Crux Seabed Survey

ENVIRONMENT PLAN
2022

Crux Seabed Survey Environment Plan

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REVISION HISTORY					
Ver.	**Change Description**	**Date**	**Originator**	**Reviewed by**	**Approved by**
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This Environment Plan (EP) summary has been prepared from material provided in this EP. The summary consists of the following as required by Regulation 11(4):

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2 Introduction

Shell Australia Pty Ltd (Shell), together with Joint Venture Participant Seven Group Holdings (SGH) Energy,[1] is progressing planning for the prospective development of the Crux gas field, located approximately 160 km north-east of the Prelude field in the northern Browse Basin, offshore the Kimberley coast, Western Australia (WA) (Figure ES 1).

The Crux field is located in Commonwealth marine waters in the northern Browse Basin, 190 km offshore north-west Australia and 620 km north-north-east of Broome.

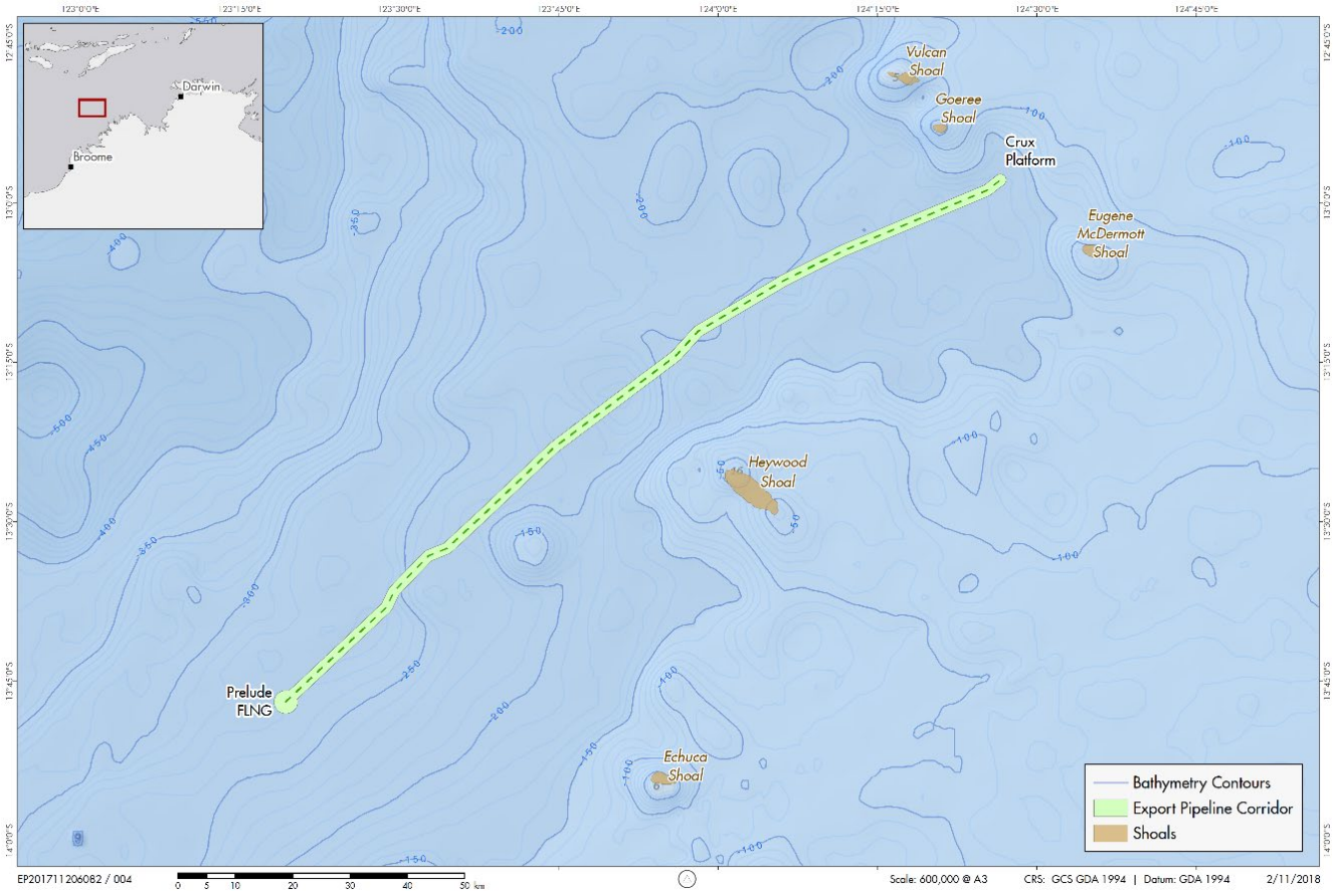

Figure ES 1: Location of the Crux Seabed Survey Operational Area

The Crux project has been identified as the primary source of backfill gas supply to the Prelude Floating Liquefied Natural Gas (FLNG) facility. The proposed Crux project consists of a Not Normally Manned (NNM) platform in approximately 165 m water depth; with five production wells, minimal processing and utility systems, tied back to the existing Prelude FLNG facility via a 165 km export pipeline. Crux will be operated remotely from the Prelude FLNG facility.

[1] At the time of submission of this EP, Osaka Gas Crux Pty Ltd was in the process of exiting the Crux Joint Venture and will not be on title once this EP is approved and operationalised.

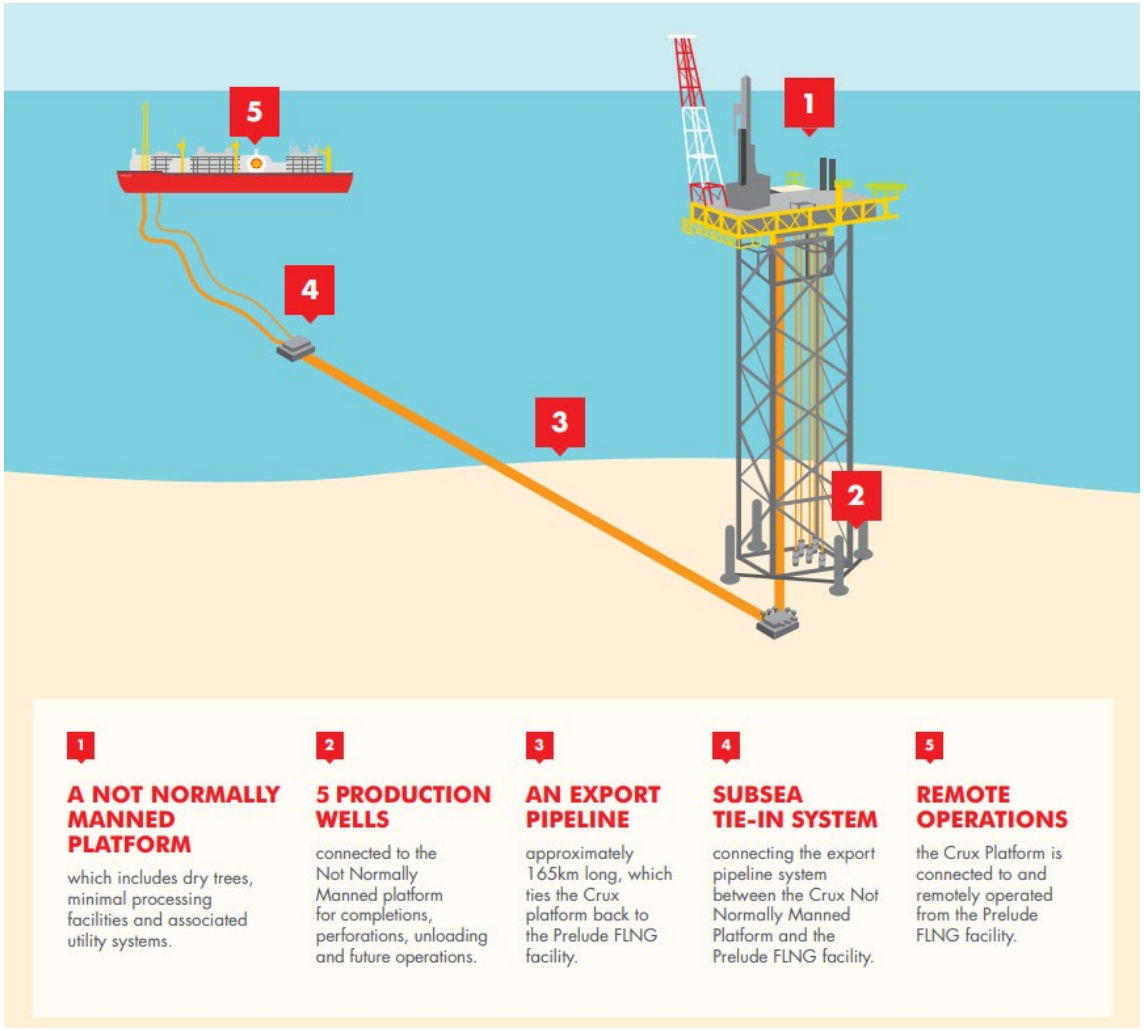

Figure 2-1: Crux Infrastructure Schematic

This Environment Plan (EP) is for seabed survey activities linked to the Crux trunkline detailed design and supporting installation activities which are described in detail in section 6.

3 Requirements

This section is intended to fulfil the requirements of Regulation 13 (4) of the OPGGS(E) Regulations and meet NOPSEMA's expectations stated in the Environment Plan Content Requirements Guidance Note (2019). Regulation 13 (4) – Requirements of the OPGGS(E) Regulations stipulates that an EP must:

> *"(a) describe the requirements, including legislative requirements, that apply to the activity and are relevant to the environmental management of the activity; and*
>
> *(b) demonstrate how those requirements will be met*."

The Environment Plan Content Requirements Guidance Note (NOPSEMA 2019a) provides additional information on NOPSEMA's expectations of EP content relating to Regulation 13 (4). NOPSEMA does not expect that requirements that are not relevant to the environmental management of petroleum activities be included in the EP.

This section contains the following, which are intended to meet the requirements stated above:

- Legislation
- Standards and guidelines
- International agreement and conventions.

3.1 Legislation

This section describes the Australian legislation that is applicable to the environmental management of the petroleum activities within the scope of this EP. The name of each piece of legislation is provided, along with a description of its relevance to the petroleum activities. A link to the section of the EP related to how these legislative requirements have been considered is also provided.

As the planned activities considered in the EP take place entirely in Commonwealth waters, legislation relating to the environmental management of the petroleum activities considered in this EP are primarily Commonwealth Acts and subsidiary legislation. Key Acts include the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (Cth) (OPGGS Act) and the EPBC Act. These Acts and subsidiary legislation are discussed in Sections 3.1.1 and 3.1.2 respectively; additional Commonwealth legislation is considered in Section 3.1.3.

Large volume unplanned hydrocarbon releases may under some circumstances impact upon the environment within the jurisdiction of the State of Western Australia. Western Australian legislation that may be applicable to the environmental management of such hydrocarbon releases has also been considered in Section 3.1.3.

3.1.1 Offshore Petroleum and Greenhouse Gas Storage Act 2006

The OPGGS Act provides the regulatory framework for petroleum exploration, production and greenhouse gas activities in Commonwealth waters. The OPGGS Act is supported by a range of subsidiary legislation, including:

- the *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* (Cth) which ensure that facilities are designed, constructed, installed, operated, modified and decommissioned in Commonwealth waters only in accordance with Safety Cases that have been accepted by NOPSEMA; and

- the OPGGS(E) Regulations.

Of particular relevance to this EP are the OPGGS(E) Regulations, which require the environmental impacts and risks of offshore petroleum and greenhouse gas storage activities be managed to a level that is acceptable and ALARP. The OPGGS(E) Regulations are discussed further below.

3.1.1.1 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009

The OPGGS(E) Regulations provide for the protection of the environment in Commonwealth waters by requiring that petroleum and greenhouse gas storage activities be managed in a way that:

- reduces the environmental impacts and risks of the activity to a level that is ALARP;
- reduces the environmental impacts and risks of the activity to an acceptable level; and
- is consistent with the principles of Ecologically Sustainable Development (ESD), as defined in section 3A of the EPBC Act, which includes:
  - decision-making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations
  - if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation
  - the principle of inter-generational equity—that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations
  - the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making
  - improved valuation, pricing and incentive mechanisms should be promoted.

The methodology applied to assess environmental impacts and risks from the petroleum activities considered in this EP details how impacts and risks are managed to a level that is acceptable, ALARP and consistent with the principles of ESD. This methodology is described in Section 7.4 and Sections 9.1-9.2, with aspect-specific demonstrations provided in each of the impact and risk assessment in Sections 9.3-9.13.

Regulation 13(3) of the OPGGS(E) Regulations requires EPs to consider Matters of National Environmental Significance (MNES) protected under the EPBC Act, including the following:

- the world heritage values of a declared World Heritage property within the meaning of the EPBC Act
- the national heritage values of a National Heritage place within the meaning of that Act
- the ecological character of a declared Ramsar wetland within the meaning of that Act
- the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act
- the presence of a listed migratory species within the meaning of that Act
- any values and sensitivities that exist in, or in relation to, part or all of:
  - a Commonwealth marine area within the meaning of that Act

- Commonwealth land within the meaning of that Act.

MNES that may credibly be impacted, or are at risk of being impacted, are described in Section 7 and are considered in the assessment of environmental impacts and risks.

Regulation 10A of the OPGGS(E) Regulations states the criteria for acceptance of an EP. These are summarised in Table 3-1, along with the sections of this EP that relate to each of the criteria.

Table 3-1: Relationships between OPGGS(E) Regulation 10A requirements and EP sections

OPGGS (E) Regulation	Requirement	Relevant Section of EP
10A (a)	The EP is appropriate for the nature and scale of the activity	Section 6 and Section 9 detail the nature and scale of the petroleum activities considered within this EP. Section 7 describes the environmental receptors that may credibly be impacted, or are at risk of being impacted, by the planned and unplanned activities. Section 9.3 to Section 9.13 provides the environmental impact and risk assessments based on the context provided by Sections 6, Section 7 and Section 5 (as well as Shell's internal context and the context provided by Relevant Persons).
10A (b)	The EP demonstrates that the environmental impacts and risks of the activity will be reduced to ALARP	Section 9.1 to Section 9.2 details the method by which Shell demonstrates environmental impacts and risks are managed to a level that is ALARP. Aspect-specific ALARP demonstrations are provided in the impact and risk assessments provided in Section 9.3 to Section 9.13.
10A (c)	The EP demonstrates that the environmental impacts and risks of the activity will be of an acceptable level	Section 7.4 details the method by which Shell demonstrates environmental impacts and risks are managed to a level that is acceptable. Aspect-specific demonstrations of acceptability are provided in the impact and risk assessments provided in Section 9.3 to Section 9.13.
10A (d)	The EP provides or appropriate environmental performance outcomes (EPOs), environmental performance standards (EPSs) and measurement criteria (MCs)	EPOs, EPSs and MCs are detailed in Section 9.3 to 9.13.
10A (e)	The EP includes an appropriate implementation strategy and monitoring, recording and reporting arrangements	The implementation strategy for the EP is provided in Section 10.

OPGGS (E) Regulation	Requirement	Relevant Section of EP
10A (f)	The EP does not involve the activity or part of the activity, other than arrangements for environmental monitoring or for responding to an emergency, being undertaken in any part of a declared World Heritage property within the meaning of the EPBC Act.	Section 6 detail the planned petroleum activities considered in this EP, none of which will occur within a World Heritage Area.
10A (g) (i) & 10A (g) (ii)	The EP demonstrates that: (i) the titleholder has carried out the consultations required by Division 2.2A; and (ii) the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate	The consultation undertaken in relation to the EP are detailed in Section 5, including Shell's responses to any claims or objections made by Relevant Persons. Any management measures adopted in response to stakeholder consultation outcomes are considered in the aspect-specific impact and risk assessments in Section 9.3 to Section 9.13.
10A (h)	The EP complies with the Act and the regulations.	Section 3.1.1 (i.e. this section) shows the relationship between the Act, regulations and components of the EP.

3.1.2 Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act and supporting regulations provide for the protection of the environment and the conservation of biodiversity in Australia. Amendments to the OPGGS Act and OPGGS(E) Regulations in February 2014, undertaken as part of the streamlining of environmental approvals for petroleum activities in Commonwealth waters, require impacts and risks to matters protected under Part 3 of the EPBC Act (i.e. MNES) be considered in the EP. Following the streamlining arrangements, NOPSEMA became the sole environmental regulator for petroleum activities (i.e. regulates activities under the OPGGS Act and EPBC Act) in Commonwealth waters.

The matters protected under Part 3 of the EPBC Act that are required by the OPGGS(E) Regulations are outlined above in Section 3.1.1.1 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations. As part of the streamlining arrangements, matters protected under Part 3 of the EPBC Act must be considered by NOPSEMA when assessing an EP.

3.1.2.2 Australian Marine Park Management Plans

The EPBC Act provides for the declaration of Australian Marine Parks (AMPs) based on the International Union for the Conservation of Nature (IUCN) principles and guidelines for categorising protected areas. Australia has established a network of AMPs throughout Commonwealth waters, which are managed under a series of region-based management plans. These plans detail the management objectives of the AMPs, the environmental values within each of the AMPs and the activities that area

permissible within the zones of the AMPs. AMPs are part of the Commonwealth Marine Area, which is an MNES.

The planned petroleum activities considered within this EP will not credibly impact upon any AMPs, however an unplanned hydrocarbon spill from a worst-case loss of well containment was identified as potentially impacting upon several AMPs. These AMPs are described in Section 7.3.2 and managed under the Australian Marine Parks - North Marine Parks Network Management Plan 2018 (Director of National Parks 2018a) and Australian Marine Parks - North-west Marine Parks Network Management Plan 2018 (Director of National Parks 2018b).

The requirements of the management plans for AMPs are considered as part of Shell's determination of the acceptability of environmental impacts and risks. Refer to Section 9.3 to Section 9.13 for further information.

3.1.2.3 Recovery Plans and Conservation Advice

Species and communities listed as threatened under the EPBC Act are MNES and receive protection under Commonwealth law. The Threatened Species Scientific Committee may publish conservation advice for a threatened species, which provides information on threats and conservation management. Recovery plans relating to threatened species may also be published by the Commonwealth Department of the Environment and Energy. Recovery plans are intended to provide a framework to prevent further decline, and facilitate the recovery, of threatened species. Recovery plans may contain actions that warrant consideration during the assessment of environmental impacts and risks. Recovery plans may also identify habitat critical for the survival of a species; such habitat is protected under the EPBC Act.

Shell has identified a number of threatened species that may credibly be impacted, or are at risk of being impacted, by the petroleum activities considered in this EP. Details on these species, along with relevant information from recovery plans and conservation advice, are provided in Section 7.2.8.

3.1.3 Other Legislation

Other legislation applicable to the environmental management of the petroleum activities considered in this EP, along with a justification as to why they are relevant, are provided in Table 3-2.

Table 3-2: Summary of Relevant Legislation

Legislation	Summary	Relevance to the Project
Australian Heritage Council Act 2003	This Act identifies areas of heritage value, including those listed on the World Heritage List, National Heritage List and the Commonwealth Heritage List (all of which are MNES under the EPBC Act).	The EP will take into consideration any heritage values (see Section 7.3.1 for details).
Australian Maritime Safety Authority Act 1990	Provides that a function of AMSA is to combat pollution in the marine environment. AMSA is the control agency for vessel-based non-petroleum activity spills in commonwealth waters.	Vessel emergencies, including oil spills in Commonwealth waters.
Biodiversity Conservation Act 2016 (WA) *Biodiversity Conservation Regulations 2018*	Requires WA conservation management agencies to take a lead role in oiled wildlife response in Western Australia. DBCA has the responsibility and statutory authority to treat, protect and destroy wildlife.	Oiled wildlife response will comply with this Act.
Biosecurity Act 2015	The Act and its supporting legislation are the primary legislative means for managing risk of pests and diseases entering Australian territory. The Act includes requirements for pre-arrival reporting, ballast water management plans and certificates.	The EP will comply with biosecurity requirements, specifically in relation to biofouling and ballast water requirements.
Emergency Management Act 2005 (WA)	Requires the WA DoT (Hazard Management Agency) shall be the Control Agency for spills within or entering WA state waters. It is the legislative basis for the WA WestPlan – MOP.	Emergencies including oil spills which enter state waters.
Environment Protection (Sea Dumping) Act 1981	This Act protects is intended to prevent pollution of the sea by prohibiting the discharge of potentially harmful materials to the sea.	Chemical inventories onboard the vessels may potentially breach this convention if unpermitted via this EP and deliberately discharged to the sea.
Hazardous Waste (Regulation of Exports and Imports) Act 1989	This Act regulates the export, import and transport of hazardous waste to ensure that hazardous waste is managed appropriately so that human health and the	The project will comply with the export, import and transport requirements for hazardous waste.

