters into the Operational Area and for them to establish in the local environment. There is a smaller risk of transfer of IMPs from Australian waters. There is also a theoretical potential for IMPs to be transferred into Australian Territory and coastal waters via support vessels when commuting from the Operational Area to/ from State/ Territory or Commonwealth waters.

7.1.2 Impacts and risks

The introduction and establishment of IMPs can result in impacts on native marine fauna and flora, including:

- Competition, predation or displacement of native species;
- Alteration of natural ecological processes;
- Introduction of pathogens with the potential to impact human and/or ecological health;
- Reduction and/or competition with commercial fish and aquaculture species; and
- Increased requirement for maintenance of vessels and marine infrastructure.

Potential sources for the transfer and establishment of IMPs include:

- Biofouling on vessels and other external niches (e.g. propulsion units, steering gear and thruster tunnels);
- Biofouling of vessels or other internal niches (e.g. sea chests, strainers, seawater pipe work and anchor cable lockers);
- Biofouling on equipment that routinely becomes immersed in water (including but not limited to equipment such as conductor casing and ROVs); and
- Discharge of high-risk ballast water taken up from international or domestic sources.

Ballast water is responsible for up to 30% of all IMS incursions into Australian waters, however, research indicates that biofouling (the accumulation of aquatic micro-organisms, algae, plants and animals on vessel hulls and submerged surfaces) has been responsible for more foreign marine introductions than ballast water (DAWR 2017).

There are three key steps involved for a successful IMP incursion:

- Colonisation and establishment of the IMP on a vector (e.g. vessel) in a donor region (e.g. home port);
- Survival of the organism on the vector during the voyage from the donor to the recipient region; and
- Colonisation (e.g. reproduction or dislodgement) of the recipient region by the IMP, followed by successful establishment of a viable new population which then constitute a 'pest' presence (Commonwealth Government, 2009).

Colonisation requires suitable environmental conditions for that particular species including water temperature, water depth, salinity and habitat type. As such, most exotic marine species introduced to Australian waters have distributions restricted to shallower coastal habitats. IMPs able to survive outside of their natural range may pose a significant threat to the Australian marine environment. It is estimated that Australia has over 250 established marine pests, and it is estimated that approximately one in six introduced marine species becomes pests (DoE 2015).

Following their establishment, eradication of marine pest populations is often extremely difficult and costly, limiting management options to ongoing control or impact minimisation. For this reason, increased management requirements have been implemented by Commonwealth and State agencies with the implementation of Australia's National System for the Prevention and Management of Marine Pest Incursions which focusses on managing biofouling and ballast water.

Biofouling

Under the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), a risk assessment approach is recommended to manage biofouling.

The potential biofouling-mediated IMP transfer risk presented by vessels (including MODUs), is influenced by a number of inter-playing factors. These factors include the type and age of the anti-fouling coating, operational and maintenance history since last drydocking (including where the vessel had been operating), length of time intended to operate in Australian coastal waters and whether the vessel has undergone biofouling inspection and/or cleaning prior to entering Australian waters.

Any vessel or marine infrastructure destined for WA waters from interstate or overseas is required to meet the aquatic biosecurity standards set out under the *Fisheries Resources Management Act 1994*, including, as may be warranted, a Marine Biosecurity Inspection for the purposes of assessing the presence of known and potential IMPs to ensure compliance with Regulation 176. The responsible agency, the WA Department of Primary Industries and Regional Development (DPIRD) has promulgated a list of declared marine pest species.

The MODU will have been inspected and verified to be clear of biofouling-mediated IMP at the time of entry into Australian waters, and this is one of the foundations upon which the selected MODU will be contracted for the Montara drilling activity. The MODU will arrive into the Operational Area in a condition considered to be free of biofouling representing a marine biosecurity hazard to Australian waters.

None of the WA listed marine species of concern should be present on any vessel intended to visit WA waters due to legislated management requirements. In accordance with marine pest management guidelines (as enforced under the *WA Fisheries Resources Management Act* 1994; and Fish Resources Management Regulations 1995):

- Immersible equipment and the vessel hull, sea chests and other niches must be 'clean' before vessels enter WA waters and ports;
- To minimise risk, a vessel should leave its last overseas port of call within seven days of the last anti-fouling coating application or IMP inspection, prior to direct transit to its target port/area in WA waters. If experiencing delays or deviations, you should seek advice from the Department; and
- The suspected or confirmed presence of any marine pests or disease must be reported within 24-hours by email (biosecurity@fish.gov.au) or telephone (FishWatch tel: 1800 815 507). This includes any organism listed on the WA Prevention List of Introduced Marine Pests, and any other non-indigenous organism, that demonstrates invasive characteristics.

Ballast water

The Commonwealth Department of Agriculture (DoA: formerly the Department of Agriculture and Water Resources [DAWR]) is the lead agency for management of ballast water, with responsibility for the management of ballast water sourced both from international and domestic (i.e. Australian) locations. DoA introduced the Australian Ballast Water Management Requirements (DAWR 2017) that are enforced under the *Biosecurity Act 2015* (as amended). Under these arrangements, all vessels that intend to discharge ballast water in Australian waters are obligated to assess and manage their ballast water in accordance with DoA requirements. These arrangements prohibit the discharge of high-risk ballast water within Australian territorial seas (within 12 NM of the Australian territorial sea baseline) unless the ballast water has been managed to the satisfaction of DoA or is otherwise assessed to be 'low risk', and prior approval has been obtained for that discharge. By extension, all vessels (including MODUs), mobilised for the project and intending to discharge ballast water within the Australian territorial sea (i.e. within 12 NM of the Australian territorial sea baseline) will be required to manage ballast water to the satisfaction of DoA. For the MODU, and unless treated with an approved ballast water treatment system, this would entail the conduct of ballast water exchange 'on the high seas' to the satisfaction of DoA before arrival in Australian waters.

A MODU typically takes on ballast (including from international waters – such as after dry-docking) and de-ballasts as required (e.g. during mobilisation/ demobilisation) to maintain stability and to spud-in effectively. In accordance with the International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention) vessels (including the MODU), should have Ballast Water Management Plans and Ballast Water Record Books which detail the arrangements in place to manage ballast water and record the time, location and details of any uptake and discharge of ballast water.

The DoA requires vessels that operate between Australian ports and offshore oil and gas installations within the Australian Exclusive Economic Zone (EEZ) to manage their ballast water before arrival at both the installation and the Australian port. The acceptable area for a ballast water exchange between an installation and an Australian port is in sea areas that are no closer than 500 m from the offshore installation, and no closer than 12 NM from nearest land.

Ballast water discharged in the same place where the ballast water is taken up is considered low risk. There is no requirement to manage ballast water that is taken up and discharged in the same place if the low risk water is at least 95 % from the 'same place' to be within one nautical mile of the point of uptake, or within the port limits of the same port.

Given that the MODU will exchange ballast water before entering Australian waters and will then be discharging low risk ballast water/ taking up seawater at location, no adverse impacts to marine ecology are expected.

Support vessels are similarly required to adhere to Australian ballast water management requirements, as detailed in the *Australian Ballast Water Management Requirements, Version 7*. As such and assuming adherence to mandatory Australian requirements, no adverse effects are expected from the discharge of ballast water by support vessels engaged in the drilling activity.

Sensitive Receptor	Impact description	
Benthic habitats	The Operational Area benthic habitat comprises soft sandy sediments in 70 to 80 m water depth, open ocean conditions and lacking abundant light at this depth. The only hard substrate available is that associated with the WHP and subsea infrastructure such as flowlines. Given these conditions, the successful establishment of introduced species on the natural habitat is considered unlikely. There is a possibility of establishment on the artificial substrate in the area, but this too is considered to be unlikely. If IMPs were introduced and established successfully on the benthic habitat, it could result in an overall change in localised areas and some degradation of the ecosystem. The potential impact was assessed as ***Minor** effect; recovery in weeks to months; death of individuals* as impacts could result in potential mortality to fauna associated with the benthic habitat, with impacts likely localised to within approximately 1 km of the activity.	
Fish and Fisheries	There are increased concerns regarding fishery impacts following the introduction of IMPs into Australian waters. Should IMPs be introduced, they have the potential to outcompete and displace native species which may in turn affect the local marine ecosystem, and potentially fisheries operating in the area affected. However, the Operational Area does not contain any known critical areas (i.e. feeding, breeding) or highly significant habitat (i.e. coral reef, seagrass) for fish. It is also unlikely that IMPs will be able to establish and reproduce in water depths of the Operations Area. However, if IMPs were established, it may have a ***Moderate*** impact - *Local effect; recovery in months to a year; impact to localised community.*	
Likelihood assessment		
	Asian green mussel, American slipper limpet and Black striped false mussel were detected in Darwin marinas in 1999 and were successfully eradicated. No recognised marine pest species are known to be established in Darwin harbour. Vessels operating from Darwin are expected to have arrived there free of IMPs, it is therefore unlikely that they would acquire any pest species from Darwin. Furthermore, it is not likely that IMPs entering the Operational Area would establish on the benthic habitat (soft sediments). The water depth, open ocean conditions and lack of available light provides a very different environment to that within sheltered port and shallow coastal areas which have historically been colonised by IMPs. Some possibility exists of establishment on the artificial substrate in the area, but if so, such colonisation would in all probability be confined to the artificial substrate. The likelihood of a potential introduction and establishment of IMPs is considered ***unlikely*** for this location with the intended controls in place.	
Consequence	**Likelihood**	**Ranking**
Moderate	Unlikely	Medium

7.1.3 Environmental performance

Hazard		Marine Pest Introduction		
Performance outcome		**No introduction of marine species**		
ID	**Management controls**	**Performance standards**	**Measurement criteria**	**Responsibility**
094	Vessels and MODU comply with the Biosecurity Manual (JS-70-MN-G-00001)*	All vessels demonstrate compliance with the biosecurity manual requirements	Documented evidence of compliance with DoA ballast water management requirements. Documented evidence of effective management of ship biofouling management, consistent with National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009).	Drilling Manager Vessel Master

* The biosecurity manual applies to all marine vessel operations in Operational Areas and has as its purpose to:

a) Describe the marine biosecurity management process for Jadestone Energy (Australia) Pty Ltd activities including vessels contracted to perform marine operations.

b) Prevent the introduction of Invasive Marine Pests (IMP) into Australian Waters and the Operational Area through translocation vectors such as marine and petroleum vessels, immersible equipment and ballast water.

c) Ensure contracted vessels (including MODUs) and vessel operators are aware of and apply the marine biosecurity requirements when chartered to execute their scope of work.

d) Ensure compliance with Commonwealth and State Australian Government legislation.

e) Detail the risk-based approach and mitigations used to reduce the risk of IMPs being introduced to the operational area to As Low as Reasonably Practicable (ALARP).

7.1.4 ALARP assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk of IMPs being introduced and getting established to the level of ALARP. The residual risk ranking for this potential impact is Medium. Good industry practice has been applied for the situation or risk. Additional controls were considered but rejected as detailed below. No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Support vessels to be sourced only from Australian waters	Eliminate	No	No	Wherever possible, domestic vessels will be sourced, but this may not always be feasible. Delays to activities can result from non-availability of suitable vessels if only drawn from Australian waters. Regardless, all vessels are subject to IMP risk assessment and must manage their ballast water and biofouling in accordance with regulatory requirements. Minimal benefit gained given the implemented controls ensure only low IMP risk vessel are contracted.
Follow-up marine pest inspection around 75 days after arrival if the vessel is still in WA waters	Isolation	No	No	The objective is to ensure that vessels and the MODU engaged in project activities are free of IMPs at the time of mobilisation. Accordingly, the residual risk of IMP is considered low due to inspection and cleaning controls and the need for any follow-up inspections of vessels 75 days after arrival is negated. If any IMP enters the Operational Area, the nearest habitat is the WHP structure or the benthic habitat (sandy seabed) and the environment is hostile compared to sheltered port and shallow coastal areas which have historically been colonised by IMPs.
Application of new anti-fouling coating to all vessels prior to contract commencement	Engineering	No	No	Substantial additional cost, potential delay to commencement of activity. Little benefit given the requirement to rank as low risk using the IMP risk assessment. Anti-fouling coating on the in-water surfaces of vessels, and the chemical dosing of sea chests (marine growth prevention system) will occur. Anti-fouling coatings containing TBT are not an option as these biocides are prohibited from use in Australia.

7.1.5 Acceptability assessment

The potential impacts of marine pest introduction are considered 'Acceptable' as the residual risk is Medium and ALARP can be demonstrated (refer above), based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.

Policy compliance	Jadestone's HSE Policy objectives are met.
Policy & management system compliance	Section 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and their practices to reflect the requirements of marine pest management in Australian waters.

Stakeholder & reputation	Stakeholder consultation has been undertaken (see Section 4), and no stakeholder concerns have been raised. Jadestone will continue to liaise with WA Department of Primary Industries and Regional Development (Fisheries) on current requirements for the management of the risk of marine pest introduction in WA and NT waters.
Law and industry best practice	The implementation of a Biofouling Management Plan and the maintenance of a Biofouling Record Book are consistent with the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), and in the IMO Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species. Ballast water management will be consistent with the requirements of the Biosecurity Act 2015, as detailed in the *Australian Ballast Water Management Requirements, Version 7*.
Environmental context & ESD	Section 7.1.2 notes it is unlikely that IMPs entering the Operational Area will establish and propagate. The potential residual risk is considered acceptable after consideration of: • Potential impact pathways: section 7.1.1 and 7.1.2 assess risks from biofouling and ballast water; • Preservation of critical habitats: activities are remote from Protected Areas and shallow water, protected environments where the establishment of IMPs is more likely; • Assessment of key threats as described in species and Area Management/ Recovery plans: See 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan mentions the potential for Asian green mussels *Perna viridis* to cause damage in Commonwealth waters of the NW Marine Region, but these mussels typically prefer habitat up less than about 12 m deep. The proposed management actions align with the NW Bioregional Plan objectives by minimizing the risks; and • Principles of ecologically sustainable development (ESD): the proposed management of biofouling and ballast water risks minimizes the likelihood to adverse effects on biodiversity and ecosystem integrity from invasive species.
Conservation and management advice	Application of guidelines detailed in the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (2009), and in the IMO Guidelines for the Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species. Jadestone has had regard to the representative values of the protected areas within the Operational Area, and the respective management plans and other published information. Impacts from any hypothetical successful establishment of marine pests will not impact on any of the social and ecological objectives and values, of any AMPs, or state marine parks. This is consistent with the objectives of the protected area management plans (Appendix B) and considered acceptable.

7.2 Interaction with fauna

7.2.1 Description of hazard

Interaction with fauna	The movement of support vessels and helicopters in the Operational Area increases the potential for physical or disruptive interaction with marine fauna.

7.2.2 Impacts and risks

Fauna most susceptible to vessel strike include cetaceans, whale sharks and turtles, and this is reflected as a threat in many of the conservation advice and recovery plans for these species (refer Appendix B). Other fauna such as fish and sea snakes are more likely to avoid vessels and so are considered at low risk of potential strike and will not be discussed further.

Marine Mammals

Cetaceans are naturally inquisitive and often attracted to vessels underway; for example, dolphins commonly 'bow ride' with vessels. There have been recorded instances of cetacean deaths as a result of vessel collisions in Australian waters (e.g. a Bryde's whale in Bass Strait in 1992) (WDCS 2006). The data indicates deaths are more likely associated with container ships and fast ferries. Collisions between vessels and cetaceans are more frequent on continental shelf areas where high vessel traffic and cetacean habitat occur simultaneously (WDCS 2006).

Vessel speed is a strong contributor to the rate of collisions with marine fauna, with increasing vessel speed resulting in a higher collision risk (Hazel et al. 2007; Silber et al. 2010). A study on collisions between ships and whales (Laist et al. 2001) observed that most lethal or severe injuries to cetaceans involved vessels 80 m or longer in length and were associated with vessels travelling at 14 knots or faster.

The reaction of whales to the approach of a vessel is variable. Some species remain motionless when in the vicinity of a ship while others are known to be curious and 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).

The Conservation Management Plan for the Blue Whale (DoE 2015) identifies vessel strike as a threat to the species.

Marine Turtles and Sharks (Whale Sharks)

Marine fauna like turtles and whale sharks that are present in shallow waters or surface waters are susceptible to vessel strike due to their proximity to the vessel (hull, propeller or equipment), presence at the surface (breathing, basking etc) and their limited ability to avoid vessels.

Whale sharks may be behaviourally vulnerable to boat strike. They spend a significant amount of time feeding in surface waters (DEH 2005; Norman 1999) and scars have been observed on several whale sharks that have likely been caused by boat collision (DEH 2005). There have also been several reports of whale sharks being struck by bows of larger ships in other regions where whale sharks occur (Norman 1999).

Marine birds

Should listed or migratory bird species transit the Operational Area, the worst-case consequence of a bird strike with a helicopter would be a fatality of individuals with no lasting effects to populations.

Sensitive Receptor	**Impact description**
Marine mammals	The likelihood of vessel/ whale collision being lethal is influenced by vessel speed: the greater the speed at impact, the greater the risk of mortality (Laist *et al*. 2001, Jensen and Silber 2003). Vanderlaan and Taggart (2007) found that the chance of lethal injury to a large whale as a result of a vessel strike increases from about 10% at 4 knots to 80% at 15 knots. Cetaceans demonstrate a variety of behaviours in response to approaching vessels (attributed to vessel noise), including longer dive times and moving away from the vessel's path with increased speed (Baker and Herman, 1989; Meike *et al*., 2004). These behaviours may also contribute to reducing the likelihood of a vessel strike.

Sensitive Receptor	Impact description
	Four listed threatened and migratory species of cetacean potentially occur or have habitat in the Operational Area: the sei whale, blue whale, fin whale and humpback whale. There are no known key aggregation areas located within or immediately adjacent to the Operational Area; with the Pygmy blue distribution BIA the nearest at about 64km away. The likely worst-case consequence from a support vessel strike to a marine mammal would be the fatality of a single adult, but no effect to populations. With the controls implemented to reduce likelihood of impacts to marine mammals, potential disturbances are expected to be ***Minor*** – *Minor effect; death of individuals.*
Marine reptiles	Turtles are susceptible to vessel strikes when resting on the surface and surfacing to breathe. While turtles typically avoid vessels by rapidly diving, their response varies significantly in relation to the speed of the vessel and the activity of the turtle. Hazel et al. (2007) suggested that higher vessel speed is more likely to cause impacts in shallow waters where turtles are abundant and the success of avoidance behaviour is a factor of the response time available (i.e. visual observation distance/ vessel speed). Six species of listed threatened and migratory marine turtle were identified as potentially occurring in, or having habitat in the Operational Area; loggerhead, green, leatherback, hawksbill, olive ridley/Pacific ridley and flatback turtles (Section 3). Marine turtles are predominantly oceanic species except in the nesting season when they come ashore. There are no shorelines near the Operational Area, but turtles may transit the Operational Area to forage on nearby shoals with the closest nesting areas 92 km away (green turtle, Cartier Island). Vessel strike is an identified impact within relevant conservation and recovery plans for marine turtles. However, vessel strikes are unlikely in the Operational Area where vessels are travelling at low speeds. The worst-case consequence was assessed as the potential mortality of an individual adult but no effects on the population size at either a local or regional scale i.e. ***Minor*** *- Minor effect; recovery in weeks to months; death of individuals.*
Whale sharks	Although the Whale shark's skin is thicker and tougher than other shark species, the species may be more vulnerable to boat strike as they spend a significant amount of time close to the surface (DEH 2005a). The most northern part of whale shark foraging BIA overlaps the Operational Area. However, only occasional individuals are expected to occur as there are no Whale shark aggregations (such as the Ningaloo Reef aggregation) within the region. The worst-case consequence was assessed as **Minor** due to the potential mortality to an individual adult – *Minor effect; recovery in weeks to months; death of individuals.*
Seabirds.	Helicopter movements have the potential to affect birds through direct strike, however, considering the high visibility and noise levels associated with helicopter movements, birds are expected to avoid collisions. Flights occur in the daylight and not within major roosting areas, thereby reducing potential interactions and subsequent impacts. Collisions are therefore assessed as **Minor** due to the potential mortality to individual adults– *Minor effect; recovery in weeks to months; death of individuals).*
Likelihood assessment	
Unlikely	The Drilling Activities support vessels typically travel at speeds under 14 knots during most supply runs as this represents the most economical speed. On rare occasions, higher speeds may be used during urgent deliveries. Supply vessel speeds within the Operational Area when approaching the MODU are low and are required to be less than 5 knots within the 500 m PSZ. Hence the chance of a vessel-cetacean collision resulting in lethal outcome is reduced.

Sensitive Receptor	Impact description	
	Due to the general low vessel speeds, warning noise of helicopters and lack of any significant bird or cetacean/reptile aggregations nearby, the chance of a vessel collision with marine fauna and bird strikes resulting in a lethal outcome is reduced as individuals are expected to take avoidance behaviour. Worst case risks are on an individual level and the risk ranking with controls in place (Section 7.2.3) was assessed as ***unlikely***.	
Consequence	**Likelihood**	**Ranking**
Minor	Unlikely	Low

7.2.3 Environmental performance

Hazard		**Interaction with fauna**		
Performance outcome		**No death or injury to EPBC Act listed marine fauna due to activities in the Operational Area**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
095	Potential for collision with marine fauna reduced by vessels operating at speeds aligned with Montara Marine Facility Manual (MV-90-PR-H-00001)	Vessels operating within the PSZ must not exceed a speed of five (5) knots.	Vessel Masters provided and required to operate in accordance with the Montara Marine Facility Operating Manual – Sign-off sheet for completed by Vessel Master.	Vessel Master
096	Competency and Training Management System [JS-60-PR-Q-00014] provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability	Online induction includes information on speed limits in the PSZ and requirements on interacting with marine fauna	Induction Records (Vessel Masters)	HR Manager
097	Marine fauna collisions reported to National Ship Strike Database	Any vessel collision with a whale in the operational area is submitted to the National Ship Strike Database at: https://data.marinemammals.gov.au/report/shipstrike Death or injury to EPBC Act listed marine fauna (including cetaceans or whale sharks) from vessel collision are recorded/reported to NOPSEMA and DoEE in line with regulations	Vessel collision incident report Database entry number	HSE Manager

7.2.4 ALARP assessment

Based on the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk risk of fauna strike to ALARP. The residual risk ranking for this potential impact (minor) is considered Low. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.				
Rejected control	**Hierarchy**	**Practicable**	**Cost Effective**	**Justification**
Removal or reduce frequency of vessels and helicopter use	Eliminate	No	No	Vessels and helicopters are required during drilling activities and there are no practicable alternatives. The potential for interaction between vessels and fauna cannot be eliminated, however the risk is low given the location, low volume of vessel activity and low speeds and helicopter noise acts as a deterrent.
Reduce or remove vessel and helicopter use during key sensitive periods	Isolation	No	No	Reducing or removing vessel and helicopter activities during known migration periods of marine fauna is not a viable option as these activities are necessary for the safe and efficient operation of the MODU all year round.
Use of marine fauna observers on all vessels to identify fauna close to vessels	Administrative	No	No	Vessel Masters will complete an environmental induction which includes the applicable requirements. The introduction of a specialist marine fauna observer is unlikely to increase detection and the additional cost is considered grossly disproportionate given the low vessel speeds reduce the potential for impacts on marine fauna.

7.2.5 Acceptability assessment

The potential impacts of helicopters and vessels on marine fauna during the operation are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy & management system compliance	Jadestone’s HSE Policy objectives are met. Section 8 demonstrates that Jadestone’s HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholder & reputation	Stakeholder consultation has been undertaken (Section 4), and no stakeholder concerns have been raised with regards to impacts from vessel/ helicopter operations on sensitive receptors.
Environmental context & ESD	The Operational Area overlaps a small area at the northern end of the Whale shark BIA. Risks to megafauna is considered low and acceptable as vessels will travel at low speeds within the Operational Area; minimal vessel activity in the area, and risk of mortality from a low-speed vessel strike is low. In this way, aspects of the EPBC Regulations 2000, Division 8.1 – Interacting with Cetaceans – are addressed. The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 7.2.2 describes the consequences and likelihood of vessel strike; • Preservation of critical habitats: location remote from Protected Areas and

	aggregations of most vulnerable cetaceans, dugongs and reptiles with proposed management minimizing residual risk to individuals; • Assessment of key threats as described in species and Area Management /Recovery plans: see 'Conservation and Management Advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan ranks vessel strike to cetaceans, dugongs, turtles within BIA as a 'high risk of significant impact'. No specific actions were raised; hence the management controls are considered sufficient to maintain a residual consequence ranking of negligible; and • Principles of ecologically sustainable development ESD: as worst-case consequences will not impact population levels of protected species, no impacts on biodiversity or ecosystem integrity are predicted.
Conservation and management advice	**Recovery Plan for Marine Turtles in Australia, (EA 2003).** The Recovery Plan for marine turtles in Australia (DoEE, 2017) identifies the following risk - Vessel Disturbance. It requires that risk of vessel strikes is evaluated and, if required, appropriate mitigation measures are implemented. This EP and the proposed controls are consistent with this advice. **Conservation Management Plan for the Blue Whale, 2015-2025.** The Management Plan identifies the following risk - 'Vessel Disturbance". It requires that risk of vessel strikes is evaluated and, if required, appropriate mitigation measures are implemented. This EP and the proposed controls are consistent with this advice. **Conservation Advice for Humpback Whales (*Megaptera novaeangliae*) DoE 2015.** The Conservation Advice identifies the following risk' Vessel Disturbance'. It requires that risk of vessel strikes is evaluated and, if required, appropriate mitigation measures are implemented. This EP and the proposed controls are consistent with this advice. Jadestone has had regard to the representative values of the protected areas within the RISK EMBA, and the respective management plans and other published information. Interactions with fauna may have a minor impact on any of the social and ecological objectives and values, of AMPs, or state marine parks. However, with controls in place to minimise the likelihood (to protect protected fauna), this is considered consistent with the objectives of the conservation advice or management plans (Appendix B) and considered Acceptable.

7.3 Unplanned Release of Solids

7.3.1 Description of hazard

Solid waste release	An unplanned release of solids to the environment has the potential to occur from: • Waste overboard from MODU or supply vessel operations (e.g. overfull and/or uncovered bins); • Lifting resulting in dropped objects; and • Accidental discharge of dry bulk products (e.g. during supply transfer).

7.3.2 Impacts and risks

Solids overboard has the potential to pollute marine habitats and injure or kill fauna through entanglement, ingestion or exposure (Ryan et al. 1988). The effects are dependent on the size and material.

Sensitive Receptor	Impact description	
Marine fauna	Release of hazardous solid wastes may result in the pollution of the immediate receiving environment, leading to detrimental health impacts to marine fauna through ingestion or absorption by individual fish, cetaceans, marine reptiles and seabirds. Foraging behaviour in turtles has resulted in turtles mistaking plastic for jellyfish (Mrosovsky et al. 2009). Marine fauna (including seabirds) encountered within the Operational Area are expected to be limited to small numbers of transient individuals as there are no known critical habitats within the Operational Area for EPBC listed species. The Operational Area overlaps with the northern section of the whale shark foraging however, only low numbers are likely to be present. The accidental release of waste may result in injury or even death to individuals but is not expected to result in a threat to population viability; hence the consequence to marine fauna was assessed as ***Minor*** given the likely objects dropped overboard, the transient nature of marine fauna at this location and lack of foraging habitat within the Operational Area.	
Benthic habitats	Benthic habitats have the potential to be impacted by accidental spills of solids resulting in possible damage to or loss of soft sediment communities within the area affected. The potential impact may be short term to long term depending on the waste type, degradation rate, and volume. The extent of physical seabed damage will be limited to the size of an inert dropped object and given the size of standard materials lifted overboard, impacts are expected to be very localised. There are no sensitive or unique marine habitats in the Operational Area and the diversity and coverage of epibenthos is low (ERM 2011), benthic communities are expected to rapidly recolonise any damaged area (Currie and Isaac, 2004). Given the relatively small footprint of any dropped object, the widespread distribution and abundance of benthic communities within and beyond the Operational Area, the consequence to benthic communities would be a highly localised, negligible, and reversible change to a very small proportion of the overall benthos. The consequence of an unplanned release of solid waste on benthic habitats was assessed as ***Minor***.	
Other users	Buoyant solid waste accidentally released to the marine environment may create a navigational hazard to other marine users. The consequence of an unplanned solid waste on other marine users was assessed as ***Negligible*** given the likely objects that could be dropped overboard.	
Likelihood assessment		
Likely	The control measures and checks will ensure that the risks of dropped objects, lost equipment or release of solid waste to the environment has been minimised. The likelihood of transient marine fauna occurring in the Operational Area is limited. As such, the likelihood of releasing solids to the environment resulting in a negligible consequence is considered ***likely***.	
Consequence	**Likelihood**	**Ranking**
Minor	Likely	Medium

7.3.3 Environmental performance

Hazard		Unplanned discharge of solid waste		
Performance outcome		**Zero unplanned discharge of solid wastes into the marine environment**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
098	Waste generated during operations will be managed in accordance with MARPOL 73/78 Annex V Regulation 9 and the vessels' and MODU Waste Management Plan as required	Solid waste materials are stored in fit for purpose storage containers and/or lifting skips, labelled and equipped with lids / covers to prevent loss of material during storage and handling.	Garbage Record Book shall be maintained on all facilities in accordance with MARPOL 73/78 Annex V Regulation 9	OIM Vessel Masters
099		Hazardous solid wastes will be managed in accordance with Marine Orders – Part 94 (Marine Pollution Prevention – Packaged Harmful Substances), Navigation Act 2012 and Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (Part III) requirements, and Environmental Protection Regs (Controlled Waste)	A waste register will be maintained to show that hazardous wastes are being collected and returned onshore for disposal	
100	MODU and vessel lifting procedures align with Montara Lifting Operations Procedure (MV-00-PR-F-00006) to prevent dropped loads	All personnel involved with lifting equipment operations and maintenance receive adequate training and are competent appropriate to their level of responsibility	MODU training records and Competency matrix	
101		JSA completed for all lifts under PTW system, and all lifts completed with certified lifting equipment rated for the task	Completed PTW documentation	
102		A Lift Plan completed for Complex and/or Engineered Lifts	Approved Lift Plan	

7.3.4 ALARP assessment

On the basis of the impact and risk assessment process completed, Jadestone considers the control measures described above are appropriate to manage the risk of unplanned discharges of solid waste to ALARP. The residual risk ranking for this potential impact is considered **Medium** based on a likelihood of **Likely** and consequence of **Minor**. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.

Rejected control	Hierarchy	Practicable	Cost Effective	Justification
No use of hazardous materials or production of wastes	Eliminate	No	No	Solid wastes produced onboard are disposed of onshore and are not discharged to the marine environment, therefore there is no planned impacts to the marine environment. Complete elimination of hazardous solids is not feasible; therefore, the risk from unplanned releases remains, but consequences are negligible.
Substitute any hazardous chemical use with non-hazardous chemical use	Substitute	No	No	Where appropriate, selection of chemicals or materials to achieve low or no environmental effect is made. Some hazardous waste is unavoidable from the use of batteries, lights etc. and therefore there are limited opportunities for substitution.
None identified	Engineering	N/a	N/a	All waste bins have lids and wastes are segregated at the time of disposal. No other engineering controls were considered.
None identified	Administrative	N/a	N/a	None identified. Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, and certified equipment.

7.3.5 Acceptability assessment

The potential impacts of unplanned discharges of solid wastes during the activity are considered 'Broadly Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.

Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.
Stakeholder & reputation	Stakeholder consultation has been undertaken (Section 4), and no stakeholder concerns have been raised with regards to impacts from solid waste generation or unplanned discharges on sensitive receptors.
Laws, standards and industry best practice	Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, certified equipment. No further controls were identified. The APPEA Code of Environmental Practice (CoEP) (2008) objectives are met with regards to all solid wastes, chemicals and other wastes are disposed of or recycled at appropriate facilities in accordance with legislative requirements and agreed procedures.
Environmental context & ESD	Benthic habitats have the potential to be impacted with solid wastes resulting in potential loss of soft sediment communities and harm to marine fauna. If impacted, benthic habitats and associated biota are well represented in the region and there are no known areas of sensitive habitat within the area that may be affected by accidental release of solid waste. Marine fauna

	can become entangled in waste plastics, which can also be ingested when mistaken as prey potentially leading to injury or death. Generally, no toxic effects are expected from non-hazardous solids. The potential scale of environmental harm from accidentally discharged solid waste is small in comparison to the vast size of soft substrata habitats spanning the region and the transient nature of marine fauna that may be present in the Operational Area. The potential impact is considered acceptable after consideration of: • Potential impact pathways: consequences and likelihood of pathways are assessed in section 7.3.1 and 7.3.2; • Preservation of critical habitats: the drilling location is remote from Protected Areas and aggregations of protected and migratory species that could be impacted above 'negligible' from solids discharges; • Assessment of key threats as described in species and Area Management /Recovery plans: see 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan considers marine debris (such as entanglement and ingestion) a threat to turtles, dolphin, dugong, and various KEF. The proposed management controls are aligned with minimizing this risk; and • Principles of ecologically sustainable development ESD; with the proposed management controls, any worst-case impacts would not affect population levels, hence no impacts to biodiversity or ecosystem integrity are predicted.
Conservation and management advice	Marine debris is identified as a potential threat to a number of marine fauna species in relevant Recovery Plans and Conservation Advice: • Approved Conservation Advice for *Megaptera novaeangliae* (humpback whale); • Conservation management plan for the blue whale: A recovery plan under the EPBC Act 1999 2015-2025; • Conservation advice *Balaenoptera borealis* (sei whale); • Conservation advice *Balaenoptera physalus* (fin whale); • Recovery Plan for Marine Turtles in Australia; and • Recovery Plan for the white shark (*Carcharodon carcharias*). The controls implemented demonstrate that the activity will be conducted in a manner that reduces marine debris and therefore the activity will be conducted in a manner that is acceptable under the relevant Recovery Plans and Approved Conservation Advice to prevent accidental release of non-hydrocarbon solids (marine debris). The limited quantities associated with this event indicate that even in a worst-case release of solid waste, fatalities would be limited to individuals and is not expected to result in a decrease of the local population size for any of the species identified.