Legislation	Summary	Relevance to the Project
	environment are protected from the harmful effects of the waste.	
National Environment Protection (National Pollutant Inventory) Measure 1998 (established under the *National Environment Protection Council Act 1994*)	This measure provides the framework for the development and establishment of the National Pollutant Inventory (NPI), which provides publicly available information on the types and amounts of 93 toxic substances being emitted into the Australian environment. These substances have been identified as important due to their possible effect on human health and the environment.	The project will comply with the NPI NEPM through the reporting of relevant NPI substances.
National Environment Protection Council Act 1994	This Act establishes the National Environment Protection Council (NEPC). The primary functions of the NEPC are to define National Environment Protection Measures (NEPMs) to ensure that Australians have equivalent protection from air, water, soil and noise pollution, and assess and report the implementation and effectiveness of NEPMs.	The project will comply with the requirements of the relevant NEPMs.
National Greenhouse and Energy Reporting Act 2007 *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015*	The Act provides a single, national framework for the reporting and distribution of information related to greenhouse gas (GHG) emissions, GHG projects, energy production and energy consumption. Reporting obligations are imposed upon corporations that meet emissions/energy thresholds. The Act includes National Greenhouse and Energy Reporting (NGER) requirements and the Safeguard Mechanism requirements.	Shell reports as a corporate group under the Act which includes emissions from activities under its operational control. Where operational control is determined to sit with Shells contractors, it is the contractor's responsibility to adhere to the Act.
Navigation Act 2012 *Navigation Regulations 2013* *Marine Order 21 (Safety and emergency arrangements) 2016*	This Act relates to maritime safety and the prevention of pollution of the marine environment in Australian waters. It gives effect to several international conventions relating to maritime issues to which Australia is a signatory. The Act also has subordinate	The project, including vessels, will adhere to the Act and subsidiary legislation enabled by the Act, such as Marine Orders relating to the international conventions listed in Section 3.3.

Legislation	Summary	Relevance to the Project
Marine Order 27 (Safety of navigation and radio equipment) 2016 *Marine Order 28 (Operations standards and procedures) 2015* *Marine Order 30 (Prevention of collisions) 2016* *Marine order 60 (Floating offshore facilities) 2001* *Marine Order 71 (Masters and deck officers) 2014*	legislation contained in Regulations and Marine Orders.	
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 and Regulations 1995	The Act protects the environment by reducing emissions of ozone depleting substances (ODSs) and synthetic greenhouse gases (SGGs). It controls the manufacture, import and export of ODSs and SGGs and products containing these gases.	The project will adhere to restrictions on import and use of ODSs/SGGs through implementing appropriate measures that control procuring of products which contain these gases.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 *Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994* *Marine Order 91 (Marine pollution prevention — oil) 2014* *Marine Order 93 (Marine pollution prevention — noxious liquid substances) 2014* *Marine Order 94 (Marine pollution prevention — packaged harmful substances) 2014* *Marine Order 95 (Marine pollution prevention — garbage) 2018* *Marine Order 96 (Marine pollution prevention — sewage) 2018* *Marine Order 97 (Marine pollution prevention — air pollution) 2013*	The Act regulates discharges from ships to protect the sea from pollution. This includes regulation of discharges of oil or oily mixtures, noxious liquid substances, packaged harmful substances, sewage and garbage to the sea. The Act imposes a duty to report certain incidents involving prohibited discharges and to maintain record books and management plans. The Act and subsidiary Marine Orders enact the International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL).	The FLNG and vessels within the Operational Area are subject to this Act and will adhere to the requirements for discharges and waste management outlined in the relevant MARPOL and Marine Orders (as appropriate to vessel class).

Legislation	Summary	Relevance to the Project
Underwater Cultural Heritage Act 2018	An Act to protect Australia's underwater cultural heritage. The Act came into effect on 1 July 2019, replacing the *Historic Shipwrecks Act 1976*. This act protects Australia's shipwrecks, and broadens protection to sunken aircraft and other types of underwater cultural heritage.	Planned petroleum activities will not interfere with any underwater cultural heritage sites (see Section 7.3.1 for details).

3.2 Standards and Guidelines

3.2.1 Industry Good Practice Standards

In Australia, the petroleum exploration and production industry operates within an industry code of environmental practice developed by the Australian Petroleum Production and Exploration Association (APPEA) (APPEA 2008). This code provides guidelines for activities and has evolved from the collective knowledge and experience of the oil and gas industry both nationally and internationally. The code provides the Australian petroleum industry with guidance on management measures to protect the environment during exploration, production and decommissioning phases. Shell is a signatory to the APPEA guidelines and will align with their intent in the implementation of this EP.

The following Australian guidelines are also applicable to the project:

- GN1344 Environment Plan Content Requirements Guidance Note (NOPSEMA 2019a)
- GN1785 Petroleum activities and Australia marine parks (NOPSEMA 2018a)
- GN1488 Oil Pollution Risk Management (NOPSEMA 2018b)
- IP1349 Operational and Scientific Monitoring Programs (NOPSEMA 2016)
- IP1765 Acoustic impact evaluation and management (NOPSEMA 2018c)
- Australian Ballast Water Management Requirements (Department of Agriculture and Water Resources 2017)
- National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009 (Department of Agriculture, Fisheries and Forestry 2009)
- Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA 2015)
- Advisory Note for Offshore Petroleum Industry Consultation with Respect of Oil Spill Contingency Plans (AMSA 2018), and the corresponding Marine Oil Pollution: Response and Consultation Arrangements (Department of Transport 2020).

The following international guidelines are also applicable to the project:

- Improving Social and Environmental Performance: Good Practice Guidance for the Oil and Gas Industry (IPIECA 2017)
- Environmental Management in Oil and Gas Production (United Nations Environment Program and Oil Industry International Exploration and Production Forum 1997).

3.2.2 International Standards and Guidelines

Shell refers to World Bank (WB)/International Finance Corporation (IFC) guidelines as the basis for many of its operation guidelines, as aligned with the Shell HSSE & SP Control Framework. The WB/IFC guidelines are the minimum environmental, social and health standards for WB funded projects, unless the standards of the host country are more stringent.

The WB/IFC guidelines of primary relevance to the project include:

- IFC Performance Standards on Environmental and Social Sustainability (IFC 2012)
- General Environmental, Health, and Safety (EHS) Guidelines (IFC 2007)
- EHS Guidelines for Offshore Oil and Gas Development (IFC 2015).

3.2.3 Shell Health, Security, Safety, Environment and Social Performance Management Framework

Shell maintains and implements a Health, Security, Safety, Environment and Social Performance Management Framework, which contains a range of standards and guidelines. It is the means by which Shell ensures that the industry good practice standards and international standards and guidelines detailed in Sections 3.2.1 and 3.2.2 are implemented. It forms the basis of the implementation strategy of this EP. Refer to Section 4 for further information.

3.3 International Agreements and Conventions

Australia is signatory to several international conventions and agreements that are relevant to the environmental management of the petroleum activities considered in this EP. These are typically implemented by Commonwealth legislation, much of which is detailed above in Section 3.1. Relevant international agreements and conventions, along with a justification of their relevance to the petroleum activities considered in this EP, are provided in Table 3-3.

Table 3-3: Summary of relevant international agreements and conventions

Agreement / Convention	Summary	Relevance to the Project
Convention on the Conservation of Migratory Species of Wild Animals 1979 (the Bonn Convention)	This convention aims to conserve migratory fauna species throughout their ranges, particularly where their range crosses international jurisdictional boundaries. It is implemented in Commonwealth law by the EPBC Act, which makes provision for species listed under the Bonn Convention to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	Several species listed as migratory under the EPBC Act were identified as potentially being impacted by the petroleum activities considered in this EP. Refer to Section 7.2.8.
The East Asian - Australasian Flyway Partnership 2006 (EAAFP)	Adopted in the list of the World Summit on Sustainable Development as a Type II initiative which is informal and voluntary, the Partnership was launched on 6 November 2006 and aims to protect migratory waterbirds, their habitat and the livelihoods of people dependent upon them. There are currently 37 Partners including 18 countries, 6 intergovernmental agencies, 12 international non-governmental organisations (NGOs) and 1 international private enterprise.	Several migratory birds species that utilise the East Asian - Australasian Flyway were identified as potentially being impacted by the petroleum activities considered in this EP. Section Refer to Section 7.2.8.
The Agreement on the Conservation of Albatrosses and Petrels (ACAP)	ACAP through its 13 Parties strives to conserve albatrosses and petrels by coordinating international activities to mitigate threats to their populations.	Several albatross and petrel species were identified as potentially being impacted by the petroleum activities considered in this EP. Section Refer to Section 7.2.8.
Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds in Danger of Extinction and their Environment 1974 (JAMBA)	This agreement aims to conserve migratory bird species that travel between Japan and Australia. This includes many species of shorebirds that use the East Asian - Australasian Flyway. It is implemented in Commonwealth law by the EPBC Act, which makes provision for species listed under JAMBA to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	Several birds listed as migratory under the EPBC Act were identified as potentially being impacted by the petroleum activities considered in this EP. Section Refer to Section 7.2.8.
Agreement between the Government of Australia and the Government of the People's Republic of China for the	This agreement aims to conserve migratory bird species that travel between China and Australia. This includes many species of shorebirds that use the East Asian - Australasian Flyway. It is implemented in Commonwealth law by the EPBC Act, which	Several birds listed as migratory under the EPBC Act were identified as potentially being impacted by the petroleum activities considered in this EP. Refer to Section 7.2.8.

Agreement / Convention	Summary	Relevance to the Project
Protection of Migratory Birds and their Environment 1986 (CAMBA)	makes provision for species listed under CAMBA to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	
Agreement between the Government of Australia and the Government of the Republic for Korea for the Protection of Migratory Birds and their Environment 2007 (ROKAMBA)	This agreement aims to conserve migratory bird species that travel between the Republic of Korea and Australia. This includes many species of shorebirds that use the East Asian - Australasian Flyway. It is implemented in Commonwealth law by the EPBC Act, which makes provision for species listed under ROKAMBA to be listed as migratory under the EPBC Act. Species listed as migratory under the EPBC Act are MNES.	Several birds listed as migratory under the EPBC Act were identified as potentially being impacted by the petroleum activities considered in this EP. Refer to Section Refer to Section 7.2.8.
International Convention on Wetlands of International Importance 1975 (Ramsar)	This convention aims to conserve and promote the sustainable human use of wetlands. Many wetlands have been identified as important habitat for migratory bird species, and Ramsar wetlands are of importance in conserving many species of migratory shorebirds and waders. Ramsar wetlands are protected under the EPBC Act and are MNES.	The Ashmore Reef Ramsar wetland was identified as potentially being impacted in the event of an unplanned release of large volumes of hydrocarbons (e.g. loss of well control). Refer to Section 7.2.5.
Memorandum of Understanding between the Government of Australia and the Government of the Republic of Indonesia Regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Exclusive Fishing Zone and Continental Shelf 1974	This memorandum recognises the long history of traditional Indonesian fishermen exploiting biological resources within Timor Sea waters within Australia's exclusive economic zone. The memorandum provides for an area (commonly referred to at the MoU box) within which traditional Indonesian fishing is permitted. The area includes several offshore reefs, including Ashmore Reef, Cartier Island, Scott Reef and Seringapatam Reef.	The Operational Area is situated within the MoU box. Refer to Section 7.3.3.
London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London Convention)	This convention is an agreement to control pollution of the sea by intentional disposal at sea of potentially harmful materials. It is implemented under Commonwealth law by the *Environment Protection (Sea Dumping) Act 1981*.	Chemical inventories onboard vessels may potentially breach this convention if unpermitted via this EP and deliberately discharged to the sea.

Agreement / Convention	Summary	Relevance to the Project
International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL)	This convention is an agreement to minimise the pollution of the marine environment by ships. The convention provides a standardised approach to the environmental management of international and domestic shipping. The convention is implemented in Commonwealth law by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and a series of Marine Orders made under this Act.	All marine support vessels are required to comply with MARPOL.
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 (STCW)	This convention provides a standardised approach to the qualifications and competencies of masters, officers and watch personnel. It is implemented in Commonwealth law by the *Navigation Act 2012* and a series of Marine Orders made under this Act.	All project vessels and crew are required to comply with STCW.
International Convention for the Safety of Life at Sea 1974 (SOLAS)	This convention provides internationally agreed minimum standards for the construction, equipment and operation of vessels. It is implemented in Commonwealth law by the *Navigation Act 2012* and a series of Marine Orders made under this Act.	All project vessels are required to comply with SOLAS.
International Regulations for Preventing Collisions at Sea 1972 (COLREGS)	These regulations provide internationally agreed rules for the navigation of vessels, which are intended to reduce the likelihood of vessel collisions. COLREGS are implemented in Commonwealth law by the *Navigation Act 2012* and a series of Marine Orders made under this Act.	All project vessels are required to comply with COLREGS.
Paris Agreement on Climate Change (2015)	The Paris Agreement is an instrument made under the UNFCCC, with the central aim of strengthening the global response to the threat of climate change by keeping the global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius in order to prevent dangerous human caused interference with the climate system. It deals with GHG emissions mitigation, adaptation, and finance. The agreement's language was negotiated by representatives of	The Paris Agreement provides the international framework and context around Australia's NDC, which is important to establishing the defined acceptable level of GHG emissions from the Prelude facility.

Agreement / Convention	Summary	Relevance to the Project
	196 state parties, including Australia, and adopted by consensus on 12 December 2015, before entering in to force in late 2016. Australia has since ratified the Paris Agreement. The Paris Agreement requires each party to: • volunteer its own Nationally Determined Contributions (NDCs), to report against them annually, and improve them if it is determined that the collective commitment to NDCs is considered ineffective or insufficient to keep global temperature increases to less than 2ºC below pre-industrial levels. This allows for variation in emissions reduction performance according to the development status of the country; and • determine, plan, and regularly report on the contribution that it undertakes to mitigate global warming. No mechanism forces a country to set a specific emissions target by a specific date, but each target should go beyond previously set targets. Australia has set Nationally Determined Contribution under the Paris Agreement of 26% to 28% reduction over 2005 levels. (Source: climatetracker.org – LULUCF means land use, land-use change, and forestry). The Intergovernmental Panel on Climate Change (IPCC) released a report in October 2018 on the 1.5 degrees Celsius target; it concluded that global emissions need to reach net zero around mid-century to give a reasonable chance of limiting warming to 1.5 degrees Celsius.	

4 Shell Environmental Management Framework

4.1 Shell Health, Security, Safety, Environment and Social Performance Management Framework

Shell, as a subsidiary of Shell plc, is a member of the Shell group of companies (and in this EP, where there is reference to Shell's activities globally, the term "Shell Group" is used).

The Shell Group operates under a common set of business principles, supported by policies, standards and business controls which are implemented throughout the organisation structure. In support of the business principles, there is a Shell Group Health, Security, Safety, Environment and Social Performance Policy which requires every Shell Company to manage HSSE and SP in a systematic manner.

The Shell Group HSSE and SP Control Framework is a corporate management framework which applies to every Shell Group company, contractor and joint venture under Shell's operational control.

4.2 HSSE & SP Policy

The Shell Commitment and Policy on HSSE & SP applies across the Shell Group and is designed to protect people and the environment. The policy, endorsed and adopted by Shell, is presented in Figure 4-1. The policy illustrates the commitment made by the senior management and all staff of Shell to achieve not only compliance with environmental standards set by the Australian Government and the Company, but also to seek continual improvements in performance.

Key features of the policy are:

- systematic approach to HSSE and SP management designed to ensure compliance with the law and to achieve continuous performance improvement
- targets for improvement and measurement, appraisal and performance reporting
- requirement for contractors to manage HSSE and SP in line with this policy
- effective engagement with neighbours and impacted communities.

SHELL COMMITMENT AND POLICY ON HEALTH, SECURITY, SAFETY, THE ENVIRONMENT AND SOCIAL PERFORMANCE

COMMITMENT

In Shell we are all committed to:

- Pursue the goal of no harm to people;
- Protect the environment;
- Use material and energy efficiently to provide our products and services;
- Respect our neighbours and contribute to the societies in which we operate;
- Develop energy resources, products and services consistent with these aims;
- Publicly report on our performance;
- Play a leading role in promoting best practice in our industries;
- Manage HSSE & SP matters as any other critical business activity; and
- Promote a culture in which all Shell employees share this commitment.

In this way we aim to have an HSSE & SP performance we can be proud of, to earn the confidence of customers, shareholders and society at large, to be a good neighbour and to contribute to sustainable development.

POLICY

Every Shell Company:

- Has a systematic approach to HSSE & SP management designed to ensure compliance with the law and to achieve continuous performance improvement;
- Sets targets for improvement and measures, appraises and reports performance;
- Requires contractors to manage HSSE & SP in line with this policy;
- Requires joint ventures under its operational control to apply this policy, and uses its influence to promote it in its other ventures;
- Engages effectively with neighbours and impacted communities; and
- Includes HSSE & SP performance in the appraisal of staff and rewards accordingly.

Ben van Beurden
Chief Executive Officer

Tony Nunan
EVP / Country Chair Shell Australia

Originally published in March 1997 and updated by the Executive Committee December 2009.

General Disclaimer: The companies in which Royal Dutch Shell plc directly and indirectly owns investments are separate entities. In this Policy the expression "Shell" is sometimes used for convenience where references are made to companies within the Shell group or to the group in general. Likewise, the words "we", "us" and "our" are also used to refer to Shell companies in general or those who work for them. These expressions are also used where no useful purpose is served by identifying specific companies.

Figure 4-1: Shell Australia's HSSE & SP Policy

4.3 HSSE & SP Control Framework

All Shell's operations are conducted in accordance with Shell's HSSE & SP Control Framework, a comprehensive corporate management framework. This Framework

defines a set of mandatory requirements that define minimum HSSE & SP principles and expectations, which are documented in a set of manuals. Figure 4-2 outlines the various control framework manuals applicable to Crux.

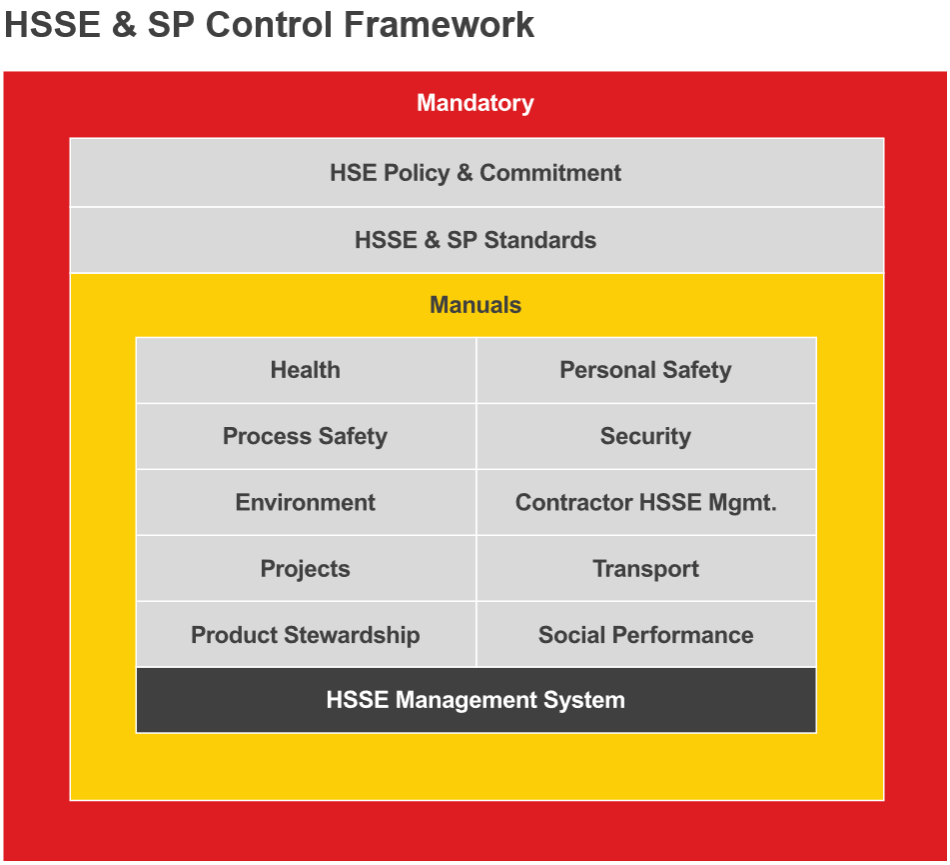

Figure 4-2: Shell HSSE & SP Control Framework

4.4 HSSE & SP Management System (MS)

The Shell HSSE &SP-MS provides a structured and documented system for the effective management of impacts and risks and demonstrates how the requirements of the Shell Group HSSE & SP Control Framework are implemented throughout Shell. The Shell HSSE & SP-MS Manual consists of the following elements:

- Leadership and Commitment
- Policy and Objectives
- Organisation, Responsibility and Resources, Standard and Documents
- Risk Management
- Planning and Procedures
- Implementation, Monitoring and Reporting
- Assurance, and
- Management Review.

The HSSE & SP-MS is subject to a continuous improvement 'plan, do, check, review' loop, with the eight elements as listed above. There are numerous, specific ongoing (typically annual) assurance activities against each of the eight elements in the HSSE & SP-MS Manuals, to ensure that the system is being implemented, is effective and to identify areas for improvement.

Environmental management for Crux is through the implementation of the Shell HSSE & SP-MS, supplemented by facility/asset specific HSSE systems/procedures (e.g. Shell Permit to Work system and associated procedures such as Confined Space Entry, Isolations, etc. as appropriately developed at the stage of project implementation).

Shell implements specific pre- and post-contract award processes and activities aimed at ensuring that contracts consistently and effectively cover the management of HSSE & SP risks and deliver effective management of HSSE & SP risks for contracted activities. Contractor HSSE & SP Management is governed by the Shell HSSE & SP Control Framework.

As a minimum, all relevant field active contractors' HSSE & SP-MS will be assessed to ensure they meet materially equivalent outcomes to Shell's HSSE & SP-MS.

5 Stakeholder Consultation

As operator, Shell has consulted with Relevant Persons in accordance with the NOPSEMA Decision-making guideline – Criterion-10A(g) Consultation Requirements (N-04750-GL1721 Rev 6 2021) under the OPGGS (E) Regulations 2009 for this EP.

Shell has ensured all Relevant Persons (Table 5.3) have been provided with sufficient information and had the opportunity to raise any objections or claims within a reasonable period.

Shell has addressed any objections and claims raised in relation to this EP and can demonstrate that the risk or impact in question has been reduced to ALARP and to an acceptable level.

5.1 Background

Consultation and stakeholder engagement for Crux began when the gas field was first explored in the year 2000 and subsequent appraisal wells drilled in 2007 and 2008. Additionally, a public consultation period was undertaken to support the development of the Crux Offshore Project Proposal, approved by NOPSEMA in August 2020. Each EP developed to support the Crux project (including this EP) is required to include EP specific consultation with Relevant Persons. Consultation was also undertaken in 2021 for the FDP, Production and Pipeline Licenses.

The following consultation overview is therefore part of a series of consultation activities undertaken over the life of the Crux Project.

5.2 Shell General Business Principles and Stakeholder Engagement

Stakeholder engagement and consultation is an integral part of Shell's social performance, impact assessment and project development process, helping to both inform business decisions and identify issues that require action. Shell has internal policies and processes which outline the requirements of stakeholder engagement. These are underpinned by Shell's General Business Principles (refer to Section

3.2Standards and Guidelines), which govern how the Shell companies that make up the Shell Group conduct their affairs.

Key principles for stakeholder engagement:

- Local communities – Shell aims to be a good neighbour by continuously improving the ways in which we contribute directly or indirectly to the general wellbeing of the communities within which we work. We manage the social impacts of our business activities carefully and work with others to enhance the benefits to local communities, and to mitigate any negative impacts from our activities. In addition, Shell companies take a constructive interest in societal matters, directly or indirectly related to our business.
- Communication and engagement – Shell recognises that regular dialogue and engagement with our stakeholders is essential. In our interactions with local communities, we seek to listen and respond to them honestly and responsibly. Part of this commitment is ensuring those people and organisations that are impacted by our activities are engaged, and that their concerns are heard and responded to.

5.2.1 Stakeholder Engagement Process

In supporting Shell's adherence to the Shell general Business Principles is a comprehensive stakeholder strategy which ensures that:

- the external context is monitored and understood;
- stakeholder needs, interests, concerns and expectations are understood, shared and outcomes defined;
- there is a clear and direct link between impacts and risks/opportunities;
- stakeholder engagement protocols established and consistent; and
- explicit inclusion of external perspectives in business decisions.

5.2.2 The Team

Shell Australia has a Corporate Relations (CR) team, which includes Social Performance, that facilitate stakeholder and community engagement in Australia on behalf of the business with teams in Perth, Canberra, Melbourne and Queensland.

The CR team manages the interface for the business with external stakeholders such as communities, NGOs, Government(s) and the media. Working as an integrated team allows a 'whole of Shell view' to be provided in stakeholder engagements and ensure stakeholders receive consistent and coordinated information. This is important where, for example, project activities, have similar stakeholders to the Prelude FLNG facility and therefore require an aligned approach. We call this grouping the Prelude/Crux Performance Unit.

An EP specific meeting is held monthly between the relevant HSSE and CR leads which is driven by the EP commitments register.

5.2.3 Crux Stakeholder Engagement Approach

The Stakeholder Engagement Management Approach includes a stakeholder management system where we document all Relevant Persons feedback and maintain a Relevant Persons list and their functions, interests or activities related to the project.

Shell's approach to stakeholder engagement for Crux, as is the case for all of Shell's assets, has always been "no surprises" which has driven proactive engagements with a range of stakeholders from an early stage. Shell has developed long-term working relationships with those who may be impacted by the Crux development or who may have an interest in it.

5.2.4 EP Consultation Strategy

The EP Consultation Strategy was formed using various examples of historical EP's, the Crux OPP and the Corporate Relations knowledge of business stakeholders.

Subject matter experts were engaged, as needed throughout the process, to inform the development of the plan and to ensure the CR Team had sound understanding of the Crux environmental risks and mitigations.

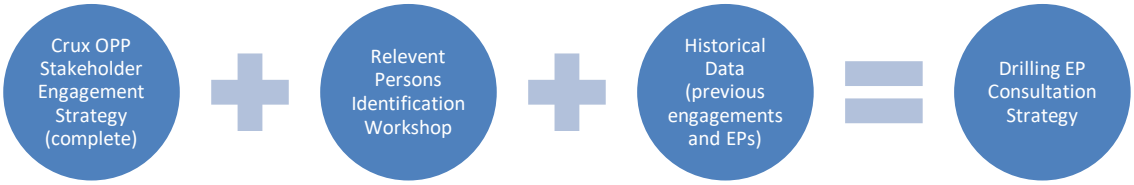

Figure-1: Development of Consultation Strategy

Relevant Persons

Shell has an internal process to identify, prioritise and understand stakeholders. The process includes the following steps:

Identify stakeholders against specific business objectives.

Prioritise stakeholders based on stakeholder views/concerns.

Analyse value drivers and views on our activities.

Define desired shared outcomes; and

Early engagements with stakeholders to understand views of impacts, risks and opportunities.

This process was used to develop the Crux Development Drilling Stakeholder Matrix and formed the foundation for a Relevant Persons Identification Workshop.

If you believe you are a relevant person and have not yet been consulted

If you believe your functions, interests or activities may be affected by the Crux Project activities, please contact us.

- Call the Community Hotline: 1800 059 152
- Email: SDA-crux-project@shell.com

Shell is committed to upholding the Shell Business Principles in all our activities and will consider any self identified potential Relevant Persons on a case by case basis.

The workshop was held on 13 June 2022 and attended by CR representatives as well as Safety and Environment subject matter experts. During the workshop, each potential stakeholder was assessed based on how Crux activities could impact their functions, interests or activity.

The workshop was informed by:

- historic information gathered as part of the initial Crux OPP submission and Shell Crux stakeholder engagement process
- desktop research to identify the specific functions, interests and activities of each Relevant Person.

Once stakeholders were identified, Shell determined the most appropriate consultation approach and associated information to communicate based on the:

- functions, interests and activities of the Relevant Person
- prior feedback and information from Relevant Persons on their perspectives and how they prefer to be engaged gathered as part of the Crux stakeholder engagement process; and
- information gathered during prior engagement activities and/or ongoing communication with stakeholders.

The result was a list of all Relevant Persons who require formal consultation and their information requirements are shown in Table 5.3. Upon acceptance of this EP, Shell will uphold its commitments to ensuring Relevant Persons continue to be consulted throughout the five-year duration of this plan.

A validation review was undertaken in June 2022 with the primary purpose to re-validate that the methodology used to inform the identification of Relevant Persons met the requirements of the OPGGS(E)R 2009, and where required, establish additional protocols to infer how a person is deemed relevant with regard to the specifics of Regulation 11A and 14(9). The review confirmed our approach had been thorough, and only one additional Relevant Person was identified through this process.

Consultation is tailored to the specific functions, interests or activities of the Relevant Persons. The planned frequency of these consultations for each Relevant Person can be found in Table 5.3. The frequencies and requirements were identified and discussed in the Relevant Persons Identification Workshop and updated as feedback was gathered as part of the consultation process.

The assessment is dynamic and could change, for example changes to scope, in which case the Stakeholder Engagement Plan would be updated. Progress of planned consultation is tracked and recorded, and it is subject to a half yearly review at the regular Environment Plan meetings held.

Relevant Persons themselves can identify their preferred ongoing engagements for Crux. In such cases, that suggestion is considered and if appropriate, implemented.

Shell's internal 'management of change' process will also ensure that any material changes to the activity scope will trigger engagement with those who may be impacted.

Relevant Persons will be reviewed annually as part of the standing agenda for the EP Monthly Meeting.

EP Guidance on Consultation

Stakeholder consultation for this activity has also been guided by various stakeholder organisation expectations for consultation on planned activities. The guidance included but is not limited to those summarised in Table 5.1.

Table 5-1: Guidance for EP Stakeholder Consultation

Organisation	Guidance
NOPSEMA	• Consultation with Commonwealth agencies with responsibilities in the marine area (N-06800-GL1887 March 2022). • NOPSEMA Decision-making guideline – Criterion-10A(g) Consultation Requirements (N-04750-GL1721 June 2021) • Petroleum activities and Australian Marine Parks Guidance Note (N-04750-GN1785 June 2020)
Australian Fisheries Management Authority (AFMA)	• Petroleum industry consultation with the commercial fishing industry
Commonwealth Department of Agriculture, Water and the Environment (DAWE)	• Fisheries and the Environment – Offshore Petroleum and Greenhouse Gas Act 2006 • Offshore Installations Biosecurity Guide 2019
WA Department of Primary Industries and Regional Development (DPIRD)	• Guidance statement for oil and gas industry consultation with the Department of Fisheries 2013
WA Department of Transport (DOT)	• Offshore Petroleum Industry Guidance Note July 2020
Western Australian Fishing Industry Council (WAFIC)	• Guidance on consultation with Commercial Fisheries

Reasonable Period

Shell typically allows a minimum of 30 days as a reasonable period for formal consultation. This is a common duration specified for matters that are open to public comment and Shell's historic engagements support that it is sufficient time to allow for a Relevant Person to assess the information provided by Shell in a letter containing all the risks as outlined in the EP and respond, detailing any claims or objections.

The 30-day period acts as a minimum period in Shell's consultation planning processes, and Relevant Persons are explicitly asked to respond within that time. However, Shell acts on a case-by-case basis depending on the response received from Relevant Persons and will allow for requests to extend this period, if considered reasonable. Shell will also follow up after the 30-day period if no response is received, where contact details are available (attempts are made prior to consultation commencing to ensure the latest contact details are on file).

As part of the review, it was identified that a reasonable period needed to be defined for ongoing consultation.

In the case of this petroleum activity, given historical consultation carried out for the Crux OPP, pipeline licence and drilling development EP, 14 days was considered to be a reasonable period for initial consultation with an open invite for relevant persons to request more time. This was also considered reasonable given the limited window of opportunity to carry out the survey in the second half of 2022.

Sufficient Information

When carrying out consultation with Relevant Persons, Shell considers the potential impacts of Crux activities on the particular functions, interests and activities of each Relevant Person to ensure that sufficient and appropriate information is provided. In summary, EP submission consultation involved the following:

Letter and accompanying factsheet

Shell provided Relevant Persons with a letter and accompanying factsheet outlining all the key risks and mitigations identified within the EP. This approach ensured that recipients had access to the impacts and risks outlined in the EP and the associated mitigations; and could make their own assessment on the impact of the activity. Therefore, removing potential for Shell to make any assumptions about what Relevant Persons would be interested or concerned about.

The factsheet also contained contact details, location specifics, details of the activity and the response period of 30 days (Appendix A:Factsheet), a link to the Crux project on the Shell Australia website was also provided for those seeking more detailed information.

The letter and/or cover email was tailored to meet the needs of specific Relevant Persons as determined by the Relevant Persons Identification workshop. For example, for Commercial Fishers who can only be contacted by mail and taking into account feedback from WA Fishing Industry Council (WAFIC), a tailored version of the factsheet was provided to Commercial Fishers.

Shell believes that this letter and factsheet, access to the Crux project on the Shell website and the follow up process provided Relevant Persons with sufficient information to be able to consider the impacts on their functions, interests and activities.

Meetings

In most cases, engagement for the EP did not require a one on one meeting and the majority of Relevant Persons did not request a meeting with Shell. However, if a Relevant Person were to request a one on one meeting, these could be arranged to engage and share information, with access to Shell subject-matter experts.

Crux Website

Shell Australia has web pages dedicated to the Crux project that were updated prior to consultation. This includes an outline of the risks, impacts and mitigation measures in a digestible format for the general public. This website forms the basis for additional information sought by Relevant Persons, allowing stakeholders to select the information which interests them most.

5.2.5 Assessment of merits of claims and objections

Shell has a claims process which guides our actions in response to claims and objections received from stakeholders related to Crux.

Claims received are recorded through Shell's Global Community Feedback tool. Identified Claims or Objections are tracked within this system and handled in accordance with the local complaints and feedback mechanism. Failure to close out complaints in the system results in an escalation process for resolution.

Shell has adhered to NOPSEMA's guidance (N-04750-GL1721, 2021) in relation to the definitions of claims and objections, where an '*objection or claim*' is taken to mean:

- To express opposition, protect, concern or complaint about the proposed activities; a request or demand that certain action be taken by the titleholder to address adverse impacts; and
- An assertion that there will be an adverse impact; or allegation to cast doubt about the manner in which the activities will be managed."

5.2.6 Summary of Consultation

A summary of consultation activities undertaken, and the Relevant Persons consulted during the development of this EP are presented in *Table 5-3*. An assessment of merit was undertaken and is presented in Table 5.5.

Table 5-2: Relevant Persons Identified for the Activity

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP01	Community	**Bardi and Jawi Niimidiman Aboriginal Corporation (Registered Native Title bodies Corporate)**	No	Yes	No	Yes	No	Interest in traditional activities on land and water. Native Title rights on shoreline from proposed project.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP02	Community	**Broome International Airport**	No	Yes	No	Yes	No	Broome International Airport supports the regional hub of north western Australia. Considered the 'Gateway to the Kimberley', BIA meets the needs and expectations of Community, Tourism and Industry, including development of Liquefied Natural Gas (LNG) in the Browse Basin. BIA is privately owned.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP03	Community	**Broome Shire**	No	Yes	No	Yes	No	Local Government area responsible where transit of personnel occurs for project. Interest in economic development of region and Broome as LNG transit hub. Responsible for development approvals in Broome Shire should any further infrastructure be required for the project (not planned at this stage).	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP04	Community	**Broome Visitors Centre**	No	Yes	No	Yes	No	Tourism outlet - assisting with Broome accommodation, Broome tours, Kimberley tours, details on The Gibb River Road, Cape Leveque and the	e) An organisation that Shell	• As required through EP change assessments; or • When major non-standard activities arise which may

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
								Dampier Peninsula, car hire, Cable Beach accommodation, what's on in Broome, hotels in Broome and more.	considers relevant.	directly affect the functions, interests or activities of the Relevant Person.
RP05	Community	**Dambimangari Wanjina-Wunggurr (Native Title) Aboriginal Corporation (Registered Native Title bodies Corporate)**	No	No	No	Yes	No	Interest in traditional activities on land and water. Native Title rights on shoreline from proposed project.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP06	Community	**Darwin city council**	No	No	No	Yes	No	City of Darwin is the local government body responsible for the municipality of Darwin. Interest in economic development of region.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP07	Community	**Djarindjin Aboriginal Corporation (DAC)**	No	Yes	No	Yes	No	Djarindjin is a medium-sized Aboriginal community located 170 km north of Broome in the Kimberley Region of Western Australia, within the Shire of Broome. Djarindjin Aboriginal Corporation (DAC) operate the airport for Prelude – anticipate would extend for Crux.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP08	Community	**Department of Fire and Emergency Services (DFES)**	No	Yes	No	Yes	No	The Department of Fire and Emergency Services (DFES) was established on 1 November 2012 and performs a critical role coordinating emergency services for	d) An organisation whose functions,	• As required through EP change assessments; or

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
								a range of natural disasters and emergency incidents threatening life and property.	interests or activities may be affected by the activity.	• When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP09	Community	**Goolarabooloo Aboriginal Corporation**	No	Yes	No	Yes	No	Interest in traditional activities on land and water. Native Title rights on shoreline from proposed project.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP10	Community	**Kimberley Ports Authority**	No	Yes	No	Yes	No	The Port of Broome is the largest deep-water access port servicing the Kimberley region and is open to shipping on a 24-hour, seven days a week basis. The port supports livestock export, offshore oil and gas operations, pearling, fishing, charter boats, cruise liners and is the main fuel and container receival point for the region. Prelude already makes use of the port for its infield support vessels.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP11	Community	**Kimberly Land Council**	No	Yes	Yes	Yes	No	Native Title Representative Body. Peak Indigenous body in the Kimberly region. Supports Aboriginal groups to secure Native Title, as well as undertake conservation and land management.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions,

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
										interests or activities of the Relevant Person.
RP12	Community	**Mayala Inninalang Aboriginal Corporation**	No	No	No	Yes	No	Interest in traditional activities on land and water. Native Title rights on shoreline from proposed project.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP13	Community	**Nimanburr Aboriginal Corporation**	No	No	No	Yes	No	Interest in traditional activities on land and water. Native Title rights on shoreline from proposed project.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP14	Community	**Northern Land Council**	No	No	No	Yes	No	Native Title Representative Body	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP15	Community	**Nyamba Buru Yawuru and Yawuru Native Title Holders Aboriginal Corporation (Registered**	No	Yes	No	Yes	No	Traditional Owner organization in Broome. Interest in Traditional activities on Land and water around Broome. Social Investment partner for Prelude.	e) An organisation that Shell	• As required through EP change assessments; or • When major non-standard activities arise which may