7.4 Unplanned Release of (Non-Hydrocarbon) Liquids

7.4.1 Description of hazard

Unplanned discharge of liquids	The MODU is designed to have no direct discharge to the marine environment as there are no direct drainage points. However, non-hazardous and hazardous liquids and chemicals are routinely transported to and from, stored and used aboard the MODU from support vessels, therefore, there is potential for these to be accidentally spilled to the marine environment. The largest instantaneous volume of a non-hydrocarbon hazardous liquid that could be inadvertently spilt is one mud pit, a total volume of approximately 80–120 m^3. The maximum volume of non-hydrocarbons (such as solvents and detergents) released from the deck is likely to be small and realistically limited to the volume of individual containers (e.g. IBCs/ drums

	etc i.e. ~1 m^3). Chemicals, for example solvents and detergents, are typically stored in small containers of 5 – 25 L capacity and used in areas that are bunded. Leaks and spills of non-hydrocarbon liquids are typically contained within the immediate storage/ use area on board. Hazardous industrial liquid wastes may include radioactive materials, paint and thinners, waste oil, proprietary cleaning agents and chemicals for chemical injection. Dropped objects are discussed under Section 7.3. Accidental liquid releases may occur during any season at any time given the duration of Drilling Activities Some chemicals may persist in the marine environment.

7.4.2 Impacts and risks

Should non-hydrocarbon liquids be spilled to the marine environment, the potential impact pathways to marine fauna and benthic communities are:

- Ingestion or physical contact with chemical compounds within the water column or sediment; and
- Accumulation and biomagnification of chemicals within the food chain.

The potential exposure to non-hydrocarbon liquids would be dependent on the type, volume of discharge, concentration, toxicity, persistence and bioaccumulation potential. Also, exposure may vary depending on the dilution and dispersion potential of the chemical, or whether the chemical floats/sinks to the sea floor. Hazardous liquids have the potential to impact local water quality which in turn, may impact on the health and reproductive development of marine fauna (e.g. pelagic fish, cetaceans, marine reptiles and seabirds) and have a flow-on effect through the whole ecosystem including socio-economic receptors.

For the purposes of this impact assessment, evaluation of the worst-case credible release scenario, that of 120 m^3 of water-based mud (WBM) accidentally discharged to the marine environment, has been evaluated.

Sensitive Receptor	Impact description
Water Quality	If WBM is discharged to the sea in this accidental scenario, it is expected that the plume will largely disperse at sea surface due to the fine particles present in the liquid (for noting, the discharge of WBM from the mud pit does not contain cuttings, and therefore the discharge behaviour in the marine environment is slightly different to the case of planned drilling discharge scenarios considered in Section 6.5. The released mud within the upper water column will disperse with the prevailing currents away from the release point and be diluted rapidly in the receiving waters. In well-mixed sea waters, WBM can be expected to be diluted by 100-fold within 10 m of the discharge and by 1,000-fold after a transport time of about 10 minutes at a distance of about 100 m from the release point (Neff, 2005). Most drilling mud ingredients are low toxicity, non-toxic or used in such small amounts within the WBM that they do not contribute to its toxicity. Potential impacts will include a temporary and highly localised increase in turbidity and decline in water quality with recovery likely within 24-hours. The potential for toxicity to marine fauna is limited due to the temporary exposure and low toxicity resulting from the rapid dilution in the marine environment. The consequence of an unplanned release of non-hydrocarbon liquids on water quality was assessed as ***Negligible*** given the likely volumes and types of liquids and the rapid dilution and dispersion that would occur, and full recovery of water quality predicted within days.
Benthic Habitat	Reduction in water quality is expected to occur for a very short duration; as such any affects to benthic habitats are expected to be localised and temporary, given the water depth and the high dispersion of any potential marine pollutant in an open-ocean environment. There is no emergent or inter-tidal habitat that could be impacted by a surface spill and the benthic habitat is predominately soft sediments. Any spilled material is unlikely to reach demersal species or benthic habitats on the seabed at impact concentrations. Sub-lethal or

Sensitive Receptor	Impact description
	lethal effects from unplanned discharges at the seabed on marine fauna, is considered ***unlikely*** given the expected low concentrations and short exposure times. The consequence of an unplanned release of non-hydrocarbon liquids was assessed as ***Negligible -*** based on the likely volumes and types of liquids, the low sensitivity of the benthic habitat and the rapid dilution and dispersion that would occur.
Marine Fauna	Liquid discharges may cause negligible short-term water quality degradation (see above) and as a result a possible alteration to marine fauna behaviour. The changes to water quality that may result could potentially lead to short-term impacts on marine fauna (e.g. pelagic/benthic fish, epifauna, cetaceans, marine reptiles and seabirds), with chronic impacts not expected owing to the short exposure times likely. The susceptibility of marine receptors will be dependent on the nature of the liquid released, toxicity and other chemical properties such as biodegradation and bioaccumulation potential. The Operational Area overlaps the Whale shark BIA but aggregations such as those found in Ningaloo are unlikely. Potential impacts to water quality are likely to be limited to the immediate vicinity (tens to hundred metres) of the release point and are not expected to affect overall population viability of these protected species. Contaminated fish stocks and filter feeders such as oysters and mussels can pass on harmful chemicals to humans, if contaminated organisms are consumed. Potential impacts are varied depending on characteristics and volumes of the spilt chemical and the sea state, and, are likely to be limited to the immediate vicinity and unlikely to affect overall population viability or have economic impacts. The consequence of an unplanned release of non-hydrocarbon liquids on marine fauna was assessed as ***Negligible*** given the likely volumes and types of liquids and the rapid dilution and dispersion that would occur in the Operational Area.
Likelihood assessment	
Rare	The control measures and checks proposed will ensure that the risks of unplanned releases of liquids to the marine environment are minimised. The likelihood of transient marine fauna occurring in the Operational Area is limited. Given the controls in place, the likelihood of releasing non-hydrocarbon liquids to the environment resulting in a negligible consequence is considered ***rare*** based on the presence of bunding around non-hydrocarbon liquid containers, and drainage systems and volumes /types of liquids aboard.

Consequence	Likelihood	Ranking
Negligible	Rare	Low

7.4.3 Environmental performance

Hazard		Unplanned discharge of solid waste		
Performance outcome		**Zero unplanned discharges into the marine environment**		
ID	**Management Control**	**Performance standards**	**Measurement criteria**	**Responsibility**
103	MODU and vessel chemical management aligns with requirements of the Jadestone Hazardous Substances & Dangerous Goods Standards (JS-70-STD-I-00035) and Marine Order 94	Any hazardous liquid storage on deck must be designed and maintained with at least one barrier (i.e. form of bunding) to contain and prevent deck spills entering the marine environment.	Pre-start inspection	HSE Manager OIM Vessel master
104		Safety data sheet (SDS) available for all chemicals to aid in the process of hazard identification and chemical storage and disposal management	Pre-start inspection	
105		Chemicals managed in accordance with SDS in relation to safe handling and storage, spill-response and emergency procedures, and disposal considerations	Pre-start inspection	
106	MODU and Vessels are compliant with Marine Order 93 to prevent any contaminating liquids and chemicals from entering the marine environment	Vessels and MODU chemical management is compliant with Marine Order 93: • Having a valid International Pollution Prevention Certificate; • Reporting marine incidents to AMSA - An incident involving a discharge from a vessel of a mixture containing a liquid substance, carried as cargo or as part of cargo in bulk, must be reported to AMSA via AMSA Form 196 (Harmful Substances Report form) within 24-hours; • Enacting a compliant Shipboard Marine Pollution Emergency Plan; • Using a compliant Cargo Record Book; and • Washing vessel tanks in accordance with the Pollution Prevention Act.	Valid International Pollution Prevention Certificate Valid SOPEP/SMPEP Cargo Record Book	
107	Spill kits on the MODU are present in areas of high spill risk	Spill kits are: • Located near high risk spill areas. • Intact, clearly labelled and contain adequate quantities of absorbent materials with waste managed as per MODU Waste Management Plan	Pre-start inspection	

7.4.4 ALARP assessment

Jadestone considers the control measures described above are appropriate to manage the risk of unplanned discharges of non-hydrocarbon liquids to ALARP. The residual risk ranking for this potential impact is considered **Low** based on a likelihood of **Rare** and consequence of ***Negligible***. Additional controls considered but rejected are detailed below. No further controls are required and therefore ALARP has been demonstrated.				
Rejected control	**Hierarchy**	**Practicable**	**Cost effective**	**Justification**
No use of hazardous materials or production of wastes	Eliminate	No	No	Liquid wastes produced onboard are disposed of onshore and are not discharged to the marine environment, therefore there is no planned impact to the marine environment. Complete elimination of hazardous materials, drilling muds and waste is not feasible; therefore, the residual risk of unplanned releases remains but is low.
Substitute any hazardous chemicals use with non-hazardous chemicals	Substitute	No	No	Where appropriate selection of chemicals or materials to achieve low or no environmental effect is made. Some hazardous liquids are unavoidable such as corrosion inhibitors and biocides, with limited opportunities for substitution.
None identified	Engineering Isolation	N/a	N/a	All waste bins have lids and wastes are segregated at the time of disposal. No other engineering controls were considered. Safeguards will be implemented as required, by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and MARPOL Annexures I, II and III. Such safeguards include designated storage and handling areas, correct stowage, accurate labelling and marking, SDS information, spill clean-up equipment and containment (e.g. bunds). No other potential controls were identified. The Activity is remote from sensitive receptors and coastlines.
None identified	Administrative	N/a	N/a	Maintenance management system implemented, compliance with relevant and appropriate MARPOL and legislative requirements, certified equipment. No further controls were identified.

7.4.5 Acceptability assessment

The potential impacts of unplanned discharges of non-hydrocarbon liquids during the activity are considered 'Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.	
Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of meeting environmental management requirements for this activity.

Stakeholder & reputation	Stakeholder consultation has been undertaken (Section 4), and no stakeholder concerns have been raised regarding impacts from unplanned discharges of non-hydrocarbon liquids.
Laws, standards and industry best practice	The APPEA Code of Environmental Practice (CoEP) (2008) principles are met with regards to complying with relevant laws and regulations, and meeting industry's objective to maintain a social licence to operate. MARPOL requirements are internationally recognised in the shipping industry to manage the potential for pollution.
Environmental context & ESD	While unplanned liquid discharges could occur from the activity, the risk assessment process indicates credible discharges would have a temporary and localised impact on marine waters and will not result in significant impacts to marine fauna. The residual risk is considered acceptable after consideration of: • Potential impact pathways: Section 7.4.1 and 7.4.2 assesses the likelihood and consequences to water quality and marine habitats, flora and fauna from liquid spills; • Preservation of critical habitats: the location is remote from Protected Areas and aggregations of sensitive receptors; • Assessment of key threats as described in species and Area Management /Recovery plans: see 'Conservation and management Advice' below; • Consideration of North-West Bioregional Plan; the Plan regards chemical pollution/ contamination from oil and gas activities and vessels as a pressure on biodiversity, ecosystem function or integrity, social amenity or human health. This EP is aligned with the objectives of the NW Bioregional Plan by minimizing the risks of spills; and • Principles of ecologically sustainable development: the likelihood and consequence of the worst-case credible liquids spill is not predicted to impact above individual marine fauna or localized habitats; hence biodiversity and ecosystem integrity are not at risk.
Conservation and management advice	Minimising chemical discharge is an action identified by the Recovery Plan for Marine Turtles in Australia 2017-2027. This requires that best practice industrial management is implemented to minimise impacts to marine turtle health and habitats. A marine chemical spill is unlikely to result in population effects due to the controls in place for secure storage and on-board clean-up of spills, transient nature of marine fauna and the remote open ocean environment. There are no relevant management requirements in the recovery plan to implement for this hazard.

7.5 Unplanned Release of Hydrocarbons – Scenarios

7.5.1 Credible spill scenarios

Hydrocarbon spill scenarios due to an unplanned event resulting in a Montara or Skua crude oil spill to the marine environment were identified were identified during the Drilling Activities ENVID workshop. **Table 7-2** summarises the credible scenarios.

To determine the maximum worst-case credible spill volumes for each identified spill scenario, Jadestone has considered the AMSA (2015) guideline: *Technical guideline for preparing contingency plans for marine and coastal facilities* and NOPSEMA Bulletin #1 Oil Spill modelling (April 2019). Jadestone considers that in adopting the AMSA guideline, the estimated spill volumes are appropriately conservative given that for the scenarios presented, there are multiple barriers/ controls in place; meaning the total volumes evaluated are much greater than what would be released in the event of a spill.

Table 7-2: Credible hydrocarbon spill scenarios to the marine environment

Subsea release Scenario	Maximum Credible Spill Volume	Duration
Rupture of subsea flowline	1,700 m^3	1 day
LOWC H6 at WHP subsea Montara Crude	234,498 m^3	77 days
LOWC Skua-12	124,976 m^3	77 days
LOWC Skua-10	57,235 m^3	77 days
LOWC H3	57,235 m^3	77 days
Surface release Scenario	**Maximum Credible Spill Volume**	**Release duration**
LOWC H6 topside at WHP* Montara Crude	234,682 m^3	77 days
Diesel	At surface - vessel collision	906 m^3 released over 5 hours

*Re-analysed data from modelling previously done for H-5 also at WHP location for slightly larger volume and surface discharge, (RPS, 2017) for 236,349m^3 (77 days)

7.5.2 Credible worst-case scenarios

From the scenarios listed in Table 7-2, stochastic modelling was used to determine the greatest extent for each fraction of hydrocarbon (surface, shoreline, dissolved and entrained) to form the conservative combined RISK EMBA for all seasons for all identified scenarios (See Appendix B). The H6 modelling results are based on modelling undertaken in 2017 at the same location for the drilling of H5 and rerun for Jadestone. This previous modelling was for a larger surface release of 236,349 m^3.

The LOWC scenario from surface release at well H6 is the greatest surface release for floating and shoreline oil loadings. The LOWC scenario from the H6 subsea release is the greatest subsea release for the entrained oil and dissolved hydrocarbon fractions. The surface diesel spill from a vessel collision is the greatest diesel spill (refer Section 7.7). Therefore, the RISK EMBA represents the greatest possible extent of each fraction and has been used to identify all the relevant environmental receptors to inform the impact assessment.

7.5.3 Discounted scenarios

Refuelling of helicopters on the helideck of vessels or MODU/WHP was discounted as a credible spill scenario to the marine environment due to the high volatility of aviation fuel and that the refuelling system for helicopters is a fully self-contained system on the WHP. Also, dragged anchor or misplaced anchor scenarios are discounted as neither the vessels nor the MODU will be using anchors.

7.6 Worst Case Crude Oil Spills

7.6.1 Description of hazard

Crude oil release	A loss of well control during drilling or workover activities may occur resulting in a release of crude oil at sea surface or subsurface due to: • Catastrophic damage to the Montara wellhead platform and associated wells; • Loss of function downhole of safety critical equipment (loss of barriers); and • Damage to subsea well infrastructure (well valves, wellhead) or existing flowlines.

	Hydrocarbons may be released to the marine environment at either the WHP floor (sea surface), subsea wellheads/ infrastructure (seabed) or flowlines (Table 7-2). In a worst-case credible loss of well control scenario, large quantities of hydrocarbon (worst-case oil release 236,349 m^3 Montara crude) will be released to the marine environment until well control can be re-established.

7.6.2 Montara and Skua Characteristics

Two crude oil types were considered in the LOWC scenarios: Montara and Skua crude oils. The properties of these oils and their weathering behaviour are detailed in the OPEP (Appendices A5 and A6), in Section 2.7 of this EP and in Section 4.1 of the OPEP.

7.6.3 Modelling Approach

To determine the spatial extent of impacts from a potential crude oil spill (surface and subsurface) and the dispersion characteristics of the oil over time, modelling was completed by RPS (RPS 2017, 2018 and 2019). Spill modelling was performed using several simulated environmental conditions from two seasons (March to August, September to February) thus providing a range of realistic spill trajectories from which to determine the spatial extent of potential impacts and receptors which might be affected by a spill.

The quantitative hydrocarbon spill risk assessment evaluates three of the potential hydrocarbon spill scenarios due to LOWC (release scenarios for the well H-6 at surface and subsea, as well as the Skua-12 subsea well at seabed).

Oil spill modelling was undertaken using a three-dimensional oil spill trajectory and weathering model, SIMAP (Spill Impact Mapping and Analysis Program), which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces. With a number of different release scenarios resulting in different surface oil, entrained oil and dissolved aromatic hydrocarbon affected areas, the results for each hydrocarbon component and scenario were combined to create total RISK EMBA to accommodate the modelling results.

A summary of the modelling method is described below.

1. **Stochastic approach**: stochastic modelling was carried out using an historic sample of wind and current data for the 'study area' that spanned ten years (2008–2017, inclusive). For each season, a large number of replicate simulations (100) were modelled for each season (i.e. 200 simulations in total), each initialised at different, randomly selected points in time for that seasonal period and hence under a different time series of environmental conditions. This stochastic sampling approach provides an objective measure of the possible outcomes of a spill, because environmental conditions will be selected at a rate that is proportional to the frequency that these conditions occur over the study area. More simulations will tend to use the most commonly occurring conditions, while conditions that are more unusual will be represented less frequently.
2. **Contact thresholds**: oil spill models can track hydrocarbon concentrations of surface oil, entrained oil and dissolved aromatic hydrocarbons below biologically significant impact levels. Consequently, threshold concentrations are specified for the model to control what contact is recorded for surface oil and subsurface locations (entrained oil and dissolved aromatic hydrocarbons) to ensure that recorded contacts are for biologically meaningful concentrations. Thus, it is important to describe the thresholds used as the boundary of the EMBAs will be influenced by the thresholds set in the hydrocarbon spill modelling.

3. **Data generated**: during each simulation (of which there are 100 for each season), the model recorded the location (latitude x longitude x depth) of each of the particles (representing a given mass of hydrocarbon) on or in the water column, at regular time steps.

   The collective records from all simulations were then analysed by dividing the study area into a three-dimensional grid. For oil particles classified as being at the water surface, the sum of the mass in all hydrocarbon particles located within a grid cell, divided by the area of the cell provided an estimate of the concentration of oil in that grid cell, at each time step.

   For entrained and dissolved hydrocarbon particles, concentrations were calculated at each time step by summing the mass of particles within a grid cell and dividing by the volume of the grid cell. The concentrations of oil calculated for each grid cell, at each time step, were then analysed to determine whether concentration estimates exceeded defined threshold concentrations. The risks were then summarised as follows:

   - The probability of exposure at a location was calculated by dividing the number of spill simulations where contact occurred above a contact threshold at that location by the total number of replicate spill simulations. For example, if contact occurred at the location (above a contact threshold) 50 out of 100 simulations, a probability of exposure of 50 per cent is indicated; and
   - The minimum potential time to a shoreline location was calculated by the shortest time over which oil was calculated to travel from the source to the location in the replicate simulations.

4. **Probability contours**: the results were presented in terms of statistical probability maps based on the simulations considered, each generated under different environmental conditions. The contours of probability are not representations of a single spill event.

5. **Completion of modelling**: each of the 100 simulations was run for a period of three weeks allowing for the fate of dispersed hydrocarbons to be evaluated. Fate assessment stops once hydrocarbon concentrations fall below the defined contact thresholds. In this manner, the full extent of the spill scenario is assessed against the specified contact thresholds.

7.6.4 Exposure pathways and impact thresholds

To assess environmental effects from an unplanned hydrocarbon release, four separate hydrocarbon components that pose differing environmental risks were evaluated (refer Table 7-3):

- Surface hydrocarbons – hydrocarbons that are ‘on’ the water surface;
- Entrained hydrocarbons – hydrocarbon that is entrained ‘in’ the water;
- Dissolved hydrocarbons – the dissolved component of hydrocarbon in’ the water; and
- Shoreline accumulation – hydrocarbons that accumulate along shorelines.

Threshold concentrations for each of the three hydrocarbon phases were developed and applied to the modelling outputs to define the EMBA for each phase. A receptor (biological organism) was considered ‘affected’ by one of the phases as soon as the threshold for the phase at that location was exceeded (i.e. instantaneous impact approach).

The rationale for the selection of the thresholds was determined by review of the NOPSEMA Bulletin #1 guidance and contemporary scientific knowledge. Appendix F provides a summary of the contact thresholds applied, and represents a consistent, logical and robust approach in the selection of oil exposure values.

7.6.5 Modelling results of the LOWC scenarios

Modelling results for potential exposure to surface, water column and stranded hydrocarbons are described in Table 7-4 and depicted in Figures 7.1 to 7.5 below. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that Jadestone propose to have in place during the campaign to reduce volumes and/or prevent hydrocarbons from reaching sensitive areas.

Table 7-3: Summary of the contact thresholds applied in the hydrocarbon spill modelling

Floating oil (g/m^2)		Shoreline Oil		Entrained oil (ppb)		DAHs (ppb)	
1	Low (approximates range of socio-economic effects and establishes planning area for scientific monitoring)	100	Moderate (loading predicts area likely to require clean-up effort)	100	High (as appropriate given oil characteristics for informing risk evaluation)	70	Medium (approximates potential toxic effects)
10	Moderate (approximates lower limit for harmful exposures to birds and marine mammals)						

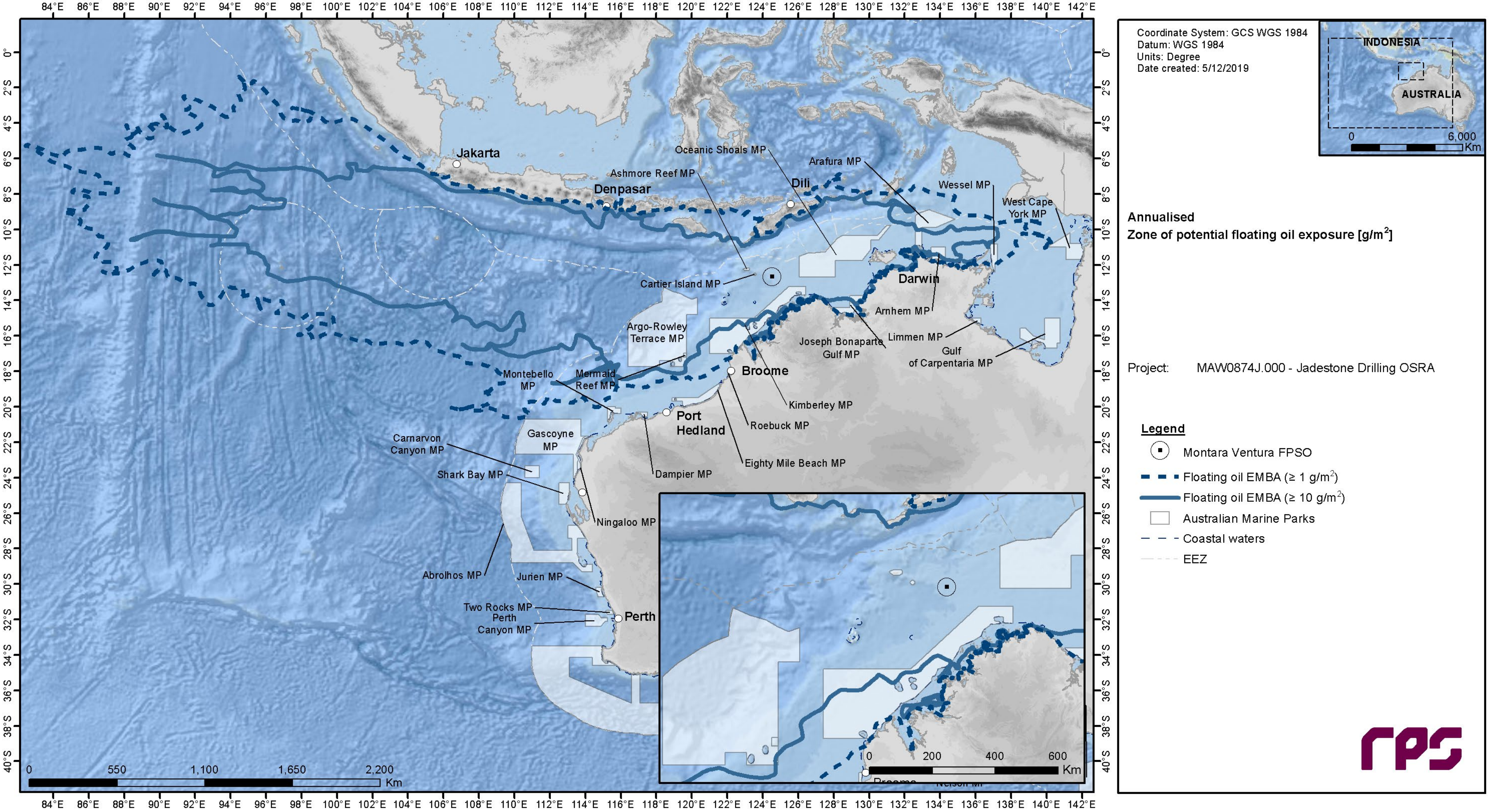


Figure 7-1: Predicted EMBA floating oil exposure resulting from worst case

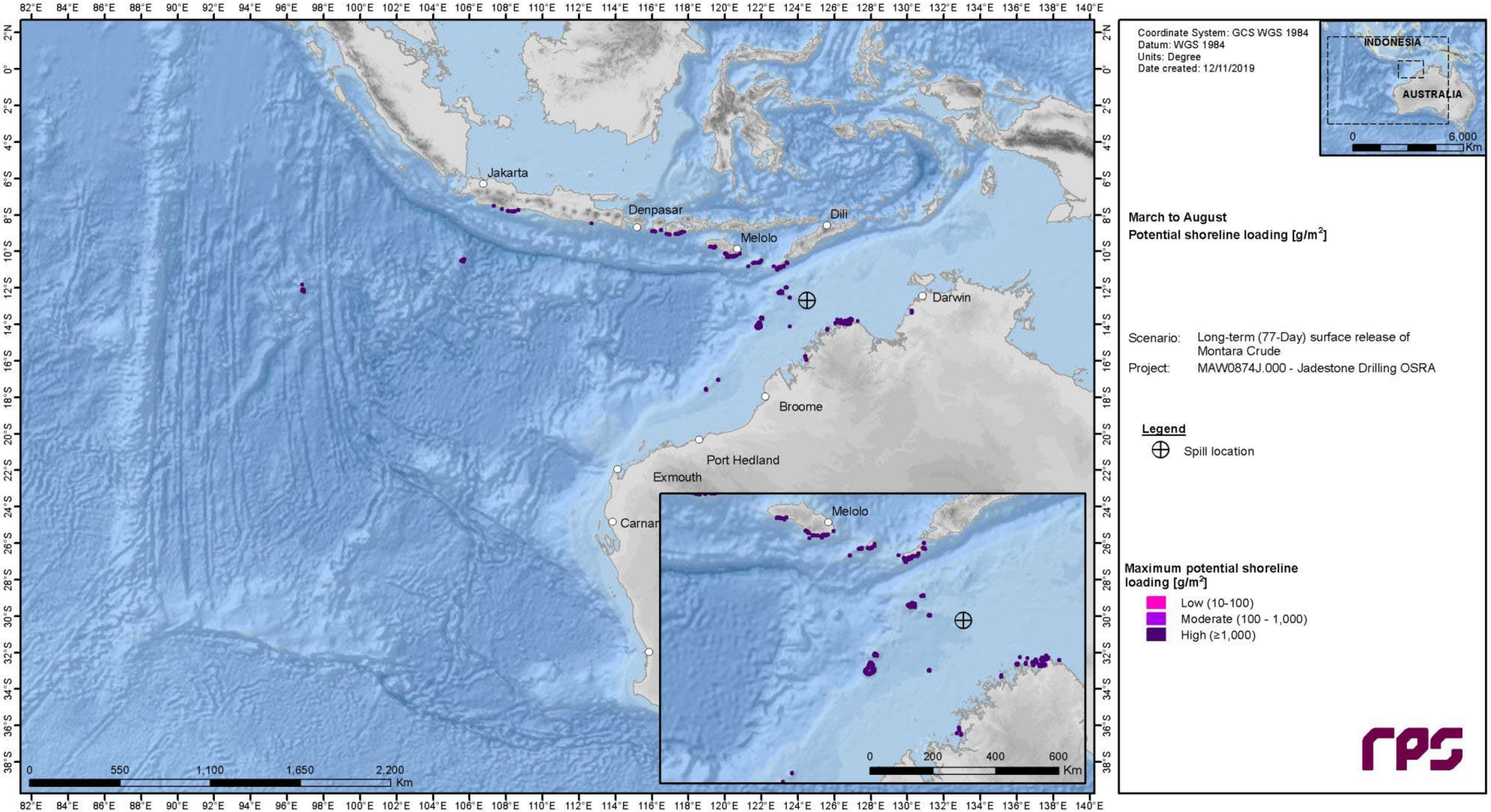


Figure 7-2: **Predicted EMBA potential shoreline oil loading resulting from worst case, March to August**

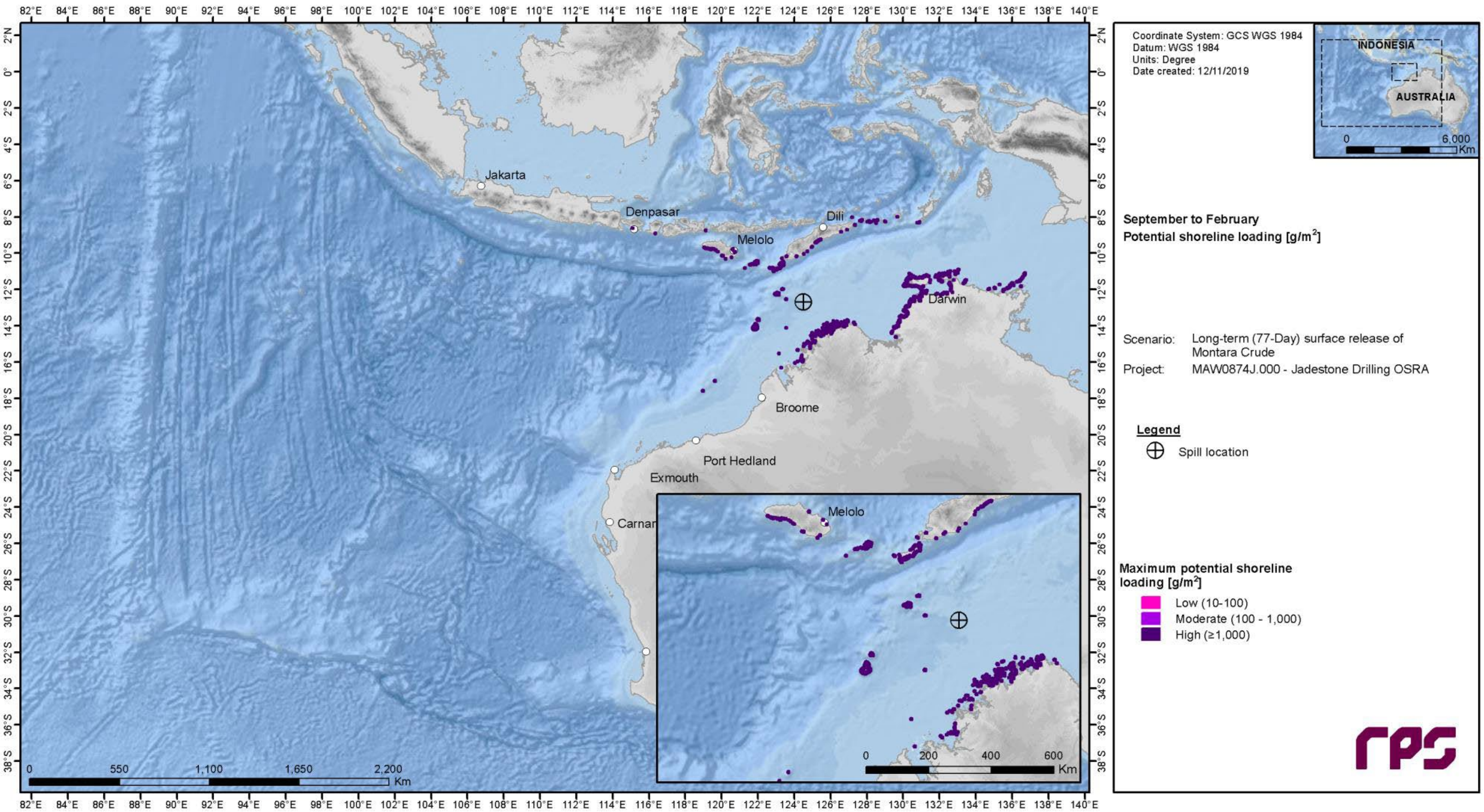


Figure 7-3: Predicted EMBA shoreline loading resulting from worst case, September to February

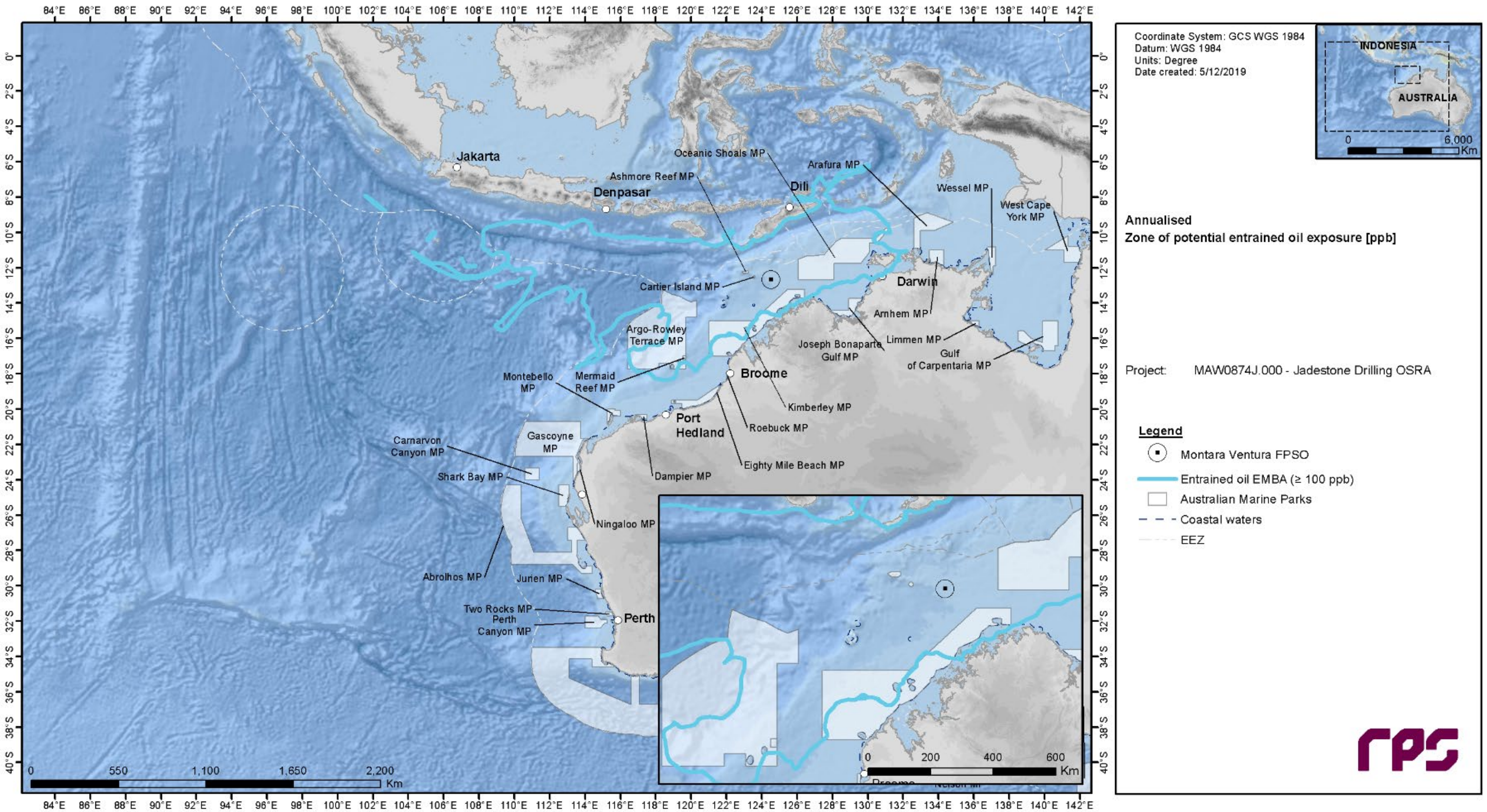


Figure 7-4: Predicted EMBA of potential entrained oil exposure resulting from worst-case.