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
		Native Title bodies Corporate)						Interest in traditional activities on land and water. Native Title rights in and around Broome area where transit proposed to take place for Crux.	considers relevant.	directly affect the functions, interests or activities of the Relevant Person.
RP16	Community	**Port of Darwin**	No	No	No	Yes	No	Darwin Port operates commercial wharf facilities at East Arm Wharf and the cruise ship terminal at Fort Hill Wharf. The Port of Darwin is strategically positioned as Australia's nearest port to Asia. It is also a key support hub for the expanding offshore oil and gas, including off the coast of Western Australia. Shell already makes use of the port for transiting goods and services to Prelude FLNG and expects to use transport routes for Crux where relevant.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP17	Community	**Wanjina-Wunggurr (Native Title) Aboriginal Corporation (Registered Native Title bodies Corporate)**	No	No	No	Yes	No	Interest in traditional activities on land and water. Native Title rights on shoreline from proposed project.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP18	Community	**Gogolanyngor Aboriginal Corporation**	No	No	No	Yes	No	Interest in traditional activities on land and water. Native Title rights on shoreline from proposed project.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions,

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
										interests or activities of the Relevant Person.
RP19	Environmental NGOs	**Australian Conservation Foundation**	No	Yes	No	Yes	No	The Australian Conservation Foundation (ACF) stands for ecological sustainability. They aim to tackle the underlying social and economic causes from environmental problems. They work across society to influence urgent, transformative action to deliver lasting change on the scale required to secure a sustainable environment.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP20	Environmental NGOs	**Australian Marine Conservation Society**	No	Yes	No	Yes	No	The Australian Marine Conservation Society (AMCS) is the voice for Australia's ocean wildlife. They are an independent charity, staffed by a committed group of professional and passionate scientists, educators and advocates who have defended Australia's oceans for 50 years.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP21	Environmental NGOs	**Conservation Council of WA**	No	Yes	No	Yes	Yes	For over 45 years, the Conservation Council has been Western Australia's outspoken and independent voice for the environment and communities. As Western Australia's peak environmental group they represent tens of thousands of individual supporters and over 100 Member Groups with diverse interests across the state.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP22	Environmental NGOs	**Environmental Defenders Office WA**	No	Yes	No	Yes	No	The Environmental Defender's office of WA (EDOWA) is a not-for-profit and non-Government organisation that specialises in public interest environmental law.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP23	Environmental NGOs	**Environs Kimberley**	No	No	No	Yes	No	Environs Kimberley. Saving the nature of the Kimberley. Donate. As the peak environmental NGO for the Kimberley region in far north-west Australia, Environs Kimberley is dedicated to looking after the health of the land and waters of the region.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP24	Environmental NGOs	**Greenpeace**	No	Yes	No	Yes	No	Greenpeace is an independent campaigning organisation that uses non-violent direct action to expose global environmental problems and to force solutions which are essential to a green and peaceful future. Greenpeace's goal is to ensure the ability of the earth to nurture life in all its diversity.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP25	Environmental NGOs	**Save the Kimberley**	No	Yes	No	Yes	No	Save The Kimberley is not-for profit, independent awareness organisation. 100% volunteer run, established to educate the Australian and international community about the threat to the Kimberley Coast and its inland	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions,

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								wilderness areas posed by large-scale industrial developments, and disseminate information about the Kimberley's globally unique cultural importance and the threats created by uncontrolled development.		interests or activities of the Relevant Person.
RP26	Environmental NGOs	**WA Marine Science Institute**	No	No	No	Yes	No	Its structure is like no other because it is a collaboration of State, Federal, industry and academic entities cooperating to create benchmark research and independent, quality scientific information. Western Australia's marine ecosystems are facing unprecedented pressure from an increasing number of uses such as oil and gas extraction, tourism, aquaculture and large coastal developments.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP27	Environmental NGOs	**Wilderness Society**	No	Yes	No	Yes	No	Concerns offshore activities impacts - the Nature Campaign aims to protect wilderness and nature across Australia by creating protected areas and strong, nationally consistent laws and institutions.	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP28	Environmental NGOs	**WWF**	No	Yes	No	Yes	No	WWF has long recognised that the planet's species, people, habitats, governments and global markets are directly and often delicately inter-related. They believe meaningful conservation cannot take place without addressing the	e) An organisation that Shell considers relevant.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions,

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								complex relationships that exist between these elements.		interests or activities of the Relevant Person.
RP29	Commonwealth Fisheries	**Australian Bluefin Tuna Industry Association**	Yes	Yes	No	Yes	No	The Australian Southern Bluefin Tuna Industry Association (ASBTIA) represents the Australian Southern Bluefin Tuna industry. ASBTIA pioneered global tuna farming in 1991 and works to maintain a high level of quality and performance.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP30	Commonwealth Fisheries	**Australian Fishery Management Authority (AFMA)**	Yes	Yes	Yes	Yes	No	The AFMA is the Australian Government agency responsible for the efficient management and sustainable use of Commonwealth fish resources, in particular, Section 7 of the Fisheries Administration Act 1991.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP31	Commonwealth Fisheries	**Commonwealth Fishing Association**	No	Yes	No	Yes	No	The Commonwealth Fisheries Association (CFA) is the peak body representing the collective rights, responsibilities and interests of a diverse commercial fishing industry in Commonwealth regulated fisheries. The CFA was formed in April 2002 as a non-profit organisation.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP32	Commonwealth Fisheries	**North West Slope Trawl Fishery**	Yes	Yes	No	Yes	No	Activities exist in or in close proximity to Crux. Bottom trawl.	d) An organisation whose functions,	• As required through EP change assessments; or • When major non-standard activities arise which may

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									interests or activities may be affected by the activity.	directly affect the functions, interests or activities of the Relevant Person.
RP33	Commonwealth Fisheries	**Northern Prawn Fishery via the Association**	No	No	No	Yes	No	Activities exist in or in close proximity to Crux (shipping transit route).	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP34	Commonwealth Fisheries	**Western Tuna and Billfish Fishery**	Yes	Yes	No	Yes	No	Activities exist in or in close proximity to Crux. Near surface longline and minor line gear used.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP35	WA State Fisheries	**Mackerel Managed Fishery License Holders**	Yes	Yes	No	Yes	No	Activities exist in or in close proximity to Crux. Near-surface trawling activities near coastal areas primarily.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.

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RP36	WA State Fisheries	**Northern Demersal Scalefish Fishery**	Yes	Yes	No	Yes	No	The only known active fishery that overlaps the Operational Area - primarily trap based fishery.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP37	WA State Fisheries	**Pearl Producers Association**	Yes	Yes	No	Yes	No	Peak industry representative body for the Pinctada maxima pearling industry licensees in Western Australia. Activities exist in or in close proximity to Prelude. Bottom drifting divers from Lacepede Islands south to Exmouth.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP38	WA State Fisheries	**Western Australian Fishing Industry Council (WAFIC)**	Yes	Yes	No	Yes	No	Represents the interests of commercial fishers with licenses in the WA State Managed Fishery.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person. • Ongoing consultation will be held around the adjustment protocol/framework developed for fishing permit holder who may be impacted by the project.

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RP39	Industry	**INPEX**	Yes	No	No	Yes	No	Operator of WA-532-P and AC/P36 Shell notes that INPEX is also a Joint Venture partner for the Prelude project and is frequently kept updated with Crux milestones.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP40	Marine Organisations	**Australian Marine Oil Spill Centre (AMOSC)**	No	Yes	Yes	Yes	No	The Australian Marine Oil Spill Centre Pty Ltd (AMOSC) operates the Australian oil industry's major oil spill response facility. AMOSC's stockpile of oil spill response equipment includes oil spill dispersant and containment, recovery, cleaning, absorbent and communications equipment. AMOSC's also play a role in training and coordinating industry personnel ready to provide immediate emergency oil spill response.	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP41	State and Commonwealth Government	**Dept of Home Affairs including Maritime Border Command and Australian Border Force (ABF)**	Yes	Yes	Yes	Yes	No	Maintains the integrity of Australia's international borders including customs and immigration. Maritime Border Command (MBC) is enabled by Australian Border Force (ABF) and the Australian Defence Force	d) An organisation whose functions, interests or activities may be affected by the activity.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.

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								(ADF). Along with management of maritime security threats, MBC manages Petroleum Safety Zones.		
RP42	State and Commonwealth Government	**Australian Hydrographic Service including the Department of Defence – Operations Branch**	Yes	Yes	Yes	Yes	No	The Royal Australian Navy (RAN) Australian Hydrographic Service is the Commonwealth Government agency responsible for the publication and distribution of nautical charts and other information required for the safety of ships navigating in Australian waters. Issue notice to mariners and update nautical charts. The Department of Defence is the Government Agency protecting Australia's borders and offshore maritime interests. Activities in transit area of Crux.	(a) Department or agency of the Commonwealth to which the activities to be carried out under the environment plan	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person. • Continued liaison will take place for Notices to Mariners as well as notification 3 weeks prior to commencement of activity.
RP43	State and Commonwealth Government	**Australian Marine Safety Authority (AMSA) including AMSA RCC.**	Yes	Yes	Yes	Yes	Yes	Statutory agency for vessel safety and navigation and legislated responsibility for oil pollution response in Commonwealth Waters.	(a) Department or agency of the Commonwealth to which the activities to be carried out under the environment plan	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person. • AMSA to be involved in any developments of the plan regarding navigation safety and informed as part of any pollution response.

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RP44	State and Commonwealth Government	**Clean Energy Regulator (CER)**	Yes	Yes	No	Yes	No	Responsible for the administration of schemes legislated by the Australian Government for measuring, managing, reducing or offsetting Australia's GHG emissions.	(a) Department or agency of the Commonwealth to which the activities to be carried out under the environment plan	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP45	State and Commonwealth Government	***Former* Department of Agriculture, Water and the Environment (DAWE)**	Yes	Yes	Yes	Yes	No	Biosecurity regulator and responsible for Australia-Indonesia Memorandum of Understanding regarding the Operations of Indonesian Traditional Fishermen in Areas of the Australian Fishing Zone and Continental Shelf – 1974.	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person. • If there are any interactions with international persons, conveyances or goods (e.g. provisioning outside of Australia) the department need to be advised immediately.
RP46	State and Commonwealth Government	**WA Department of Transport (DOT)**	Yes	Yes	Yes	Yes	Yes	Legislated responsibility for oil pollution response in State Waters.	(b) Department or agency of a State or the Northern Territory to	• As required through EP change assessments; or • When major non-standard activities arise which may

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									which the activities to be carried out under the environment plan.	directly affect the functions, interests or activities of the Relevant Person. • Consultation if there is a risk of a spill impacting State waters.
RP47	State and Commonwealth Government	**Department of Industry, Science, Energy and Resources**	No	Yes	Yes	Yes	No	Responsible for the OPGGSA. They are the policy maker for the offshore petroleum sector.	(a) 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.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP48	State and Commonwealth Government	**Department of Jobs, Tourism, Science and Innovation (JTSI)**	No	Yes	Yes	Yes	No	The Department of State Development provides leadership to drive responsible development for Western Australia's future. Working closely with industry, communities and government agencies, the department coordinates the	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions,

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Consultation for Crux Drilling EP	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
								development of major resource, industrial and infrastructure projects and works to attract strategic investment.	under the environment plan.	interests or activities of the Relevant Person.
RP49	State and Commonwealth Government	**Department of Water & Environmental Regulation (DWER)**	Yes	Yes	Yes	Yes	No	Responsible for implementing Commonwealth policies and programs to support the agriculture, fisheries, food and forestry industries.	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP50	State and Commonwealth Government	**Director of National Parks / Parks Australia**	Yes	Yes	Yes	Yes	No	The Director of National Parks is the statutory authority responsible for administration, management and control of Commonwealth marine reserves. Parks Australia looks after Australia's natural treasures – including Kakadu, Uluru and our beautiful oceans. They are responsible for six national parks, 58 marine parks and the Australian National Botanic Gardens	(a) 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.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person. • 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 and within 24 hours.

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RP51	State and Commonwealth Government	**Federal Member for Kimberley - Melissa Price**	No	Yes	No	Yes	No	Electorate for Northern Western Australia, including the centres of Broome, Carnarvon, Dampier, Derby, Exmouth, Geraldton, Kalbarri, Karratha, Kununurra, Merredin, Moora, Newman, Port Hedland, Wiluna and Wyndham. Includes industry of mining and oil and gas.	(a) Department or agency of the Commonwealth to which the activities to be carried out under the environment plan.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP52	State and Commonwealth Government	**WA Department of Primary Industries and Regional Development - Fisheries Division (DPIRD)**	Yes	Yes	Yes	Yes	Yes	Responsible for managing State fisheries.	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP53	State and Commonwealth Government	**NT Department of Environment, Parks and Water Security**	Yes	No	Yes	Yes	Yes	Northern Territory Department of Environment, Parks and Water Security is responsible for the protection of the environment and natural resources in the Northern Territory (NT).	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person. • The Dept should be made aware of oil/gas pollution

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									environment plan.	incidences likely to enter the waters of the NT as soon as possible and within 24 hours.
RP54	State and Commonwealth Government	**NT Department of Infrastructure, Planning and Logistics – Marine Safety Branch**	Yes	No	No	Yes	No	Responsible for marine safety in NT waters.	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP55	State and Commonwealth Government	**NT Department of Primary Industry and Resources**	Yes	Yes	Yes	Yes	No	The NT Department of Primary Industry and Resources drive economic development on Northern Territory (NT) lands, coastal areas and inland waterways. Its major functional areas are mines and energy, fisheries and product integrity, primary industry economic development and NT geological survey.	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP56	State and Commonwealth Government	**WA Department of Mines, Industry Regulation & Safety (DMIRS)**	Yes	Yes	Yes	Yes	No	Required to be consulted under the Regulations.	(b) Department or agency of a State or the Northern Territory to	• As required through EP change assessments; or • When major non-standard activities arise which may

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									which the activities to be carried out under the environment plan.	directly affect the functions, interests or activities of the Relevant Person. • Pre-start notification confirming start date and cessation notification. • Reporting of environmental incidents that could impact on land/water in the State jurisdiction.
RP57	State and Commonwealth Government	**State Member for Kimberley - Divina Grace D'Anna**	No	Yes	No	Yes	No	Advocate for the people of the Kimberley region and will ensure that the region continues to have a strong voice in the Parliament	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan.	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.
RP58	State and Commonwealth Government	**WA Department of Biodiversity, Conservation & Attractions (DBCA)**	Yes	Yes	Yes	Yes	No	Responsible for managing WA's parks, forests and reserves. Planned activities do not impact DBCA's functions, interests or activities.	(b) Department or agency of a State or the Northern Territory to which the activities to be carried out under the	• As required through EP change assessments; or • When major non-standard activities arise which may directly affect the functions, interests or activities of the Relevant Person.

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									environment plan.	• In the event of a hydrocarbon release, notification will be provided to the DBCAs Kimberley Regional office as soon as practicable.
RP59	General Public	**Professor John Chandler, UWA**	No	Yes	No	Yes	Yes	Nominated himself relevant when he commented during the OPP Public Comment Period.	e) A person that Shell considers relevant.	• As required through EP change assessment

Table 5-3: Stakeholder Consultation Activities During Development of EP

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
Community				
RP01	**Bardi and Jawi Niimidiman Aboriginal Corporation RNTBC**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP02	**Broome International Airport**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP03	**Broome Shire**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP04	**Broome Visitors Centre**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP05	**Dambimangari Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP06	**Darwin city council**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP07	**Djarindjin Aboriginal Corporation (DAC)**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP08	**Department of Fire and Emergency Services (FESA)**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP09	**Goolarabooloo Aboriginal Corporation**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP10	**Kimberley Ports Authority**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP11	**Kimberly Land Council**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP12	**Mayala Inninalang Aboriginal Corporation**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP13	**Nimanburr Aboriginal Corporation**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP14	**Northern Land Council**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP15	**Nyamba Buru Yawuru and Yawuru Native Title Holders Aboriginal Corporation RNTBC**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP16	**Port of Darwin**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP17	**Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP18	**Gogolanyngor Aboriginal Corporation**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
Environmental NGOs				
RP19	**Australian Conservation Foundation**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP20	**Australian Marine Conservation Society**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP21	**Conservation Council of WA**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP22	**Environmental Defenders Office WA**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		23 June 2022	Email	Automatic response that email was received.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP23	**Environs Kimberley**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		23 June 2022	Email	Automatic response that email was received.
RP24	**Greenpeace**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		23 June 2022	Email	Automatic response that email was received.
RP25	**Save the Kimberley**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP26	**WA Marine Science Institute**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP27	**Wilderness Society**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP28	**World Wildlife Fund (WWF)**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		23 June 2022	Email	Automatic response that email was received.
Commonwealth Fisheries				

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP29	**Australian Bluefin Tuna Industry Association**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP30	**Australian Fishery Management Authority (AFMA)**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		05 July 2022	Email	Email received with reminder to consult with all operators who have entitlements to fish within the proposed area.
		14 July 2022	Email	Email response to confirm we had current addresses.
RP31	**Commonwealth Fishing Association**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP32	**North West Slope Trawl Fishery**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP33	**Northern Prawn Fishery Association (transit route)**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP34	**Western Tuna and Billfish Fishery**	23 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		01 July 2022	Post	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
WA State Fisheries				
RP35	**Mackerel Managed Fishery License Holders**	23 June 2022	Letter	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		01 July 2022	Post	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP36	**Northern Demersal Scalefish Fishery**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		01 July 2022	Post	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP37	**Pearl Producers Association**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP38	**Western Australian Fishing Industry Council (WAFIC)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		14 July 2022	Email	Email received asking whether fishing gear would need to be removed from the water to conduct the survey.
		14 July 2022	Email	Email response to confirm that fishing gear would not need to be removed from the water to conduct the survey.
Industry				

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP39	**INPEX**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
Marine Organisations				
RP40	**Australian Marine Oil Spill Centre (AMOSC)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
State and Commonwealth Government				
RP41	**Dept of Home Affairs including Maritime Border Command and Australian Border Force (ABF)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP42	**Australian Hydrographic Service including the Department of Defence – Operations Branch**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		28 June 2022	Email	Email acknowledgment, data to be registered for updating Navigational Charting products.
RP43		24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
	Australian Marine Safety Authority (AMSA) including AMSA RCC.	28 June 2022	Email	Email received requesting continued liaison with the AHS for Notices to Mariners, ensure 3 weeks notification prior to commencement of activity and confirming address details http://www.hydro.gov.au/aboutus/contact.htm.
		14 July 2022	Email	Email sent confirming request.
RP44	**Clean Energy Regulator (CER)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		24 June 2022	Email	Automatic response that email was received.
RP45	**Department of Agriculture, Water and the Environment (DAWE)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP46	**WA Department of Transport (DOT)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		27 June 2022	Email	Email received re risk of spill
		14 July 2022	Email	Email confirming DOT as key stakeholder

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP47	**Department of Industry, Science, Energy and Resources**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP48	**Department of Jobs, Tourism, Science and Innovation (JTSI)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP49	**Department of Water & Environmental Regulation (DWER)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		04 July 2022	Phone call	Spoke to a contact at DWER who gave us a general mailbox to send material to and they will pass it on to the correct person.
		04 July 2022	Email	Resent material to new email address.
RP50	**Director of National Parks (DAWE) / Parks Australia (PA)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		7 July 2022	Email	Email received re operational area
		14 July 2022	Email	Email sent re approved Oil Pollution Emergency Plan which documents the agreed linkages with the Director of National Parks

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP51	**Federal Member for Kimberley - Melissa Price**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		24 June 2022	Email	Automatic response that email was received.
RRP52	**WA Department of Primary Industries and Regional Development - Fisheries Division (DPIRD)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP53	**NT Department of Environment, Parks and Water Security**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		24 June 2022	Email	Automatic response that email was received.
RP54	**NT Department of Infrastructure, Planning and Logistics – Marine Safety Branch**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP55	**NT Department of Primary Industry and Resources**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		24 June 2022	Email	Automatic response that email was received.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP56	**WA Department of Mines, Industry Regulation & Safety (DMIRS)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		24 June 2022	Email	Automatic response that email was received.
RP57	**State Member for Kimberley - Divina Grace D'Anna**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
RP58	**WA Department of Biodiversity, Conservation & Attractions (DBCA)**	24 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.
		5 July 2022	Email	Email noting DBCA have no comments related to the activity.
		14 July 2022	Emil	Email confirming receipt of email.
RP59	**Prof. John Chandler, UWA**	30 June 2022	Email	Info provided on proposed activity with a summary of impacts and mitigation measures and a link to the Pipeline License Factsheet.