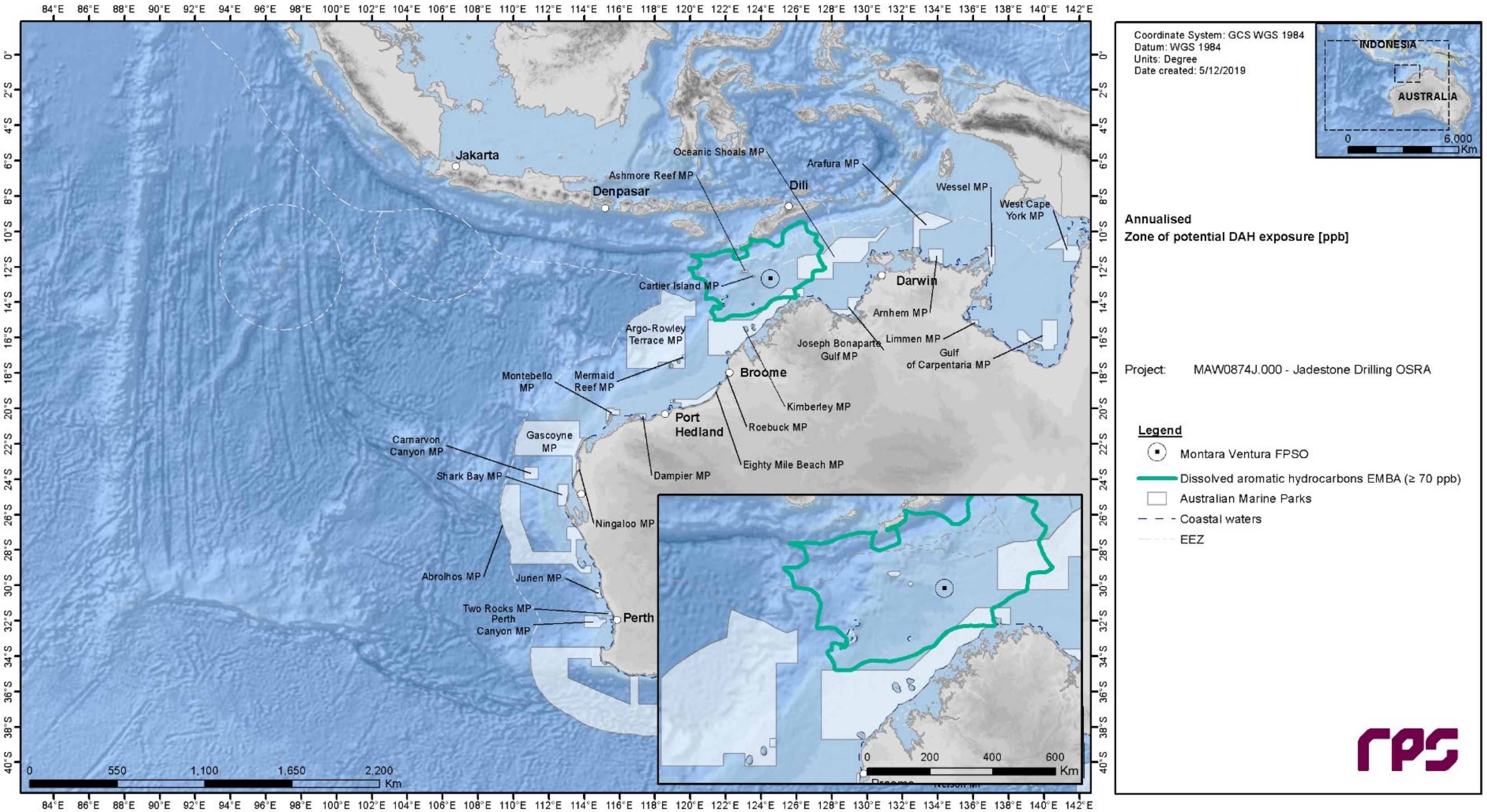


Figure 7-5: **Predicted EMBA of dissolved oil exposure resulting from worst-case.**

Table 7-4 Worst case crude blow out modelling results summary

Scenario	**Montara crude (236,349 m^3), H5 surface spill. Source: RPS 2019**
Surface	Results of the worst-case modelling indicate that surface sheens of floating oil (<1 g/m^2) may pass over the following sensitive receptors: • Ashmore Reef, Cartier Island and surrounding Commonwealth waters KEF after 3 days; • Oceanic Shoals AMP after 6 days; and • Seringapatam Reef and Commonwealth waters in the Scott Reef Complex KEF after 10 days. Submerged Banks, Shoals and Reefs Sea surface exposure above a concentration of >10 g/m^2 has the highest probabilities of occurring at the Barracouta (92 %), Vulcan Shoal (86 %), Goeree Shoal (72 %), Johnson (52 %), Woodbine (52%), Hibernia (48%), Seringapatam Reef (30 %). Probabilities at other shoals and banks were < 25%. KEFS (all submerged) The highest probabilities of sea surface exposure at a concentration of >10 g/m^2 within KEFs were at Ashmore Reef, Cartier Island and surrounding Commonwealth Waters (88 %), Continental slope demersal fish communities (81 %), Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex (30 %), Ancient coastline at 125 m depth contour (24 %). Other probabilities were < 10%. Fisheries The fisheries with the highest probability of exposure were the North-west Slope Trawl Fishery (100 %), Southern Bluefin Tuna Fishery (100 %), Western Skipjack Fishery (100 %) and the Western Tuna and Billfish Fishery (100 %). All other fisheries were ≤ 5 %. Australian Marine Parks The Australian Marine Parks with the highest probability of exposure were Cartier Island (88 %), Ashmore Reef (72%), Oceanic Shoals AMP (46 %), Kimberley AMP (45 %), Argo-Rowley Terrace (16 %) AMP. Probabilities at other Australian Marine Parks were ≤ 15%. State Marine and National Parks The highest probability of exposure was the North Kimberley MP (3 % -@ 129 days). All other Marine and National Parks were <3% probability of exposure. BIAs The shark BIAs had a 100% probability of sea surface exposure (>10 g/m^2), while seabirds BIA had 95 %, 88 % for marine turtle and 72 % for whales. Other receptors had exposure probabilities ≤ 3%. Indonesia and Timor Leste The Indonesian coastline has a maximum of 10 % probability of exposure to sea surfaces >10g/m^2 and Timor Leste of 8 %. Figure 7.1 shows the locations of potential floating oil above the threshold of 1 g/m^2 and 10 g/m^2.

<table>
<tr><td>Shoreline</td><td>
The maximum oil volume loading on all shorelines during a single spill event was predicted as 24, 169 m^3 for a spill commencing during the September to February period.

The minimum time before shoreline accumulation at 100 g/m^2 was 3 days and 5 days for Cartier Island and Ashmore Reef (Marine Park boundaries) respectively and 7 days for the Kimberley coast.

The following sensitive receptors had the highest predicted accumulated quantity of hydrocarbon on the shoreline:
<table>
<tr><th>Receptor</th><th>Max accumulated volume (m^3) across shoreline (>100g/m^2) in worst-case replicate</th><th>Average accumulated volume (m^3) across shoreline (>100g/m^2) in worst-case replicate</th></tr>
<tr><td>Kimberley Coast</td><td>11,220</td><td>1,023</td></tr>
<tr><td>Joseph Bonaparte Gulf (NT)</td><td>8,694</td><td>2,031</td></tr>
<tr><td>Seringapatam and Scott Reef</td><td>7,152</td><td>1,032</td></tr>
<tr><td>Coburg Peninsula</td><td>6,424</td><td>243</td></tr>
<tr><td>Ashmore Reef /Cartier Island</td><td>5,284</td><td>2,247</td></tr>
<tr><td>Bathurst Is</td><td>4,529</td><td>837</td></tr>
<tr><td>Darwin Coast</td><td>4,255</td><td>537</td></tr>
<tr><td>Melville Is</td><td>3,846</td><td>567</td></tr>
<tr><td>Indonesia and Timor Leste</td><td>3,408</td><td>412</td></tr>
<tr><td>East Arnhem land</td><td>2,289</td><td>79</td></tr>
<tr><td>Kakadu Coast</td><td>2,068</td><td>206</td></tr>
<tr><td>West Arnhem Land</td><td>715</td><td>45</td></tr>
<tr><td>Browse Island</td><td>511</td><td>101</td></tr>
</table>
Figure 7.2 and 7.3 show the locations of potential shoreline contact above the threshold of 100 g/m^2.
</td></tr>
<tr><td>Scenario</td><td>Montara crude (234,498 m^3), H6 subsea spill. Source RPS 2019</td></tr>
<tr><td>Entrained</td><td>
Maximum entrained hydrocarbon exposure at levels ≥100 ppb impact threshold at any depth in the worst replicate is shown below for all contact probabilities >25% within the EMBA for the worst-case scenario.

<u>Submerged Banks, Shoals and Reefs</u>

The shoal areas with the highest probability of exposure were the Barracouta (95 % - 1 044 ppb), Johnson and Woodbine (90% - 6 493 and 6 799 ppb respectively), Jabiru (83 % - 5 465 ppb), Mangola Shoal (81 % - 3 170 ppb), Eugene McDermott Shoal (77 % - 1 121 ppb), Pee (74 % - 4 884 ppb), Sahul Bank (71 % - 8 852 ppb), Heywood Shoal (70 % - 9 053 ppb), Vee Shoal (69% - 2 198 ppb), Seringapatam Reef (67 % - 1 784 ppb), Gale Bank (66 % - 1 862 ppb), Hibernia (64 % - 3 193 ppb), Barton Shoal (56 % - 3 874 ppb), Favell Bank (55 % - 1 701 ppb), Fantome (54 % - 1 846 ppb), Dillon Shoal (49% - 2 507 ppb), Karmt Shoal (48 % – 2 581 ppb), Baldwin Bank (43 % -1 128 ppb), Big Bank Shoals (37 % - 2 582 ppb), Van Cloon Shoal (35 % - 1 579 ppb),Bellona Bank (34 % - 734 ppb). Probabilities at other shoals and banks are ≤ 25%.
</td></tr>
</table>

	<u>KEFS</u> The KEFs with the highest probability of exposure were the Carbonate Bank and Terrace System of the Sahul Shelf (100 % - 16 151 ppb), Continental Slope Demersal Fish Communities (100 % - 16 505 ppb), Ashmore Reef and Cartier Island and surrounding Commonwealth Waters (100 % - 8 852 ppb), Ancient Coastline at 125m Depth Contour (100 % - 12 048 ppb), Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex KEF (67 % - 5 826 ppb), Pinnacles of the Bonaparte Basin (65 % - 2 719 ppb), Carbonate Bank and Terrace System of the Van Diemen Rise (53% - 4 609 ppb). Probabilities at the other KEFs were ≤ 25 %. <u>Fisheries</u> The fisheries with the highest probability of exposure were the North-west Slope Trawl Fishery (100 % - 46 860 ppb), Southern Bluefin Tuna Fishery (100 % - 102 812 ppb), Western Skipjack Fishery (100 % - 102 812 ppb), the Western Tuna and Billfish Fishery (100 % - 102 812 ppb) and the Northern Prawn Fishery (71 % - 3 327 ppb). All other fisheries were ≤ 25 %. <u>BIAs</u> The BIA with the highest probability of exposure were the shark, seabird, whale and marine turtles, all with 100 % and 102 812 ppb, 19 151 ppb, 11 153 ppb and 11 153 ppb respectively. Dugong BIA was 92 % - 6 144 ppb while all other BIAs had a probability of exposure ≤ 25 %. <u>Australian Marine Parks</u> The Australian Marine Parks with the highest probability of exposure were Cartier Island (100 % - 8 400 ppb), Ashmore Reef (100% - 8 574 ppb), Oceanic Shoals (90 % - 6 232 ppb), Kimberley (64 % - 15 816 ppb), Argo-Rowley Terrace (25 % - 1 602 ppb). Probabilities at other Australian Marine Parks were ≤ 25%. <u>State Marine and National Parks</u> The highest probability of exposure was the North Kimberley MP (8 % - 2 850 ppb). All other Marine and National Parks were ≤ 10% probability of exposure. Figure 7.4 shows the zones of potential entrained oil exposure at ≥100 ppb threshold.
Dissolved	Maximum dissolved hydrocarbon exposure at levels ≥70/100 ppb impact threshold at any depth in the worst replicate is shown below for all contact probabilities >25% within the EMBA for the worst-case scenario. <u>Submerged Banks, Shoals and Reefs</u> The shoal areas with the highest probabilities were Barracouta (78 % - 2 293ppb), Vulcan (75 % - 1 259 ppb), Eugene Mc Dermott (64 % - 2 544 ppb), Woodbine (35 % - 1 293 ppb), Johnson (32 % - 2 012 ppb) and Jabiru Shoals (25 % - 1 165 ppb). All other reefs had probabilities ≤ 25 %. <u>KEFS</u> The KEFs with the highest probability of exposure were the Carbonate bank and terrace system of the Sahul Shelf (73 % - 5 703 ppb), Ancient Coastline at 125m Depth Contour KEF (57 % - 1 824 ppb), Continental Slope Demersal Fish Communities KEF (55 % - 2 237 ppb) and Ashmore Reef and Cartier Island and surrounding Commonwealth Waters KEF (51% - 2 563 ppb). The remaining KEFS have exposure probabilities ≤ 15 %. <u>BIAs</u> The BIA with the highest probability was the Shark (100 % - 10 437 ppb), seabirds (100 % at 3 458 ppb), marine turtle (65 % at 2 237 ppb) and whales (37 % at 2 563 ppb). The likelihood of dissolved exposure to other BIAs was ≤ 15%. <u>Australian Marine Parks</u> The highest probabilities were Cartier Island (51 % - 1 675 ppb) and Ashmore Reef (22 % - 864 ppb). All other Australian Marine Parks had a probability of exposure ≤ 20 %.

	<u>State Marine and National Parks</u> North Kimberley NP had a probability of 1 % with 79 ppb. All other state marine and national parks had no contact. <u>Fisheries</u> The fisheries with the highest probability of exposure were the North-west Slope Trawl Fishery (100 % - 9 496 ppb), Southern Bluefin Tuna Fishery (100 % - 10 437 ppb), Western Skipjack Fishery (100 % - 10 437 ppb) and the Western Tuna and Billfish Fishery (100 % - 10 437ppb). All other fisheries were ≤ 3 %. Figure 7.5 shows the zones of potential dissolved aromatic exposure ≥ the 100 ppb threshold.

7.6.6 Impacts and risks

The environmental consequences of a loss of well control are highly variable, dependent on the characteristics of the hydrocarbon released, the dynamics of the receiving environment and the proximity of the release point to sensitive environmental receptors. They include:

- Reduction in water quality;
- Direct/indirect toxic or physiological effects on marine biota, including corals;
- Direct/indirect loss/disturbance to marine mammals, marine reptiles, birds, fish and sharks/ rays;
- Hydrocarbon/chemical contact with shoals/banks, reefs and islands at concentrations that result in adverse impacts;
- Direct/indirect loss/disturbance of significant habitat;
- Disturbance of non-conservation significant populations/ communities;
- Disturbance of conservation significant individuals (e.g. change in fauna behaviour/ movement, or injury/ mortality);
- Physical damage and/or disturbance to unique KEF and AMP values; and
- Socio-economic, human health impacts and reputational damage.

The determination of biologically meaningful impact levels is complex since the degree of impact will depend on the sensitivity of the biota contacted, the duration of the contact (exposure) and the toxicity of the hydrocarbon mixture making the contact. The toxicity of a hydrocarbon will change over time, due to weathering processes altering the composition of the hydrocarbon.

Impact pathways and impact threshold concentrations are detailed below for surface (floating) oil, entrained oil and dissolved aromatic hydrocarbons (DAHs).

7.6.7 Level of Impact on Sensitive Receptors within the RISK EMBA

Table 7-5 lists key potential impacts to sensitive receptors present in the RISK EMBA. Appendix I summarises the scientific monitoring plans activated in response to predicted contact with AMPs.

Table 7-5: Potential impacts to sensitive receptors present in the Risk EMBA

Shoreline habitats (excluding Mangroves)
Sensitivity There are a wide variety of different types of shorelines found along Australia's western and northern coast and offshore islands. The type of shoreline will influence the volume of hydrocarbon that could be stranded ashore and its thickness before the shoreline saturation point occurs. For instance, a sandy beach may allow hydrocarbon to percolate through the sand, and weathered oil may be buried, thus increasing its ability to hold more hydrocarbon

ashore over tidal cycles and various wave actions in comparison to a rocky shore; hence hydrocarbon can increase in thickness onshore over time. Shoreline data was obtained from the OzCoasts Smartline data set sourced via Geoscience Australia.

Floating

Shoreline habitats which have the potential to be contacted by stranded oil include intertidal coral reefs, cays, sandy shorelines, rocky shorelines and intertidal mud/sandflats. Fauna associated with these can be exposed to toxic effects from ingestion as fauna attempt to clean themselves (e.g. preening of feathers or licking fur), reduced mobility and inability to thermoregulate due to oil coating. Contact to eyes, noses and breathing apparatus (invertebrates) from oil coating can result in irritation and/or inability to breathe or see.

While oil will likely be deposited at the surface of the beach there is also the possibility that a proportion of the stranded oil will contaminate sand deeper into the beach profile. This may occur through re-suspension of sediments in the surf zone, the oil melting and moving down through the beach sediments or soluble fractions of the stranded oil percolating through to deeper beach sediments.

Oiling of tidal zones and rocky shores may cause coating of organisms present possibly leading to suffocation or loss of purchase on the substrate. While oil may stick to platform surfaces, in high energy areas high water movement and energy will remove oil over time; however, in lower energy areas stranded oil may persist and oil may also be 'hidden' under rubble, ledges and in pockets/crevices. Once oil has been removed from platform surfaces, re-colonisation of the hard substrate surfaces by organisms is often rapid (weeks to months).

Entrained and dissolved

Intertidal and subtidal zones may be exposed to entrained and dissolved hydrocarbons with impacts similar to coral reefs. Impacts may occur due to increased hydrocarbon levels in the nearshore waters and in sediments above the low water mark. Concentrations of hydrocarbons in nearshore waters and sediments, will fluctuate over short time scales (days to weeks), due to volatilisation, wave and tidal action, biological processes and potential arrival of more oil. Fauna associated with these habitats may experience sub-lethal effects. However, due to the expected weathering of crude, the accessibility of PAHs to aquatic organisms is decreased.

Potential impact from modelled event

Locations of shoreline habitats (sandy shores, rocky shores and intertidal flats are listed in Appendix B and could be impacted by surface oil.

Stranded oil was predicted to contact sandy beaches along the WA/NT coast and coasts of Indonesia and Timor Leste (Figures 7.2 and 7.3). These locations have the potential to provide habitat for EPBC Act listed reptiles and seabirds but also habitat for invertebrates including polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans and insects. Potential impacts to reptiles and seabirds are discussed under marine fauna below.

De La Huz et al. (2005) investigated the impacts of the Prestige oil tanker spill off the Galician coast on 17 exposed sandy beaches. The study investigated species richness of polychaetes, molluscs, marine crustaceans, semi-terrestrial crustaceans and insects on the affected beaches, by comparing the total number of species in each group before and after the oil spill. The investigation identified that the most affected beaches lost up to 66.7% of the total species richness after the oil spill and dry sand areas received the highest volumes of hydrocarbons ashore.

Quantitative spill modelling conducted by RPS (2019) predicted that during the unlikely event of an uncontrolled well blowout the maximum hydrocarbon loads ashore would be 11 220 g/m^2 at the Kimberley Coast and 8 694 g/m^2 at the Joseph Bonaparte Gulf (NT). Based on the earliest predicted mainland shoreline contact of 7 days at the Kimberley coast it is anticipated that shorelines will be exposed to weathered Montara crude waxy sheets or flakes that are biodegradable and generally of lower toxicity than the oil itself, due to containing less of the more toxic lighter hydrocarbon fractions, which tend to be lost through volatilisation. Therefore, impacts on sensitive receptors at sandy beaches are limited to the physical effects from the presence of such waxy residues and coating as opposed to toxicity effects.

Thomas (1978 cited in French-McCay 2009) observed recovery of invertebrates after three years on sandy beaches oiled by the 1970 Arrow spill of Bunker Oil. Additionally, Judd et al. (1991 cited in French McCay 2009) observed dune vegetation recovery after three years following removal experiments.

Timeframe to recover

Similar to benthic habitats, recovery of shoreline habitats exposed to entrained hydrocarbons and experiencing impacts would be expected within weeks to months of return to normal water quality conditions.

Consequence

The consequence of a loss of well control event on shoreline habitats was assessed as **Major** given recovery may take years.

Mangroves and saltmarshes

Sensitivity

Floating

Mangrove root systems (including pneumatophores) are sensitive to physical coating by crude oil which may persist for long periods of time given the persistent components of crude oil and the tendency for mangrove root habitat to trap oil. Surface slicks that make their way into a mangrove will make contact with pneumatophores used by mangroves for gas exchange. Crude oil that coats pneumatophores will impede gas exchange that may result in yellowed leaves, defoliation and tree death depending on the extent and degree of oiling. Exposure of mangroves to surface oil may also cause toxicity including damage to cellular membranes leading to impairment of salt exchange, disruption of ion transport mechanisms, and growth of branched pneumatophores in response to tissue death of coated pneumatophores. More chronic toxicity impacts include genetic damage have population-scale effects (e.g. reduction/ loss of chlorophyll content in leaves). A high sensitivity of seedlings to oiled sediments would also impact longer term recruitment of the affected population.

This could have prolonged negative effects on the faunal communities within mangroves. Of the emergent habitat types mangroves are likely to be one the most susceptible and slowest recovering habitat types with recovery potentially on a decadal scale if death of trees was to occur.

Salt marshes would likely trap floating crude oil to a certain degree and therefore persistent oil may remain within these areas even after tidal water has receded. This could have prolonged negative effects on the faunal communities within salt marshes. Depending upon the degree of weathering, crude oil may have toxic impacts from physical coating of salt marshes potentially ranging from death to sub lethal stresses such as reduced growth rates and reduced reproductive output/ success. Such impacts would be restricted to the seaward fringes of salt marsh communities.

Entrained and dissolved

Mangrove communities may be impacted through the sediment/ mangrove root interface. Where entrained hydrocarbons include contaminants that may become persistent in the sediments (e.g. trace metals, PAHs), this can lead to effects on mangroves due to uptake, or effects on benthic infauna leading to reduced rates of bioturbation and subsequent oxygen stress on the plants' root systems (Lewis et al., 2011).

Impacts to mangroves include yellowing of leaves, defoliation, reduced reproductive output and success, mutation and increased sensitivity to other stresses (NOAA, 2010). This is in addition to impacts to the marine organisms utilised mangrove habitat (invertebrates, fish, birds).

Potential impact from modelled event

Quantitative spill modelling conducted by RPS (2019) predicted that during the unlikely event of an uncontrolled well blowout the maximum hydrocarbon loads ashore would be 11 220 g/m^2 at the Kimberley Coast and 8 694 g/m^2 at the Joseph Bonaparte Gulf (NT). Given the minimum shoreline contact time of 7 days any stranded oil reaching coastal mangrove communities is expected to be weathered. It is therefore anticipated that shorelines will be exposed to Montara crude wax, which could coat mangrove breathing pores and cause some sub-lethal effects from toxicity. These mangroves are identified as KPI values within many of the respective management plans. Floating crude oil could reach salt marsh areas (e.g. North Kimberley Marine Park), which are often landward of mangrove communities, on high spring tides.

Timeframe to recover

Depending upon the level of impact, recovery to affected mangrove areas can be on the scale of years to decades (NOAA, 2010).

Consequence The consequence of a loss of well control event on mangroves and saltmarshes was assessed as ***Critical*** given recovery may take years.
Plankton
Sensitivity *Floating* Presence of surface oil can affect light qualities and the ability of plankton to photosynthesise. Reduced primary productivity could occur while surface oil is present *Entrained and dissolved* There is potential for localised mortality of plankton due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest. Planktonic communities comprise sensitive receptors to hydrocarbon exposure including single-celled organisms (e.g. phytoplankton) and larval stages of vertebrates and invertebrates. Smaller organisms are more likely to become entrained in a parcel of water; if contaminated with dissolved aromatic hydrocarbons, and organisms are entrained in a parcel of water for 96 hours or more acute/lethal effects may result. Where plankton are exposed to entrained hydrocarbons for a period less than 96 hours and at concentrations that may cause effect, chronic/non-lethal impacts may occur including impaired movement, predatory/avoidance response, respiration. Numerous studies on the influence of oil on plankton communities have been carried out, including a study conducted by Varela et al. (2006), which also compared their results with other published studies. Despite limitations (oil type, environmental conditions and planktonic communities) it was not possible to demonstrate any effects on plankton communities; and that any changes are within the range of natural ecosystem variability. 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 oil. However, if a shallow entrained/dissolved hydrocarbon plume were to intercept a mass, synchronous spawning event, recently spawned gametes and larvae would be particularly vulnerable to oil spill effects. Being generally positively buoyant they would be exposed to surface spills. Under most circumstances, impacts on plankton are expected to be localised and short term; however, if an entrained/dissolved surface expression reached a coral or fish spawning location during a spawning event, localised short to medium term impacts could occur. Commercial target fish species have been reported to spawn in offshore waters within the RISK EMBA, with spawning and juveniles most likely to occur around reefs and bays in nearshore shallow waters (Section 4). The southern bluefin tuna in the Indian Ocean, spawning ground extends between northern WA and Java from 7° S to 20° S, approximately 200 km to the west of the Operational Area. Spawning occurs between August and April (with a peak period from October to February) (DOE 2015b). In the unlikely event of a spill occurring, there is potential for a reduction in successful fertilization and larval survival as a result of elevated entrained and to a lesser extent the dissolved hydrocarbons (Given the area of overlap of impact concentrations compared to the whole spawning grounds, any incidental impacts to fish larvae beyond the predicted area for impact are unlikely to be of consequence to fish stocks, particularly compared with significantly larger losses through natural predation and fishing. **Potential impact from modelled event** High abundance of phytoplankton typically occurs around topographical features that may result in upwelling or a disruption to the current flow which may be present around banks and shoals and offshore islands within the EMBA. The EMBA has the potential to overlap with spawning of some fish species given the year-round spawning of some species and the ongoing operations activity. In the unlikely event of a spill occurring, fish larvae may be impacted by hydrocarbons entrained in the water column with effects greatest in the upper 10 m of the water column where most plankton concentrate and closest to the spill source. Larvae within small areas of the KEF - Continental Slope Demersal Fish Communities have a 100 % probability that a part of the KEF could be exposed to

entrained oil ≥100 ppb and 55 % probability of exposure to dissolved oil >70ppb (refer Table 7-4), but likelihood is lessened significantly depending on the timing, species and location of the spawning.

Recovery timeframe

Reproduction by survivors or dispersion from unaffected areas (via sea surface currents) would be likely to rapidly replenish any losses from permanent zooplankton (Abbriano et al. 2011). Plankton have life cycles based on rapid reproduction with levels of high productivity. It is also in the nature of plankton to be dispersive – it is why many benthic taxa have adopted a pelagic early life history stage to increase dispersion via a vector with a consistent food supply. Field observations from oil spills have shown minimal or transient effects on marine plankton (Abbriano et al. 2011).

Once background water quality conditions have re-established, the plankton community will take weeks to months to recover (ITOPF 2011), allowing for seasonal influences on the assemblage characteristics.

Consequence

The consequence of a loss of well control event on plankton was assessed as ***Minor*** given recovery may take weeks to months.

Benthic habitat and communities (including deepwater habitats and shallow shoals, corals, intertidal zones)

Sensitivity

Floating

Contact of floating crude oil could occur with intertidal corals at low tide. The degree to which impacts such as bleaching, mortality or reduced growth could occur will depend upon the level of coating (concentration of oil and/or loading of oil on shorelines) and how fresh the oil is.

Prolonged contact of oil with corals has been observed to lead to tissue death and bleaching to exposed parts of colonies.

Impacts to hard corals could be intensified if a spill was to reach shallow coral areas during the peak spawning seasons since surface oil could smother intertidal corals in the process of spawning or could contact floating coral eggs and larvae following spawning events. Dependent on the level of contact, this could diminish coral recruitment, and impact longer term recovery.

Other benthic habitats are unlikely to be impacted by surface oil given the water depths of them.

Entrained and dissolved

Intertidal and subtidal zones may be exposed to entrained hydrocarbons with impacts similar to coral reefs. Impacts may occur due to increased hydrocarbon levels in the nearshore waters and in sediments above the low water mark. Concentrations of hydrocarbons in nearshore waters and sediments, will fluctuate over short time scales (days to weeks), due to volatilisation, wave and tidal action, biological processes and potential arrival of more oil.

The coating of submerged benthic habitats and those within tidal zones from water column oil has only been reported where very large oil spill quantities have affected these habitats or very sticky oil slicks have encountered exposed coral surfaces or polyps. Where entrained oil reaches the shoreline habitats of intertidal zones, sub-lethal effects may occur, with mangroves and reef areas being the most sensitive.

There is a paucity of information on the long-term impacts on coral reefs of hydrocarbons entrained in the water column although NOAA (2001) indicate that some effects may be transient whilst others are long-lasting depending on the type of corals, reproduction period and health of the reef. Response to hydrocarbon exposure can include impaired feeding, fertilisation, larval settlement and metamorphosis, larval and tissue death and decreased growth rates (Villanueva et al., 2008).

Entrained hydrocarbon concentrations below parts per million (ppm) concentrations in marine waters have not been associated with any observed stress, degradation or death of corals. Macrophytes, including seagrasses and macroalgae, require light to photosynthesise. Presence of entrained hydrocarbon within the water column can affect light qualities and the ability of macrophytes to photosynthesise. Reduced primary productivity could occur while entrained hydrocarbons are present in the water column.

Waters that contain extensive fringing coral reef may experience impacts from entrained hydrocarbons as described below for benthic habitats. Reefs are often characterised by increased levels of biological productivity, which attracts commercially valuable fish species. Impacts from entrained hydrocarbons will be as described below for reef fish.

Epifauna associated with hard substrates such as ascidians and sponges may experience direct toxicity through ingestion.

Potential Impact from Modelled Event

Benthic habitats in the EMBA that may be impacted by entrained oil include soft sediments and benthic fauna, coral reef, sponges, macroalgae and seagrasses. The nearest shoals to the Operational Area are Goeree and Vulcan Shoals, approximately 28 km to the southwest, Eugene McDermott Shoal (approximately 41 km south) and Barracouta Shoal (approximately 39 km northwest).

The Barracouta and Vulcan Shoals plateau at approximately 20- 50 m depth (Heyward et al. 2011a). Occasional higher ground rises to within approximately 10 m of the sea surface, hence not be contacted by a surface slick. Contact with entrained hydrocarbons above the 100ppb concentration threshold is not predicted in water depths below 30m (RPS 2019), but can be encountered in the shallow waters (0-20m) overlying a number of shoals in the RISK EMBA (refer Table 7-4). Consequently, impacts to benthic habitats are possible in those shallow water areas. Exposure to dissolved aromatics above the 70 ppb threshold is predicted to be the highest at three shoals (Barracouta, Vulcan and Eugene MacDermott) with the probabilities >50% (refer Table 7-4). Dissolved oil may be dispersed throughout the water column, so potential impacts may vary significantly, depending on well discharge (seabed or surface), shoal location and depth, spill volume and season.

In the event of exposure, filter feeders present at submerged reefs and shoals, including corals, are at risk of ingesting entrained hydrocarbons and absorb dissolved aromatics with lethal and various sub-lethal effects. The latter include alteration in respiration rates, decreases infilter feeding activity, reduced growth rates, biochemical effects, increased predation, reproductive failure and mechanical destruction by waves due to inability to maintain a hold on substrate (Ballou et al. 1989; Connell and Miller 1981).

Emergent regionally important coral reef communities, including protected areas at Ashmore Reef, Cartier Island (approximately 147 km and 92 km respectively from the Operational Area), Seringapatam Reef, Browse Island and Scott Reef may be impacted by exposure to surface hydrocarbons and have contact with entrained hydrocarbons above the 100 ppb threshold. Ashmore Reef and Cartier Island are the most exposed with a probability of 100 % for entrained oil >100 ppb.

Exposure to dissolved aromatics above the 70 ppb threshold is predicted at Ashmore Reef and Cartier Island with a probability of 51 %.