Table 5-4: Stakeholder Claims and Objections – Assessment of Merit

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
Community					
RP01	**Bardi and Jawi Niimidiman Aboriginal Corporation RNTBC**	-	No response received	No claim or objection received	No response required
RP02	**Broome International Airport**	-	No response received	No claim or objection received	No response required
RP03	**Broome Shire**	-	No response received	No claim or objection received	No response required
RP04	**Broome Visitors Centre**	-	No response received	No claim or objection received	No response required
RP05	**Dambimangari Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC**	-	No response received	No claim or objection received	No response required
RP06	**Darwin city council**	-	No response received	No claim or objection received	No response required
RP07	**Djarindjin Aboriginal Corporation (DAC)**	-	No response received	No claim or objection received	No response required

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
RP08	**FESA**	-	No response received	No claim or objection received	No response required
RP09	**Goolarabooloo Aboriginal Corporation**	-	No response received	No claim or objection received	No response required
RP10	**Kimberley Ports Authority**	-	No response received	No claim or objection received	No response required
RP11	**Kimberly Land Council**	-	No response received	No claim or objection received	No response required
RP12	**Mayala Inninalang Aboriginal Corporation**	-	No response received	No claim or objection received	No response required
RP13	**Nimanburr Aboriginal Corporation**	-	No response received	No claim or objection received	No response required
RP14	**Northern Land Council**	-	No response received	No claim or objection received	No response required
RP15	**Nyamba Buru Yawuru and Yawuru Native Title Holders**	-	No response received	No claim or objection received	No response required

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
	Aboriginal Corporation RNTBC				
RP16	**Port of Darwin**	-	No response received	No claim or objection received	No response required
RP17	**Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC**	-	No response received	No claim or objection received	No response required
RP18	**Gogolanyngor Aboriginal Corporation**	-	No response received	No claim or objection received	No response required
Environmental NGOs					
RP19	**Australian Conservation Foundation**	-	No response received	No claim or objection received	No response required
RP20	**Australian Marine Conservation Society**	-	No response received	No claim or objection received	No response required
RP21	**Conservation Council of WA**	-	No response received	No claim or objection received	No response required

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
RP22	**Environmental Defenders Office WA**	-	No response received	No claim or objection received	No response required
RP23	**Environs Kimberley**	-	No response received	No claim or objection received	No response required
RP24	**Greenpeace**	-	No response received	No claim or objection received	No response required
RP25	**Save the Kimberley**	-	No response received	No claim or objection received	No response required
RP26	**WA Marine Science Institute**	-	No response received	No claim or objection received	No response required
RP27	**Wilderness Society**	-	No response received	No claim or objection received	No response required
RP28	**WWF**	-	No response received	No claim or objection received	No response required
Commonwealth Fisheries					
RP29	**Australian Bluefin Tuna Industry Association**	-	No response received	No claim or objection received	No response required
RP30	**Australian Fishery Management Authority (AFMA)**	05 July 2022	Confirming receipt of information. Recommending how to contact licensed fishers.	This matter was actioned accordingly but is not considered to be an objection or claim.	We can confirm that we have up-to-date contact details for relevant operators through AFMA and have commenced consultation with them.

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
RP31	**Commonwealth Fishing Association**	-	No response received	No claim or objection received	No response required
RP32	**North West Slope Trawl Fishery**	-	No response received	No claim or objection received	No response required
RP33	**Northern Prawn Fishery (transit route)**	-	No response received	No claim or objection received	No response required
RP34	**Western Tuna and Billfish Fishery**	-	No response received	No claim or objection received	No response required
WA State Fisheries					
RP35	**Mackerel Managed Fishery License Holders**	-	No response received	No claim or objection received	No response required
RP36	**Northern Demersal Scalefish Fishery**	-	No response received	No claim or objection received	No response required
RP37	**Pearl Producers Association**	-	No response received	No claim or objection received	No response required

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
RP38	**Western Australian Fishing Industry Council (WAFIC)**	14 July 2022	Questioning whether fishing gear needs to be absent/out of the water during the survey, if so, this may require specific consultation and the development of a protocol? Noting - it is an offense under the Fish Resources Management Act 1994 to interfere with fishing gear?	This matter was considered but ruled out as we can work around the fishing gear and there is no need for it to be out of the water.	There will not be a requirement for fishing gear to be out of the water during this survey. The survey activity will be able to work around any fishing activity that may be occurring in the area at the time.
Industry					
RP39	**INPEX**	-	No response received	No claim or objection received	No response required
Marine Organisations					
RP40	**Australian Marine Oil Spill Centre (AMOSC)**	-	No response received	No claim or objection received	No response required
State and Commonwealth Government					
RP41	**Dept of Home Affairs including Maritime Border Command and Australian Border Force (ABF)**	-	No response received	No claim or objection received	No response required

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
RP42	**Australian Hydrographic Service including the Department of Defence – Operations Branch**	-	No response received	No claim or objection received	No response required
RP43	**Australian Marine Safety Authority (AMSA) including AMSA RCC.**	27 June 2022	Ensure that timely and relevant Maritime Safety Information is promulgated for the area and nature of your operations. 1. Contact the Australian Hydrographic Office no less than four weeks before operations 2. Notify AMSA's Joint Rescue Coordination Centre (for promulgation of radio-navigation warnings at least 24-48 hours before operations commence. 3. Plan to provide updates to both the Australian Hydrographic Office and the JRCC on progress and, importantly, any changes to the intended	This matter is considered to have been adequately addressed within the Crux Seabed Survey Environment Plan .	In accordance with AMSA's request, I can confirm that Shell Australia will ensure that timely and relevant Maritime Safety Information (MSI) is promulgated for the area and nature of operations for the Crux project. This includes contacting the Australian Hydrographic Office and AMSA's Joint Rescue Coordination Centre (JRCC) prior to commencement of operations as well as to provide updates on progress and notifications if there are any changes to the intended operations. We also note your reminder regarding vessel obligations to

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
			operations. 4. Exhibit appropriate lights and shapes to reflect the nature of operations – we remind vessels of their obligation to comply with the International Rules for Preventing Collisions at Sea (COLREGs).		comply with International Rules for Preventing Collisions at Sea. We will ensure our Marine team are aware of this.
RP44	**Clean Energy Regulator (CER)**	-	No response received	No claim or objection received	No response required
RP45	**Department of Agriculture, Water and the Environment (DAWE)**	-	No response received	No claim or objection received	No response required
RP46	**WA Department of Transport (DOT)**	27 June 2022	Ensure DOT is consulted as outlined in the Offshore Petroleum Industry Guidance Note.	This matter is considered to have been adequately addressed within the approved Oil Pollution Plan for Prelude.	Shell has an approved Oil Pollution Emergency Plan for the Prelude FLNG facility which also documents the agreed linkages with DOT and this will be built on for future oil spill planning and preparedness for Crux seabed survey activities.

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
RP47	**Department of Industry, Science, Energy and Resources**	-	No response received	No claim or objection received	No response required
RP48	**Department of Jobs, Tourism, Science and Innovation (JTSI)**	-	No response received	No claim or objection received	No response required
RP49	**Department of Water & Environmental Regulation (DWER)**	-	No response received	No claim or objection received	No response required
RP50	**Director of National Parks (DAWE) / Parks Australia (PA)**	07 July 2022	Confirmed receipt of consultation material for the Crux Drilling Environment Plan and confirmation that Shell does not overlap any Australian Marine Parks. The guidance note details that a reasonable time for consultation with the DNP is four weeks. Please note this for future consultation. No further notification of progress made in relation to this activity is required unless details regarding	This matter is considered to have been adequately addressed within the approved Oil Pollution Plan for Prelude.	Many thanks for your email confirming receipt of consultation material for the Crux Seabed Survey Environment Plan and confirmation that we do not overlap any Australian Marine Parks. We note your requirements for four weeks for consultation and appreciate your quick response in this instance.

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
			the activity change and result in an overlap with or new impact to a marine park, or for emergency responses (see details below). 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.		Shell has an approved Oil Pollution Emergency Plan for the Prelude FLNG facility which documents the agreed linkages with the Director of National Parks. This will be built on for future oil spill planning and preparedness for Crux activities. We note the number for reporting Emergency Response incidents and this will be included in the Crux Oil Pollution and Emergency Plan.
RP51	**Federal Member for Kimberley - Melissa Price**	-	No response received	No claim or objection received	No response required
RP52	**WA Department of Primary Industries and Regional Development - Fisheries Division (DPIRD)**	-	No response received	No claim or objection received	No response required

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
RP53	**NT Department of Environment, Parks and Water Security**	-	No response received	No claim or objection received	No response required
RP54	**NT Department of Infrastructure, Planning and Logistics – Marine Safety Branch**	-	No response received	No claim or objection received	No response required
RP55	**NT Department of Primary Industry and Resources**	-	No response received	No claim or objection received	No response required
RP56	**WA Department of Mines, Industry Regulation & Safety (DMIRS)**	-	No response received	No claim or objection received	No response required
RP57	**State Member for Kimberley - Divina Grace D'Anna**	-	No response received	No claim or objection received	No response required
RP58	**WA Department of Biodiversity, Conservation & Attractions (DBCA)**	05 July 2022	Based on the documentation provided for review and other readily available information, DBCA has no comments in relation to its	No claim or objection received	Many thanks for your email confirming receipt of consultation material for the

Stakeholder ID	Stakeholder	Dates	Summary of Each Stakeholder Response	Assessment of Merit of Claims or Objections	Summary of Shell's Response to Objections and Claims
			responsibilities under the Conservation and Land Management Act 1984 and Biodiversity Conservation Act 2016. Please continue to provide all future notifications to EMBAdmin@dbca.wa.gov.au.		Crux Seabed Survey Environment Plan. We will continue to consult using the EMBAdmin@dbca.wa.gov.au mailbox.
RP59	**Prof. John Chandler, UWA**	-	No response received	No claim or objection received	No response required

5.2.7 Ongoing Consultation

Shell will uphold its commitments to ensuring relevant authorities, persons and organisations continue to be consulted throughout the duration of this EP and through subsequent Crux activity specific EPs as detailed in Table 5.6. Consultation will be tailored to the specific functions, interests or activities of the Relevant Persons. This ongoing consultation is used to inform Relevant Persons on specific activity timing, duration, location and other information relevant to the activity and Relevant Persons needs.

Table 5-5: Ongoing Consultation Activities

Activity	Description
Monthly Meeting Implemented	Monthly meeting attended by HSSE and Corporate Relations representatives to track and assess consultation and EP compliance, manage requests for information and the assessment of merit of any claims and objections. Set agenda with actions tracked in Commitments Register.
Updated Commitments Register	Lists Relevant Persons, details consultation commitments as per EP Consultation Strategy and tracks consultation, and outlines EP compliance actions. Holds actions from monthly meetings.
Ongoing Consultation Procedure	Details the procedure of ongoing consultation with Relevant Persons.
Updates to Claims and Objections Process	Introduction of Shell's global system for reporting and follow up on complaints. Identified Claims or Objections will be tracked within this system. Failure to close out complaints in the system results in escalation to senior management and risks a breach of Shell's social performance standards.
Subsequent stakeholder consultation for activity specific Crux EPs.	This EP is an activity specific EP to allow for the Crux Development Drilling to occur. Subsequent EP's which are subject to additional stakeholder consultation will be developed as the Crux project is progressed.

Shell will continue to accept feedback from all Relevant Persons and work with them to address any future concerns if they arise throughout the duration of this EP and the wider Crux project. The process for ongoing consultation is managed in the same manner as described in Sections 5.2.7. Shell will ensure any claims or objections, or feedback, from the ongoing consultation are processed as per Shell's internal claims process in a timely manner, and any identified risks will be managed to ALARP levels as required in this EP.

In particular, Shell will continue to engage and consult with relevant stakeholders through:

- Direct stakeholder and community engagement as part our standard business processes
- Updated factsheets and notifications prior to commencement of major activities and key milestones
- Community Hotline number and the Crux mailbox provided on factsheets and our website, mechanisms through which the public (including Relevant Persons) can share feedback or ask questions about the Crux development.

Consultation with Relevant Persons also occurs via our ongoing strategic relationship engagements (for example, with Department of Transport and Department of Agriculture, Water and Environment) and ad hoc engagements by the Corporate Relations and Social Performance teams at various industry and social investment events.

In addition, to ensure we receive further input from our community stakeholders, Shell conducts a biennial Pulse Survey, a community based survey that covers key stakeholders in Broome and Kimberley region and Darwin. The survey identifies, assesses and measures impacts, gauges the communities' perception of Shell and gathers feedback.

6 Description of the Activity

6.1 Scope of the EP

This section provides a description of the petroleum activity, including the details of the location in which the activities will occur, in accordance with Regulation 13(1) of the OPGGS(E)R.

This Environment Plan covers the following activities within the Operational Area (***Figure 6-1***) located within permit area pipeline licence applications (Crux – offshore western Australia (NEATS reference: PWNV8J (WA)) and Crux - Offshore Area of the Territory of Ashmore and Cartier Islands (NEATS reference: V2M9JS(AC)):

The seabed assessment will compose of a geophysical survey and a geotechnical survey with the objective to:

- investigate sub-seabed geological conditions at the proposed for the purposes of understanding conditions at the proposed pipeline pipelay initiation and the Pipeline End Manifold (PLEM) locations for the Crux pipeline;
- check geological conditions for proposed pipeline end terminations (PLET) foundations at both the Crux and Prelude ends of the proposed Crux pipeline;
- identify potential seabed debris and obstructions;
- identify and map the nature and distribution of seabed surface types along potential pipeline routes; and
- accurately measure water depth and map seabed topography.

Non-petroleum activities are outside of the scope of this EP.

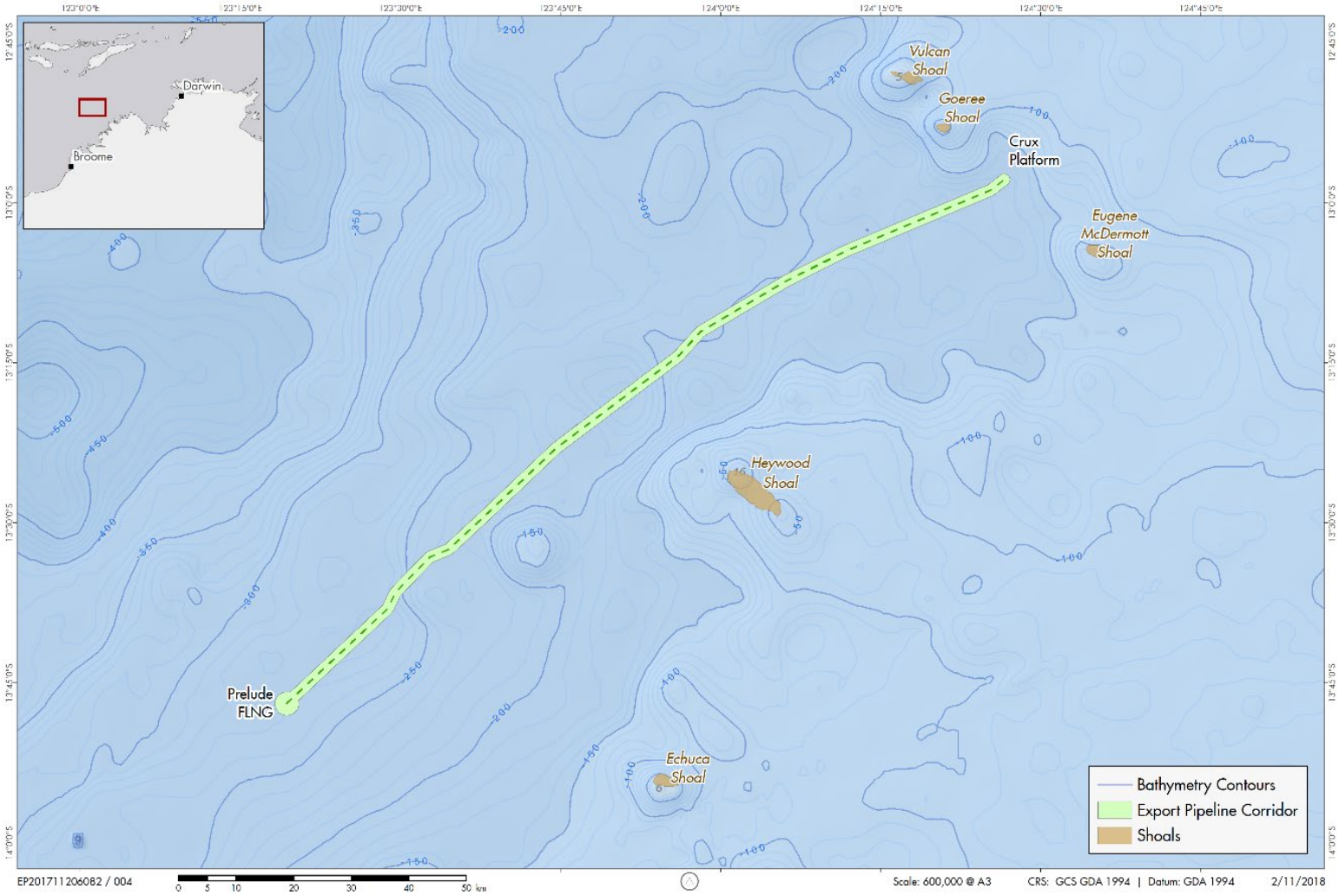


Figure 6-1: EP Operational Area

This EP does not include the general transit of vessels to or from the Operational Area. These activities will be undertaken in accordance with relevant maritime legislation, such as the Commonwealth Navigation Act 2012, and are within the jurisdiction of AMSA. Activities undertaken by the vessels which are not carrying out petroleum activities are not considered in this EP. Any impacts and risks outside of these activities are provided for via the HSSE and SP Control Framework, outside of the formal EP acceptance and implementation process, to support the transparent, whole-of-project assessment process.

6.2 Location and Timing

The Crux seabed survey location is located in Commonwealth and Ashmore Cartier marine waters, 200 km offshore northwest Australia and 460 km north-north east of Broome (Figure 6-3), in 160m to ~260 m from Mean Sea Level (MSL) water depth.