Any contact by oil at coral reef locations during spawning events (October/November) has the potential to cause significant population level impacts.

The Montara Environmental Monitoring Program included a study to determine the level of impact of any Drilling Activity spill incident on the marine life of various submerged banks, shoals and coral reefs that are within the EMBA (Heyward et al. 2010, 2011a). Key findings of this study identified that shoal and reef communities showed no obvious signs of recent disturbance attributable to the spill.

A review of the depth at which submerged reefs and shoals in the area surrounding the title area reach a plateau indicates that the area of highest biodiversity is at a water depth of 20 to 40 m which is where entrained oil may be present at above impact thresholds.

Within the RISK EMBA, seagrasses occur along the mainland coastline of the Northern Territory and Western Australia and within the protected coastal areas of islands, including Barracouta Shoal Vulcan Shoal located approximately 28 km southwest supports up to 36% seagrass cover (*Thallasodendron ciliatum*) (Heyward *et al.* 2010),the Tiwi Islands, outer Darwin Harbour and in the waters surrounding the Van Diemen Gulf adjacent to Arnhem Land (Roelofs et al. 2005) and Buccaneer Archipelago located north of the Dampier Peninsula (Wells et al. 1995). Ashmore Reef seagrass supports a small dugong population (Whiting and Guinea 2005).

A significant loss of seagrass was recorded at Vulcan Shoal in 2011 when compared with data from surveys conducted in 2010, six months after the Montara oil spill. The cause of seagrass loss at Vulcan Shoal cannot be determined, however is noted that a delayed effect from the Montara incident resulting in a change sometime between 6 and 18 months after the incident is considered unlikely to be due to the Montara spill (Heyward et al. 2011a).

Recovery Timeframe

Recovery of benthic habitats exposed to entrained hydrocarbons and experiencing impacts would be expected within weeks to months of return to normal water quality conditions. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Burns et al., 1993; Dean et al., 1998).

Consequence

The consequence of a loss of well control event on benthic habitats was assessed as ***Moderate*** given recovery may take months to a year depending on the habitat type and degree of exposure (duration and concentration).

Marine Reptiles

Sensitivity

Marine reptiles (including turtles) are potentially directly affected by the toxicity of in-water and surface hydrocarbons through ingestion, volatile organic compounds through inhalation, as well as potentially suffering from effects of physical contact with surface hydrocarbons.

Floating

Marine turtles and sea snakes when basking on the surface or surfacing to breathe may be affected from surface slick hydrocarbons through damage to their airways and eyes. Turtles and sea snakes may be affected by oil through tainted food source or by absorption through the skin. Risk of contact would likely be greatest along intertidal sections of nesting beaches or within shallow waters adjacent to nesting beaches. Contact might also occur within foraging areas.

Depending on species, adult females will lay eggs on the beach above the high tide mark followed by emergence of hatchlings that will make their way to the water. Adult females will often wait in nearshore water before coming up onto the beach and may revisit the beach a number of times before exiting onto the beach and laying her eggs. Coating (particularly of hatchlings) can lead to reduced mobility and buoyancy- mortality, drowning, starvation, dehydration, increased predation and behavioural disruption.

Other impacts expected:

- Inhalation of volatile compounds
- Ingestion and internal adsorption
- External contact and adsorption across exposed skin and membranes
- Indirect impact to predators through ingestion of oiled prey

Mortality, cell damage, lesions, secondary infections, reduced metabolic capacity, reduced immune response, disease, reduced growth, reduced reproductive output, reduced hatchling success, growth abnormalities, behavioural disruption

Entrained

Turtles and seasnakes may be affected by oil through tainted food source or by absorption through the skin. Turtle hatchlings and turtle/seasnake adults may be exposed to hydrocarbon through ingestion of entrained hydrocarbons and tainted food source. These effects may cause physiological effects such as disruption of digestion. As for other megafauna that may be exposed to entrained hydrocarbons, acute impacts due to exposure to adult turtles are not expected. Whilst turtle nesting beaches may be contacted by crude (floating or accumulated), turtles will always nest above the high tide mark and any oil moving through the beach profile should not contact nests. Entrained and dissolved oil may harm to internal anatomy if ingested, irritation or damage sensitive external features such as eyes and skin and damage to respiratory processes if significant inhalation of volatile fumes occurs at the surface.

Dissolved

The majority of publicly available information detailing potential impacts to turtles and seasnakes due to exposure to hydrocarbons is based on impacts due to heavy oils. Impacts due to exposure to DAHs are less understood. One information source provides a case study detailing a spill of 440,000 gallons of aviation gasoline nearby to an island supporting approximately 1,000 green turtles that aggregate and nest at the atoll in the west Pacific Ocean annually (NOAA, 2010b). Timing of the spill was of concern as it coincided with expected peak hatchling emergence. Population comparisons with a census that had been completed just prior to the spill were undertaken to evaluate impacts; no impacts were reported during the spill response and population effects were not detected.

For marine reptiles that may be exposed to DAHs dosages that exceed the threshold, acute impacts to turtles and seasnakes are not expected. Impacts to turtle hatchlings may occur however due to the risk of them becoming entrained in a parcel of water allowing them to be continuously exposed to toxic hydrocarbons for an extended period

Whilst turtle nesting beaches may be contacted by weathered oil, turtles will always nest above the high tide mark and any oil moving through the beach profile should not contact nests. Entrained and dissolved oil may result in harm to internal anatomy if ingested, irritation or damage to sensitive external features such as eyes and skin and damage to respiratory processes if significant inhalation of volatile fumes occurs at the surface.

Potential Impact from Modelled Event

The RISK EMBA intersects with a number of nesting, inter-nesting and foraging BIAs for Threatened and Migratory marine turtle (Appendix B). Significant habitats, in particular nesting areas, include Ashmore Reef and Cartier Island CMRs, Cassini Island, Sandy Islet (Scott Reef) and Browse Island. Minimum times to turtle BIA are: Surface concentrations above 10 g/m^2 are predicted to reach the nesting BIA for green turtles (Ashmore and Cartier) in a minimum time of 3.5 days; inter-nesting BIAs (e.g. green turtle at Hibernia Reef) turtles in a minimum time of 8 days and foraging BIA in approximately olive ridley in 8 days.

Quantitative spill modelling conducted by RPS (2019) predicted that the surface oil will be highly weathered before shoreline contact is made and only waxy residues of a lesser toxicity are expected to accumulate on the shoreline. Turtles on the shoreline, in particular, hatchlings may be impacted by exposure to weathered hydrocarbons where impacts are more likely to be physical coating rather than acute toxicity. However, it is noted that while less toxic to eggs and embryos than freshly spilled oil, weathered oil residues can still have significant impacts on hatchlings and adult turtles including acute toxicity, impaired movement and normal bodily functions (Shigenaka, 2003 and increased vulnerability to predation.

Both hatchlings, juveniles, and adult turtles can be affected through the ingestion of tarballs typically through starvation from gut blockage, decreased absorption efficiency, absorption of toxins, and buoyancy problems caused by the build-up of fermentation gases (floating prevents turtles from feeding and increases their vulnerability to predators and boats) (Shigenaka, 2003). However, turtles have been shown to have a well-developed hepatic system of enzymes (cytochocrome P450-1A) to metabolise organic contaminants and aid in elimination from the body. Glutathione transferases (a cellular defence against electrophilic DNA damage by such toxicants as PAHs) have also been isolated from green sea turtles. Therefore, when turtles are exposed to PAHs in crude oil in low dosages, endogenous mechanisms exist to enhance elimination of xenobiotics compounds out of the organism (Gagnon and Rawson, 2010).

Based on the above information, it is anticipated that in the unlikely event of an uncontrolled well blowout turtles, in particular hatchlings, may be impacted by exposure to hydrocarbons. Stranded oil with its proximity to sandy beaches with known turtle nesting habitats, in excess of the threshold, may have effects on populations, turtle nesting and juveniles

Two species of listed sea snakes were identified that may occur in, or have habitat in the EMBA, short-nosed sea snake and leaf-scaled sea snake, both critically endangered. Sea snakes are known to occur at several locations in the EMBA including Cartier Island and Hibernia Island with established populations of several species present (Guinea, 2013). Sea snakes have also been reported in high abundance at Ashmore Reef in the past, but recent evidence has shown a significant decline in numbers. Based on colour patterns of the sea snake species observed during a recent survey there is thought to be very little gene flow between reefs implying that if a species is lost from a reef, recolonisation may take several years (Guinea, 2013). The short-nosed sea snake is known from Ashmore Reef and the leaf-scaled sea snake is known from both Ashmore Reef and the reefs off Cartier Island.

Montara Commission of Inquiry reported one dead sea snake as a result of the Montara oil spill in 2009 (PTTEP AA 2010), during which surface hydrocarbons were present for more than 74 days, with an accumulative area exposed to Montara crude wax and sheen of 95,554 km^2 (PTTEP AA 2012). However, a range of sub-lethal impacts and further mortalities may have been occurred.

Recovery Timeframe

Recovery of marine reptiles will depend on the degree of oiling and potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within years e.g. if a spill occurred in turtle hatchling season and significant numbers were affected when leaving turtle nesting beaches.

Consequence

The consequence of a loss of well control event on marine reptiles was assessed as ***Major*** given impacts may occur at population level with recovery in multiple years.

Fish and Sharks

Sensitivity

Floating

Near the sea surface, fish are able to detect and avoid contact with surface slicks and as a result, fish mortalities rarely occur in open waters from surface spills (Kennish, 1997; Scholz et al., 1992). Pelagic fish species are therefore generally not highly susceptible to impacts from hydrocarbon spills.

However, hydrocarbon droplets can physically affect fish and sharks exposed for an extended duration (weeks to months). Coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth.

Entrained

Reef fish with high site fidelity will experience protracted water quality conditions with entrained hydrocarbon concentrations >500 ppb within the EMBA. Hydrocarbon droplets can physically affect fish exposed for an extended duration (weeks to months) by coating of gills. This can lead to lethal and sub-lethal effects from reduced oxygen exchange and coating of body surfaces resulting in increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth (NRC, 2005). Lethal effects to reef fish may be observable within days to weeks. Sub-lethal effects of coral reef fish communities will take weeks to months to become measurable. Pelagic and demersal fish species (including sharks) exposed to entrained hydrocarbons can result in tainting and contamination of fish flesh by insoluble PAHs associated with the weathered hydrocarbon.

Whale sharks feed on plankton, krill and bait fish near or on the water surface and it is possible that they contact entrained oil or ingest entrained oil if a large-scale spill occurred when they (and their prey) were present in the region (Woodside, 2005).

Dissolved

Tainting by DAHs of commercially targeted pelagic fish species may occur. Tainting can have a range of effects from affecting edible quality of the fish and have economic consequences, to containing toxic levels above recommended human consumption guidelines.

Potential Impact from Modelled Event

Whale sharks could potentially transit through the RISK EMBA and the foraging activity occurring in July-November each year, albeit in low densities. Whale sharks may be vulnerable to surface oil due to their surface feeding nature and may result in coating of gills and ingestion of oil. Entrained and dissolved oil affecting whale sharks, and their food source plankton, can result in impacts as described above. It is noted that the area exceeding dissolved thresholds for impact is to approximately 500 km from the release site (albeit at a very low probability, non-continuous concentrations that vary with depth and direction) and this area is only a portion of the full extent of the whale shark BIA. However, the probability of some of the Shark BIA being exposed to dissolved and entrained oil above impact thresholds is 100%.

The NW Marine Bioregion supports a diverse assemblage of fish and shark species, particularly in shallower water near islands and shoals. Other shark and pelagic fish species may transit the spill trajectory area and be exposed to

entrained and dissolved oil. Some fish assemblages within the EMBA are also part of protected areas such as AMPs or KEFs and may also be targeted in the commercial fishing industry. **Recovery Timeframe** Recovery of fish and sharks will depend on the degree of oiling and potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within months given relatively regular spawning activity that occurs in most fish species. While tainted pelagic fish will recover naturally over time (months) once water quality conditions have returned to normal, re-opening of a fishery will require an understanding of when recovery from tainting has occurred for the target species of interest. **Consequence** Following the Montara blowout, the Montara Environmental Monitoring Program included a study to determine effects of the spill incident on commercial fish species in Australian waters (Gagnon and Rawson 2012). The results of this study identified evidence of exposure of targeted fish species to petroleum hydrocarbons within the vicinity of the Montara well head platform, but limited signs of adverse health or reproductive effects related to hydrocarbon exposure, as captured fish were in good physical condition (Gagnon and Rawson 2012). Based on this evidence from within the same geographical region, in the unlikely event of an uncontrolled well blowout, significant impacts on fish are considered to be unlikely. Potential impacts to commercial fish spawning are considered below with other planktonic communities. The consequence of a loss of well control event on fish and sharks was assessed as ***Moderate*** given impacts may occur to localised populations with recovery in months to a year.
Marine Mammals
Sensitivity _Floating_ Physical and chemical effects of hydrocarbons in sea surface waters have been demonstrated through direct contact, for example through physical coating, adsorption to body surfaces and ingestion (NRC, 2005), lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth; and potential illness can result. Whales, dolphins and dugongs are smooth skinned, hairless mammals so hydrocarbons tend not to stick to their skin therefore physical impacts from surface oil coating is unlikely. Physical impacts due to ingestion are applicable to surface slicks; however, the susceptibility of cetacean species varies with feeding habits. Baleen whales are more likely to ingest surface slick hydrocarbon than "gulp feeders" such as toothed whales and are particularly vulnerable to hydrocarbon ingestion while feeding. Oil may stick to the baleen while the whales "filter feed" near slicks. Humpback whales, whose BIA overlaps the EMBA are more likely to occur in the area during the northern migration period in June/July and southern migration in Sep/Oct so a sea surface plume (>10 g/m^2) of oil might contact humpback whales as they migrate. Similarly, blue whales may encounter a sea surface plume (>10 g/m^2) as they pass through the area during their northern migration in May–August. Dugongs are distributed off the northern coast of WA, extending around the Northern Territory coastline. Established seagrass habitats including Vulcan Shoal, Ashmore Reef, Cartier Island and shallow waters along the mainland coastline and islands of Australia and Indonesia may provide dugong habitat. Ashmore Reef is identified as a BIA for dugongs, with estimates of between ten and 60 individuals (Whiting and Guinea 2005). Marine mammals are at risk of inhaling volatile compounds evaporating from a spill if they surface to breathe in an oil slick (Geraci and St Aubin, 1990). _Entrained_ Impacts to marine mammals from entrained hydrocarbons could result in behavioural (e.g. deviating from migratory routes or commonly frequented feeding grounds) impacts. These impacts may affect individuals within or transiting the spill area during migration. Whales, dolphins and dugongs are smooth skinned, hairless mammals so hydrocarbons tend not to stick to their skin therefore physical impacts from entrained oil coating is unlikely.

Impacts from ingested hydrocarbon can be lethal or sub-lethal. However, the susceptibility of marine mammal species varies with feeding habits as with surface oil (described previously). Entrained oil attached to seagrass can also be ingested by dugongs. Dugong populations may be indirectly affected by the loss of seagrasses meadows impacted by entrained or dissolved oil phases at a number of shoals and island locations.

Oil may foul sensory hairs around the mouth and/or contact eyes while surfacing to breathe which may cause inflammation and infections. Similar to cetaceans, inhalation of volatile compounds evaporating from a spill may also result in physiological impacts to dugongs.

Dissolved

Marine mammals that may occur within the RISK EMBA for DAHs include whales in offshore waters. According to Geraci and St Aubin (1990), inhalation of volatile compounds evaporating from a spill at sea surface is the greater risk to cetaceans when surfacing to breathe. For these marine mammals, the potential for chemical effects due to exposure is considered unlikely, particularly for highly mobile species such as dolphins because it is very unlikely that these animals will be constantly exposed to high concentrations for continuous durations (e.g. >96 hours) that would lead to toxic effects.

Potential Impact from Modelled Event

Marine mammals present within the EMBA include threatened and migratory whales and dolphins, and potentially dugongs. The activity may be undertaken at any time in the year and may overlap with blue whale migration and humpback whale migration and calving as well as dugong calving and breeding. Crude oil may contact whales and dugongs during these life stages when the fauna are less likely to move away from affected areas if undertaking critical breeding activity.

Surface concentrations above the impact threshold of 10 g/m^2 are predicted from the stochastic modelling to reach the BIA for Pygmy blue whale in a minimum time of 3 days, and the BIA for foraging (Scott Reef N) in a minimum time of 15 days. The likelihood of contact for some part of the BIA is predicted to be more than 72 % for exposure to concentrations of surface oil >10g/m^2. For humpback whales, surface concentrations greater than 10 g/m^2 are not predicted to reach the BIAs for calving, nursing, resting and migration (probability of contact (<1% Camden Sound/Prince Regent National Park). Dugong BIA have a <1% probability of exposure to surface oil >10g/m2. For coastal dolphin species (Australian snubfin and Indo-pacific humpback dolphins), surface concentrations greater than 10 g/m^2 are predicted to reach BIAs ranging from a minimum time of 7 days to 129 days, with a likelihood of contact with surface oil >10g/m^2 ranging from 3% to 15%.

Entrained and/or dissolved hydrocarbons may reach parts of the BIAs for whales with a probability ≤ 95% and 63 % respectively at concentrations above the thresholds for impact. As such, individuals may pass through areas with exposure to elevated concentrations along parts of their migratory routes and therefore be affected.

Recovery Timeframe

Recovery of marine mammals will depend on the degree of potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within years e.g. if a spill occurred in migration or calving season and significant numbers were affected by impeded migration and calving. Recovery of individual cetacean may be more rapid once moved away from the area of potential impact due to their smooth hairless skin.

Consequence

The consequence of a loss of well control event on marine mammals was assessed as ***Major*** given impacts may occur at population level with recovery in 1–2 years.

Avifauna

Sensitivity

Floating

Seabirds are highly susceptible to hydrocarbon spills and oiled birds may experience hypothermia due to matted feathers and an inability to fly. These impacts are primarily attributed to oiling of birds at the surface from slicks. Oiled birds may experience decreased foraging success due to a decline in prey populations following a spill (Andres 1997, NRC 2003) or due to increased time preening to remove oil from their feathers (Burger 1997). During both winter and migration, shorebirds spend much of their time feeding and depend on nonbreeding habitats to provide the fuel necessary for migratory flight (Withers, 2002).

Oil can reduce invertebrate abundance or alter the intertidal invertebrate community that provides food for nonbreeding shorebirds (Andres 1997, NRC 2003) such as at Ramsar sites. Reduced abundance of a preferred food may cause shorebirds to move and forage in other potentially lower- quality habitats. Prey switching has not been documented in shorebirds following an oil spill. However, shorebirds will feed in alternative habitats when the intertidal zone alone cannot fulfil their energy requirements.

A bird's inability to obtain adequate resources delays its pre-migratory fattening and can delay the departure for its breeding grounds. Birds arriving on their breeding grounds earlier realise higher reproductive success through increased clutch size and offspring survival (for a review, see Harrison et al. 2011). If coastal habitats are sufficiently degraded by oil that pre-migratory fattening is slowed and birds delay departure for their breeding grounds, the individual effects could carry over into the breeding season and into distant breeding habitats (Henkel et al. 2012).

Entrained and dissolved

Seabirds may come into contact with entrained oil while searching for food (diving) below the sea surface, exposure times would be very short in this scenario limiting the opportunity for oiling of feathers. Short-term physiological effects due to ingestion of entrained oil or contaminated prey may also occur. Ingested oil can have several sublethal toxicological effects, including haemolytic anaemia, reduced reproduction, and immunosuppression.

As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour.

Potential Impact from Modelled Event

Numerous species of birds frequent the Timor Sea area or fly through the area on annual migrations. Seabird feeding grounds, roosting and nesting areas are found at the offshore atolls in the wider region. In particular, Ashmore Reef, Cartier and Browse Islands support internationally significant numbers of breeding seabirds and migratory shorebirds with all species variously listed under the EPBC Act. Ashmore Reef is also a Ramsar wetland of international importance. Up to 33 migratory shorebirds species and 18,000 individuals have also been documented using the reserves (Clarke 2010). Peak migration time of migratory shorebirds is between October and December (Clarke 2010). It is expected that some individuals of these species may pass through the wider EMBA during their annual migrations. A number of BIAs in addition to Ashmore Reef, Cartier and Browse Islands for seabirds have been identified within the RISK EMBA). Surface concentrations above the impact threshold of 10 g/m2 could reach breeding BIAs for crested terns; greater frigatebirds; lesser crested terns; little terns; red-footed boobys; roseate terns; wedge-tailed shearwaters, common noddy, bridled tern and white-tailed tropicbirds; and a resting BIA for little terns. Surface concentrations at ≥10g/m2 threshold are expected to reach BIAs in a minimum time of 38 or 74 hours (to the edge of the BIA or shoreline) to 1216 hours (51 days) depending on the location of the BIA.

The full extent of shoreline habitats exposed to accumulated concentrations greater than the 100 g/m2 threshold is illustrated in Figure 7.2 and 7.3. It has been estimated that as little as four microliters of petroleum contaminating a fertile egg can cause the embryo to die (AMSA 1998), and there is potential for serious impact of oiling of birds from shoreline hydrocarbon contact should the nest be within tidal reach.

Given the earliest shoreline contact, during any season is 7 days at the Kimberley coast, hydrocarbons are expected to have weathered resulting in stranded hydrocarbons containing lower amounts of toxic volatile components.

However, weathered oil has been shown to reduce hatching success in exposed mallard eggs (Finch et al. 2011), and adverse effects from the leaching of PAHs from weathered oil have been observed years after the Exxon Valdez oil spill (Esler et al. 2002, 2010). Shorebirds foraging and feeding in intertidal zones are at potential risk of exposure to shoreline hydrocarbons, potentially causing acute effects.

Following the Montara well release in 2009, petroleum-based products were reported in the vicinity of Ashmore Reef and Cartier Island. Small numbers of oiled seabirds were recovered both at sea and on the islands at Ashmore Reef, although search effort was limited (Clark and Herrod 2016). In a post-impact study of the effects of the spill on bird populations, the total number of seabirds breeding at Ashmore Reef was found to increase after the spill event when compared to pre-impact data (Clark and Herrod 2016). This trend also applied to breeding populations

of individual seabird species. Declines in non-breeding seabirds during were detected and some of these declines met the a priori definition of significant impact. As breeding populations increased over the same time period, Clark and Herrod (2016) conclude that these declines likely reflect variability in seasonal response rather than evidence for significant impact arising from the Montara oil spill. Declines in migratory shorebird numbers were detected at Ashmore Reef following the spill, however, this response was anticipated given ongoing declines of migratory shorebirds throughout the flyway. When compared with control sites at Eighty-mile Beach, WA, the decline in numbers was not found to be significantly different and therefore no significant impact as a result of the Montara spill. **Recovery Timeframe** Recovery of avifauna will depend on the degree of oiling and potential impacts at critical life stages but could result in impacts at a population level resulting in recovery within years e.g. if a spill occurred in turtle nesting season and significant numbers were affected when foraging in the region resulting in impacts carrying over into the breeding season and other breeding habitats. **Consequence** The consequence of a loss of well control event on avifauna was assessed as ***Major*** given impacts may occur at population level with recovery in multiple years.
Socio economic
Sensitivity *<u>Floating</u>* Surface oil may impact upon socio-economic receptors including the oil and gas industry, commercial shipping, fisheries (commercial and traditional)/aquaculture, recreation and tourism, resulting in an economic and social impact. Floating and stranded oil can be highly visible and have a resultant negative effect on tourism. Response activities can require temporary exclusion zones. A sheen of oil (1g/m^2) may be visible slightly further than the EMBA for biological impacts boundary and impact on the values of a marine parks or tourism beaches. Many of the protected areas have 'wilderness' and 'seascapes' identified as values, and these would be compromised by the presence of any oil. *<u>Entrained</u>* Impacts to fish may result in tainted flesh and fishery closure resulting in an economic impact on commercial, recreational and subsistence fishing. Entrained oil can also lead to impacts on aquaculture (e.g. pearls, seaweed) due to a decrease in water quality and reduced stock. Reduced marketability of products (perceived or real) could occur for target species. *<u>Dissolved</u>* Socio-economic receptors will be affected by hydrocarbon exposure in three ways: Loss of income (e.g. reduction in catch for commercial fisheries), restriction of access and reduction in aesthetic values. Impacts to fish may result in tainted flesh and fishery closure resulting in an economic impact on commercial fishing. DAH in the water column can also lead to impacts on aquaculture (e.g. pearls, seaweed) due to a decrease in water quality and reduced stock. Reduced marketability of products (perceived or real) could occur for target species. **Potential Impact from Modelled Event** Impacts to fisheries could occur due to fish death and tainting of flesh resulting in potential fishery closures and loss of income. The potential area of impact may also be closed to fishers during clean-up for health and safety reason, reducing the area and timeframe for fishing to occur and potentially affecting income. Perceived and actual impacts to areas popular for tourism can result in a loss of income to the local region through reduced numbers of visitors.

Generally, there is little recreational fishing that occurs within the greater EMBA due to its distance from land and deep waters. Recreational day fishing is concentrated around the population centres of Broome, Derby and Wyndham, as well as other readily accessible coastal settlements which are generally at the edge of the EMBA some distance away from the well location. These areas are predicted through stochastic modelling to be reached by a surface slick above the visible threshold of 1 g/m^2. Commercial fisheries that transect the EMBA predominantly operate in shallower waters with generally low levels of fishing activity reported (AMFA 2012) (Section 3.6).

The MOU, within the Australian Fishing Zone encompasses Scott Reef and associated reefs, including Seringapatam Reef, Browse Island, Ashmore Reef, Cartier Island and various banks within the EMBA. These areas are predicted through stochastic modelling to be reached by a surface slick above the impact threshold of 10 g/m^2. Under the MOU, Indonesian and Timorese fishermen are legally permitted to harvest marine products using traditional methods. The peak fishing season is between August and October with fishers departing the region at the onset of the northwest monsoon season. Therefore, traditional fishing could be affected by impacts to fish and benthic habitats (discussed in the above subsections).

It is noteworthy that after the Macondo oil spill, the multi-species tuna fishery landings had recovered within one-year (Carroll et al. 2016) and the shrimp (prawn) harvest rebounded only two years after the spill. Inaccurate negative public perceptions towards a fishery following a spill could be mitigated at the time by positive marketing as was effective after Macondo. The overall consequence ranking for fishing from exposure to hydrocarbons is ***Major*** with recovery predicted in multiple years.

Most recreational and tourism activities in the region occur predominantly in WA State and NT waters. Coastal waters north of Broome, WA through to the eastern cape of East Arnhem, are predicted through stochastic modelling to be reached by a surface slick above the threshold of 1 g/m^2. Limited tourism activities occur at Scott Reef, Ashmore Reef and Cartier Island (Section 3.6), which are predicted to be reached by a surface slick above the threshold of 10 g/m^2. Natural features visited by tourist fishing charters and bird watching tours may therefore be affected in the event of a well blow out.

Shoreline exposure has the potential for localised short-term impacts to marine-based tourism and recreation in the area. Modelling predicts 46 % and 29 % probability that shoreline loads >10 g/m^2 will occur at the Kimberley coast and Kakadu National Park respectively. The earliest predicted shoreline contact is 7 days at the Kimberley coast. As such, stranded oil is expected to weather naturally and breakdown with assistance of ocean currents and as a result, only waxy residues of a lesser toxicity are expected to accumulate on the shoreline.

Tourism also has the potential to be impacted if exclusion zones are implemented where AMSA's spill response strategy overlaps with key visiting areas. Alaska's tourism economy took approximately two years to recover from the Exxon Valdez (BOEM, 2017).The Eastern Research Group (2014) reported that while the Macondo spill had had a significant impact on several areas of tourism in the short term and had wide-ranging impacts across the Gulf, the tourism economy has rebounded to pre-spill levels within four years.

The overall consequence ranking for tourism and recreation activities from exposure to hydrocarbons is ***Moderate.***

For the low level of commercial shipping activity transiting the EMBA, exposure risk is limited to surface slicks potentially oiling vessel hulls and requirements to deviate around exclusion zones during the response activities. Similar exposure is predicted for Defense activities such as Customs Coastwatch, Navy and Customs vessels operating in the EMBA as well as for Petroleum Exploration and Production operators in the Timor Sea. Overall consequences to shipping, defense and other Oil and Gas Operators is ranked ***Minor*** with recovery in weeks to months***.***

Recovery Timeframe

Recovery will depend on the degree of oiling along shorelines and that which is perceived by the public. Recovery of fish is likely to occur within months to years of water quality returning to normal given the regular spawning events that occur. Timeframes for fish may be based on tainting disappearing. Reputation may be impacted nationally with persistent national coverage, with full recovery taking multiple years.

Consequence

The consequence of a loss of well control event on socio-economic receptors was assessed as **Majo**r given impacts on the values of tourism and fisheries may take multiple years to recover and have a national reputational impact.

Protected Areas
Sensitivity *Floating* Surface oil and/or shoreline loading may be expected at some AMPs affecting shoreline habitats and intertidal zones. *Entrained and dissolved* Entrained hydrocarbons will or may impact the coral and seagrass habitats, as well as other marine park values fauna including listed dugongs, sea snakes (protected), fish, avifauna and other marine mammals. Impacts to these receptors are described under individual receptors. **Potential Impact from Modelled Event** AMPs The following AMPs are present within the EMBA and have potential to be exposed to surface oil >10g/m^2: Cartier Island (88 %), Ashmore Reef (72%), Oceanic Shoals AMP (46 %), Kimberley AMP (45 %), Argo-Rowley Terrace (16 %) AMP. Surface oil could be expected to accumulate at some locations (e.g. Cartier Island and Ashmore Reef MPs have 100 % probabilities of exposure to >10g/m^2. Elevated dissolved hydrocarbons may occur at or above impact concentrations within the Cartier and Ashmore Reef, Oceanic and Kimberley AMPs, Oceanic Shoals and Kimberley MP. Elevated entrained hydrocarbons above impact thresholds are predicted in the Cartier Island MP, Ashmore Reef MP, Kimberley, Oceanic, and Argo Rowley Terrace AMPs. Entrained hydrocarbons could therefore impact on the potential values and includes all marine fauna as described within this table, marine habitats and socio-economic receptors. With the deeper(>30m) AMP features, the geomorphological features are unlikely to be affected by entrained hydrocarbons, but the receptors may be affected by the change in water quality and impacts to the food chain. However, shallower features within AMPs such as coral reefs around Ashmore Reef and Mermaid Reef would potentially have long term impacts to the habitats supporting receptors as described within this table for coral reefs and other habitats. Impacts on the values associated with Protected Areas may result in loss of fauna/ habitat diversity and/ or abundance, reduction in commercial/recreational/ subsistence fishing, loss of livelihood and loss of income from reduced tourism and commercial productivity. Several of the AMPs – such as the Kimberley MP, have conservation values associated with biological attributes including migratory seabirds, flatback turtles, humpback whales, freshwater, green and dwarf sawfish, Australian Snubfin, Indo-Pacific Humpback and Indo-Pacific bottlenose dolphins. Tourism may be impacted by real or perceived reduction in health or mortality of habitats that support tourism activities. Commonwealth, State and Territory Marine Parks The minimum time before exposure to surface hydrocarbons above the impact threshold of 10 g/m^2 for any protected area is predicted to be 7 days at the Kimberley CMR. The minimum time before shoreline accumulation at the impact threshold of 100 g/m^2 is 7 days for the Kimberley coast. Considerable weathering of hydrocarbons will therefore occur before reaching the protected areas. There are five marine parks within the EMBA: Garig Gunak Barlu Marine Park (NT), Lalang Garram / Camden Sound (WA), Rowley Shoals Marine Park (WA), Scott Reef Nature Reserve (WA) and Browse Island. Values associated with these marine parks include marine fauna and coral reefs, mangroves, saltmarshes and sandy beaches. These values may be contacted by entrained and dissolved oil which would potentially impact the receptors as described in this table. The values of these marine parks are described in Appendix B. World, National and Commonwealth Heritage Places The Kakadu National Park is the only Australian world heritage place within the EMBA and has an 8 % probability of surface oil >10g/m2 in 25 days and maximum 19 % probability of oil accumulated onshore >100g/m2. Receptors within this park include mangroves and wetlands which in turn support migratory birds. Impacts to these receptor types are described in this table from surface, entrained and dissolved oil.

The minimum time before exposure to surface hydrocarbons above the impact threshold of 10 g/m^2 for any heritage area is predicted to be 4 days at the Kimberley National Heritage area. The minimum time before shoreline accumulation at the impact threshold of 100 g/m^2 is 7 days for the Kimberley coast. Threatened Ecological Communities The Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula is the only Threatened Ecological Community within the EMBA. Receptors within this TEC include coastal sand dunes and beaches which may result in impacts to fauna utilising the beaches. Impacts to shoreline habitats are described in this table from both entrained and dissolved oil. Wetlands of International Importance Wetlands identified within or adjacent to the EMBA include Ashmore Reef National Nature Reserve, Cobourg Peninsula, Hosnies Spring, Ord River Floodplain, Kakadu National Park Pulu keeling national park, and The Dales. Some of these wetlands represent wetland types near natural condition within the region and may be contacted by surface or entrained oil. Impacts to wetlands, tidal marshes and associated receptors are described within this table, with impact consequence depending on each site's access to open ocean, degree and duration of oiling and the degree of weathering of the arriving oil. KEFs There are no KEFS that would be impacted by surface oil as the KEFs relate to geomorphologic features which are not expected to be impacted by hydrocarbons. Values and sensitivities associated with the KEFs include marine fauna due to the higher diversity of fish species associated with the higher diversity in fish communities or nutrients such as Continental Slope Demersal Fish Communities; or benthic habitats at Ashmore Reef and Cartier Island and surrounding Commonwealth waters - as discussed individually above. There are a number of KEFs that are overlapped by the RISK EMBA including: Continental Slope Demersal Fish Communities, Ashmore Reef and Cartier Island and Surrounding Commonwealth Waters, Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex, Canyons Linking the Argo Abyssal Plain with the Scott Plateau, Mermaid Reef and Commonwealth Waters Surrounding Rowley Shoals, Pinnacles of the Bonaparte Basin, Ancient Coastline at 125 m Depth Contour Carbonate Bank and Terrace System of the Sahul Shelf, Shelf Break and Slope of the Arafura Shelf, Carbonate Bank and Terrace System of the Van Diemen Rise, Exmouth Plateau, Tributary Canyons of the Arafura Depression, Glomar Shoals and Gulf of Carpenteria Basin. The minimum time before exposure to surface hydrocarbons above the impact threshold of 10 g/m^2 for any KEF is predicted to be 32 hours for the Carbonate bank and terrace system of the Sahul Shelf. Impacts to features (such as canyons or pinnacles) in deep waters are not expected to be affected by entrained or dissolved oil due to the nature of these features. However, values associated with shallower KEFs such as reefs and islands and the surrounding waters will be affected by changes in water quality and impacts to receptors within the water as described in this table. Contact with entrained hydrocarbons above the 100 ppb threshold is predicted at all the KEFs in the EMBA albeit most at very low probabilities (<1%) for some, depending on the season, water depth and distance (e.g. Exmouth Plateau and Tributary Canyons of the Arafura Shelf,) consequently impacts are not anticipated. Likewise, exposure to dissolved aromatics above the 70 ppb threshold is predicted with the highest probability at the Carbonate bank and terrace system of the Sahul Shelf, Ancient Coastline, Ashmore Reef and Cartier Island KEF and Continental Slope Demersal Fish Communities with a low probability of < 1 for the remote KEFs. **Recovery Timeframe** Recovery of benthic habitats within Protected Areas exposed to entrained hydrocarbons and experiencing impacts would be expected within weeks to months of return to normal water quality conditions. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Burns et al., 1993; Dean et al., 1998). The timeframe for recovery of receptors within these areas are described within this table. **Consequence** The consequence of a loss of well control event on protected areas was assessed as ***Critical*** given recovery to some habitats such as corals with longer restitution times within these protected areas may take decades to recover.