Figure 6-2: EP Operational Area in context of North West Australia

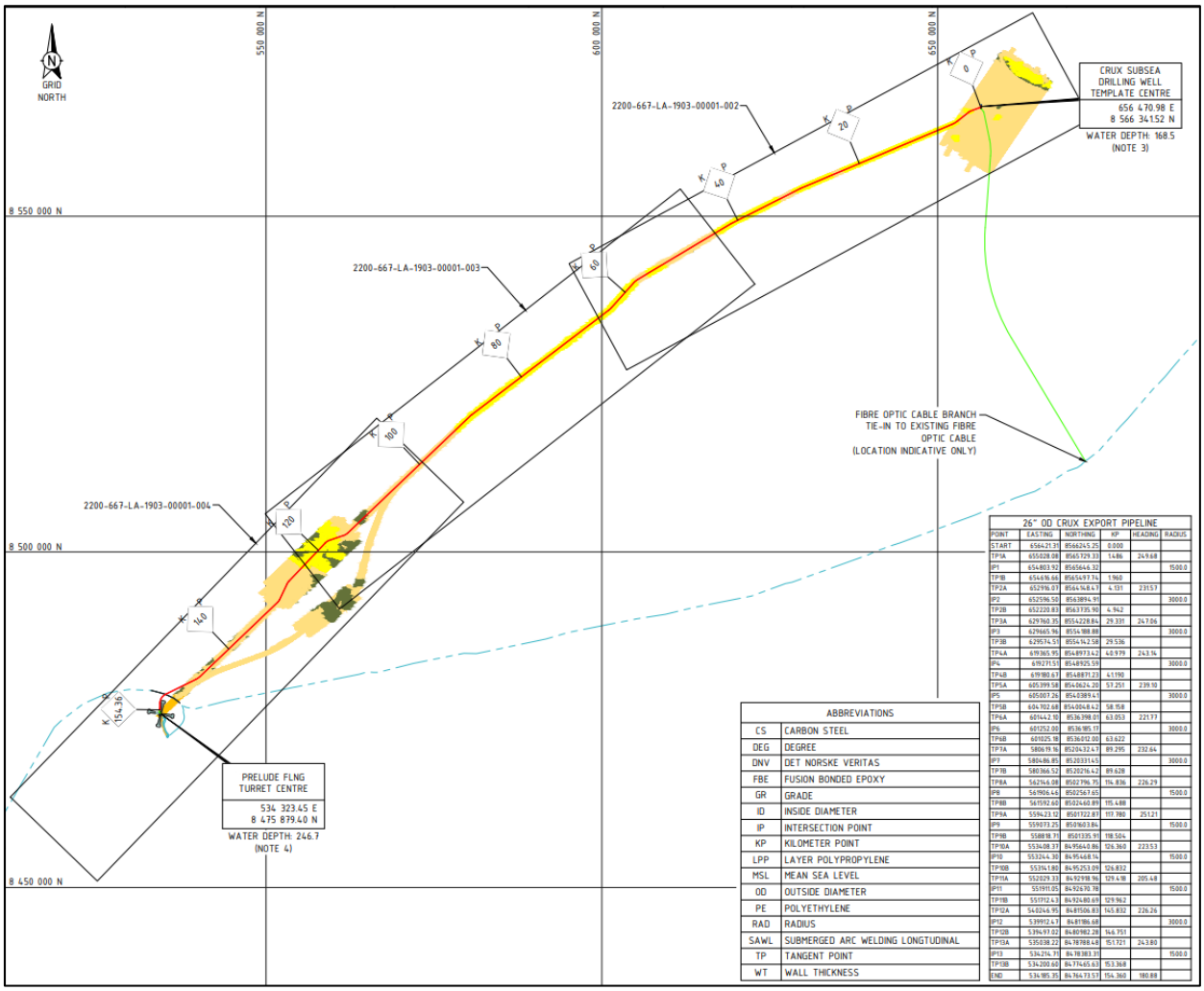


Figure 6-3: Location of Crux Seabed Survey Operational Area

The activity duration is expected to take 1 week. For planning purposes of this EP, the survey is considered to take up to a worst case 30 days which accounts for unforeseen circumstances and potentially more survey activities. The window for completing the survey is currently planned to occur in a single campaign between 15th July 2022 and 31st December 2022.

Timings and durations for the geophysical and geotechnical surveys are contingent on the availability of suitable vessels, weather and the receipt of environmental approvals.

Table 6-1: Geospatial coordinates (GDA 2020) of core activities within the Operational Area

Location	GDA2020 /MGA Zone 51		GDA2020 Coordinates		Activity	
	Easting	Northing	Latitude	Longitude		
	[m]	[m]	[dd mm ss] South	[ddd mm ss] East	PCPT	Core sample
Future Start-up pile Location 1	534184	8476434	13 46 52.815	123 18 58.491	✔	✔
Future Start-up pile Location 2	534183	8476394	13 46 54.117	123 18 58.459	✔	✔
Future Prelude PLET	534185	8476474	13 46 51.513	123 18 58.522	✔	✔
Future Crux PLET	656421	8566245	12 57 55.564	124 26 31.598	✔	✔
Nominal route near IP 13	534435	8478249	13 45 53.723	123 19 06.770		✔
Nominal route KP 150	536582	8479548	13 45 11.344	123 20 18.209		✔
Nominal route TP 10B	553142	8495253	13 36 39.205	123 29 28.597		✔
Alternative Route Location 1	538612	8482131	13 43 47.169	123 21 25.681		✔
Alternative Route Location 2	542224	8485429	13 41 59.633	123 23 25.772		✔
Alternative Route Location 3	545837	8488728	13 40 12.049	123 25 25.866		✔
Alternative Route Location 4	549452	8492028	13 38 24.416	123 27 25.996		✔

6.3 Survey Activities

6.3.1 Geophysical survey

It is intended that a geophysical survey is performed along the entire pipeline route. This is a length of circa 155Km and the coordinates of the centre line are presented in

***Table 6-1**. The area to be surveyed will cover an area of 200m either side of the pipeline route.*

The equipment to be used for the geophysical survey is described in Table 3-2 and shown in Figure 3-2.

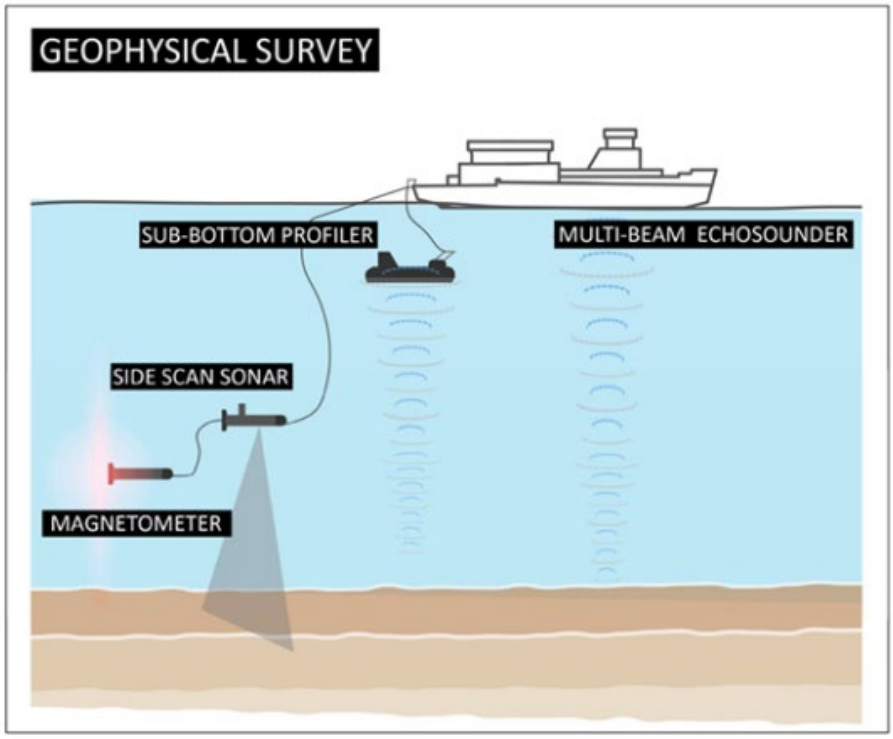


Figure 3-2: Geophysical survey equipment

Table 3-2: Description of geophysical survey activities

Equipment	*Purpose*	*Activity Details*
Multi-beam echosounder (MBES)	*Measure bathymetry*	*A MBES mounted on the vessel hull is typically used. A MBES acquires a wide swath (strip) of bathymetry data perpendicular to the vessel track and provides total seabed coverage with no gaps between vessel tracks.* *A MBES transmits a broad acoustic pulse from a transducer over a swath across a vessel track. The MBES then forms a series of received beams that are each much narrower and form a 'fan' (with a half-angle of 30-60°) across the seabed, perpendicular to the vessel track. The transducer(s) then 'listen' for the reflected energy from the seabed. The fans of seabed coverage produce a series of strips along each track, which are lined up side-by-side to generate two dimensional georeferenced bathymetric maps of the seabed.*
Side scan sonar (SSS)	*Detects hazards such as existing pipelines, lost shipping containers, boulders, debris, unmarked wrecks, reefs and craters.*	*The SSS method of surveying generates oblique acoustic images of the seabed by towing a sonar 'towfish.' The towfish is provided with power and digital telemetry services and towed from the vessel using a reinforced or armoured tow cable.* *The towfish is equipped with a linear array of transducers that emit, and later receive, an acoustic energy pulse in a specific frequency range. Typically, a dual-channel, dual-frequency SSS is used. SSS is like MBES but operates at a wider fan angle.* *The acoustic energy received by the towfish (backscatter) provides information as to the general distribution and characteristics of the surficial sediment and outcropping strata. Shadows result from areas of no energy return, such as shadows from large boulders or sunken ships, and aid in interpretation of the sonogram image.* *The towfish is constructed of stainless steel and is a cylindrical torpedo-like device. It is typically towed 50-100 m above the seabed depending on water depth and the frequency range.* *The SSS is operated at the same time as the MBES.*

Sub-bottom profiler (SBP)	*SBP is used to investigate the layering and thickness of the uppermost seabed sediments. The SBP imagery penetrates to a minimum depth of at least 30 m below the seabed.*	***Compressed High-Intensity Radar Pulse (CHIRP)*** *Very high frequency systems including pingers, parametric echo sounding and CHIRP – produce a swept-frequency signal. CHIRP systems usually employ various types of transducers as the source. The transducer that emits the acoustic energy also receives the reflected signal. CHIRP signals typically penetrate only about 5-10 m into the seabed and provide the best resolution, but lowest penetration. A CHIRP is normally hull mounted when used for shallow water operations but may also be towed in a similar fashion to the SSS.* ***High-frequency boomers*** *High frequency boomers generate a broadband, high amplitude impulsive acoustic signal in the water column that is directed vertically downward. Boomers are mostly surface towed but may also be towed below the surface to avoid sea surface wave related noise and movement.* *The receiver for the boomer system is usually a hydrophone or hydrophone array consisting of a string of individual hydrophone elements. They typically contain eight to 12 hydrophone elements evenly spaced in a tube that is 2.5 to 4.5 m in length and 25 mm in diameter. The SBP system is towed and operated at the same time as the MBES and SSS.*

Magnetometer	*This equipment detects metallic objects on or below the seabed (e.g. buried pipelines, petroleum wellheads, shipwreck debris and dropped objects such as unexploded ordnance, cables, anchors, chains) that may not be identified using acoustic techniques.*	*A magnetometer sensor is housed in a towfish and is towed as close to the seabed as possible and sufficiently far away from the vessel to isolate the sensor from the magnetic field of the vessel.* *The magnetometer survey will be conducted at the same time as the MBES, SSS and SBP.* *The magnetometer towfish is constructed of stainless steel and is a cylindrical torpedo-like type device.*
Ultra-Short Baseline (USBL) *The USBL sandbag will cover an area of 0.2 m2*	*Used for positioning the SSS and geotechnical equipment.*	*The side scan sonar towfish and geotechnical equipment are positioned utilising ultra-short baseline (USBL) methods. It is necessary to calibrate the transceiver, which is usually deployed on retractable pole under the vessel, or over the side. The calibration requires a transponder to be deployed on the sea floor, at working depth and on the vessel; surveys a pattern around the transponder to ascertain the error (pitch, roll, heading & velocity) of the USBL transceiver. The transponder is lowered to the seabed with a sandbag fitted with an acoustic release. Once the calibration is complete, the acoustic release is triggered, and the transponder recovered. The sandbag anchor remains on the seabed. During a typical seabed survey, a hessian bag is utilised, filled with sand. As the calibration must be completed at working depth and close passes are required it is impractical to buoy the transponder/sandbag, without the risk of entanglement.*
Tow camera *Drop camera*	*To visually observe the physical and biological environment*	*Cameras may be operated off the back of the survey vessel. No impacts.*

6.3.2 Geotechnical survey

The geotechnical scope will use two generic methods to gather information on the seabed structure; Piezo Cone Penetration Test (PCPT) and potentially other sampling as defined in Table 3-3.

It is intended to perform up to a maximum of 10 PCPT tests as follows;

Location Description	*Location Coordinates*	*Qty Tests*
Pipeline Initiation and PLET location at Prelude	*To be performed within a 100m of coordinates outlined within* ***Table 6-1***	*6*
PLET location at Crux	*To be performed within a 100m of coordinates outlined within* ***Table 6-1***	*4*

A maximum of 20 core samples will be taken along the pipeline route and are anticipated to be taken to a depth of between 5-20m in the following locations:

Location Description	*Location Coordinates*	*Qty Tests*
Pipeline Initiation and PLET location at Prelude	*To be performed within a 100m of coordinates outlined within* ***Table 6-1***	*6*
Pipeline Corridor	*As described in* ***Table 6-1*** *(centreline coordinates)*	*10*
PLET location at Crux	*To be performed within a 100m of coordinates outlined within* ***Table 6-1***	*4*

The scope and equipment to be used for the geotechnical survey is described in Table 3-3 and shown in Figure 3-3.

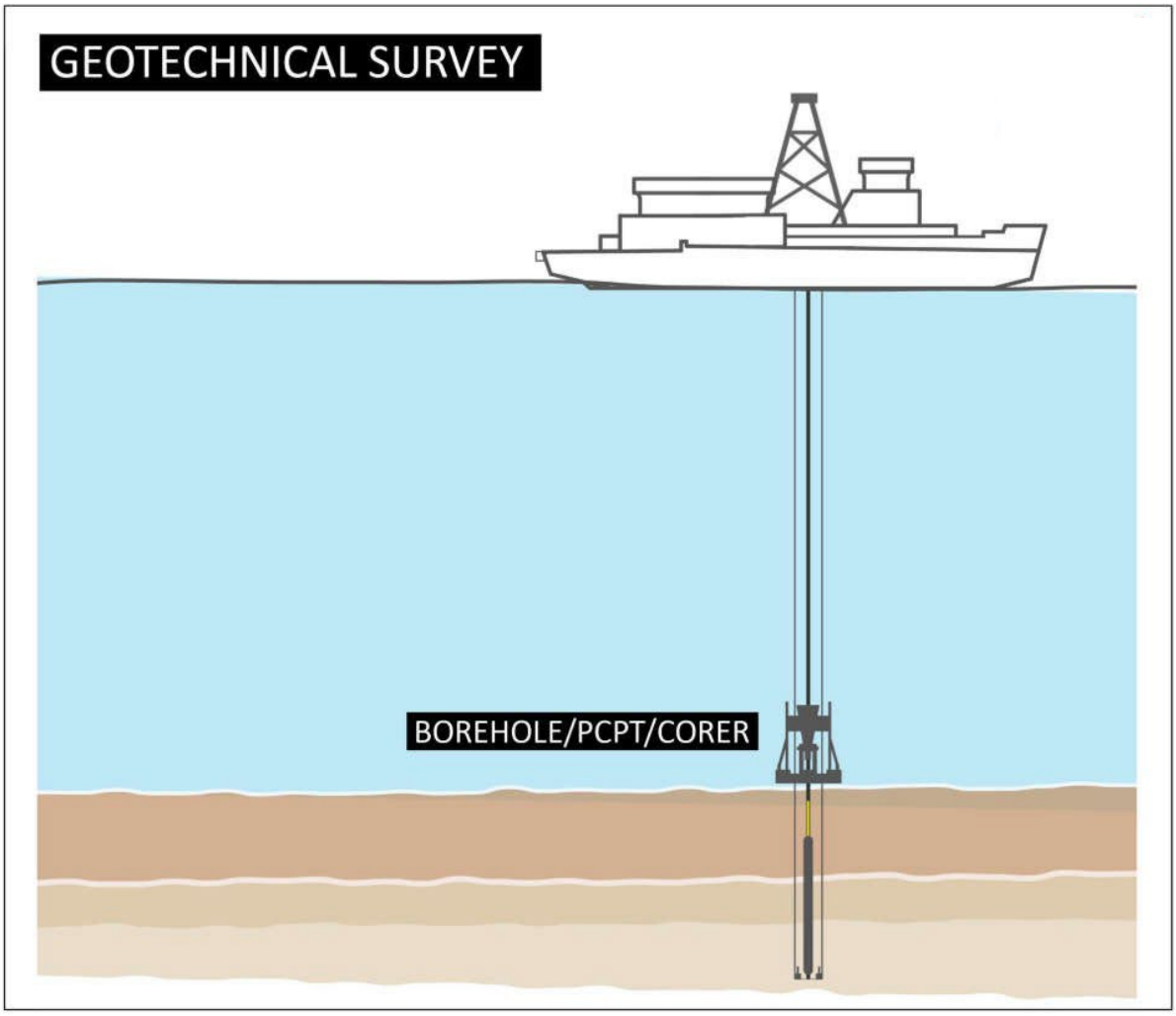


Figure 3-3: Geotechnical survey equipment

Table 3-2: Description of geotechnical survey activities

Equipment	***Purpose***	***Activity Details***
Borehole sampling	*Obtain core samples for geological analysis of formations below the seabed.*	*Borehole sampling involves drilling through seabed sediments with an open-centred drill bit used to recover the seabed core sample. Drilling will either be undertaken from the survey vessel or using a sea floor drilling system. The seafloor drilling systems is lowered to the seabed from the survey vessel. Both techniques require a guide base on the seafloor ~ 2.5 m x 2.5 m with a footprint of ~ 6.25 m2.* *Borehole sampling generates minimal cuttings as the aim of the sample is to recover the core. Based on experience, cuttings are typically generated in*

Equipment	Purpose	Activity Details
		the top 5 m of the borehole with the rest of the borehole material trapped within the core tube. Thus, for a 0.35 m diameter borehole the estimated volume of cuttings is 0.48 m3. Bentonite and/or seawater will be used to lubricate and cool the drill bit. *1 x 50m radius area at Prelude: 6 x 20 m boreholes* *1 x 50m radius area at Crux: 4 x 20m boreholes* *1 x 155 km corridor: 10 x 10 m boreholes* *Total footprint: 187.5m2*
Piezo Cone Penetration Test (PCPT)	*Determine soil strength and helps to delineate soil stratigraphy.*	*PCPT involves the in-situ measurement of the resistance of ground to continuous penetration. This process involves lowering a frame to the seabed and pushing the PCPT unit into the sediment at a steady penetration rate (usually 2 cm per second).* *A frame is lowered to the seabed with the PCPT unit integrated into it and operated remotely. When the required penetration depth is reached, all equipment is withdrawn from the seabed. A small hole will remain in the seabed, which will eventually collapse and infill with the movement of seabed sediments.* *The PCPT frame is ~ 5 m x 1 m with a footprint of ~ 5 m2. The piezo cone is ~ 10 cm in diameter and penetrates the seabed from 10 to 60 m.* *Prelude area (50m radius): up to 6 PCPTs* *Crux area (50m radius): up to 4 PCPTs* *Total footprint: 50 m2*
Box core	*Obtain core samples for geological analysis.*	*A box core is used to collect core samples from soft, unconsolidated sediment. The corer is lowered to the seabed and then the instrument is triggered by a trip as the main coring stem passes through its frame. The stem has a weight of up to 800 kg to aid penetration. While pulling the corer out of the sediment a spade swings underneath the sample to prevent loss of the core.* *The box core is ~ 0.8 m x 0.8 m with a footprint of ~0.64 m2. The box core penetrates the seabed to ~ 1m.* *1 x 50m radius area at Prelude: 6 box cores* *1 x 50m radius area at Crux: 4 box cores*

Equipment	Purpose	Activity Details
		1 x 155 km corridor: 10 box cores *Total footprint: 12.8m2*
Vibro core	*Obtain core samples for geological analysis.*	*Vibrocoring is a technique for collecting core samples in unconsolidated sediments by using a vibrating device to drive a coring tube into the seabed. Typically, two large electrical motors power two concentric weights, which produce the necessary vibration. Once the unit is on the seabed, the high-power vibrator motors are engaged and drive the core barrel with PVC liner into the seabed.* *The vibro core frame is ~ 5 m x 5 m with a footprint of ~25 m2. The vibro core has a diameter of ~ 15 cm and penetrates the seabed to ~ 4 m.* *1 x 50m radius area at Prelude: 6 vibro cores* *1 x 50m radius area at Crux: 4 vibro cores* *1 x 155 km corridor: 10 vibro cores* *Total footprint: 500m2*
Gravity core	*Obtain core samples for geological analysis.*	*Gravity coring is normally used on soft, unconsolidated sediment. A gravity corer is a general-purpose tool that relies on its weight for penetration into the seafloor. It is lowered to a predetermined height above the seabed using a wire rope before being allowed to freefall. The resulting core enters the internal sleeve and is held in place by a core catcher.* *The gravity core has a diameter of ~15 cm with a footprint of ~0.018 m2. The gravity core penetrates the seabed to ~ 4 m.* *1 x 50m radius area at Prelude: 6 gravity cores* *1 x 50m radius area at Crux: 4 gravity cores* *1 x 155 km corridor: 10 gravity cores* *Total footprint: <10m2*
Van veen grab	*Collecting small samples of surface sediments from the seafloor.*	*A Van Veen grab sampler is a light weight sampler designed to take samples in soft seabed sediments. It has long lever arms and sharp cutting edges on the bottom of the scoops (like a set of jaws) which enable it to cut into the seabed. The sampler is lowered to the seabed via a winch.* *Only surface sediments are collected and the sampler has no ability to penetrate to depth.*

Equipment	*Purpose*	*Activity Details*
		Up to 100 samples may be collected along the pipeline route. Other samples may be obtained at areas of interest as identified visually by the camera (up to 40 to be conservative) *The grab sample can leave a hole 0.4 m x 0.4 m (footprint ~0.16 m2) and be up to 20 cm deep.* *1 x 50m radius area at Prelude: 6 grabs* *1 x 50m radius area at Crux: 4 grabs* *1 x 155 km corridor: 10 grabs* *Total footprint: 3.2m2*

6.4 Vessel activities

The geophysical and geotechnical surveys may be undertaken from the same vessel or from separate vessels. However, there will only be one vessel undertaking a survey at a time.