Overall Consequence	Likelihood	Ranking
Critical (worst-case of all above receptors)	Unlikely	Medium

7.6.8 Priority receptors

For spill response planning purposes, priority receptors were identified from the sensitive receptors using the criteria outlined in Section 5. In a spill event, the IAP, NEBA and planning process takes over; utilising real-time operational data and focusing operations on locations to be contacted (which will be a subset of what is planned for). This allows for preparedness and planning for the most credible scenarios whilst retaining flexibility in response to manage an event.

Nine priority receptors for spill response have been determined from the worst-case modelling results (Table 7-6).

Table 7-6: Priority receptors rationale

Priority receptors	Individual locations included in receptor	Rationale
Ashmore Reef / Cartier Island	• Ashmore Reef and Cartier Island and surrounding Commonwealth waters	• Shoreline loading volumes • Minimum time to contact • High value • >5% probability of contact
International Waters	• Timor Leste • Indonesia	• Shoreline loading volumes • High value • >5% probability of contact
Darwin Coast	• Darwin Coast	• Shoreline loading volumes • Time to contact • High value • >5% probability of contact
Joseph Bonaparte Gulf NT	• Joseph Bonaparte Gulf Northern Territory	• Shoreline loading volumes • High value • Time to contact • >5% probability of contact
Western NT	• Kakadu Coast • Cobourg Peninsula • East Arnhem Land • West Arnhem Land	• Shoreline loading volumes • High value • Time to contact • >5% probability of contact
Tiwi Islands	• Melville Island • Bathurst Island	• Shoreline loading volumes • High value • Time to contact • >5% probability of contact
Kimberley Coast	• Kimberley Coast	• Shoreline loading volumes • High value • Time to contact • >5% probability of contact

Priority receptors	Individual locations included in receptor	Rationale
Browse Island	• Browse Island	• Shoreline loading volumes • High value • Time to contact • >5% probability of contact
Seringapatam Reef and Scott Reef	• Seringapatam Reef, Scott Reef and Sandy Islet	• Shoreline loading volumes • High value • Time to contact • >5% probability of contact

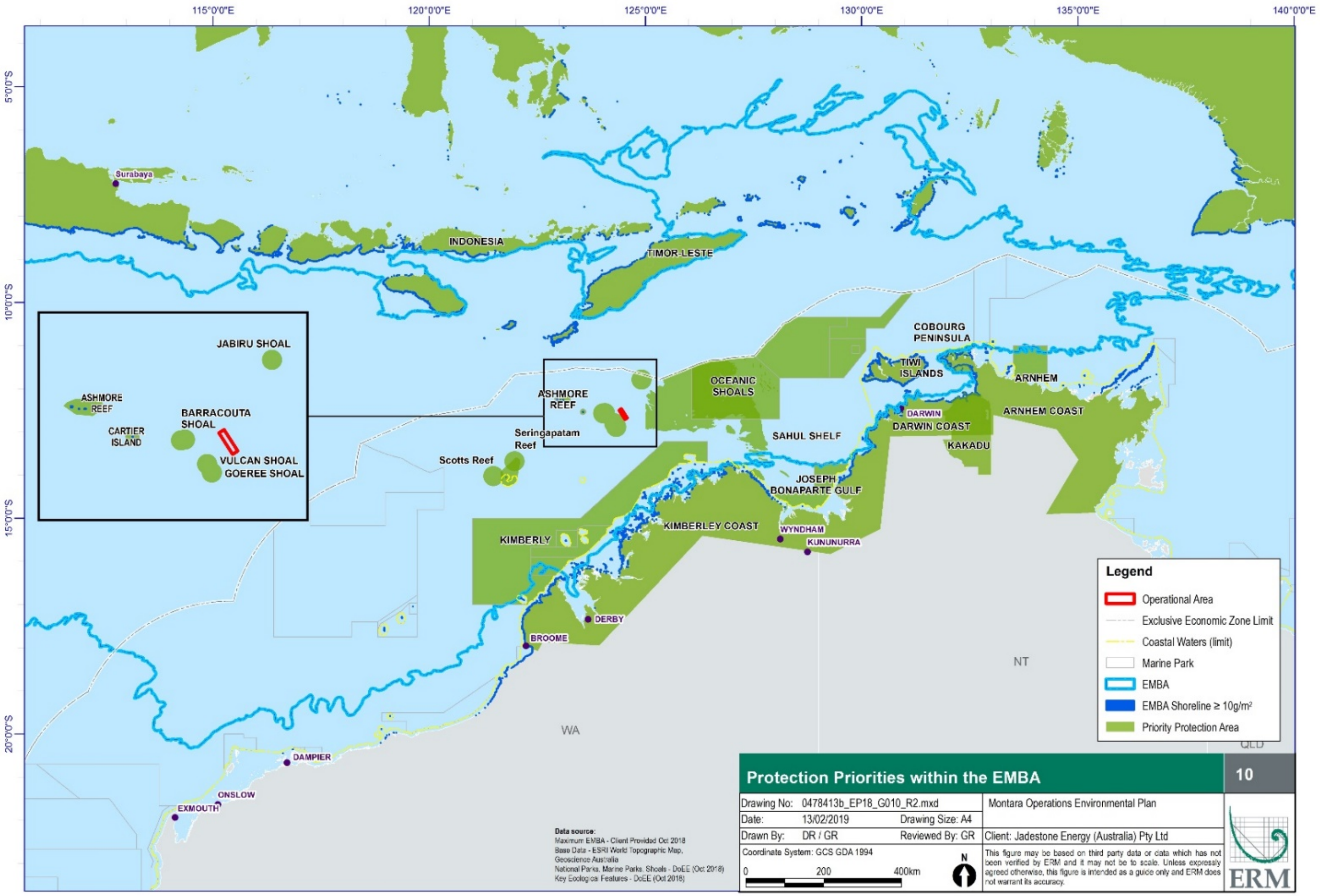


Figure 7-6: Priority receptors

Table 7-6 lists the rationale for the Priority Receptor selection (also refer Section 5) and Appendix H details the specific key values and modelled contact of the Priority receptors.

A NEBA was conducted to determine the Environmental Performance Outcome (EPO) for the locations and the spill response measures that would be required to meet the EPO and thereby reduce impacts associated with spill response to ALARP (Table 7-7).

7.6.9 Net Environmental Benefit Assessment (NEBA)

Net environmental benefit assessment (NEBA) is a structured approach used by the spill response community and stakeholders to select spill response strategies that will effectively remove oil, are feasible to use safely in particular conditions, and will reduce the impact of an oil spill on the environment.

The NEBA process is used during pre-spill planning (Strategic NEBA) and during a response (Operational NEBA). A Strategic NEBA is an integral part of the contingency planning process and is used to ensure that response strategies for scenarios are well informed. An Operational NEBA is used to ensure that evolving conditions are understood, so that the response strategy can be adjusted as necessary to manage individual response actions and end points.

Balancing trade-offs may involve differing and conflicting priorities, values and perceptions of the importance of sensitive receptors. There is no universally accepted way to assign perceived value or importance and is not a quantitative process. Overall, the NEBA process provides an estimate of potential environmental effects which are sufficient to allow the parties to compare and select preferred combinations of response strategies to reduce environmental impacts to ALARP.

Table 7-7 provides the NEBA for the Priority receptors and the potential impact that response strategy has on the environmental values of the area, noting that response strategies are not used in isolation. This information is to be considered during the development of the Incident Action Plan in a spill response (i.e. an Operational NEBA). An Operational NEBA will also consider feedback from operational and scientific monitoring activities (refer OPEP), real time monitoring of the effectiveness and potential impacts of a response and will also consider accessibility, feasibility and safety of responders.

Table 7-7: Impact of selected spill response strategy on the environmental values of Protection Priorities

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan								
Ashmore Reef / Cartier Island									
Seabirds									
Mangroves								n/a	
Emergent reefs								n/a	
Turtle nesting beaches									
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected Areas									
Wetlands								n/a	
Socio-economic									
Darwin Coast									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Socio-economic									
International waters (Timor Leste and Indonesia)									
Seabirds									
Mangroves								n/a	

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable** **- Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant)** **- Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan**								
Emergent reefs								n/a	
Turtle nesting beaches									
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
National Park									
Wetlands							n/a	n/a	
Socio-economic									
Joseph Bonaparte Gulf NT									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected Areas									
Wetlands								n/a	
Socio-economic									
Western NT (incl, Kakadu Coast, Coburg Peninsula, East and West Arnhem Land)									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan**								
Marine fauna						n/a	n/a		
Protected Areas									
Wetlands								n/a	
Socio-economic									
Turtle nesting beaches									
Tiwi Islands (Melville Island and Bathurst Island)									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a	n/a	
Socio-economic								n/a	
Turtle nesting beaches									
Kimberley Coast									
Seabirds									
Mangroves								n/a	
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected Areas									
Wetlands									
Socio-economic									

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable - Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant) - Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan**								
Turtle nesting beaches									
Browse Island									
Seabirds									
Emergent reefs								n/a	
Turtle nesting beaches									
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected Areas									
Socio-economic									
Seringapatam and Scott Reef									
Seabirds									
Mangroves								n/a	
Emergent reefs								n/a	
Turtle nesting beaches									
Coral reefs						n/a	n/a	n/a	
Marine habitat						n/a	n/a	n/a	
Marine fauna						n/a	n/a		
Protected Areas									

Protection Priority environmental values	No controls	Source control	Dispersant (surface / Subsea) *	Operational Monitoring	Containment and recovery	Shoreline Protection	Shoreline Clean-up	Oiled Wildlife Response	Scientific Monitoring
Environmental Outcomes	**- Reduce oil volumes from reaching the shoreline to as low as reasonably practicable** **- Prioritise sanctuary zones and KPI species and habitats (as per marine park management plan if relevant)** **- Reduce impacts to marine and coastal fauna through the implementation of the WA Oiled Wildlife Response Plan**								
Socio-economic									
Legend		Beneficial Impact							
		Possible beneficial impact dependent upon the situation (e.g. Timeframes and metocean conditions to dilute entrained oil)							
		Negative impact							
	n/a	Not applicable for the environmental value							

7.6.10 Environmental performance

Environmental Risk		**Unplanned release of crude oil**		
Overall Performance Outcome		**No reportable spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
108	Implementation of the Jadestone Drilling Management System - Well Integrity Manual	Barrier verification pressure testing and well barrier analysis undertaken	Records of well barrier verification and pressure testing maintained and reported in daily drilling report and end of well report.	Drilling Manager
109	Implementation of the Jadestone Drilling Management System - Well Operations Management Plan	Overall well activity management processes and life cycle activities undertaken including well integrity performance monitoring and well integrity incidents excursion management in accordance with the NOPSEMA accepted WOMP.	Records of well integrity performance monitoring and well integrity incidents maintained and reported in daily drilling report and end of well report.	Drilling Manager
			Completed Well Handover Data Books in CMMS	OIM
110	WHP: emergency shutdown functional in accordance with Performance Standards Report (MV-70-REP-F-00002)	The SIS are tested according to the Assurance Plan which is planned and managed using CMMS	Inspection and testing records	OIM
111		Emergency Shutdown push buttons located in the central control room and throughout the WHP tested and fit for purpose	Audit records confirm standard	
112		ESDVs are regularly tested and fit for purpose	ESDV testing records	OIM
113		PSVs undergo external inspection annually and internally inspected	Inspection and testing records	OIM
114	Wellhead valves installed and tested in alignment with Performance	Wellhead Valves are installed/maintained/ tested and found fit for purpose	Installation. maintenance and testing records in CMMS	OIM

Environmental Risk		Unplanned release of crude oil		
Overall Performance Outcome		**No reportable spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
	Standards Report (MV-70-REP-F-00002)			
115	MODU move procedures followed and in alignment with the Marine Operating Manual	• Functioning positioning equipment (DGPS) on MODU • Functioning AHTS for final positioning • Preload method as per underwriter and drilling contractor's Marine Operating Manual • Position of infrastructure (platform, pipelines, subsea wellheads) marked into positioning software. • Surveyor on board MODU during MODU move in. • Wells shut in and depressured at surface for rig approach and positioning. • Rig move procedures in place (including minimum 3 support vessels for positioning) • Minimum bollard pull requirements for AHTS met or exceeded. • Weather window acceptable for tow and pre-load phase. • Tow vessels inspected by Tow Master prior to commencement of tow. • Experienced Tow Master to move the MODU and on board for all transits and positioning	MODU move procedure reviewed and approved by JSE, drilling contractor and surveying company. Realtime display and logging Marine Operating Manual checklist completed Inspection and survey reports Master Mariner qualifications and experience	MODU and WHP OIM Tow Master Supply Chain Lead
116	Tow equipment confirmed fit for purpose	Tow equipment certified as fit for purpose. Tow equipment visually inspected by Rig Mover / Tow Master prior to commencement of tow.	Evidence inspection record	Tow Master

Environmental Risk		Unplanned release of crude oil		
Overall Performance Outcome		**No reportable spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
117	Seabed study – no punch through of seabed risk.	Prior to commencement of activity, a survey using ROV will be undertaken which will include a visual survey of the seabed within the footprint of the mooring area. Study reviewed independently by MODU underwriter.	Approved Seabed Study	MODU OIM
118	SIMOPs Plan	An interfacing alarm and shut down system will be employed to assist with the safe management of the operations. A handheld radio UHF communications system will be available between the MODU and the FPSO. A copy of the Simultaneous Operations Plan must be available to all personnel on the MODU and Jadestone	Approved SIMOPs Plan in place and available to all personnel on MODU and Jadestone	WHP OIM MODU OIM
119	Blowout Contingency Plans (JS-70-PLN-D-00001)	Intervention actions undertaken in accordance with the Blowout Contingency Plan.	Records confirm the Blowout Contingency Plan was implemented.	Drilling Manager
120	Relief rig available through Petroleum Industry Oil Spill Response MoU	Maintenance of access to a drilling rig should the need arise for a relief well to be drilled.	Record of valid MoU in place.	ER Lead
121	Implement Oil Pollution Emergency Plan (OPEP)	In the event of a Level 2 or Level 3 spill, compliance with OPEP including develop and implement an IAP using the processes described within the OPEP.	Response records confirm OPEP was adhered to and an IAP was developed and implemented.	IMT Lead
122	Incident Management Team Response Plan (JS-70-PLN-F-00008)	Implement the Incident Management Team Response Plan in the event of a spill of hydrocarbons to the marine environment	Incident log	IMT Lead

Environmental Risk		Unplanned release of crude oil		
Overall Performance Outcome		**No reportable spill of hydrocarbon to the marine environment.**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
123	Emergency Pipeline Repair Plan (GF-09-PLN-L-00039)	Repair of damage to subsea export pipeline to its original capacity such that pipeline license requirements are fulfilled, and the environmental and business consequence of any failure are minimised.	Incident log	IMT Lead
124	Post spill scientific monitoring program undertaken	Monitor impacts and recovery of the values and sensitivities identified in this EP in accordance with the OSMP.	Monitoring reports indicate no long-term impacts to the values and sensitivities identified in this EP.	IMT Lead
125	MODU and Montara Operations Safety case	Maintain safety critical aspects as per Safety Case	Records confirm Safety Case standards met	MODU OIM Operations Manager

7.6.11 ALARP assessment

Since this is an infill drilling campaign, the oil type and well characteristics are relatively well understood. As such, the control measures to be used to reduce the risk of oil spills to ALARP are likely to be similar to previous drilling campaigns within this field. All safety options have been considered for the Drilling Activity with no additional safety options possible, it is considered that the risk of a loss of containment occurring has been reduced to ALARP. The combination of the standard controls (which reduce the likelihood of the event happening), and the spill response strategies (which reduce the consequence) together aim to reduce potential impacts from a hydrocarbon spill. An oil spill response review was undertaken and a summary of the rationale behind the spill response measures selected is provided in Table 7-6.

Subsea Controls

Pipeline rupture from external factors through anchor drag is not considered credible as the vessels and the MODU will not be using anchors. The scenario of a dropped object damaging the subsea export pipeline was considered not credible due to the final MODU position and supply arrangements for MODU not including the pipeline within the respective dropzone footprints. The rigid riser section of the pipeline is also protected by a frame and runs inside the jacket leg footprint providing additional protection from swinging loads and vessel impacts.

Controls are in place (refer Section 7.6.10) which reduce the likelihood of spill events, in particular the wells and flowlines shut in and depressured when moving the MODU in. There are no further controls that are considered to provide a net benefit in reducing the likelihood or consequence of a release of Montara or Skua crude to the marine environment and thus the controls are considered ALARP.

Spill Response Controls

For a Level 1 crude oil spill, containment and clean-up is assisted through the bunding system provided around drilling equipment and the regular inspection programs. Spills are responded to as per emergency and spill response procedures which are practised through regular spill/ emergency response drills on the rig and vessels. In the event that diesel or crude oil is not contained through the barriers and procedures onboard the MODU, the OPEP, which outlines the detailed response and logistical requirements necessary to combat a worst-case spill, will be implemented to reduce the impacts of a crude oil spill to ALARP.

A Net Environmental Benefit Analysis (NEBA) will be used to determine which spill response strategies are appropriate for a given spill scenario and is an integral part of the IAP process. Source control, operational monitoring activities and spill response strategies considered for a Level 2/3 spill are shown in. Table 7-7.

The spill response strategies have undergone a robust evaluation and environmental risk assessment process. The applicability of the control to the spill scenario and establishing requirements for each control to ensure its effectiveness in meeting the EPO was also undertaken.

The assumption was that existing controls were ineffective (i.e. 100% probability the spill occurred) and each control would be exposed to the full volume of oil under the maximum credible worst-case scenario. This approach promoted a level of conservatism in the proposed control strategies, and, in particular, the measures for determining the effectiveness of controls and the requirements to achieve the level of effectiveness.

The ALARP assessment for the level of resourcing required for each of the spill response strategies adopted is provided in Table 7-8, based on the capability described in the OPEP. This considers the incremental benefit of increasing resourcing levels for each spill response strategy and the associated upfront costs. The effectiveness of each of these response strategies has been increased to a point where further sacrifice made would result in a disproportionately small reduction in environmental benefit.

From this assessment, it is considered that through the resourcing arrangements outlined within the OPEP and in Section 6.8.3 (including spill response equipment and personnel from internal and external sources including via the AMOSPlan, AMSA, OSRL, other operators and other national suppliers) the spill response strategies and control measures reduce spill risk to ALARP.

Table 7-8: ALARP assessment for the level of resourcing available for spill response strategies

Strategy tasks and resources arrangement improvements considered	Environmental/Social/Economic consequences of additional resources from those described in the OPEP	Practicality of additional resources	ALARP assessment	Adopted?
Source Control – increase oil spill response capability of MODU and support vessels beyond a Level 1 response (as well as FPSO capabilities in the vicinity) Section 8 of OPEP	Reduce volume or speed of spill entering marine environment.	Significant cost would be incurred for Jadestone to alter the contractual arrangements to increase capability with consideration for equipment, storage, maintenance, crew training and safety of crew when deploying gear.	The rig and vessel have the response capability as described in the SOPEP and geared towards a Level 1 incident. The SOPEP is to provide shipboard notification and response procedures for stopping or minimizing the unexpected discharge of oil from a rig/vessel without compromising the safety of the crew, the rig/vessel or the environment. Unexpected discharge includes the discharge of oil during rig/vessel operations, or rig/vessel casualty. It is consistent with the National Plan that the FPSO, MODU and vessels have a level 1 capability. For Jadestone to increase the response capability above a Level 1, would be a disproportionate benefit for the effort. In addition, the worst-case spill results from a vessel collision and the priority of the vessel master is to safeguard the crew and remove all non-essential personnel. Therefore, there is no value in supplementing the vessels' SOPEP capability, and therefore the arrangements described in the OPEP are considered ALARP.	No
Source Control – Monitor external drilling programs for MODU availability	Potentially reducing the time to drill the relief well, resulting in less hydrocarbons to the environment.	The cost is minimal.	Jadestone can monitor the availability of rigs within Australia that may be contracted by other oil and gas operators that overlap with the drilling programs, potentially providing availability of a relief well drilling rig quicker.	Yes

Source control - Monitor status of Registered Operators/ Approved Safety cases for rigs	Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	The cost is minimal.	Jadestone can monitor the status of Registered Operators for rigs operating within Australia (and therefore safety case status). This allows for a prioritised selection of rigs in the event of a response with priority given to those with an existing safety case.	Yes
Source control – Jadestone to become a signatory to the APPEA MOU for mutual aid to facilitate and expedite the mobilisation of a relief well	Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	The cost is minimal.	The APPEA MoU commits the signatories to share rigs, equipment, personnel and services to assist another operator in the event of a LOWC incident. This would potentially enable Jadestone to source a suitable relief well drilling rig quicker, and would also provide access to additional equipment, personnel and services.	Yes
Source control - standby MODU available in-field during drilling operations instead of having to source and deploy at the time of loss of containment	Potentially reducing the time to drill the relief well, resulting in less hydrocarbon to the environment.	The total cost is approx. $105 million during the 150-day program. If adopted this cost is paid regardless if there is a loss of containment event or not.	A MODU on standby close to the well location for the duration of the EP in readiness to drill a relief well may remove 10 days from the base case required to source and mobilise the MODU. However, the MODU would be required to be on standby 24/7 over the 150 days of the Drilling Program– this is not feasible. The costs, safety concerns and complexity of having a MODU and maintaining this arrangement for the duration of the EP is grossly disproportionate to the environmental benefit gained.	No
Source control - Position Subsea First Response Toolkit (SFRT) to Darwin, closer to the potential spill location	Potentially reducing the time to start the application of subsea dispersants, resulting in a reduction of surface oil and shoreline loading	AMOSC does not agree to the relocation of the SFRT due to the risk to other SFRT members	Relocating the SFRT is not a reasonably practicable strategy as the SFRT is a shared resource. Mobilisation of the SFRT will occur at the same time as mobilisation of a suitable construction class vessel to Darwin. The SFRT cannot be transported to the well location until the vessel is available in Darwin, which is expected to take 7 days.	No

			This option has not been adopted as it is not reasonably practicable and the costs and risks to other SFRT members are considered grossly disproportionate to the environmental benefit that might be gained.	
Source control - Monitor status of available construction class vessels that would be required to deploy SFRT	Potentially reducing the time to start the application of subsea dispersants, resulting in a reduction of surface oil and shoreline loading	The cost is minimal	Jadestone can monitor the availability of suitable construction class vessels within the Asia-Pacific Region that may be able to deploy the SFRT, if required. This would potentially provide availability to a suitable vessel to deploy the SFRT quicker.	Yes
Aerial surveillance – additional dedicated aircraft and observers	Limited environmental benefit by having additional dedicated resources -increase identification of marine fauna presence.	Additional charter costs would be incurred by Jadestone to increase aerial surveillance. There may be a need for additional resources if determined through the IMT based on the amount of available information and potential data gaps. These can be arranged without need for further upfront costs or planning.	Aerial surveillance is not the only dedicated surveillance tactic. Opportunity for surveillance will also occur from responder movements, chemical dispersant applications and C&R. Increasing aerial surveillance would increase the safety risk. The spatial extent of the spill is more dependent on tidal influences than the wind. The two-passes per day dedicated aerial surveillance is sufficient to validate and inform the IAP process to ensure overall response is commensurate with nature and scale of incident. Therefore, there is no value in increasing dedicated overpasses and therefore the arrangements described in the OPEP are considered ALARP.	No
Vessel surveillance – additional dedicated vessels and observers	No environmental benefit for additional dedicated resources given the need is met through vessel sharing and surveillance will also be conducted through a number of complementary	In the event that additional dedicated vessels are required due to data gaps, resources are available. The cost of the additional vessels will	There is no benefit in having additional dedicated surveillance vessels given surveillance can be performed from any vessel and these duties will be shared amongst spill response vessels. Increasing vessel surveillance would increase the safety risk.	No

	operational monitoring strategies (aerial surveillance, tracker buoys	be added to the cost of the response.	Aerial surveillance, tracker buoys and UAVs are more efficient and effective at determining extent of oil movement, vessel surveillance is a secondary tactic. Therefore, there is no value in increasing dedicated vessel numbers and therefore the arrangements described in the OPEP are considered ALARP.	
Tracking buoys – additional tracking buoys	No environmental benefit for additional dedicated resources. Tracker buoys require maintenance which can be scheduled from the CPF as part of the spill response equipment	Additional buoys are available through AMSA and AMOSC within days. There is no additional upfront cost for accessing these secondary buoys.	Tracking buoys are one tactic in the operational monitoring strategy. The number of buoys immediately available is sufficient to cover tracking of oil given the other response activities that will be undertaken. Therefore, there is no value in increasing tracker buoy numbers and therefore the arrangements in the OPEP are considered ALARP.	No
Fluorometry	The purpose of fluorometry is to: 1) inform the location and concentration of entrained oil plumes; 2) inform the scientific monitoring; 3) provide validation for trajectory modelling predictions and tracker buoys. Additional fluorometers may limit missed data opportunities. Fluorometry will target subsea plumes approaching those sites that have the greatest potential for environmental impact (i.e. the most sensitive areas with the highest predicted concentration of entrained oil). Any additional fluorometers would be deployed to other sensitive areas in the EMBA	Jadestone can access 5 subsea gliders with fluorometers through Blue Ocean Monitoring (via Astron) and additional fluorometers through CSIRO. This is considered sufficient for upfront planning. Additional tow behind fluorometers can be sourced from CSIRO if apparent there are data gaps that can't be filled by existing arrangements. This would not be an upfront	The existing arrangements are considered sufficient to meet fluorometry purpose. Additional fluorometers can be arranged and deployed should the need arise this is not considered time critical and the additional benefit is considered low. Therefore, there is no value in increasing fluorometry numbers and therefore the arrangements described in the OPEP are considered ALARP	No

	and once those fluorometers have confirmed presence of entrained oil, these units can be moved to other areas. Therefore, it is considered there is little additional environmental benefit in having more fluorometers.	cost, but the need and costs would be assessed after a spill event.		
Ongoing real time collection of data prior to any spill event.	Greater awareness of the environment	An ongoing surveillance program would be at considerable cost to the project. Depending on the measured parameters this could involve ongoing costs in the order of hundreds of thousands each year.	Ongoing collection of real time environmental data would provide immediate inputs into decision making however this would require the use of aerial resources, satellite resources, ground surveys and marine surveys. The existing contracts in place for aerial surveillance, satellite imagery, trajectory modelling, and shoreline surveys can be activated in a timeframe that provides short, medium, and long-term access to data.	No
SCAT – additional resources to increase number of SCAT	Shoreline Clean up and Assessment Technique (SCAT) is a systematic method for surveying an affected shoreline after an oil spill. SCAT is designed to support decision-making for shoreline clean up. It is flexible in its scale of surveys and in the detail of datasets collected SCAT continues during the response to verify shoreline oiling, clean-up effectiveness, and eventually, to conduct final evaluations of shorelines to ensure they meet clean-up endpoints.	The cost of additional resources is not considered the limiting factor; the limiting factor is the availability to use resources at the physical location. Additional people from described in the OPEP could cause unnecessary environmental impacts. If required, additional equipment will be sourced, and the	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP). Not all of the shoreline in the RISK EMBA will be contacted. The potentially oiled shorelines are remote, and the majority is made up of mangroves, tidal wetlands and no access via land. Aerial and marine deployment of teams and surveys can be done efficiently for those areas able to be accessed. The limiting factor is being able to access those areas. Current capability is 25 teams which can be deployed across the shorelines for accessible locations. The minimum time to contact for SCAT is 7 days at Kimberley Coast, which is enough time for Jadestone to determine the direction of the spill, deploy SCAT and gather information for the IMT.	No

		additional cost borne by Jadestone.	The existing arrangements are considered sufficient to meet SCAT purposes. Additional personnel can be sourced and deployed should the need arise; this is not considered time critical and the additional benefit is considered low. Therefore, there is no value in increasing SCAT numbers and therefore the arrangements described in the OPEP are considered ALARP.	
Chemical dispersant application – additional resources to that in the OPEP	Potential for further reduction of surface oil and shoreline loading (reducing/eliminating further environmental impacts - clean-up and protection and deflection intrusions, oiled wildlife) and an increased ability of the environment to biodegrade the oil more rapidly to below threshold levels; thus, reducing the severity and duration of the spill and subsequent economic and social impacts. A negative consequence is the further increase in localised entrained and dissolved oil concentrations with subsequent risk of additional environmental impacts to organisms in the water column. This could have negative flow-on social and economic consequences e.g. recreational and commercial fishing, diving.	Additional resources include: Dispersant costs of \$10,000 per m^3. FWADC aircraft \$15,000 per aircraft per day. Vessels \$15,000 per day plus fuel costs of \$1,600 per day. Additional expert personnel. Chemical dispersant operations are to be conducted in daylight hours only. Indicative costs: Cost of suitable aircraft (e.g. crop duster) USD\$350,000 Standby for Jadestone specialist personnel \$150,000 p.a.	Jadestone undertook an evaluation to determine the most effective resource requirements to reduce the environmental risk from a worst-case spill event to ALARP. Aspects considered were weathering of oil, volume of surface oil, timeframe and spread of spill, best case target area (i.e. thickness of oil), location of sensitive receptors, geographic location of application, location and type of dispersant stocks, volume of dispersant required, number of vessels and aircraft and ancillary resources. Evidence from the Montara oil spill in 2009 from AMSA reported that 'based on experienced personnel during the response the use of dispersant was highly effective in assisting the natural process of biodegradation and minimising the risk of oil impacts on reefs and shorelines' (Refer Appendix 4 of the OPEP). If there is a weather condition that prevents the application of dispersant (which is unusual for the environment around the Montara facility), this in itself, creates dispersion. The results of the best-case capability evaluation for dispersant application is described in the Chemical Dispersant Plan as detailed in the OPEP Section 10.5 and 16.5 shows that Jadestone has access to more than enough dispersant through national and international stockpiles to exceed the required need. The OSRL Global Dispersant Stockpile volume was determined after evaluating global loss of well control events and accepted as being able to meet these events. An analysis was undertaken to determine the most effective mix of aircraft and vessels applying dispersant. Comparisons made between	No

		Purchasing dispersant stock and maintenance in Darwin $400,000 p.a. Purchasing dispersant vessel and application equipment $300,000.	4, 6 and 8 FWADC aircraft and different vessel numbers indicated that 6 FWADC, 1 Hercules, 1 Boeing 727 and 5 vessels was the optimum. Jadestone has calculated the amount of dispersant required based upon the volume of oil that is released each day and then liaised with agencies to evaluate the best delivery timeframes. Jadestone is able to begin dispersant spraying on Day 2, ramp up by Day 4 and then meet and exceed the need from Day 8 onwards. This access to more dispersant than needed will allow Jadestone to spray on residual oil to account for the time prior to the need being met. • **Application of Chemical Dispersant from the FPSO/WHP or MODU**. Storing sufficient resources for dispersant application on the FPSO/WHP/ MODU to spray on the spill at source could result in faster dispersant application at source, until the Chemical Dispersant Plan resources are deployed. In the event of the worst-case spill, the priority is to ensure safety of people, manage the integrity of the vessels and enact source control. Once these aspects are managed, then spill response at site can be implemented. A collision capable of causing a spill to the marine environment would result in the MODU and FPSO and WHP being evacuated except for personnel essential to undertake damage repairs and tasks described in the SOPEP which, from a safety and operational perspective, would be significantly hindered if dispersant spraying was undertaken from the MODU and FPSO or WHP. The MODU, FPSO and WHP do not have the capacity to appropriately store/maintain sufficient dispersant stocks and application equipment, the skilled personnel to undertake the spraying, nor the resources to solely allocate to dispersant spraying in the event of a collision. This option is not feasible. Therefore,	

			Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. • **Dedicated dispersant vessels stationed in the field.** Specially adapted vessels (leased or owned) with dispersant, trained crew and dispersant application equipment permanently stationed at the Montara operations in the vicinity could begin spraying dispersant within 12 hours at the spill site. Although the amount of dispersant able to be stored on deck is limited, it would enable dispersion to start until the Chemical Dispersant Plan resources are deployed. In the event of the worst-case spill, the priority is to ensure safety of people, manage the integrity of the vessels and enact source control. Once these aspects are managed, then spill response at site can be implemented. To have vessels spraying dispersant near the incident within 12 hours would hinder the emergency actions and present a safety risk for personnel. The MODU, FPSO and WHP have a 500m exclusion zone within which vessels are not allowed to egress without approval and cannot be permanently moored within for legal and safety reasons. Any vessel is required to moor outside the exclusion zone. To have a vessel dedicated to dispersant application moored permanently near the drilling activities 24/7/150 creates an unnecessary safety risk to vessel crew and is grossly disproportionate to the environmental benefit. The modelling undertaken indicates negligible environmental benefit in terms of reduction of surface oil between Day 1 and Day 7 if chemical dispersant was applied earlier. Therefore, Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. • **Aircraft or vessels on 24/7 standby.** Aircraft or vessels (leased or owned) on 24/7/150 standby with dedicated crew would result in a faster chemical dispersant implementation time (application could	

			begin within 2 days). Aircraft and vessels used for spill response and dispersant application are normally employed in activities such as crop dusting, firefighting and marine services, and adapted for dispersant application when required. Jadestone would require equipped vessels and supporting resources (crew, maintenance, berthing etc) and suitably equipped aircraft and supporting resources (pilots, hangars, maintenance, registration etc). It is not practicable to have dedicated crews, aircraft or vessels in 24/7 state of readiness in Darwin because the frequency of use would result in cost being grossly disproportionate to the environmental risk. In essence, Jadestone would be replicating the FWADC which has been established for industry as a cost effective and fit for purpose preparedness measure. The modelling undertaken indicates negligible environmental benefit in terms of reduction of surface oil between Day 1 and Day 7 if chemical dispersant was applied earlier. Therefore, Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. • **Ownership / Storage of Dispersant by Jadestone in Darwin.** Ownership by Jadestone of dispersant stock and storage in Darwin waiting for use by FWADC or vessels. The limiting factor for dispersant application is the availability of aircraft and associated resources for application, not the availability of dispersant. If Jadestone had its own dispersant stock, the FWADC is still the preferred delivery mechanism to achieve ALARP; with the fastest application beginning time by Day 3. By this time, Jadestone has sufficient dispersant stock ready to be deployed by accessing the AMSA and AMOSC stockpiles. The fastest vessel dispersant application can begin is 36 hours (even if Jadestone has its own stock) due to steaming time to location. The required dispersant stocks can be sourced to conduct operations, without the need for	

			Jadestone to acquire their own resources. There is no added environmental benefit to this option and is not commensurate with the environmental risk. Therefore, Jadestone consider that the Chemical Dispersant Strategy described in the OPEP is ALARP. Jadestone Energy has evaluated the options and consider that it has access to what is required for ALARP via existing arrangements. As a member of an industry-wide oil spill response organisation (AMOSC), a party to an MOU with AMSA and OSRL for oil spill response, Jadestone has access to sufficient response capability to reduce the environmental risk associated with the worst credible spill to ALARP. Real-time planning for where the spill is going is undertaken as part of the Incident Action Planning process and provides a better operational picture for efficient and effective chemical dispersant application. The arrangements for incident management described in the OPEP reduce the environmental risks associated with chemical dispersant applications and are considered ALARP.	
Containment and recovery - additional resources to that in the OPEP	By increasing the recovery of oil off the water, less is able to contact shorelines thereby reducing potential environmental impacts. Additionally, shoreline waste volumes and associated environmental impacts on shorelines is reduced.	Approximate costs: • Vessels $15000 each per day plus $1,600 per day for fuel • Boom hire $12,000 per day for 6 teams. • 6 skimmers $6000. • Additional personnel $1500 per day	Containment and recovery operations will be focussed at source outside the dispersant operations, and near shorelines on the trajectory of the spill. If this is tracking towards Kimberley Coast (the shortest timeframe (7 days refer Section 12 of the OPEP) determined by the modelling), there are not estimated to be big volumes on mainland Australia (or contact at all). Operations will focus on the priority receptors (as the most commonly contacted and environmentally valued locations across all modelled scenarios) and the need is met by the access to resources as described in the OPEP Section 11. Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer Section 11 of the OPEP). Jadestone has the ability to mobilise 45 containment and recovery systems (90 vessels) based on the average daily volume of oil required to be recovered. Given the	No

			significant decrease in volume from Week 2 onwards (Weeks 1 and 2 are not representative of the ongoing spill release), Jadestone considers it more effective to be able to ramp up as quickly as possible to meet the average need, which actually exceeds the estimated volume from Week 6 onwards. The volume of oil released from the worst-case LOWC scenario in Weeks 1 and 2 decreases significantly (by an estimated 50%) by Week 3. Jadestone is able to mobilise 24 systems within Week 1 and 45 in Week 3. From Week 6 onwards, Jadestone has access to the required number of vessels, equipment and resources to be able to exceed the need. These additional vessels from Week 6 onwards will be used to recover excess oil from previous weeks, and also provide Jadestone with the ability to focus operations on priority receptors if required. In addition, C&R activities will be undertaken in areas outside those that have allowed for natural evaporation of the oil and been subject to chemical dispersant operations. C&R is targeted to discrete patches of oil. For Jadestone to purchase and maintain suitable vessels and equipment to be on standby 24/7/150 is cost prohibitive and disproportionate to the risk. Access to supplies via AMOSC, DoT, AMSA, OSRL, contracted marine providers and marine brokers will address nearly half the volume in Week 2, meet the need in Week 6 and exceed the need from Week 7. Jadestone monitors the availability of larger vessels through existing marine brokers to meet specifications for containment and recovery operations. It is not feasible to pre-deploy containment and recovery equipment as modelling identifies many potential shoreline contact locations, largely remote, subjected to very high tides, mangroves and uninhabited. For example, only 33% of the shoreline between Darwin and Broome is beach (OPEP Section 13). Even when the priority receptors are focussed on, the intrusion caused by equipment deployment and maintenance would result in unnecessary additional	

			impact to these locations and potential safety risks for personnel. In addition, the cost of doing this is disproportionate to the benefit. The current level of resources meets for the need as it allows for flexibility in response operations as not all locations will be contacted in a single spill event, exceeds the need from Week 6 onwards and is therefore above to recover excess oil from previous weeks, and, is the maximum realistic resource deployment. Containment and recovery arrangements described in the OPEP are considered ALARP.	
Protection and Deflection - additional resources to that in the OPEP	Additional Protection and Deflection resources reduces shoreline contact and accumulation of oil, and subsequent impacts to shorelines. However, additional resources on shorelines will increase potential environmental contact and intrusion opportunities and increase safety risks of responders.	Boom hire costs are variable depending on the configuration and type used however they are estimated to be approximately $5000 per day. The cost of additional resources is not considered the limiting factor; the limiting factor is considered to be the availability to use resources at the physical location. If required, additional equipment will be sourced and the additional cost borne by Jadestone.	Protection and deflection have limited application for most of the locations due to very high tidal influences, nature of shorelines, remoteness and lack of anchoring points for boom. Oil doesn't contact all shorelines instantaneously but reaches various locations over a period, dependant on oceanic currents and wind directions. As such, implementing a greater initial response is not appropriate, however resources are ramped up as they are required. Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP Section 12). Jadestone determined the resources required based upon the priority receptors estimated worst-case shoreline volumes and timeframes to contact. Jadestone has access to resources via AMOSC, AMSA, OSRL and DoT, and has the ability to move across locations if this strategy is determined to be feasible and safe to implement in consultation with DoT. Mobilising additional resources too early, may result in excess resources being on-location that are not required. Consequently, this has the potential to cause additional environmental impacts if larger than required storage areas and increased personnel presence result in further sensitising coastal habitats without providing significant benefit.	No

			For Jadestone to purchase equipment, store and maintain is cost prohibitive when access via existing stockpiles will meet the need, and the limiting factor is people (who are accessed from outside Darwin). It is cost prohibitive and disproportional to the risk for Jadestone to hire and maintain resources to be on standby 24/7/150 when access to vessels and equipment is granted through contracts and AMSOC/OSRL/DoT/AMSA. Vessels and people will be utilised as determined through the IAP and NEBA. Development of tactical response plans was considered, and Jadestone has access to the INPEX Browse Island Oil Spill Incident Management Guide, which guides response for remote shorelines and islands. The shortest time to contact is 14 days and Jadestone has time to utilise this Guidance to prepare a response. Jadestone has access to the Kimberley Shoreline Response Plan from PTTEP is which has a minimum contact timeframe of 7 days. Jadestone has enough time available to develop required plans without having a pre-prepared one. Given the remoteness of the locations with shoreline contact modelled and drilling activities only short term, there is considered limited benefit for pre-deployment of resources as this would create unnecessary environmental disturbance (both for placement of resources and continuing maintenance) and unnecessary safety risks. In addition, the cost of doing this is disproportionate to the environmental benefit. The current level of resources meets the need as it allows flexibility in response operations; as not all locations will be contacted in a single spill event. Therefore, the arrangements described in the OPEP are considered ALARP.	
Shoreline Clean-up - additional	While oil is arriving, there is limited benefit from additional resources	The cost of additional resources is not	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-	No

resources to that in the OPEP	that might remove oil more quickly and any additional resources may be counterproductive in that additional impacts may outweigh benefits. After the oil has finished arriving, there may be an additional benefit in having increased resources at particular locations dependent upon environmental considerations. For example, a turtle nesting beach during the nesting/hatching season may benefit in having additional resources deployed to clean the beach before nesting/hatching events. There may be benefit in deploying additional machinery in the event of greater opportunities for use, given machinery has the capacity to remove far greater volumes of bulk oil in the right circumstances. The numerous factors and consideration in determining the best approach for shoreline clean-up, the benefit of additional resources will be determined for each Operational Period. However, additional resources on shorelines will increase potential environmental contact and intrusion opportunities, increase	considered the limiting factor; the limiting factor is considered to be the ability to use resources at the physical location. If required, additional personnel and machinery will be sourced, and the additional cost borne by Jadestone.	case spill event. Section 13 of the OPEP describes how Jadestone's plan is to focus resources on the priority receptors based upon the worst-case maximum average daily oil ashore, the nature of the shoreline and the recoverable ability of the clean-up teams. The remoteness and character of potentially affected shorelines raises significant logistical challenges associated with mounting a shoreline response and the potential health and safety risks to personnel. The combination of machinery for mechanical and manual removal of oil and personnel requirements have been considered based on opportunities for use and characteristic of shoreline (i.e. may not be appropriate for small offshore islands, tidal flats, remote rocky or mangrove lined shorelines). It is the opportunity for use rather than the availability of machinery and personnel which is considered the limiting factor. For Jadestone to purchase equipment, store and maintain it is cost prohibitive when access via AMOSC Mutual Aid/DoT/OSRL and mainstream suppliers will meet the need, and the limiting factor is people (who have to be accessed from outside Darwin), health and safety issues for shoreline work and suitable vessels. Given the remoteness of the locations with shoreline contact modelled and short-term nature of drilling activities, there is considered no benefit for pre-deployment of resources as this would create unnecessary environmental disturbance (both for placement of resources and continuing maintenance) and unnecessary safety risks. Allocating shoreline clean-up resources relies on understanding the trajectory of the oil and timeframe for expected contact. It is not practical to pre-position teams ready for rapid deployment to reduce the timeframe for shoreline response. In addition, the cost of doing this is grossly disproportionate to the benefit.	

	safety risks of responders, cause physical damage and could be a negative impact.		Jadestone considered increasing the number of resources to support shoreline response, however, the stated number is based upon the nature of the shorelines and the option of natural attenuation if to conduct operations there would be too environmental damaging. Real time modelling and assessment will determine if extra resources are required. If this is the case, then the resources required are able to be obtained within the shortest time to contact timeframes. The current level of resources meets for the need as it allows flexibility in response operations and surge capacity; as not all locations will be contacted in a single spill event. The arrangements described in the OPEP are considered ALARP.	
OWR – additional resources to that described in the OPEP	The OWR level is a Level 6 (refer WAOWRP and NTOWRP). OWR aims to prevent/reduce the impact to marine fauna (e.g. birds and turtles) and any long-term effects.	Significant additional cost would be incurred if Jadestone were to purchase or hire a facility to base at a staging site or have OWR expert personnel on standby. Significant additional cost would be incurred if Jadestone provided its own oiled wildlife response (personnel, experts, facilities, plans etc).	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP). Additional strategies that have been considered include: • Additional arrangements to improve mobilisation times of international OWR resources (e.g. additional contracts/arrangements with OWR organisations or pre-mobilisation of international OWR personnel); • Jadestone to have OWR expert personnel on standby to improve response; • Jadestone to commission additional training of Australian based OWR personnel to increase numbers of competent OWR personnel; and • OWR resources purchased and based at Darwin and Broome to increase OWR facilities and process timeframes. Given the local (AMOSC and DBAC) and global (OSRL/Sea Alarm) response capability through existing arrangements could be mobilised within required timeframes, the response arrangements are considered ALARP as these plans are contextualised for WA and NT.	No

			The NTOWRP, WAOWRP and the Kimberley regional plan were developed by the Territory and State environmental agency in conjunction with industry, AMSA, AMOSC, Perth Zoo and academia. Therefore, represents the best-oiled wildlife response plans that NT, WA and Jadestone can utilise. The cost for Jadestone to: • purchase/hire OWR equipment and pre-set up facilities at Darwin and/or Broome; • have OWR expert personnel on standby; and • commission additional OWR training in WA is grossly disproportionate to the risk. The Drilling Activities 24/7/150 and significant costs would be incurred to undertake these options. The equipment can be purchased/hired easily. The level of oiled wildlife response required for a worst-case impact event is potentially a Level 6 based on worst-case population density and distribution of shorebirds and an examination of applicable case studies of similar characteristics (i.e. Macondo). The arrangements of OWR outlined within the OPEP are considered sufficient for a controlled escalation of response prior to the worst-case minimum contact times for oil at the sites of highest abundance and sensitivity. The arrangements described in the OPEP are considered ALARP.	
Waste Management - additional resources to that described in the OPEP	While oil is arriving on shorelines, there is limited benefit from additional resources that might remove waste more quickly as the waste is still being collected. After the oil has finished arriving, there may be an additional benefit in having increased resources at particular locations dependent upon environmental considerations.	The cost of additional resources is not considered the limiting factor; the limiting factor is considered to be the ability to utilise resources at the physical location. If required, additional resources will be sourced, and the	Jadestone undertook an evaluation to determine the most effective resource capability to reduce the environmental risk from a worst-case spill event (refer OPEP). The limiting factor for waste collection (which is a support service for Jadestone) is the collection of oily waste. As the arrangements in the OPEP are ALARP, the waste contractor can resource a plan that meets the nature and scale of the event within realistic timeframes. The arrangements described in the OPEP are considered ALARP.	No

	For example, a turtle nesting beach during the nesting/hatching season may benefit in having additional resources deployed to clean the beach before nesting/hatching events.	additional cost borne by Jadestone.		

<table>
<tr><td rowspan="5">Further ALARP demonstration - Engineering Risk Assessment - Evaluation of Alternate Control Measures & Associated Comparative Assessment - undertaken to further evaluate a range of control measure options in relation to the prevention of a blow-out scenario</td><td>Hierarchy of control</td><td>Control Measure Options</td><td>Comparative Assessment of Risks, Cost & Benefit for Control Measure Options</td><td>Apply</td></tr>
<tr><td>Elimination</td><td>Do not drill the well.</td><td>Drilling is required to establish the presence of hydrocarbons and meet the objectives of the title, so not drilling is not an option.</td><td>No</td></tr>
<tr><td>Substitution</td><td>Undertake drilling in alternate season to potentially further reduce exposure to marine fauna from spilled hydrocarbon</td><td>The timing of the proposed activity is based upon the following considerations:
• The schedule requires flexibility to avoid down time (e.g. cyclones)
• Timeliness is important to bring online H6 and Skua-12 wells to support the ongoing production requirements and economic viability of the Montara Field.
Any restriction on activity timing would not be considered reasonably practicable.</td><td>No</td></tr>
<tr><td rowspan="2">Engineering</td><td>Use of a subsea cap and containment system in the event of a blowout.</td><td>Subsea Wells
The installation of a subsea capping and containment system is not feasible for a jack up with the BOP installed at the surface. Montara subsea wellheads are designed for jack up MODU intervention and workovers, with capping not feasible in a blowout scenario, as Capping Stack weights exceed the tree connector capability, and the water depth a little shallow for the Wild Well recommended minimum water depth need for capping stack installation of 120m.
Platform Wells
There are forms of capping stacks that have been used for onshore wells, where access to the wellhead is feasible using a large crane to lower a BOP onto an existing well, once a fire has been extinguished. This option has been considered given the installation of the BOP at the surface could allow for a similar arrangement. However, the use of this type of equipment on offshore platforms is much more difficult as the well is located within the platform topsides structure, making access very hazardous, especially if the well is on fire. Consequently, this is not considered to be a feasible option for these wells, as the likelihood of successfully installing this type of equipment for the worst-case scenario is very low and presents significant other risks.</td><td>No</td></tr>
<tr><td>Offset technology</td><td>This technology is not yet available, and thus has not been considered further</td><td>NA</td></tr>
</table>

		for the deployment of capping stack				

7.6.12 Acceptability assessment

The potential impacts of an unplanned crude release to the marine environment are considered 'Acceptable' in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.		
Policy & management system compliance	Jadestone's HSE Policy objectives are met. Section 8 demonstrates that Jadestone's HSE Management System is capable of continuously reviewing and updating activities and practices during the operation, including spill response arrangements. Alignment with Jadestone Well Integrity Manual Alignment with Jadestone Drilling Management System Alignment with Jadestone Well Integrity Assurance Management System	
Stakeholder & reputation	Stakeholder consultation has been undertaken (see Section 4), including engagement with the Director of National Parks, State and National response agencies of DoT and AMSA, Northern Territory government, commercial and recreational fishing industry bodies and fishers. No concerns have been raised with regards to impacts of a crude spill by relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBCA, AMSA, DER) will occur and thus there will be ongoing consultation with relevant persons during response operations.	
Legislation and Industry good practice	<u>Alignment with Jadestone Drilling Management System - Well Integrity Manual (D41-504807-WC):</u> The Manual is part of the Jadestone Drilling Management System and provides all standards, procedures and practices to manage well integrity and includes the following requirements: • Crews will be adequately experienced, trained in well control techniques and supervised; • Well control drills undertaken prior to entering the reservoir; • For Drilling, the primary barrier will be weighted drilling fluids and secondary barrier will be the BOP which will be regularly maintained and tested every 21 days; • For completion and workover operations two independent tested barriers will always be available • Stress analysis performed to select appropriate casing material for the well; • Casing is pressure tested; and • Memorandum of Understanding between Jadestone & other operators in the vicinity of the H-6 and Skua-12 Drilling Activities for assistance including rig for a relief well. All wells are designed to allow the installation of the required barriers where location, effectiveness and integrity can be verified for all barriers. Well barrier verification sheets documenting primary and secondary barriers shall be maintained and the well barrier verification sheet signed off prior to any of the following operations: • Use of a new barrier; or • Replacement/removal of an existing barrier.	Relevant control measures: • Well control training records • Well control drills records • Primary & secondary barriers • Casing material stress analysis • Casing pressure test results • Industry MoU • Well barrier verification sheets - signed

	<u>Well Operations Management Plan (NOPSEMA Accepted)</u> The primary purpose of the WOMP is to reduce the potential for any loss of well control. It includes a suite of tools and procedures to proactively manage lifecycle well integrity from design to abandonment for planned and unplanned events; early identification of potential hazards and indicators that may lead to a breach of well integrity resulting in a major accident event.	H6 and Skua-12 WOMP
	<u>Montara and MODU Safety Cases and Safety Case Revisions (NOPSEMA Accepted)</u> The primary purpose of the Safety Case is to reduce the potential for any MAEs to occur.	
	<u>Maintenance and Inspection</u> • BOP tested every 21 days. • Pressure and Stress analysis has been undertaken to select the appropriate casing material for the well. • Casing is pressure tested to ensure well integrity is maintained.	BOP testing and records Casing stress analysis and records
	<u>MODU Management of Change:</u> Well barrier verification sheets documenting primary and secondary barriers shall be maintained and the well barrier verification sheet signed off prior to any of the following operations: • Use of a new barrier; or • Replacement/removal of an existing barrier.	MODU MOC process
	<u>OPEP</u> In the event of an uncontrolled well blow out, the OPEP will be initiated. This includes development of an Incident Action Plan (IAP). The IAP will detail the response mechanisms and priority areas for protection based on the actual circumstances of the event, taking into account the spill trajectory, weather conditions, but also importantly safety considerations. Key activities to be addressed by the IAP include a review of the Net Environmental Benefit Assessment (NEBA), re-modelling of oil spill trajectory modelling with relevant spill and environmental data, and ongoing consultation with affected/involved parties that may be required. Response strategy options that will be evaluated in the event of a hydrocarbon spill include: • Monitor and evaluate • Dispersant application • In-situ burning • Containment and recovery • Protection and deflection • Shoreline clean-up • Responding to oiled wildlife	OPEP
	<u>Jadestone Blowout Contingency Plan / Jadestone Crisis and Emergency Response Plan</u> Well Specific Blowout Contingency Planning describes logistical arrangements, reservoir specific information and hazards, relief well considerations and relief well rig/equipment/materials requirements. Such considerations include identification of suitable rigs currently	Jadestone Blow-Out Contingency Plan

	operating in the area, sourcing of required volumes of mud to kill the well from relevant drilling fluids contractors and ensuring sufficient quantities of well casing available on consignment in Darwin. At present, in the unlikely event of a well blowout during Montara production drilling activities, drilling of a relief well will be the primary mitigation.	
	<u>Petroleum industry oil spill response</u> In order to respond to a threatened or actual subsea oil discharge or well control incident, Jadestone has a Memorandum of Understanding (MoU) with other oil and gas operators that have drilling rigs in the vicinity of the proposed activities that could be made available should the drilling of a relief well become necessary. An approximate relief well schedule is detailed in the table below.	Jadestone MOU
Environmental context & ESD	The worst-case credible crude spill scenario for the Drilling Activities is a result of a loss of well control with up to 234,498 m^3 released from within the Operational Area from H-6. The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 7.6.7 and 7.6.8 assess potential pathways and risks from exposure to surface, entrained, dissolved and accumulated oil ashore.; • Preservation of critical habitats: Section 7.6.6 and 7.6.7 describe the modelling predictions of locations where protected areas and sensitive receptors may be exposed to oil, at what concentrations and for what durations; • Assessment of key threats as described in species and Area Management /Recovery plans: See 'Conservation and management advise' below; • Consideration of North-West Bioregional Plan; The NW Bioregional Plan considers hydrocarbon spills as a threat to marine conservation values. This EP aligns with the requirement of the NW Bioregional Plan to assess potential impacts and to have an Oil Spill Contingency Plan in place; and • Principles of ecologically sustainable development: Given the predicted behavior and weathering of the crude, the location of the Drilling Program and the prevention and recovery plans, the risks from oil exposure are not predicted to impact population levels of marine fauna and communities. Biodiversity and ecosystem integrity impacts are predicted to recover fully in the long term as suggested by the Montara 2009 spill.	
Conservation and management advice	Jadestone will have regard to the representative values of the reserves and other conservation advice published and endeavor to ensure that priority is given to the social and ecological objectives and values, of any AMPs, or state marine parks impacted by unplanned crude release to ensure that the objectives of the management plans are not contravened (Appendix B). Noting 'Emergency response' is permitted in all AMPs and state marine parks. Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with activities authorised under the OPGGS Act may be conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. Protected areas within the EMBA predicted to potentially be impacted by crude above threshold levels have been identified as Priority receptors (Section 7.6.8). The 'Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species' will be applied/used as guidance in the event of an oil spill.	

Recovery Plan for Marine Turtles in Australia, 2017-2027	The Recovery plan for marine turtles in Australia (DoEE 2017) identifies Marine pollution as a risk. The Plan requires that the risk of oil spill impact to marine turtles is evaluated and, if required, appropriate mitigation measures are implemented. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Calidris ferruginea (Curlew Sandpiper)	The Conservation advice for the curlew sandpiper identifies Marine pollution as a risk: The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Calidris canutus (Red Knot)	The Conservation advice for the Red Knot identifies Marine pollution as a risk: The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Numenius madagascariensis (Eastern Curlew)	The Conservation advice for Eastern Curlew identifies Marine pollution as a risk: The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved conservation advice for green sawfish (Threatened Species Scientific Committee 2008b)	The Conservation advice for Green sawfish identifies Marine pollution as a risk: The advice requires measures to reduce adverse impacts due to pollution to be considered; and to reduce likely impact on green sawfish.
Approved Conservation Advice for Limosa lapponica bauera (Bar-tailed Godwit	The Conservation advice for Bar-tailed Godwit identifies Marine pollution as a risk: The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Limosa lapponica menzbieri (Northern Siberian Bar-tailed Godwit)	The Conservation advice for Northern Siberian Bar-tailed Godwit identifies Marine pollution as a risk: The advice requires the risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Cartier Island has been identified as important bird nesting location. This section and the proposed controls are consistent with this advice.
Approved Conservation Advice for Pristis pristis (largetooth sawfish)	The Conservation advice for large tooth sawfish identifies Habitat degradation and Marine debris as risks: The advice requires measures to reduce adverse impacts of habitat degradation and/or modification to be considered; and to reduce marine debris likely to impact on large tooth sawfish.
Approved Conservation Advice for Glyphis garricki (northern river shark)	In a LOWC scenario, habitat important for the large tooth sawfish would be identified and given high priority for protection. Any spill response activities (Section 6.8) that generate marine debris are also managed to reduce further potential environmental impacts. This is consistent with the conservation advice.
Interim Recovery Plan 2018-2023 for the Monsoon vine thickets on the	In a LOWC scenario, habitat important for the Monsoon vine thickets would be identified and given high priority for protection. Any spill response activities (Section 6.8) would be managed to reduce further potential environmental impacts. This is consistent with the conservation advice.

coastal sand dunes of Dampier Peninsula	
Interim Recovery Plan for the Threatened Migratory Shorebirds visiting Western Australia	In a LOWC scenario, habitat important for Threatened Migratory Shorebirds would be identified and given high priority for protection. Any spill response activities (Section 6.8) would be managed to reduce further potential environmental impacts. This is consistent with the conservation advice.
Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia 2015c)	In a LOWC scenario, habitat important for the migratory birds would be identified and given high priority for protection. Any spill response activities (Section 6.8) are also managed to reduce further potential environmental impacts to migratory habitats. This is consistent with the conservation advice for Common Sandpiper *(Actitis hypoleucos) and* Sharp-tailed Sandpiper *(Calidris acuminata).*
Australian Marine Parks	Australian Marine Parks are established by proclamation under the *EPBC Act* for the purpose of protecting and maintaining biological diversity in the parks. Environment plan (EP) must be consistent with the Australian Marine Park Management plans. There are nine AMPs within the EMBAs. In all cases where an activity has potential to impact or present risk to AMPs, regardless of whether the activity is inside or outside a park, the EP should evaluate how these impacts and risks will be of an acceptable level and reduced to as low as reasonably practicable (ALARP). Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with mining operations authorised under the OPGGS Act may be conducted in all zones. The requirement is that The Director should be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. Consultation to notify the Director of Parks when the proposed response activities is completed as part of the Consultation process (Section 4, Section 8). The Director notification in the event of a spill that would impact one of the AMPs is included in the OPEP and Implementation section of this EP (Section 8). As such this EP is consistent with the Australian Marine Park Management plans.

7.7 Worst Case Diesel Spill

7.7.1 Description of hazard

Diesel spill	Release of diesel may occur from vessel collision within the Operational Area or a bunkering or dropped object event. The worst-case diesel spill scenario is due to collision of a drilling support vessel with the FPSO resulting in damage to a fuel oil tank and diesel released to the ocean. The maximum worst-case credible spill volume of diesel has been calculated as 906 m^3 based on the largest fuel oil tank on the vessel.

7.7.2 Spill volume

The volume of diesel that could be released to the marine environment from vessel collision and subsequent rupture of fuel tank is largely dependent upon fuel tank position on the vessel, the degree and location of tank damage and tank volume. The AMSA (2015) guideline: *Technical guidelines for preparing contingency plans for marine and coastal* facilities has been used in determining the potential release volume of the credible scenarios. These calculations provide a spill volume of 80 – 250 m^3 for typical support vessels, 906 m^3

for the FPSO anchored in the vicinity of the drilling activities and 5 m^3 during transfer of diesel between support vessels/MODU. For the purposes of determining potential impacts, the larger volume of 906 m^3 has been used as it is considered a conservatively worst case and subsumes both the 5 m^3 and 250 m^3 scenarios.

Table 7-9: Credible diesel releases to the marine environment

Scenario	Maximum Credible Spill	Release duration	Credibility justification
Release of diesel due to vessel collision or dropped object	Based on AMSA (2015) 'other vessel collision' – volume of largest fuel tank = 80 m^3 – 250 m^3 (based on a typical operations and drilling support vessels with a ruptured wing tank); 906 m^3 - based on loss of the FPSO Montara Venture fuel tank	5 hours	Typical drilling support vessels may carry a maximum total fuel cargo of 827–1,594 m^3 total in tanks (see section 2.10). Previous modelling of a 906 m^3 diesel spill in the Operational Area has been reviewed for a conservative assessment of potential worst-case risks.
Leak or rupture of bunkering hose during support vessel to diesel transfer	Based on AMSA (2015) 'Production platform refuelling – continuous supervision' Transfer rate x 15 minutes (continuous supervision) = 20 m^3/hr for 15 minutes = 5 m^3	15 min	AMSA (2015) Indicative maximum credible spill volumes table is directly applicable for production platform refuelling. Continuous supervision is the appropriate credible level of supervision given that transfers are of short duration and refuelling procedures stipulate continuous supervision.

7.7.3 Diesel characteristics

Marine diesel is typically a mixture of volatile and persistent hydrocarbons with a low percentage of volatiles (6%) and with the greater proportion having moderate to very low volatility (89%). The aromatic content is approximately 3%. Viscosity is 4.0cP (at 25°C) and density of approximately 829.1kg/m^3 at 25°C.

In the marine environment, diesel will behave as follows:

- Diesel will spread rapidly in the direction of the prevailing wind and waves;
- Evaporation is the dominant process contributing to the fate of spilled diesel from the sea surface and will account for >50% reduction of net hydrocarbon balance;
- Diesel will entrain under the water surface particularly when wind speed and resultant wave action increase;
- The evaporation rate of diesel will increase in warmer air and sea temperatures such as those at the Drilling Activities Operational Area; and
- Diesel residues usually consist of heavy compounds that may persist longer and will tend to disperse as oil droplets into the upper layers of the water column.

7.7.4 Modelling Approach

A diesel spill scenario of 906 m^3 was modelled by RPS for a spill within the vicinity of the Drilling Activities Operational Area (i.e. where most vessel traffic will occur) to determine the dispersion behaviour of the released hydrocarbon within the marine environment. The modelling considered all seasons of the year and has been reviewed to ascertain the spatial extent of floating and entrained oil above impact thresholds.

A summary of the stochastic modelling methods used to evaluate the weathering and distribution of the 906 m^3 diesel spill are as per those described in Section 0 with respect to crude oil spill modelling.

Provided below are details specific to the diesel spill modelling scenario:

1. Stochastic approach: stochastic modelling was carried out with 60 replicate simulations each modelled for six locations within the permit area.
2. Probability contours: the results were presented in terms of statistical probability maps based on 360 simulations.
3. Completion of modelling: each of the 360 simulations was run for a period of two to three weeks allowing for the fate of dispersed hydrocarbons to be evaluated.

7.7.5 Diesel modelling results

Surface oil results

Results of the stochastic modelling indicated that surface sheens of surface oil (<1 g/m^2) may pass over the following sensitive areas, with a probability of <1% of reaching these locations:

- Vulcan Shoal after 35 hours;
- Goeree Shoal after 62 hours;
- Carbonate Bank and Terrace System of the Sahul Shelf after 68 hours; and
- Eugene McDermott Shoal after 74 hours.

Surface oil at concentrations of 10 g/m^2 were only predicted to reach Vulcan Shoals within 36 hours of commencement of release (at a probability of <1%). Oil was predicted to accumulate at Browse Island at a loading rate of 0.4 g/m^2.

Entrained Oil results

Results of the stochastic modelling indicated that entrained oil concentrations greater than 100 ppb were predicted to reach the following locations (with the highest concentrations):

- Vulcan Shoals (1,772 ppb);
- Carbonate Bank and Terrace System of the Sahul Shelf (1,344 ppb);
- Barracouta Shoals (733 ppb); and
- Goeree Shoal (846 ppb).

The AMPs predicted to be impacted by entrained diesel >100 ppb include:

- Oceanic Shoals AMP;
- Ashmore Reef AMP; and
- Cartier Island AMP.

The KEFs predicted to be impacted by entrained diesel >100 ppb:

- Continental Slope Demersal Fish Communities;
- Ashmore Reef and Cartier Island and surrounding Commonwealth waters; and
- Ancient coastline at 125 m depth contour.

Dissolved aromatic results

Dissolved aromatic hydrocarbons at concentrations of 70 ppb or greater were not predicted to contact sensitive receptors evaluated. In fact, the highest dissolved aromatic hydrocarbon concentration predicted to contact a sensitive receptor location was 23 ppb at Vulcan Shoals. Refer to Figures 7-9 to 7-9 for the environment that may be affected due to a diesel spill of 906 m^3.