While undertaking the geophysical survey the vessel will travel at approximately 4–5 knots (7–9 km/hr). For the geotechnical survey the vessel will be stationary and use dynamic positioning (DP) or propellers to maintain position as water depths are too deep for anchoring.

The use of support vessels is not required.

Vessel refuelling and crew change will not occur during the petroleum activity.

7 Description of the Receiving Environment

As required by regulations 13(2) and 13(3) of the OPGGS(E) Regulations, a description of the receiving environment that may be affected by the activities (both planned and unplanned) covered by this EP is provided in this section. The information contained in this section has been used to inform the assessment of environmental impacts and risks presented in Section 9.3 to Section 9.13.

The spatial extent of the receiving environment encompasses the physical, biological and socio-economic receptors that may be affected by planned and unplanned activities. The credible worst-case hydrocarbon release scenarios determined by modelling studies are predicted to present the greatest spatial extent of all the impacts and risks identified. The outer boundary of the area that may be influenced by the petroleum activities, identified by the modelling and referred to as the Environment that may be affected (EMBA), has been used as the outer boundary for the description of the receiving environment. The worst-case hydrocarbon releases during operations have a remote to extremely remote likelihood of occurring, and Shell implements a range of controls to ensure such incidents are prevented, and mitigated to ALARP and Acceptable Levels. The EMBA for the combined worst-case credible hydrocarbon spills from the petroleum activities is shown in

Figure 7-1 and this represents the low exposure thresholds described further in Table 9-48. The scenarios are conservatively based on much larger potential worst credible spill events from the adjacent Prelude FLNG. Refer to Section 9.12 for additional information on hydrocarbon spill modelling and risk management and associated impact thresholds applied for the assessment.

The description of the receiving environment considers environmental receptors that are protected under the EPBC Act, including:

- World heritage and national heritage values
- Ramsar wetlands
- listed threatened species, migratory species and threatened ecological communities
- values and sensitivities within the Commonwealth marine environment.

The EPBC Act Protected Matters Search Tool (PMST) was used to identify environmental receptors protected under the Act. Two EPBC Act PMST reports were generated; one based on the Operational Area and one based on the combined entrained, dissolved and surface EMBA. PMST Reports for both the Operational Area and EMBA are provided in Appendix 12.

The Operational Area as mentioned throughout sections 7 and 9 as defined by *Figure 6-1*, where referenced through text in relation to the presence of receptors or other features, is taken from the closest point of the Operational Area to that receptor.

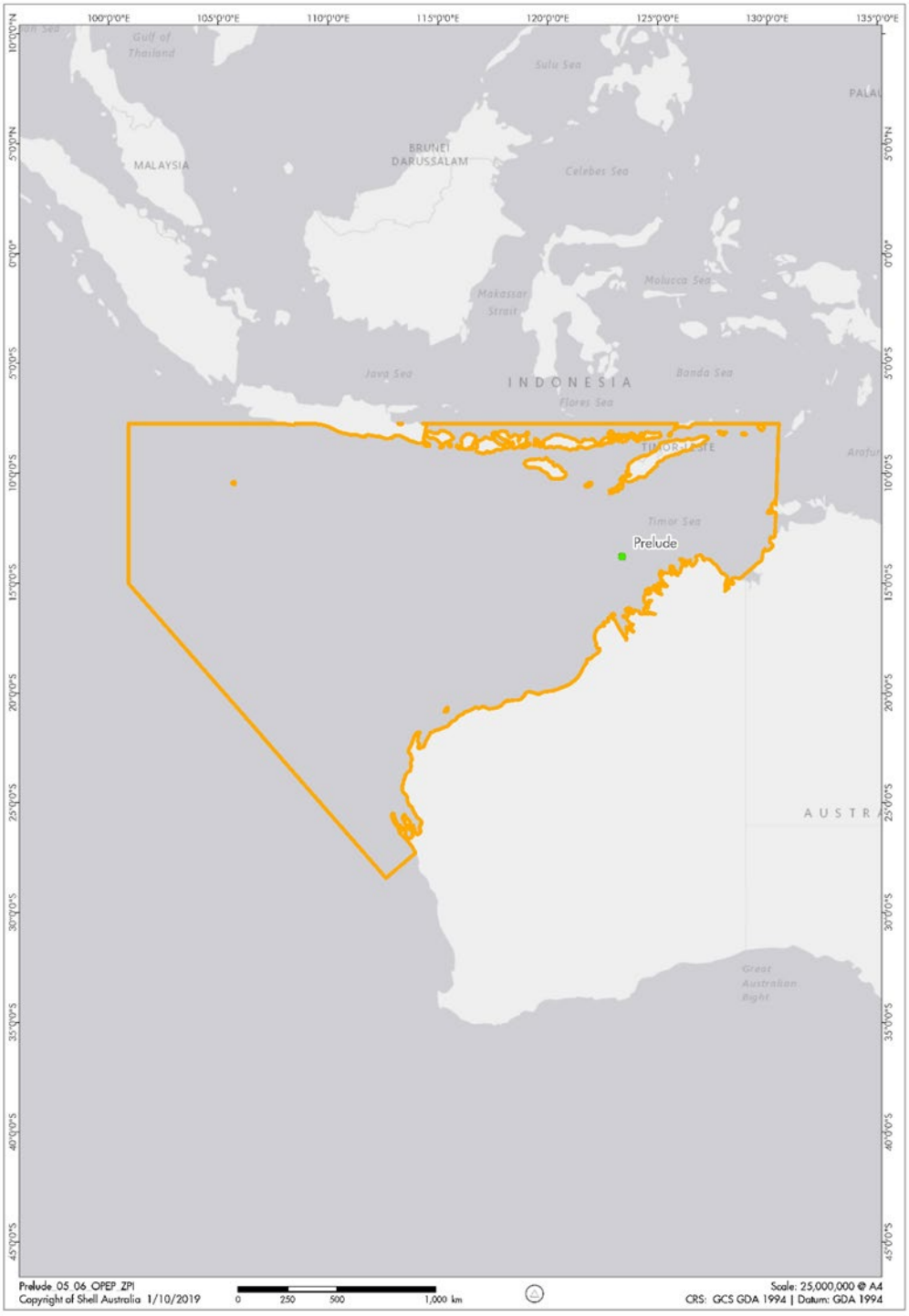


Figure 7-1: EMBA for the Petroleum Activities

7.1 Physical Environment

7.1.1 Seabed

The Operational Area is located in the Timor Sea on the outer continental slope between 200 and 300 m depth. The seabed within the Operational Area is relatively flat and featureless. Baseline environmental study results for the Prelude development show the seabed is characterised by unconsolidated sand, silt and mud (Shell 2009). No reefs or extensive areas of rocky substrate have been observed.

Notable seabed features in the EMBA beyond the Operational Area include the coral reefs and islands that occur throughout the region. The closest of these features, Browse Island, is located some 39 km southeast of the Operational Area. There are also numerous reefs, banks and shoals throughout the Timor Sea, which host diverse biological communities. Other notable seabed features in the EMBA include Ashore Reef, Cartier Island, Scott Reef, the Rowley Shoals, and numerous reefs, banks and islands off the Kimberley and Pilbara coasts. Refer to Section 7.2 for further discussion of the biological communities associated with these seabed features.

7.1.2 Climate

The Operational Area is situated in the tropics and experiences a monsoonal climate with two seasons. The Australian northern monsoon generally occurs between December and March (Figure 7-2). It is associated with the inflow of moist west to north-westerly winds into the monsoon trough, producing convective cloud and heavy rainfall over northern Australia. During the cooler months (June - September), the sub-tropical ridge that lies over continental Australia drives stable and persistent easterly winds over the region. The Australian cyclone season officially runs from November to April, although very few storms have occurred in November. The chance of experiencing an intense category 4 or 5 cyclone is highest in March and April. At the start of the cyclone season, the most likely area to be affected is the Kimberley and Pilbara coastline and offshore areas including the Operational Area, with the area threatened later in the season extending further south.

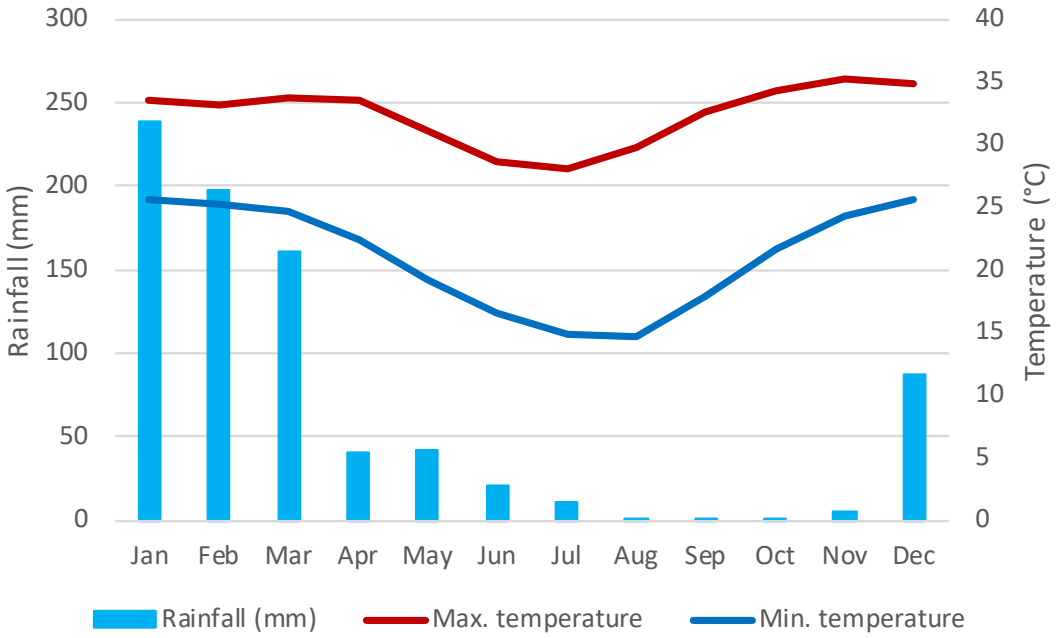


Figure 7-2: Long-term maximum and minimum temperatures and mean rainfall from Cygnet Bay (closest Bureau of Meteorology climate station to Operational Area). Data sourced from Bureau of Meteorology (n.d.)

7.1.3 Oceanography

The regional currents influencing the offshore waters off northern and western Australia are shown in Figure 7-3. The majority of water movement off northern Western Australia is poleward, with the water being relatively warm and low in nutrients (Department of the Environment, Water, Heritage and the Arts (DEWHA) 2008). A strong seasonal wind regime is closely associated with seasonality in surface currents in the region, including the seasonal strength of trade winds in the equatorial Pacific Ocean which drive the Indonesian Throughflow (ITF).

The project is located within the North West Marine Region (NWMR)[2] which experiences semi-diurnal tides. Tidal ranges are large - 0.8 m neaps and 5 m springs (RPS 2018) - and strongly influence currents in the region. Notably, tidal amplitudes seem to be retained at large distances offshore and travel initially in a north-east direction in the deeper waters of the region (RPS 2018). The tidal current component is imposed over the synoptic-scale flow.

In addition to synoptic-scale and tidal currents, locally generated wind-driven currents also influence water movement within the Operational Area and EMBA. These are more variable and are superimposed over large-scale flows.

[2] A series of bioregional plans have been developed by the Commonwealth government. These plans are intended to help improve the way decisions are made under the EPBC Act. The Operational Area (and much of the ZPI) overlaps the area covered in the Marine bioregional plan for the North-west Marine Region: prepared under the Environment Protection and Biodiversity Conservation Act 1999 (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a); hence the Operational Area is within the NWMR.

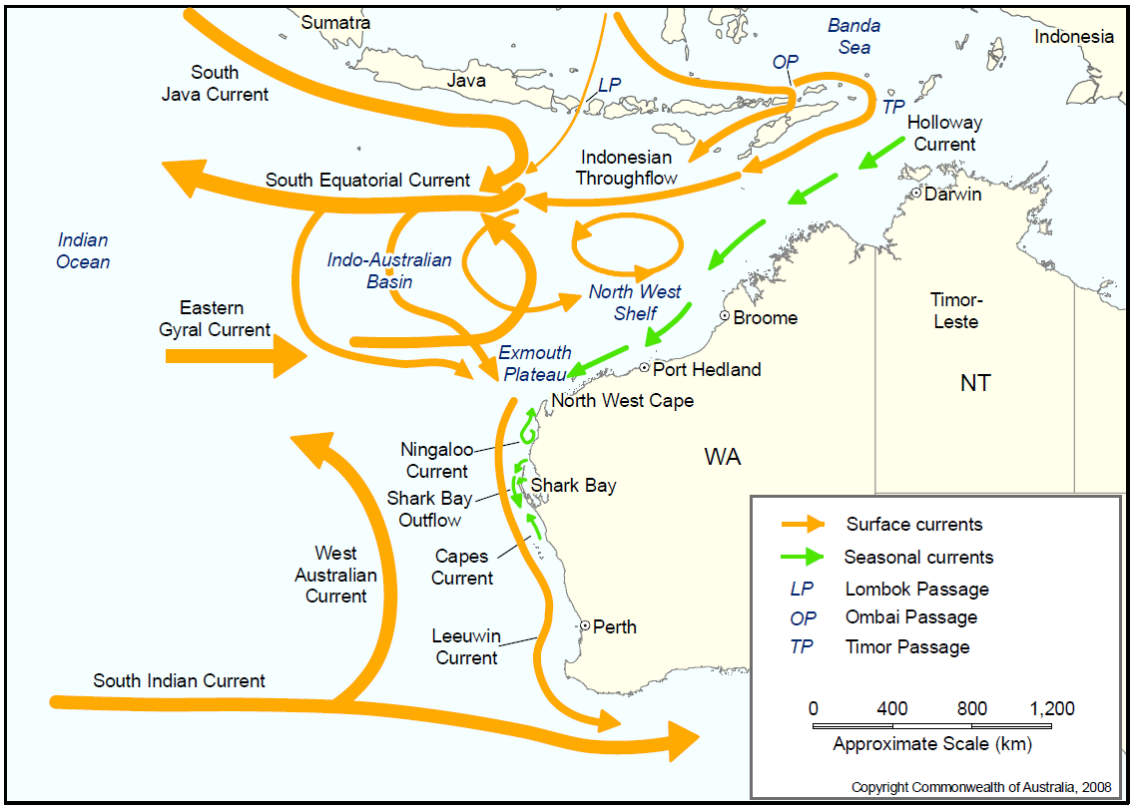


Figure 7-3: Regional synoptic-scale currents off north-western Australia (from DEWHA 2008)

7.1.4 Water Quality

Water quality in the vicinity of the Operational Area is generally high. A field survey in 2018 was carried out in the Operational Area.
Water samples were collected using Niskin water samples at depths of 5 m (surface), 150 m (mid-depth) and 5 m above the seabed (bottom) for in-situ and lab analyses. Additional in-situ samples were taken at each site at depths ranging from 1 m-200 m. Upon surfacing, in-situ measurements were immediately collected using a Hydrolab minisonde 5 probe.

Results from this 2018 baseline water quality survey, in conjunction with the Prelude EIS indicated potential contaminants, such as metals and hydrocarbons, were low and often below the laboratory detection limits (Shell 2009), refer Table 7-1: Water quality for survey results. These results are consistent with other survey results in the Timor Sea (Ross et al. 2017). Nutrient and turbidity levels in the water column were also low compared to nearshore waters, which is typical for offshore waters and is consistent with other surveys in the region (Ross et al. 2017). The average salinity for the receiving water is approximately 34.5ppt (ERM 2008).

Table 7-1: Water quality

Parameter	Range value (min – max)	Sample location/ condition
pH Range (min-max)	7.15 – 8.21	In-situ measurement collected in and around the development area
Dissolved Oxygen (mg/L)	7.27 - 4.19	DO was found to be same along the sampling point but varied by depth

TSS (mg/l)	Near surface: 3.7 Mid depth: 5.0 Near seabed: 3.8	Data obtained from a study conducted for INPEX in Exploration Permit WA-285-P (RPS, 2007b) located immediately adjacent to WA-371-P
Heavy Metals	Observed little spatial or vertical variation in seawater barium, nickel, iron, zinc and cadmium concentrations	Mean concentration of metals in all sampling zones were below trigger values identified in ANZECC guidelines

Water quality in the immediate vicinity of the Prelude FLNG facility is slightly lower due to routine discharges from the facility (e.g. grey water, sewage, PFW etc.). The area impacted by these discharge streams is localised.

7.1.5 Sediment Quality

This section provides an overview of the baseline sediment survey conducted within the project area in October/November 2016 (AECOM 2017). Twenty sample sites were chosen within the in-field development area, 16 which aligned with or were perpendicular to the prevailing tidal current axis and four reference sites located at each corner of AC/LR9. Eleven sample sites were selected at 10 km–15 km intervals along the export pipeline corridor to account for existing sediment variability.

In summary, concentrations of metals, hydrocarbons and radionucleotides were generally consistent across all sites, indicating no obvious existing anthropogenic impacts on sediment quality in the area.

7.1.6 Air Quality

No specific information concerning air quality in the local airshed area is available. However, the Operational Area is approximately 200 km from the Kimberley coastline, which itself is a remote and unindustrialised area. Therefore, the air quality is unlikely to be subject to considerable anthropogenic effects with the exception of the Prelude FLNG facility. Emissions from commercial shipping are likely to represent the main source of localised and temporary impacts on air quality. Production facilities in the broader region, such as the Montara FPSO facility (approximately 30 km from the Operational Area), the Ichthys FPSO (approximately 17 km from the Operational Area) are also expected to incrementally influence local and regional air quality.

In a regional context, the main contributors to particulate levels are ambient wind-borne dust and smoke from seasonal bush fires that are characteristic across the Kimberley regions. International contributors to reduced air quality in the project area may also include the likes of ‘slash-and-burn’ agricultural methods and other large forest fires in South-East Asian countries (Vadrevu et al. 2014; Kim Oanh et al. 2018).

7.1.7 Underwater Noise

The baseline underwater noise monitoring program in support of the Prelude EIS recorded the following natural and anthropogenic features of:

- several regular fish choruses (i.e. schooling fish calling en masse)
- several great whale calls including humpback whales, pygmy blue whales in late October 2006 and possible minke whale calls
- persistent vessel noise

- seismic survey noise associated with marine seismic survey signals.