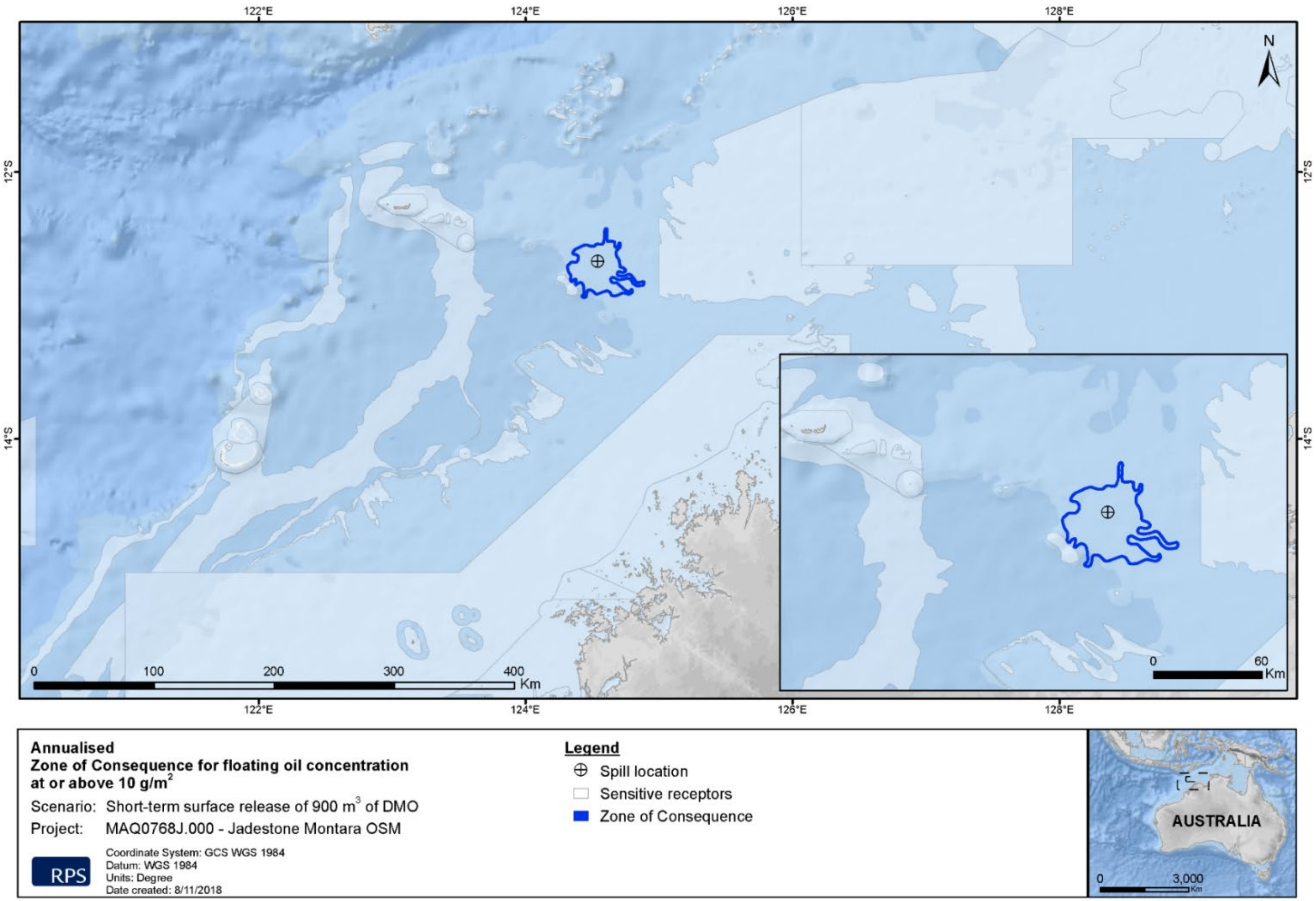


Figure 7-7: Predicted EMBA for floating oil worst case

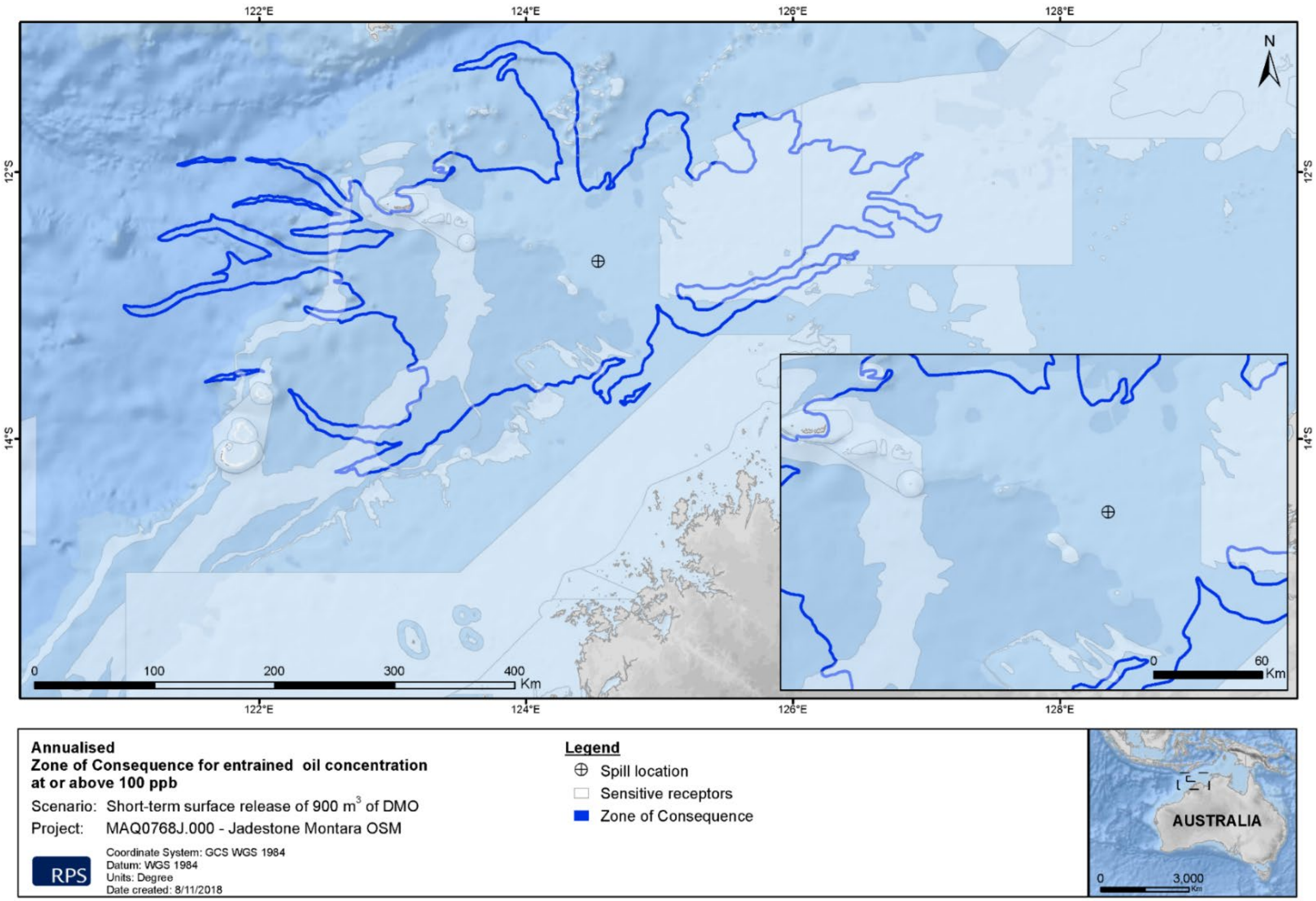


Figure 7-8: Predicted EMBA for entrained oil worst case

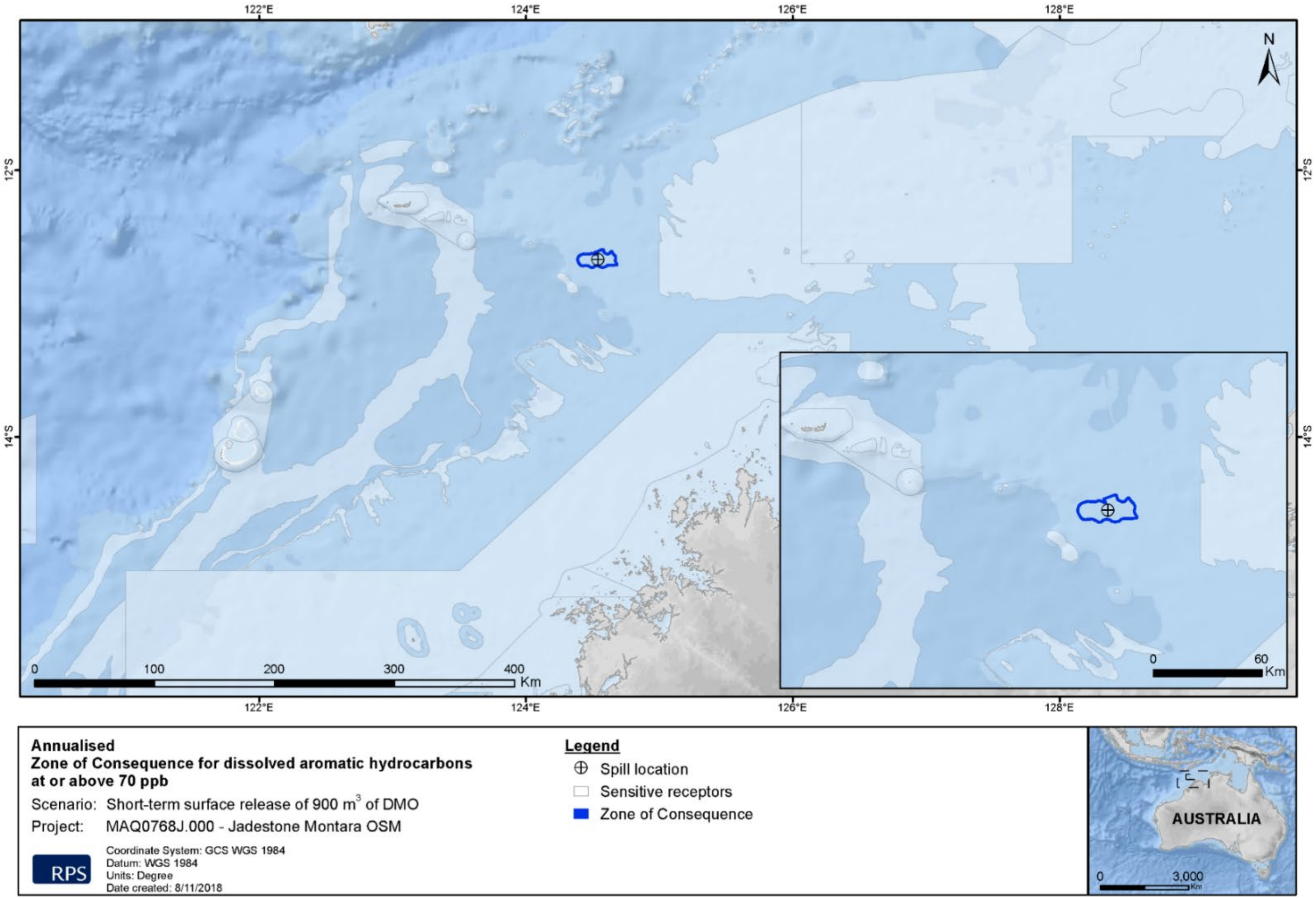


Figure 7-9: Predicted EMBA for dissolved aromatic hydrocarbon worst case

7.7.6 Impacts and risks

Marine diesel oil is a highly volatile hydrocarbon with a high proportion of toxic monocyclic aromatic hydrocarbons (MAHs) that are harmful in varying degrees to marine fauna. Diesel contains some heavy components (or low volatility components) that have a strong tendency to physically entrain into the upper water column in the presence of moderate winds (i.e. >12 knots) and breaking waves and can resurface if these energies abate.

In the event of a substantial diesel spill, the heavier components of diesel can remain entrained or at sea surface for an extended period. Given the properties of diesel, it is expected that marine fauna, marine habitats, protected and significant areas and socio-economic receptors, have the potential to be impacted by surface and entrained thresholds.

A summary of impacts and risks to sensitivities and values within the marine environment is provided in Table 7-10. For further information on the habitats, marine organisms and socio-economic receptors refer to Appendix B and Section 7.6.6.

Table 7-10 Potential Impacts to sensitive receptors from a diesel spill

<table>
<tr><th rowspan="2">Receptors</th><th colspan="3">Potential Impacts from a diesel spill</th></tr>
<tr><th>Floating and/or shoreline</th><th>Entrained</th><th>Dissolved</th></tr>
<tr><td rowspan="2">Plankton</td><td colspan="3">Potential impacts from diesel spill
There is potential for localised mortality of plankton due to reduced water quality and toxicity. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the EMBA
High abundance of phytoplankton typically occurs around topographical features that may result in upwelling or a disruption to the current flow which may be present around banks and shoals. The EMBA has the potential to overlap with spawning of some fish species given the year-round spawning of some species. In the unlikely event of a spill occurring, fish larvae may be impacted by hydrocarbons entrained in the water column with effects greatest in the upper 10 m of the water column where the majority of plankton concentrate and closest to the spill source. However, following release, the diesel will rapidly evaporate, disperse and degrade in the offshore environment, reducing the concentration and toxicity of the spill. Given duration of fish spawning periods, lack of suitable habitat for aggregating fish populations near the surface, combined with the quick evaporation and dispersion of diesel, impacts to overall fish populations are not expected to be significant.</td></tr>
<tr><td>Benthic habitat and communities
(Including deepwater habitats and shallow shoals)</td><td>n/a – Benthic habitats not exposed to surface or surface oil</td><td colspan="2">Potential impacts from dissolved and entrained oil
Benthic habitats at shoals may be affected by marine diesel. This may result in toxic effects to both the habitat (in the case where the habitat is biological such as coral reefs) and associated flora and fauna. The degree of impact will depend on several variables, including the duration of exposure to DAHs and other diesel components. Sea grasses and macroalgae may experience a phytotoxic effect caused by absorption of DAHs from the water column. The hydrocarbon molecules can concentrate in membranes of aquatic plants, inhibiting photosynthetic efficiency (Runcie et al., 2004). Recovery of habitats experiencing chronic effects are expected within weeks to months of return to ambient water quality.
Direct contact to shallow hard corals by entrained diesel could lead to impacts such as short or long-term sub-lethal effects including reduced feeding capacity and growth, reduced reproductive output and increased mucous production</td></tr>
</table>

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	Entrained	Dissolved
		(IPIECA, 1992). In the worst-case instance irreversible tissue necrosis and death could occur. Epifauna associated with hard substrates such as ascidians and sponges may experience direct toxicity through ingestion.	
	Impact assessment to receptors within the EMBA There are a number of shoals within the EMBA for the worst-case diesel spill: Goeree Shoal, Eugene McDermott Shoal, Barracouta Shoals and Vulcan Shoal. These shoals have a diversity of benthic habitats and associated fish and invertebrate assemblages which could be affected by entrained or dissolved oil. The shoals have a number of representative habitats including corals, sponges, seagrass		
Marine mammals	*Potential impacts from surface oil* Physical and chemical effects of diesel in sea surface waters have been demonstrated through direct contact with organisms, for example through physical coating, adsorption to body surfaces and ingestion (NRC, 2005). Lethal or sub-lethal physical and toxic effects such as irritation of eyes/mouth and potential illness. Whales and dolphins are smooth skinned, hairless mammals, so hydrocarbons tend not to adhere to their skin and the potential impacts of oiling on them is limited.	*Potential impacts from dissolved and entrained oil* The high volatility of the diesel will result in the rapid evaporation and loss of the more toxic aromatic components of the diesel, resulting in a reducing toxicity threat to marine fauna with time. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces. For marine mammals that may be exposed to the more toxic aromatic components of the marine diesel, chemical effects are considered unlikely since these species are mobile and therefore not be constantly exposed for extended durations that would be required to cause any major toxic effects. Clogging of baleen structures and toxicological effects from ingestion, although recorded, is sparse in the literature (Geraci and St. Aubin, 1985). The susceptibility of marine mammal species to physiological effects through ingestion of surface and water column hydrocarbon varies with the feeding mechanism of each species: • Whales with a baleen mechanism filter nutrient-rich waters containing food such as plankton and small fish over the baleen (a sieve type structure) before subsequently moving the food to the oesophagus using the tongue;	

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	**Entrained**	**Dissolved**
		• Baleen whales that skim surface waters and the water column (e.g. southern right whales) are more likely to be affected by surface hydrocarbons than other whales that 'gulp' feed such as the humpback whale; and • Toothed whales are also less susceptible to impacts owing to gulp feeding behaviour (Geraci and St. Aubin, 1985).	
	Impact assessment to receptors within the EMBA Marine mammals present within the diesel EMBA include threatened and migratory whales and dolphins, and potentially dugongs. The activity is being undertaken all year round and may overlap with blue whale migration and humpback whale migration and calving, therefore diesel may contact whales during these life stages. However, given the rapid evaporation of diesel it is unlikely that significant numbers would be impacted. The absence of key feeding, resting or breeding areas for other threatened and migratory species and rapid evaporation and dissipation of diesel means significant numbers are unlikely to be impacted.		
Marine Reptiles	*Potential impacts from surface oil* Marine turtles may be impacted by surface hydrocarbons through exposure during surface respiration, particularly where volatiles are being emitted in areas where fresher oil is weathering. Surface respiration could lead to accidental ingestion of hydrocarbons or result in the coating of sensitive epidermal surfaces.	*Potential impacts from dissolved and entrained oil* Whilst turtle nesting beaches may be contacted by weathered marine diesel, turtles will always nest above the high tide mark and any diesel moving through the beach profile should not come into contact with nests. Entrained and dissolved oil may result in harm to internal anatomy if ingested, irritation or damage to sensitive external features such as eyes and skin and damage to respiratory processes if significant inhalation of volatile fumes occurs at the surface	
	Impact assessment to receptors within the EMBA Threatened and migratory marine reptile species may occur within the diesel spill area EMBA as turtles are widely dispersed at low densities across the region and in the unlikely event of a diesel spill occurring, individuals traversing open water may come into contact with water column or surface diesel. The diesel spill EMBA overlaps with the BIAs for some turtle species and therefore there is the risk of contact with nesting turtles and hatchlings with surface and dissolved oil.		

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	**Entrained**	**Dissolved**
Fish, Sharks, Rays	*Potential impacts from surface oil* Near the sea surface, fish are able to detect and avoid contact with surface slicks and as a result, fish mortalities rarely occur in open waters from surface spills (Kennish, 1997; Scholz et al., 1992). Pelagic fish species are therefore generally not highly susceptible to impacts from hydrocarbon spills. However, hydrocarbon droplets can physically affect fish and sharks exposed for an extended duration (weeks to months). Coating of gills can lead to the lethal and sub-lethal effects of reduced oxygen exchange, and coating of body surfaces may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food leading to reduced growth.	*Potential impacts from dissolved and entrained oil* In offshore waters near to the release point, pelagic fish are at risk of exposure to the more toxic aromatic components of the marine diesel. Pelagic fish in offshore waters are highly mobile and comprise species such as tunas, sharks and mackerel. Due to their mobility, it is unlikely that pelagic fish would be exposed to toxic components for long periods in this spill scenario. The more toxic components would also rapidly evaporate, and concentrations would significantly diminish with distance from the spill site, limiting the potential area of impact. Rays are typically found on benthic habitats and may be present around shoals in the area and likely below the area of water column affected by a diesel spill.	
	Impact assessment to receptors within the EMBA Whale sharks could potentially transit through the spill trajectory area; however, this is considered unlikely given the small area affected by the diesel spill and its distance from known aggregation areas. Owing to the rapid evaporation expected and dispersion, impacts to the whale shark would be expected to be minimal. The NWS supports a diverse assemblage of fish and shark species, particularly in shallower water near islands and shoals. Other shark and pelagic fish species may transit the spill trajectory area, but impacts would be anticipated to be negligible as most species will be well below the affected area of the water column.		
Avifauna	*Potential impacts from surface oil* Estimates for the minimum thickness of surface oil that will harm seabirds (through ingestion from preening of contaminated feathers or loss of thermal protection of their feathers) range from 10 g/m^2 (O'Hara and Morandin, 2010) to 25 g/m^2 (Koops et al. 2004). Seabirds have the potential to become oiled through interactions with surface waters in the spill area or through secondary ingestion of toxins as a	*Potential impacts from dissolved and entrained oil* As most fish survive beneath floating slicks, they will continue to attract foraging seabirds, which typically do not exhibit avoidance behaviour. Potential impacts to avifauna due to entrained oil include: • Harm to internal anatomy if ingested; • Irritation or damage to sensitive external features such as eyes and skin; • Damage to feathers of marine birds;	

<table>
<tr><th rowspan="2">Receptors</th><th colspan="3">Potential Impacts from a diesel spill</th></tr>
<tr><th>Floating and/or shoreline</th><th>Entrained</th><th>Dissolved</th></tr>
<tr><td rowspan="2"></td><td>result of feeding on affected prey. Potential impacts to seabirds are from contact, ingestion and/ or oiling of feathers. In addition, diesel can erode feathers causing chemical damage to the feather structure that subsequently affects ability to thermo regulate and maintain buoyancy on water.

Seabirds may also come into contact with marine diesel around shorelines as it percolates through the beach profile during feeding, breeding and roosting activities. This may result in chemical impacts to feathers and exposed skin from the diesel.</td><td colspan="2">• Damage to respiratory processes of air breathing marine fauna if significant inhalation of volatile fumes occurs at the surface.</td></tr>
<tr><td colspan="3">Impact assessment to receptors within the EMBA

Threatened and migratory seabirds and shorebirds that may occur within the EMBA may have foraging, feeding, breeding and or nesting habitat in the vicinity of the EMBA.

The EMBA intercepts with breeding BIAs for several migratory species and therefore foraging and breeding habitat in the area may be impacted by surface and water column while foraging (dive and skim feeding). Higher numbers would be expected during breeding periods. Due to the quick evaporation and dispersion of diesel, significant impacts are not anticipated.</td></tr>
<tr><td rowspan="2">AMPs</td><td>Potential impacts from surface oil

Surface oil is not expected to occur at shorelines of AMPs.</td><td colspan="2">Potential impacts from dissolved and entrained oil

Entrained and dissolved hydrocarbons will or may impact the coral and seagrass habitats, as well as other marine park values fauna including dugongs, sea snakes (protected), fish and other marine mammals. Impacts to these receptors are described above.</td></tr>
<tr><td colspan="3">Three AMPS are present within the diesel EMBA: Oceanic Shoals AMP, Ashmore Reef AMP and Cartier Island AMP.</td></tr>
<tr><td>State Marine Parks</td><td colspan="3">There are no State Marine Parks within the diesel EMBA.</td></tr>
</table>

Receptors	Potential Impacts from a diesel spill		
	Floating and/or shoreline	**Entrained**	**Dissolved**
World, National and Commonwealth Heritage Places	There are no World, National and Commonwealth Heritage Places within the diesel EMBA.		
Threatened Ecological Communities	There are no threatened ecological communities within the diesel EMBA.		
Wetlands of International Importance	There are no wetlands of international importance within the diesel EMBA.		
KEFs	*Potential impacts from surface oil* There are no KEFS that would be impacted by surface oil as the KEFs relate to geomorphologic features which are not expected to be impacted by hydrocarbons.	*Potential impacts from dissolved and entrained oil* Values and sensitivities associated with the KEFs include marine fauna due to the higher diversity of fish species associated with the higher diversity in fish communities or nutrients such as Continental Slope Demersal Fish Communities; or benthic habitats at Ashmore Reef and Cartier Island and surrounding Commonwealth waters. Impacts to marine fauna are discussed above.	
	Impact assessment to receptors within the EMBA There are three KEFs which are overlapped by the diesel EMBA, these include: • Continental Slope Demersal Fish Communities; • Ashmore Reef and Cartier Island and surrounding Commonwealth waters; and • Ancient coastline at 125 m depth contour		
Consequence	**Likelihood**	**Ranking**	
Minor	Unlikely	Low	

7.7.7 Environmental performance

Environmental Risk		Unplanned release of diesel		
Performance Outcome		**No spill of diesel to the marine environment from vessel collision or bunkering malfunction**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
No spill of diesel to the marine environment from bunkering malfunction				
126	MODU bunkering procedures and equipment integrity checks are aligned with requirements of the Montara Marine Facility Manual (MV-90-PR-H-00001)	All hoses are fitted with dry-break couplings and are buoyant or fitted with floats	Bunkering checklist confirms preventative actions are undertaken	MODU OIM
127		Visual inspection of dry break couplings and hoses prior to diesel transfer to ensure they are in good condition		
128		Permit-to-work documentation is complete and signed off to ensure refueling is undertaken in accordance with the refueling procedure		
129		Bunding, sumps and drains are inspected prior to bunkering or transfer		
130		Testing of emergency shutdown mechanism on the transfer pumps prior to bunkering or transfer		
131		No nighttime bunkering or transfer is permitted, unless a risk assessment is undertaken and additional mitigation measures are implemented (as identified as being necessary), and signed off by the OIM		
132		Maintain radio contact with vessel during bunkering or transfer operations		
133	Shipboard Oil Pollution Emergency Plan requires: • Valid SOPEP/SMPEP	Compliance with MARPOL 73/78 Annex I (Prevention of pollution by oil) and Marine Order 91 (Marine pollution prevention – oil) (as appropriate to vessel class), including valid SOPEP for managing spills	Records demonstrate vessels have valid SOPEP/SMPEP	OIM Vessel Master

Environmental Risk		Unplanned release of diesel		
Performance Outcome		**No spill of diesel to the marine environment from vessel collision or bunkering malfunction**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
134	• Spill kits available • Timely exercises undertaken	Vessels to have stocks of onboard spill response kits/bins available and accessible onboard to respond to a spill as per their SOPEP	Pre-mobilisation inspection records spill response bins/kits are readily available and stocked	OIM Vessel Master
135		Drills undertaken as per SOPEP	Exercise records	OIM, Vessel Master
136	Implement Montara Oil Pollution Emergency Plan (MV-70-PLN-G-00001)	In the event of a tier 2 or tier 3 oil spill, implement the to reduce environmental impacts	Incident Log	IMT Lead
137	Jadestone Energy's Competency and Training management System (JS-60-PR-Q-00014) requires External Contractors to comply with project processes and procedures and have the appropriate level of HSE capability	MODU and vessel personnel trained and assessed competent in accordance with their role requirements as aligned with Recruitment Assessment Templates	Records of competency	OIM Vessel Master Drilling Manager
138	All support vessels requiring entry within the 500m safety zone shall adhere to the MODU permit to work procedures	A 500m PSZ has been established for the Montara facilities and the same safety zone will be in place for the proposed MODU activities when at Montara WHP and an additional PSZ gazetted for the Skua-12 site.	Gazette Notice to Mariners Records of reporting of unauthorised entry into the safety zone.	OIM Vessel Master
139	Vessels fitted with lights, signals, an automatic identification system (AIS) transponders and navigation equipment in alignment with the Navigation Act 2012	Vessels will comply with maritime safety and navigation requirements including: • International Regulations for Preventing Collisions at Sea 1972 (COLREGS); • Chapter V of Safety of Life at Sea (SOLAS);	Records confirm that required navigation equipment is fitted to all vessels and MODU to ensure compliance with	OIM Vessel Master

Environmental Risk		Unplanned release of diesel		
Performance Outcome		**No spill of diesel to the marine environment from vessel collision or bunkering malfunction**		
I.D	**Management controls**	**Performance Standards**	**Measurement Criteria**	**Responsibility**
		• Marine Order 21 (Safety of navigational and emergency procedures) (as appropriate to vessel class); • Marine Order 30 (Prevention of collisions) (as appropriate to vessel class); • International Association of Marine Aids Navigation and Lighthouse Authorities (IALA) Recommendations 0–139 – The marking of man-made offshore structures (applicable only to the MODU); • Vessels to maintain radio channels and other communication systems.	maritime safety and navigation requirements. Records confirm MODU and vessels maintain communication systems.	
140	In the event of a vessel collision resulting in a loss of diesel, environmental impacts will be reduced to ALARP through the implementation of response strategies.	In the event of a Level 2 or Level 3 spill, compliance with the OPEP including develop and implement an IAP using the processes described within the OPEP.	Response records confirm the OPEP was adhered to and an IAP was developed and implemented.	IMT

7.7.8 ALARP assessment

On the basis of the impact and risk assessment completed, Jadestone considers the control measures described above are appropriate to manage the risk of an unplanned release of diesel to the marine environment. The residual risk ranking for this potential impact is considered Low, and therefore ALARP has been demonstrated. Additional controls considered but rejected are detailed below.

Rejected control	Hierarchy	Practicable	Cost effective	Justification
Use alternative energy sources	Eliminate	N/A	N/A	The use of diesel for fuel for vessels and machinery cannot be eliminated, vessels and machinery are required for the operations and diesel is therefore required. Other energy sources are not readily available to power all equipment and vessels.
Substitute diesel for another hydrocarbon type	Engineering	N/A	N/A	Machinery is designed for using diesel as the fuel oil which reduces the potential impact from an unplanned release to as low as possible. As no other hydrocarbon has been identified that is more environmentally friendly that could still fulfil the equipment requirements, no engineering controls have been identified.
N/A	Isolation	N/A	N/A	The Activity is located at distance from sensitive receptors and the coastline.
N/A	Administrative	N/A	N/A	Through the application of specific controls and procedures, and maintenance of hoses, no further administrative controls were identified.

7.7.9 Acceptability Assessment

The potential impacts of an unplanned diesel release to the marine environment are considered ‘Acceptable’ in accordance with the Environment Regulations, based on the acceptability criteria outlined below. The control measures proposed are consistent with relevant legislation, standards and codes.

Policy & management system compliance	Jadestone’s HSE Policy objectives are met. Section 8 demonstrates that Jadestone’s HSE Management System is capable of continuously reviewing and updating activities and practices during the Drilling Activities, including spill response arrangements.
Stakeholder & reputation	Stakeholder consultation has been undertaken (see Section 4), including engagement with the State and National response agencies of DoT and AMSA, commercial and recreational fishing industry bodies and fishers. No concerns have been raised with regards to impacts of a diesel spill by relevant persons. During any spill response, a close working relationship with key regulatory bodies (e.g. DoT, DBaC, AMSA, DER) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Environmental context & ESD	The worst-case credible diesel spill scenario for the Drilling Activities is a result of a support vessel collision with the FPSO and 906m^3 diesel released of over five hours. Surface oil may contact Browse Island. Entrained oil is predicted to contact the KEFs - Carbonate Bank and Terrace System of the Sahul Shelf, Continental Slope Demersal Fish Communities and Ancient Coastline at 125m depth contour as well as several shoals (Barracouta, Vulcan and Goeree Shoals).

	The potential impact is considered acceptable after consideration of: • Potential impact pathways: Section 7.7.1 (and 7.6.4) assesses the likelihood and consequence of the exposure of sensitive receptors to entrained, dissolved and surface diesel; • Preservation of critical habitats: Section 7.7.5 assesses the worst-case exposure of protected habitats given three AMPs may be impacted (Oceanic Shoals, Ashmore Reef and Cartier Island). Sensitive receptors at risk include protected seabirds, shorebirds, marine fauna, intertidal and shoreline habitats • Assessment of key threats described in species and Area Management /Recovery plans: See 'Conservation and management advice' below; • Consideration of North-West Bioregional Plan: The NW Bioregional Plan considers hydrocarbon oil spills (i.e. not specifically diesel) as a threat to marine conservation values. This EP aligns with the requirement of the NW Bioregional Plan to assess potential impacts and to have an Oil Spill Contingency Plan in place; and • Principles of ecologically sustainable development ESD: Given the nature of diesel, the location of the Drilling Program and the prevention and recovery plans, the risks from diesel exposure are not predicted to impact population levels of marine fauna and communities. Biodiversity and ecosystem integrity impacts are predicted to recover fully.
Conservation and management advice	Jadestone will have regard to the representative values of protected areas and other published information or conservation advice and endeavor to ensure that priority is given to the social and ecological values, of any AMPs, or State Marine Parks impacted by diesel. Noting 'Emergency response' is permitted in all AMPs and state marine parks. Actions required to respond to oil pollution incidents, including environmental monitoring and remediation, in connection with activities authorised under the OPGGS Act may be conducted in all zones. The Director will be notified in the event of an oil pollution incident that occurs within, or may impact upon, an Australian Marine Park and, so far as reasonably practicable, prior to a response action being taken within a marine park. The 'Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species' will be applied/ used as guidance in the event of an oil spill.

8. IMPLEMENTATION STRATEGY

As required under Regulation 14(1) of the OPGGS 2009 (Environment) Regulations, Jadestone must provide an implementation strategy that will ensure:

- All environmental impacts and risks of the activity will be continually identified and reduced to a level that is ALARP;
- Control measures identified in the EP are effective in reducing the environmental impacts and risks of the activity to ALARP and acceptable levels;
- That environmental performance outcomes and environmental performance standards are met;
- Arrangements are in place to respond to, and monitor impacts of, oil pollution emergencies; and
- Stakeholder consultation is maintained through the activity as appropriate.

To meet these requirements the implementation strategy outlined in this EP includes the following:

- Details on the systems, practices and procedures to be implemented (Section 8.1);
- Key roles and responsibilities (Section 8.2);
- Training, competencies and ongoing awareness (Section 8.2.3);
- Monitoring, auditing, management of non-conformance and review (Sections 8.3 and 8.4);
- Incident response including Oil Pollution Emergency Plan (Section 7.6 and OPEP);
- Record keeping (Section 8.4.3); and
- Stakeholder consultation (Section 4).

As Titleholder, Jadestone is responsible for ensuring that the drilling activities to occur within the Operational Area are managed in accordance with this EP, as well as the implementation strategy, the Jadestone HSE Policy and the Business Management System.

8.1 Jadestone Business Management System

Jadestone applies an integrated Business Management System that is aligned with ISO 55000: Asset Management. This covers all activities and includes provision for the systematic management of environment and safety and all other business functions. The Jadestone Business Management System ensures alignment between company objectives and the activities associated with operation of the Montara facilities in a structure that is illustrated by Figure 8-1.

The management system sets a structured framework that provides governance across company processes for all organisational activities, with defined accountabilities and performance requirements for employees and contractors to deliver activities aligned to the vision and requirements of Jadestone Energy, including those identified in this EP. At the highest level, environmental performance expectations are communicated by the Jadestone HSE Policy.

The structure of the management system is organised to describe the business activities by objective functions (Figure 8-2).

Figure 8-1: Business management system structure

Figure 8-2: Business activities and objective functions

The objective functions are organised into 'Lead', 'Core' and 'Help', which describe how the intent of the business is delivered. The Lead functions are the activities that provide direction to the Core functions, which represent the life cycle of oil and gas activities. The purpose of the Lead functions is to enact and inform strategy and to guide the Core functions in the delivery of their activities.

Delivery of HSE management and performance is fully integrated (including implementation of the EP) throughout the objective functions relevant to operation of the activity. The relevant functions are:

- Operational excellence;

- Value discipline;
- People;
- Stakeholder management;
- Risk management;
- Develop;
- Produce; and
- Provide goods and services.

Below is a summary of the mechanisms by which these functional areas contribute to HSE management and performance during the activity.

8.1.1 Operational Excellence

'Operational Excellence' provides the systems, tools and processes which ensure that all learning experiences that have the potential to improve operational safety, integrity and efficiency, and reduce negative impacts to the environment, to be captured, evaluated and disseminated for future implementation.

The Operational Excellence function is a continuous process and is summarised in Figure 8-3.

The Operational Excellence function addresses the key points of:

- Capturing of lessons learnt;
- Review of lessons learnt; and
- Incorporation of knowledge in future work.

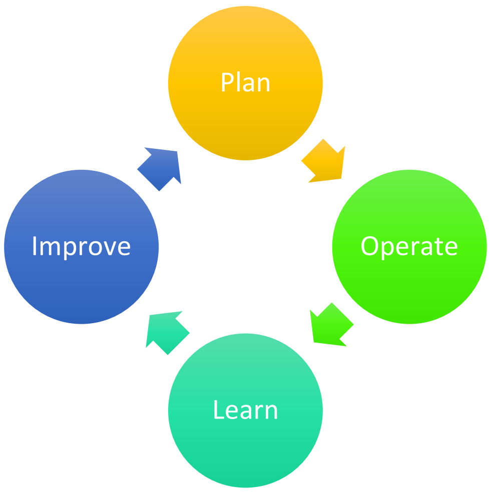


Figure 8-3: Operational and excellence business functions

Knowledge and best practices can be captured from many sources including internal and external, such as:

- Audits and inspections;
- Emergency response drills;
- Incident reviews;
- Technical papers, legislation and journals; and
- Prior experience.

Any actions arising from the assessment of information are incorporated into CMMS. Processes, procedures and systems are improved based on the historical lessons learnt and applied in subsequent phases.

8.1.2 Value Discipline

The 'Value discipline' function represents the processes – including annual budgeting, capital funding – that ensure value and capital requirements are met and support the management system functions delivering their business objectives including HSE performance. Commonly HSE performance is a proxy for business performance and therefore HSE management is of interest to the Value discipline function of the management system.

8.1.3 People

The Jadestone Energy Competency Assurance Framework provides the formal systems, tools and processes which ensure that personnel are appropriately trained and competent to complete assigned tasks to an expected standard. Competency assurance is a necessary component of any approach to reduce safety, integrity and environmental risks to a level that is ALARP.

The Competency Assurance Framework addresses the key points of:

- Competency requirements (qualification, experience and training) are maintained for all Jadestone Energy positions where the incumbent is required to undertake, supervise, review or verify critical tasks or where the incumbent has the technical authority to approve critical documents;
- Competent persons are members of the workforce who meet the competency requirements for the respective positions to perform critical tasks without direct supervision;
- Candidates being considered for appointment in a critical position are assessed against the applicable competency requirements before being formally appointed;
- Incumbents must be reassessed against the competency requirements as per the required frequency stipulated in the competency matrix; and
- All contractors with personnel in the field are prequalified in accordance with the Contractor Management Framework.

Jadestone Energy personnel are subject to the provisions of the Jadestone Competency Assurance Framework which outlines the training, development and assessment requirements necessary to ensure that all employees have the relevant knowledge and skills required to conduct their activities in a safe and environmentally responsible manner.

A training and skills matrix have been developed for all positions which identifies responsibilities, training and competency requirements. Personnel will complete relevant training and hold qualifications and certificates for their specific role (e.g. well control certificates, rigging and crane operator certificates etc.). Training records will be retained.

8.1.4 Stakeholder Management

Sub-regulation 11A(3) of the Environment Regulations provides that:

The Implementation strategy of the environment plan must provide for appropriate consultation with:

a) Relevant authorities of the Commonwealth, a State or Territory; and

b) Other relevant interested persons or organisations

Ongoing consultation activities build upon Jadestone's consultation for the activity. Section 4 outlines the processes that will be followed to ensure a standard approach to interacting with relevant persons during the life of the EP, including revision of relevant persons' list and process for dealing with feedback during this period. As part of ongoing consultation Jadestone will undertake the following activities (Table 8-1).

Table 8-1: Standard consultation actions

ID	Activity	Frequency and method	Responsibility
142	Provide response organisations with a copy of the OPEP	Email response organisations	ER Lead
143	Notification of commencement and cessation of activity to NOPSEMA	Within 4 weeks of commencement date and at cessation	Environment Lead
144	Notification of AMSA Joint Rescue Coordination Centre (JRCC) of commencement of activity	48–24-hours from commencement of operations	HSE Manager

In addition, Jadestone will undertake additional triggered consultation as outlined below, should an unplanned event occur (Table 8-2).

Table 8-2: Triggered consultation actions

ID	Trigger	Action	Responsibility
145	Feedback received from relevant person	Follow consultative process outlined in the Consultation for Environmental Approvals procedure	HSE Manager
146	Deviation to the planned activity from those originally provided in consultation	• Notification to relevant persons via email; • Notify AMP Director General if any change to risk within AMPs.	HSE Manager
147	Oil spill event	• Notification to response agencies and government agencies by phone. • Attempt to electronically notify all relevant persons listed in Montara EP Consultation plan within 72 hours of spill. • Ongoing updates and communication in accordance with requirements and response procedures. • Notification of DPIRD via environment@fish.wa.gov.au within 24-hours of incident report. • Notify AMP Director General within 24-hours of incident report and prior to spill response activities within AMP on 0419 293 465. To include titleholder details, time and location of the incident, proposed response arrangements and locations as per the OPEP and contact details for the response coordinator.	IMT Leader

ID	Trigger	Action	Responsibility
148	AMP access	Notify AMP Director General of SMP (or other response activities) within AMP 10 days prior to entering (where possible) and at the cessation of activities in AMPs.	IMT Lead
149	Biosecurity incident: suspected marine pest or disease	Notification of DPIRD via biosecurity@fish.wa.gov.au or 1800 815 507 within 24-hours.	HSE Manager
150	Change to infrastructure that affects PSZ	Notify the Australian Hydrographic Office of activities and infrastructure for inclusion in Marine Notices	HSE Manager

8.1.5 Risk Management

Jadestone has an integrated approach to risk management to cover all its business activities.

The Risk Management function provides a view of risk that is independent of production delivery. This includes strategic, commercial, and control and compliance risks. In addition, it manages Health Safety and Environment activities, including the preparation and approval of regulatory approvals (including this EP) and the management of change process, which addresses all change activities regardless of type – technical, organisational, software or procedural. Further information on the management of change process is provided in Section 8.4.2.

At the activity level, the risk management function includes all the planned activities and accidental events. Risk identification and assessment is a continuous process that identifies all the physical control measures necessary to manage the risks. Control measures are subjected to regular assurance activities. In a similar way, audits of the management system are conducted according to review cycle with timing agreed in the annual planning process. Findings from assurance activities, audits and ongoing review of performance are considered in the Operational Excellence process, which considers opportunities for continuous improvement (refer Section 8.4).

The Risk Management function is accountable for approval of facility level risk assessments and risk reduction measures; and by so doing, providing a view of risk that is independent from production delivery.

8.1.6 Produce

The Produce function delivers safe and reliable operations as well as environmental performance.

The Produce function works closely with the Operational Excellence and Risk Management functions to evaluate operational performance, including environmental performance, and reduce risk through delivery of continuous improvement activities. Produce is responsible for asset optimisation, reliability, integrity and maintaining compliance. It thus interacts with most functions.

The Produce function delivers environmental management at the activity level via the Computerised Maintenance Management System (CMMS) including detailed work instructions and tasks allowing the activity to meet the environmental performance requirements of this EP. These instructions and tasks are monitored and reviewed to ensure appropriate close out of tasks is achieved as well as ensuring the required outcomes/ performance have been achieved.

8.1.7 Provide Goods and Services

HSE performance in all activities associated with operation is achieved either through management of personnel involved, or via management of contracted works.

The Jadestone Competency Management Framework provides personnel with a systematic and uniform approach for managing and improving Health, Safety and Environmental (HSE) performance throughout the life cycle of an individual's appointment, from their selection through to post-completion performance evaluation. The Personnel Management Framework addresses the key points of selection, competency, development requirements and management.

HSE performance is also achieved through Jadestone's Contractor Management Framework. The contract management life cycle follows four steps: pre-qualification; selection; engagement; and contract completion review process. Through each of these steps Jadestone and service provider/ supplier is evaluated for previous HSE performance and engaged in the mechanisms by which HSE performance will be achieved in the contract to be established.

8.2 Key Roles and Responsibilities

As per Regulations 14(4) and 14(5), a clear chain of command setting out the roles and responsibilities of personnel involved in operation is required as well as detail on what measures are in place to ensure personnel are aware of their role requirements and how Jadestone evaluates their competency and training needs in these roles. In response to these regulatory requirements, provided in this sub-section is information on:

- **Section 8.2.1 Organisational Chart**: outlines the key roles involved in operation of the Montara drilling activities;
- **Section 8.2 Role responsibilities**: summarises the responsibilities of each key role involved in operation of Montara drilling activities;
- **Section 8.2.2 Communication requirements**: outlines how personnel fulfilling key roles are made aware of their responsibilities as described in the EP; and
- **Section 8.2.3 Assessment of Competency and Training**: outlines how Jadestone assesses and evaluate the competencies and training requirements of personnel responsible for achieving the commitments with this EP.

8.2.1 Organisational Structure and Responsibilities

The organisational structure for the drilling activity is presented in Figure 8-4.

Each position has a position description outlining their HSE role and responsibilities, accountabilities and reporting lines (**Table 8-3**). It is the responsibility of all Jadestone personnel to ensure that the requirements of the HSE Policy are applied in their area of responsibility and that personnel are suitably trained and competent in their respective roles.

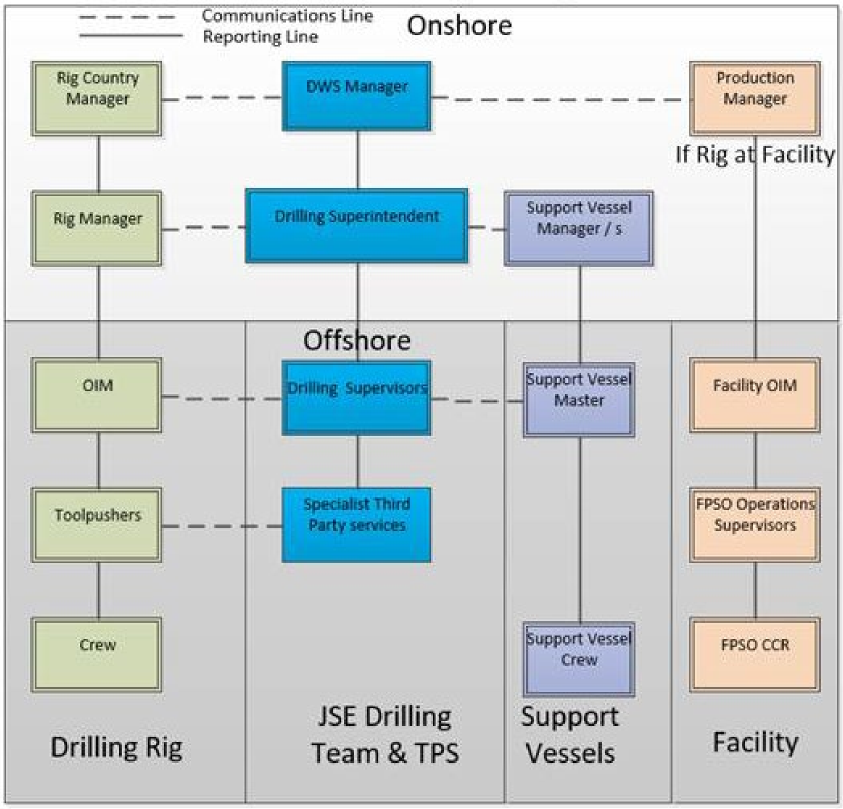


Figure 8-4: Drilling Operations organisation chart

Table 8-3: Responsibilities of Key Roles

Role	Key Responsibilities
Country Manager	• Ensures that activities are conducted in accordance with the Jadestone's HSE Policy. • Primary responsibility for Jadestone Australia operations and for meeting or exceeding corporate targets for all aspects of performance, including conducting activities in accordance with Jadestone's HSE Policy and this Environment Plan. • Responsible for providing adequate resources for environmental management. • Accountable for Operational Excellence. • Ensures the incident response strategy is implemented in the case of an incident. • Responsible for compliance with the BMS. • Maintains communication with company personnel, government agencies and the media, where appropriate.
Drilling and Completions Manager	• Responsible for ensuring that JSE policies, management principles and standards are followed in the well design and operational phases. • Responsible for ensuring that best practices are used in the planning and execution of wells during the campaign. This includes ensuring that lessons learned in previous campaigns are applied to this current campaign. • Ensure that the requirements of this EP are implemented
Drilling Superintendent	• The Drilling Superintendent is responsible for offshore well construction operations meeting environmental performance and compliance requirements of the EP. • Coordinate all drilling and associated activities are undertaken by Company personnel and its contractors in accordance with approved programmes and appropriate legislation as detailed in this EP. • Ensure that all operational, technical and environmental incidents during well construction operations are reported to the Drilling and Completions Manager • Responsible for regular reporting through daily reporting formats. • Manage HSE hazards and risks related to drilling maintenance activities by ensuring procedures and risk reduction processes have been employed for all activities under their control.
JSE Senior Drilling Supervisor	• The JSE Senior Drilling Supervisor is responsible for ensuring correct drilling procedures and practices are followed. • Providing daily instructions to well operations, including well control procedures, or other relevant information, and implementing the well control kill method which will be agreed upon with the OIM. • Responsible for HSE and operational support for all phases of rig operations. • Ensures the Program is executed in compliance with JSE policies and is communicated, verbally and in writing, to the appropriate representatives on board the MODU. • Acts as JSE's senior representative and manages all JSE contractors on board the MODU. • Reports directly to the JSE Drilling Superintendent on all matters.

Role	Key Responsibilities
Supply Chain Manager	• Overall responsibility for implementation of the contractor management framework, including communication of EP requirements to contractors at the appropriate stages of contract management cycle.
Offshore Installation Manager (OIM)	• Responsible for day to day operations at the facility. • Ensures completion of routine performance reporting for the activities. • Responsibility for the implementation and compliance with the requirements of the EP and the Jadestone's HSE Policy. • Ensures that risk management processes are employed to manage HSE hazards and risks at the facility. • Communicates the importance of appropriate levels of training, competency and environmental awareness to all personnel. • Ensures the importance of appropriate levels of training, competency and environmental awareness are communicated to facility personnel and that the training matrix is fully implemented. • Ensures all personnel undertake appropriate Montara inductions and are aware of their HSE responsibilities. • Ensures sufficient resources are made available for offshore environmental management to meet the requirements of the Environment Plan. • Ensures all relevant HSE incidents are reported in accordance with internal incident reporting and investigation procedures. • Conducts regular workplace inspections. • Implements corrective and preventative actions arising environmental inspections, audits, incidents and hazard reports. • Overall responsibility for HSE and emergency response management at the facilities. • Ensure that adequate skills are maintained for effective incident response. • Ensure regular drills and exercises are conducted and all personnel actively participate. • Ensure Facility HSE meetings are conducted as required by the BMS. • Communicates HSE hazards and risks to the workforce and the importance of following good work practices.
HSE Manager	• Ensures review of daily, weekly and monthly reporting, as applicable, from the MODU and support vessels. • Ensures environmental department liaison with the OIM to deliver compliance with all aspects of this EP. • Plans and schedules environmental audits of the activities. • Ensures regulatory documents are prepared and meet regulatory requirements. • Ensures emergency response plans are in place. • Develops and participates in oil spill response activities. • Ensures reporting of all relevant environmental incidents to NOPSEMA within the required timeframes. • Ensure environmental incident reporting meets regulatory requirements (as outlined in the EP) and incident reporting and investigation procedure.

Role	Key Responsibilities
	• Ensures that proposed changes to environmental management activities are subject to Management of Change and approved prior to application.
HSE Advisor	• Works with the HSE Manager and Drilling team to support environmental management and delivery of EP commitments. • Contributes to inspections, audits and reviews of the Environment Plan.
MODU and vessel personnel and contractors	• Adhere to work systems and procedures defined for the activities being undertaken. • Follow good housekeeping work practices. • Report HSE incidents, hazards or non-conformances to supervisors in a timely manner. • Identify HSE improvement opportunities wherever possible.

8.2.2 Communication of Responsibilities

The primary mechanism for ensuring personnel involved in the drilling activities are aware of the environmental commitments as listed in this EP are via: provision of environmental performance commitments lists via the CMMS; management of service providers and suppliers (refer below); and online induction prior to attending the Montara field.

All personnel are required to complete an online induction that contains environmental components prior to arrival at the facility. Inductions are updated to account for site-specific factors or activities, or EP management improvements. Induction attendance records for all personnel are maintained. At a minimum, inductions include:

- The Jadestone HSE Policy;
- Description of the environmental sensitivities within the operational area and surrounding waters;
- Identification of environmental risks and mitigation measures;
- Permit to work;
- Procedures for reporting of any environmental incidents or hazards;
- Waste management requirements;
- Overview of incident response and spill management procedures, including roles and responsibilities;
- Roles and environmental responsibilities of key personnel; and
- Direction on where to find copies of the EP and OPEP.

8.2.3 Competencies and Training

Jadestone Energy's Contractor Management Framework (JS-90-PR-G-00002) provides a process for ensuring that Contractors and Services Providers have the appropriate level of HSE capability. The assessment of Contractors and Service Providers competency provides a sound level of assurance that all key third-party personnel involved in operations have the necessary skills, knowledge, experience, and ability to perform their work in accordance with their company's training and competency systems.

Contractors and service personnel are assessed against their company's criteria and any additional criteria required by Jadestone Energy. Records of competent people are maintained in EDMS.

Competencies and training arrangements for personnel involved in oil pollution response are detailed in the OPEP and records maintained in EDMS.

8.3 Monitoring, Auditing, Management of Non-conformance and Review

As required under sub-regulation 14(6), Jadestone must provide for sufficient monitoring, recording, audits, management of non-conformance and review of Jadestone's environmental performance and implementation strategy to ensure that environmental performance outcomes and standards in the EP are being met and continue to minimise impacts to the environment.

Environmental performance outcomes and standards as well as management controls as detailed in this EP (Sections 6 and 7 and the OPEP) are monitored and recorded as described. Ongoing monitoring activities to determine if environmental commitments as required in this EP are being met include the CMMS, inspection program, auditing and exercising of response arrangements. In particular, routine commitments in the EP have been loaded into the CMMS that directs work activities for onshore and offshore personnel. Work activities include review of monitoring checklists, audits, inspections, maintenance and continuous improvement reviews, allowing environmental performance of the activity to be monitored. Non-conformances of EP commitments are reported, tracked and closed-out in accordance with this EP.

The collection of data from environmental performance monitoring activities forms the basis of demonstration that the commitments as listed are being met, that specified mitigation measures are in place to manage environmental risks, and that they remain working, and contribute to continually reducing risks and impacts to ALARP and acceptable levels.

8.3.1 Routine Monitoring

The purpose of monitoring and inspections is to record performance data and routinely check conformance with environmental performance standards and achievement of environmental performance outcomes defined by the EP. Routine inspection activities are scheduled and records kept in the CMMS.

Emissions and discharges to the environment are monitored to assess the environmental performance of the operation on an ongoing basis. Table 8-4 details the quantitative records that are maintained for all emissions and discharges during routine or emergencies within the Operational Area as per Regulation 14(7) of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009*.

Table 8-4: Summary of routine monitoring

Measurement	Frequency	Monitoring Strategy	Record
Ballast water discharges	Intermittently - discharge events recorded as they occur	Discharges determined from ballast water record log	Ballast water records
Volumes of the following waste types are recorded: general and putrescible waste; hazardous waste; timber/ wood; recyclables; cardboard/ paper; scrap metal; metal drums & containers; batteries (lead acid); plastic drums and containers; and oily waste/ sludge.	Logged on facility when transferred via vessel to shore then to licensed waste facility. This is done fortnightly (supply run). Vessel also records volumes on manifest	Invoicing process checks vessel manifest against waste disposal records of service provider, and evidence of disposal	Manifest documents Oil Record Book Garbage Record Book
Emissions will be directed to the Montara Venture topside production infrastructure for processing	Daily	Emissions determined from MV PDMS	Daily drilling report
Emissions will be directed to the MODU and vented to atmosphere at the top of the derrick via the BOP, choke line, choke manifold and the poor boy degasser.	Daily	Manual volumetric estimate	Daily drilling report
Cuttings discharge	Daily	Onboard cuttings management system	Daily mud report
Brine discharge stream OIW	Intermittently - discharge events recorded as they occur	Oily water monitor on waste stream	Daily drilling report
Barite does not exceed concentrations of the following metals: Mercury – maximum 1 mg/kg dry weight; Cadmium – maximum 3 mg/kg dry weight; Lead - maximum 1000 mg/kg dry weight	As purchased	Purchase records confirm that the stock barite in drilling fluids do not exceed maximum concentrations	Purchase records
Cement and drilling fluid used	Daily	Mud and Cementing Engineers monitor fluid and cement used/ discharged	Daily Drilling Report

8.3.2 Audits

An audit is a systematic examination and evaluation against defined criteria and performance indicators to determine whether activities/ processes and related results conform to planned arrangements, whether these arrangements are implemented effectively, and if they are suitable to achieve Jadestone's performance outcomes and requirements.

Environmental audits provide assurance that the systems and processes in place to deliver the EP (i.e. the implementation strategy) are suitable and effective. The Jadestone Audit Manual (JS-90-PR-G-00003) describes the planning and conduct of audit activities.

At least one audit ('pre-start inspection') of the MODU by Jadestone's HSE Manager or delegate will be completed prior to commencement of the activity.

8.3.3 Non-compliances and Corrective Actions

Non-conformances from audits, inspections, incidents, regular monitoring or response testing are communicated immediately to the OIM and tracked and monitored by the HSE Manager until closed

Opportunities for improvement and corrective actions from daily operations, reviews, audits, inspections, monitoring and testing activities are documented and tracked to closure by Jadestone's action tracking system.

8.3.4 Reporting

Table 8-5 details the approach to routine environmental performance reporting to the Regulator. Reporting activities relating to reportable and recordable incidents will be as per Regulations 26, 26A, 26AA and 26B.

8.4 Continuous Improvement (Operational Excellence)

The review of environmental performance includes an assessment of:

- Review of compliance with environmental performance outcomes and performance standards, and adequacy of measurement criteria;
- Function of environmental management controls relevant to reportable and/or recordable incidents;
- Monitoring data and trends;
- Results of audits and incident investigations;
- Inspection and checklist approaches; and
- Adequacy of monitoring, inspections and audits.

The results of the review and any identified improvements or recommendations will be incorporated into processes and procedures used for the operation, or the EP, to facilitate continuous improvement in environmental performance.

In the event that new information (audits, inspections, reviews etc.) suggests risks and impacts are no longer reduced to acceptable levels, or controls are no longer effective in reducing the risks and impacts to ALARP and acceptable levels, then the process for identification of further controls through a risk assessment will follow that of the risk assessment methodology for this EP (refer Section 5).

Any opportunities for improvements identified through the risk assessment (i.e. new controls adopted) will be evaluated via a Management of Change process prior to the EP, procedures or processes being modified.

Table 8-5: Summary of reporting requirements

Regulation	Requirement	Required Information	Timing	Type	Recipient
Before the Activity					
Regulation 29(1) & 30 - Notifications	NOPSEMA must be notified that the Activity is to commence.	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form for both notifications.	At least 10 days before the Activity commences	Written	NOPSEMA
During the Activity					
Regulation 16(c), 26 & 26A – Reportable Incident	NOPSEMA must be notified of any reportable incidents For the purposes of Regulation 16(c), a reportable incident is defined as: • An incident relating to the Activity that has caused, or has the potential to cause, moderate to significant environmental damage • Types of reportable incidents are described in **Table 10-1**.	The oral notification must contain: • All material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out; • Any action taken to avoid or mitigate an adverse environmental impact due to the reportable incident; and • The corrective action that has been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	As soon as practicable, and in any case not later than 2 hours after the first occurrence of a reportable incident, or if the incident was not detected at the time of the first occurrence, at the time of becoming aware of the reportable incident	Verbal	NOPSEMA
		A written record of the verbal notification must be submitted. The written record is not required to include anything that was not included in the verbal notification	As soon as practicable after the verbal notification	Written	NOPSEMA

Regulation	Requirement	Required Information	Timing	Type	Recipient
		A written report must contain: • All material facts and circumstances concerning the reportable incident known or by reasonable search or enquiry could be found out; • Any action taken to avoid or mitigate adverse environmental impact due to the reportable incident; • The corrective action that has 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 a similar incident occurring in the future.	Must be submitted as soon as practicable, and in any case not later than 3 days after the first occurrence of the reportable incident unless NOPSEMA specifies otherwise.	Written	NOPSEMA
Regulation 26B – Recordable Incidents	NOPSEMA must be notified of a breach of an EPO or EPS, in the environment plan that applies to the Activity that is not a reportable incident	Complete NOPSEMA's Recordable Environmental Incident Monthly Report form via submissions@nopsema.gov.au	The report must be submitted as soon as practicable after the end of the calendar month, and in any case, not later than 15 days after the end of the calendar month. If no recordable environmental incidents have occurred during a particular month, a Nil Incident report must be submitted	Written	NOPSEMA

Regulation	Requirement	Required Information	Timing	Type	Recipient
End of Activity					
Regulation 29(2) – Notifications	NOPSEMA must be notified that the Activity is completed	Complete NOPSEMA's Regulation 29 Start or End of Activity Notification form for both notifications	Within 10 days after finishing	Written	NOPSEMA
Regulation 14 (2) & 26C – Environmental Performance	NOPSEMA must be notified of the environmental performance of the Activity	Report must contain sufficient information to determine whether or not environmental performance outcomes and standards in the EP have been met	Annual report submitted within 3 months after the anniversary of the reporting period, with the period commencing on the dated Regulation 29 notification form	Written	NOPSEMA
Regulation 25A Plan ends when titleholder notifies completion	NOSPEMA must be notified that the Activity has ended and all EP obligations have been completed	Notification advising NOPSEMA of end of the Activity	Within six months of the final Regulation 29 (2) notification	Written	NOPSEMA

8.4.1 Management of Change and Revisions of the Environment Plan

Regulation 17 of the *Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009* makes clear the following requirements in respect of a number of circumstances that may lead to the deviation of an activity from the EP, or a new activity requiring an EP.

17 Revision because of a change, or proposed change, of circumstances or operations	
New activity	
17(1)	A titleholder may, with the Regulator's approval, submit to the Regulator a proposed revision of an environment plan before the commencement of a new activity.
Significant modification or new stage of an activity	
17(5)	A titleholder must submit to the Regulator a proposed revision of the environment plan for an activity before the commencement of any significant modification or new stage of the activity that is not provided for in the environment plan as currently in force.
New or increased environmental impact or risk	
17(6)	A titleholder must submit a proposed revision of the environment plan for an activity before, or as soon as practicable after:
(a)	The occurrence of any significant new environmental impact or risk, or significant increase in an existing environmental impact or risk, not provided for in the environment plan in force for an activity; or
(b)	The occurrence of a series of new environmental impacts or risks, or a series of increases in existing environmental impacts or risks, which, taken together, amount to the occurrence of:
(i)	A significant new environmental impact or risk; or
(ii)	A significant increase in an existing environmental impact or risk;
	That is not provided for in the environment in force for the activity.

Jadestone's Management of Change process will determine whether a proposed change to activities Triggered the requirements of Regulation 17, which may result in a revision and resubmission of an EP to NOPSEMA. This process is described in the Jadestone's Change Management Procedure (MoC) (JS-90-PR-G-00017). The procedure describes a system for identifying, tracking, responding, progressing and closing out change requests or queries raised by any party involved in Jadestone Energy activities. It also directs and instructs activity owners on the environmental regulatory requirements relating to a change in operations.

The procedure provides for proper consideration of temporary or permanent changes to activities, including an impact and risk assessment, approved and communicated to all appropriate stakeholders together with providing a record of the change. In particular, the system ensures the following:

- All changes required to critical outputs will be identified, recorded, risk assessed and approved – internally and externally as required – before being implemented;
- Processes and procedures are in place to ensure requirements for change are identified and unauthorised changes are prevented;
- All changes must be assessed to determine if the change introduces a new risk or impact or increases an existing impact or risk, as required by Regulation 17;
- The MoC is prepared internally by Jadestone personnel which includes consultation with relevant parties as necessary such as technical/ subject matter experts and external stakeholders as required;
- Only authorised and competent members of the workforce can approve changes, including relevant Technical Authorities. Technical Authorities are deemed as authorised and competent via the Technical Authority Framework (GA-60-STD-Q-00001);

- Approval of a change internal to Jadestone requires confirmation that impacts and risks have been assessed and appropriate reduction measures implemented (if required) to manage risk to ALARP and impacts to acceptable levels;
- All approved changes that affect the Environment Plan are properly documented and communicated to all relevant internal and external members of the workforce, e.g. via toolbox talk or HSE meetings and JSA; and
- An audit trail is kept of all changes and documents and drawings are updated accordingly.

MOC must be designed to meet the particular requirements of the type of change required and will include:

- Risk assessment to assess potential impacts to the receiving environment as detailed in this EP, including matters of NES and those protected under the EPBC Act;
- Strategies and actions to mitigate any adverse effects; identify opportunities offered by the change; and determine how impacted interfaces shall be managed;
- Timeframes for implementation;
- Documents (e.g. drawing, plan, program, procedure) against which change is monitored;
- Outline drawings or controlled documents affected; and
- Responsibilities for execution, review and approval of the:
  - Justification for the change,
  - Assessment of the impact and risk to environment,
  - Detailed implementation requirements,
  - Dissemination of the change, training personnel and updating of documentation.

All alterations and updates to controlled documents, including regulatory approvals, procedures or drawings must be in accordance with Document Control requirements. If the change meets any of the criteria detailed by Regulation 17, a revision/resubmission of the EP to NOPSEMA will occur.

Maintenance work, which covers the replacement of parts or equipment with identical (or equivalent specification) parts or equipment, and with no change to operating arrangements, is not subject to change control.

8.4.2 Record Keeping

This section of the EP meets Regulation 27(2) by detailing a systematic, auditable record of the results of monitoring and auditing of the environmental performance of the activities. The records retained are linked to the performance outcomes, standards and measurement criteria, and monitoring and reporting requirements.

As a minimum, Jadestone will store and maintain the records for five years, where records include:

- Written reports including monitoring, audit and review regarding environmental performance or the business management system;
- Environmental performance reports and associated documentation;
- Documentation generated through stakeholder consultation;
- Records of emissions and discharges;
- Records of calibration and maintenance; and
- Reportable and recordable incident reports.

8.5 Emergency Preparedness and Response

Under the Environment Regulations 14(8) the Implementation Strategy must contain an oil pollution emergency plan and provide for the updating of the plan containing adequate arrangements for responding to and monitoring oil pollution. These details are contained within the OPEP, which is part of this EP, and details the incident response arrangements in the event of an oil spill and should be referred to for all details.

Emergency response procedures and manuals are in place to describe how controls and consequences are mitigated. These documents are available on the *Montara Venture* FPSO and are made accessible to all personnel. The relevant incident response procedures and manuals are detailed in the OPEP.

The incident response procedures and manuals are regularly updated with the revised contact details of relevant organisations and individuals included. They are also frequently tested to determine where they can be improved. The OPEP details the schedule for testing the preparedness of response organisations in the OPEP.

9. REPORTING

9.1 Routine Reporting

Table 9-1 details the approach to routine environmental performance reporting to the regulator. Reports will be of sufficient detail to demonstrate whether specific environmental performance outcomes and standards have been met.

9.2 Incident Reporting

Table 9-1 defines the differences between a reportable and recordable incident. It also defines reporting protocols for initial notification of a reportable incident, written reportable incident reporting and monthly recordable incident reporting. The Incident Reporting Procedure (JS-60-PR-F-00016) incorporates reporting timeframes for incidents depending on their environmental impacts.

Table 9-1: Routine and incident reporting requirements

Requirements	Timing
Routine Reporting	
Recordable Environmental Incident Monthly Report A written report will be provided to NOPSEMA of any breaches of a performance outcome or performance standard identified in the EP and is not classed as a reportable incident (refer above). The monthly report will include the following: • Circumstances and material facts concerning the incident; • Actions taken to avoid or mitigate any adverse environmental impacts; • Corrective action taken to prevent recurrence.	Not later than 15 days after the end of each calendar month.
Reportable Incidents: Notifications	
NOPSEMA NOPSEMA will be notified of reportable environmental incidents: i.e. any unplanned event identified as having caused or having the potential to cause moderate to significant environmental damage. The following is a list of reportable environmental incidents that could occur: • Uncontrolled release of hazardous chemicals or hydrocarbons more than 80 litres to the marine environment; • Introduction of an IMS; • Harm or mortality to an EPBC listed marine fauna;	Verbal report to NOPSEMA as soon as practicable but not later than two hours of incident having been identified. As soon as practicable a written record of the verbal notification will be provided to NOPSEMA.

Requirements	Timing
• Gaseous releases of more than 300kg (~255m^3 at Standard Ambient Temperature and Pressure); and • Any unforeseen event that has caused or has the potential to cause an impact with moderate or greater environmental consequence as outlined within this EP.	Notifications to other regulators are described in Jadestone Energy Incident Management Team Response Plan (JS-70-PLN-F-00008)
AMSA Oil pollution incidents in Commonwealth waters must be reported to AMSA.	Within 2 hours of incident having been identified: Tel: 1800-641-792
Department of the Environment and Energy (DoEE) DoEE will be notified of the following incidents: • Harm or mortality to Commonwealth EPBC Act Listed Marine Fauna (attributable to the operations activity). • Spills of hydrocarbons or environmentally hazardous chemicals more than 80 litres to the marine environment. • Any unplanned event identified as having caused or having the potential to cause moderate to significant impact to a matter of NES.	Within 2 hours of incident having been identified: Tel: 1800-110-395 Tel: 02-6274-1372 compliance@environment.gov.au
Reportable Incidents: Written Reports	
NOPSEMA A written report of a reportable environmental incident will be provided to NOPSEMA and will contain: • Immediate action taken to prevent further environmental damage and contain the source of the release; • Arrangements for internal investigation; • All material facts and circumstances concerning the reportable incident that the operator knows or is able, by reasonable search or enquiry, to find out; • Immediate cause analysis; and • Corrective actions taken or proposed to prevent recurrence of similar incidents with responsible party and completion date.	Written report (Part 1) to NOPSEMA is required within three (3) days. Within 7 days of submitting the written report (Part 1) to NOPSEMA, a copy of the written report will be provided to NOPTA and DMIRS. Written report (Part 2) to NOPSEMA is required within 30 days.

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APPENDICES

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