The biological noise sources recorded in the nearby Ichthys field were similar and included regular fish choruses, infrequent calls from nearby fish and several whale calls from humpback whales, pygmy blue whales, minke whales and other unidentifiable species (INPEX Browse 2010). Anthropogenic noise sources recorded included low frequency noise from vessels and that generated from seismic surveys being conducted in the region (INPEX Browse 2010).

7.1.7.1 Prelude FLNG Noise

Airborne and marine noise emissions from Prelude operations are generated from the following operational sources and activities:

- Subsea infrastructure including wells, pipelines and risers
- Supply and other marine vessel (e.g. ASV during maintenance) operations
- Power Generation and Production Process at the FLNG vessel, including Flaring
- Product Offtake Operations including Tanker Arrival, Loading and Departure
- Helicopter Operations
- Subsea Inspection, Maintenance and Repair (IMR) works.

Subsea Infrastructure

The broadband noise produced by an operational wellhead is very low, 113 dB re 1 µPa, which is only marginally above rough sea condition ambient noise (McCauley, 2002). For this noise level to be exceeded, there would need to be multiple wellheads within a very close proximity of each other (approximately less than 50m apart) before their signals combine to increase the total noise field (with two adjacent sources only increasing the total noise field by 3 dB). Hence for Prelude field wellheads, the broadband noise level in the vicinity of the wellheads would be expected to be of the order of 113 dB re 1 µPa and this would fall to background levels within less than 200m from the wellhead (McCauley, 2002). Similar to wellhead noise, which includes flow noise in pipelines, the noise field produced along a pipeline/flowline may be expected to be very close in levels to that described for wellheads, with the radiated noise field falling to ambient levels within approximately 100m. Hence noise impacts from subsea infrastructure including wellheads and flowlines are not considered credible and will not be discussed further.

Subsea IMR activities are typically undertaken from vessels that use a Dynamic Positioning (DP) system. This allows manoeuvrability, station keeping and avoids anchoring when undertaking works in close proximity to subsea infrastructure. As the vessel will maintain its position with the continual use of DP thrusters, the thrusters will dominate as the source of underwater noise. Noise generated from these activities will be intermittent and of short duration and similar to the noise produced by other marine vessels in the field (e.g. supply boats).

Subsea inspections generally involve the IMR vessel travelling along the route of the subsea system with an ROV to identify or undertake maintenance or repair activities that may be required to ensure the assets are being maintained. Inspection techniques with the potential to generate underwater noise include side-scan sonar. Sonars are

used in relatively shallow water depths (70m to 240m) to detect objects on the sea floor including existing infrastructure and potential seabed hazards, however their use will be occasional only, e.g. once every 1-3 years, and only for several weeks at a time. The sonar operates at high frequencies (typically around 100–500 kHz) with the frequency being dependent on the substrate type, resolution of data required, and water depth.

Supply and Other Marine Vessel Operations

During normal operations, support vessels may be required to complete routine round-trip voyages between the Operational Area and Darwin or another Australian Port. The underwater noise that is produced by vessels arises from two continuous sources – propeller cavitation and the propulsion machinery (engines) inside the vessel.

Support vessels typically produce sound levels around 160-180dB re 1µPa at 1m generally dominated by low frequencies during transit and drop with reduced speed. As the ship's speed increases, broad band noise such as propeller cavitation and hull vibration noise become dominant over machinery related tones (NRC 2003). When vessels are holding station, frequencies increase considerably with the use of thrusters to maintain position. A vessel using DP produces noise of low frequency, less than 1kHz, with broadband values up to 177dB re 1µPa at 1m (Simmonds et al. 2004)

Power Generation, Production and Product Offtakes

When the FLNG thrusters are not operating, the facility's underwater noise signature is dominated by the noise produced by the utilities (e.g. power generation) and production facilities. These include the steam turbine generators, boilers, air compressors, and pumps located within the hull and topsides process equipment including compressors and motors. Other production related noise contributors include occasional hydrocarbon flaring and continuous acid gas venting.

The resulting noise amplitudes from Prelude normal operations are predicted to peak at 50Hz, and the overall source level in the frequency range 10Hz to 2kHz is predicted to be 189.1dB re1µPa at 1m. *Figure 7-4* shows predicted maximum received noise levels from FLNG facility plant as described.

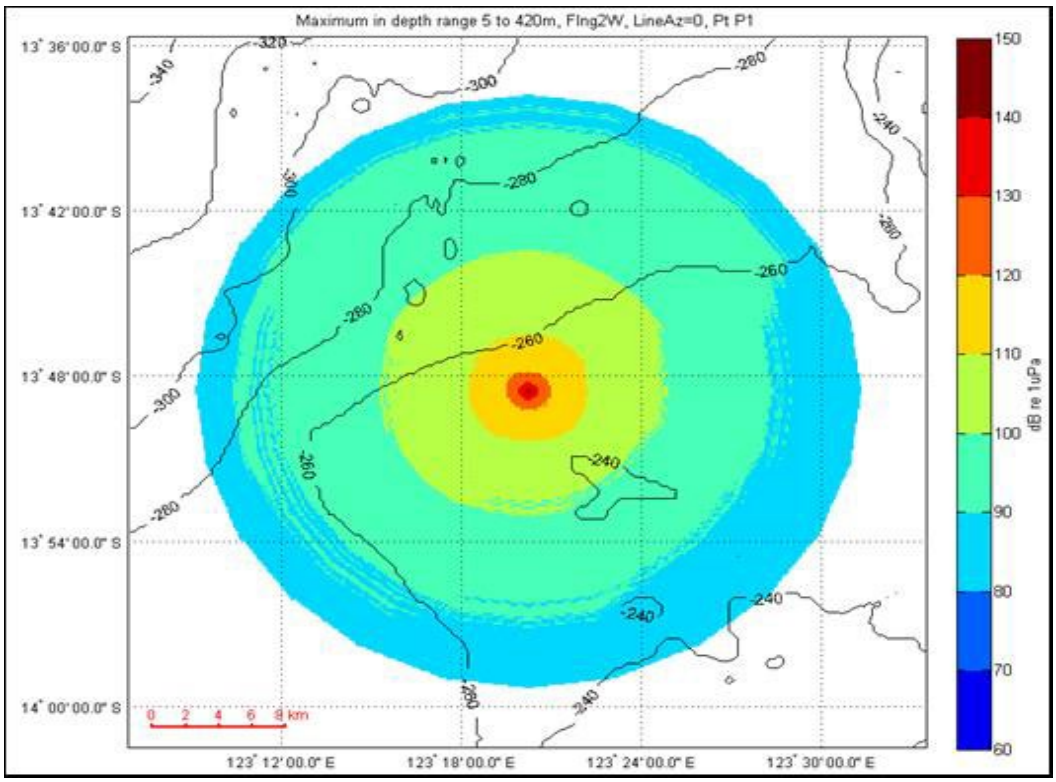


Figure 7-4: Predicted Maximum Received Levels at Any Depth Due to Non-Offtake FLNG Facility Noise as a Function of Range and Azimuth

The highest underwater noise levels will be experienced when the vessel's thrusters are used to maintain position. The requirement to use thrusters is determined by weather conditions and may occur during the berthing and de-berthing of the product offtake vessels and on occasions throughout the off-loading period. Thrusters may also be required during helicopter operations.

The alongside offloading configurations for the LNG and LPG carriers may involve the simultaneous operation of thrusters on the FLNG facility, thrusters on the two in-field support vessels (acting as tugs), and the main engines of the berthing tanker. Thrusters on the FLNG facility and tugs generate high levels of thrust in poor flow conditions, resulting in significant propeller cavitation and consequent high underwater noise levels.

Predicted noise levels peak in the frequency range 200Hz to 400Hz. The corresponding broadband source levels over 10Hz to 2kHz are predicted to be 189.1dB re 1µPa at 1m for the FLNG facility, and 189.7dB re 1 µPa at 1m for the combined effect of two tugs. If all sources are co-located, their combined source level is estimated at 192.4dB re 1µPa at 1m. ***Figure 7-5*** shows the maximum predicted received level of noise at any depth as a function of range and azimuth for the different sources during offtake operations, as well as their combined effect.

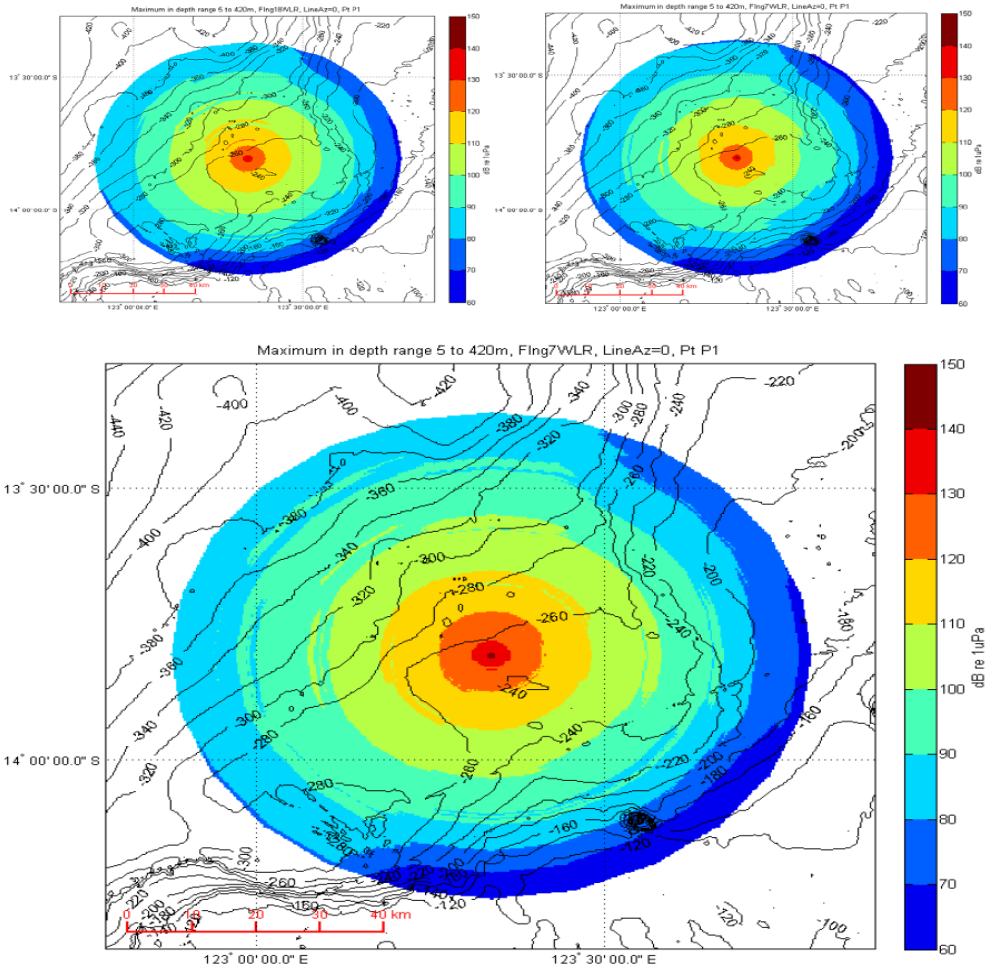


Figure 7-5: Predicted Maximum Received Levels at Any Depth due to Cavitation Noise. Top Left FLNG Facility Only; Top Right: 2 x Tugs only; Bottom: Combined Effect of Tugs and FLNG Facility. Note Change in Scale Compared to Previous Figure

Figure 7-5 illustrates the maximum distances from Prelude at which particular noise levels from normal operations and offtake operations are likely to be exceeded.

Table 7-2: Maximum Distance from FLNG at Which the Specified Received Levels are Likely to be Exceeded

Received Noise Level in 10Hz to 2kHz band (dB re 1µPa)	Cavitation noise during offtake operations	Plant noise during operations
160	60m	17m
150	200m	50m

Received Noise Level in 10Hz to 2kHz band (dB re 1µPa)	Cavitation noise during offtake operations	Plant noise during operations
140	850m	190m
130	3.7km	600m
120	9km	1.3km
110	17km	4.5km
100	30km	10km
90	44km	20km

Helicopter Operations

Helicopter flights are required from the operating base at Broome or from Djarindjin (Lombadina) Airport to site for the purposes of crew change out. The main acoustic source associated with helicopters is the impulsive noise from the main rotor. Dominant tones in noise spectra from helicopters are generally below 500Hz (Richardson et al. 1995). The level of underwater sound from helicopters is affected by helicopter altitude, aspect and strength of noise emitted, and the receiver depth, water depth and other variables (Richardson et al. 1995).

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 the vertical, much of the sound is reflected and does not penetrate into the water (Richardson et al, 1995). Therefore, strong underwater sounds are detectable for a period roughly corresponding to the time the helicopter is within a 26° cone above the receiver. Richardson (Richardson et al, 1995) reports figures for a Bell 214 helicopter (stated to be one of the noisiest) being audible in air for 4 minutes before it passed over underwater hydrophones, but detectable underwater for only 38 seconds at 3 m depth and 11 seconds at 18 m depth. The maximum received level was 109 dB re 1µPa2. s. Due to their short duration and near surface impacts only, helicopter noise emissions are not considered to be a credible source of noise impact/ risk and will not be discussed further.

Summary

Table 7-3 provides a summary of sound frequencies and sound levels expected from noise sources produced by FLNG activities and support operations.

Table 7-3: Expected Sound Frequencies and Broadband Source Levels of FLNG and Support Operations

Source	Dominant Frequency Range (Hz)	Expected source levels (dB re 1µPa at 1m)
Support vessels	100 -2,000	164-182
Vessel using dynamic positioning (DP)	50 - 1,000	177
Side Scan Sonar	100,000 – 500,000	no data
34m twin diesel work boat	630	159
Tug (pulling empty barge)	37 - 5,000	145 - 166
Tug (pulling loaded barge)	1,000 - 5,000	161 - 170
Prelude FLNG (normal operations)	< 2,000 (peak 50)	189.1 (10 - 2,000 Hz)
Prelude FLNG and offtake tankers simultaneously using thrusters	< 2,000 (peak 200-400)	192.4 (10 - 2,000 Hz)
Helicopters	< 500	Received levels at 3m water depth of 101-109dB for a Bell 212 helicopter at an altitude of 610-152m respectively.

Source: Woodside Energy Limited 2011 and Shell 2009

7.2 Biological Environment

7.2.1 Benthic Communities

7.2.1.1 Bare Sediment

Surveys of benthic habitats within the Operational Area showed low density epibenthic communities of deposit and filter feeders on bare sediments, which is typical of this habitat in the region (Baker et al. 2008). Infauna were dominated by polychaete worms, which accounted for approximately 80% of individual infauna sampled (Shell 2009). This finding is consistent with other studies across the region, which showed infauna communities in similar water depths are dominated by polychaetes and crustaceans (Heyward et al. 1997). Given the water depth within the Operational Area, no benthic primary producers will occur due to the lack of photosynthetically active radiation reaching the seabed.

Bare sediment habitats are also the most common habitat type within the EMBA, although there are discrete areas of other benthic habitat types associated with features such as islands and shoals, such as corals, macroalgae, seagrasses and mangroves (discussed below).

7.2.1.2 Corals

While hard (zooxanthellate) corals are not present within the Operational Area, they are widespread throughout the EMBA in relatively shallow (< 50 m) waters. There are a large number of shoals and banks within the Browse Basin and open offshore waters off northern Australia. The shoals closest to the Operational Area are:

- Goeree Shoal – located approximately 13 km north-west of the Operational Area
- Eugene McDermott Shoals – located approximately 18 km south-east of the Operational Area
- Vulcan Shoal – located approximately 22 km north-west of the Operational Area
- Barracouta Shoals – located approximately 63 km north-west of the Operational Area
- Browse Island – location approximately 39km south-east of the Operational Area
- Heywood Shoals – located approximately approximately 21 km from Operational Area, and
- Echuca Shoals – located approximately 53 km north of the Operational Area.

Coals reef communities are also widespread along the coastlines of Indonesia and Timor-Leste, including:

- Rote Island
- Timor
- Sawu Island
- Sumba

Corals, particularly reef-forming corals, form an important component of benthic communities by providing habitat. In turn, this habitat supports relatively diverse associated communities, such as fish assemblages and macroalgal communities. Coral rubble from dead hard coral colonies also results in in-situ sediment production, which may be an important source of biogenic sediments at banks and shoals in the Timor Sea (Heyward et al. 2012).

Corals in the region are thought to spawn seasonally, with two distinct mass spawning events in autumn and spring observed (Gilmour et al. 2009, Rosser and Gilmour 2008). This contrasts with other coral reef communities in the Indo-Pacific, such as the Great Barrier Reef and Ningaloo Reef, which typically exhibit a single annual mass spawning event. Coral reefs in the Timor Sea exhibit recruitment from both local (i.e. self-seeding) and distant (e.g. reefs located 10’s to 100’s of kilometres away) propagules (Gilmour et al. 2013). This has implications for the recovery of coral reefs following disturbance, such as bleaching events or cyclones.

7.2.1.3 Macroalgae & Seagrasses

Like corals, much of the EMBA does not receive sufficient photosynthetically active radiation at the seabed to support macroalgae and seagrass communities. The areas that do are typically associated with physical features such as reefs, banks, shoals, islands and the mainland coasts of Australia, Indonesia and Timor-Leste. Macroalgae and seagrass communities in these areas provide relatively complex habitat structure that supports greater species richness and diversity. Primary productivity from these communities also supports food webs through direct grazing and consumption of detritus.

Macroalgae are an important feature in the seabed communities at several offshore banks and shoals in the EMBA, particularly calcareous green algae in the genus *Halimeda*. Geological coring studies of several Timor Sea banks and shoals indicates extensive deposition of carbonate sediments from *Halimeda* spp. (Heyward et al. 1997), which may account for the creation and maintenance of these geological structures near the sea surface. Seagrasses at banks and shoals tends to be less common and more ephemeral than macroalgae, with surveys showing considerable temporal variability at the scale of years (Heyward et al. 2012).

7.2.1.4 Mangroves

Mangroves are widely distributed along the coastlines within the EMBA, including Indonesia (Timor and Sumba), the Pilbara and the Kimberley coastline. Mangroves habitats are of environmental value due to the shoreline stabilisation and habitat they provide. Many fauna species either complete their life cycles within mangrove habitats, or utilise mangroves during particular life history stages (e.g. nursery habitat for juveniles (Robertson and Duke 1987). The nearest potential mangrove habitat to the Operational Area are the islands and mainland coast of the Kimberley region, over 200 km from the Prelude LNG facility.

7.2.2 Pelagic Communities

7.2.2.1 Plankton

Plankton are organisms, typically small in size, whose movements are determined largely by currents rather than active movement (e.g. swimming). Plankton communities are often categorised into two groups: phytoplankton (drifting plants) and zooplankton (drifting animals).

Surveys in the Operational Area found phytoplankton communities to be highly diverse but low in abundance. Key groups identified include dinoflagellates (Dinophyceae), diatoms (Bacillariophyceae) and Prasinophyceae. The most abundant species included *Prasinophyte* sp. (Prasinophyceae); *Gyrodinium* sp. and *Heterocapsa* sp. (Dinophyceae); *Pseudonitzschia* sp., *Cylindrotheca closterium*, *Chaetoceros* sp., *Thalassionemafrauenfeldii* and *Nitzschia longissima* (Bacillariophyceae) (Shell 2009). Phytoplankton in the wider region is similar to that observed in the project area with relatively high diversity in certain groups recorded such as diatoms, dinoflagellates and coccolithophorids (Hallegraeff and Jeffrey 1984).

Zooplankton samples collected in July 2008 found crustacean assemblages to be primarily dominated by copepod species (Shell 2009). Overall densities of zooplankton assemblages were relatively low and typical of low nutrient open ocean environments in the region. A few samples were dominated by euphausiids or chaetognaths (Shell 2009).

Some fauna groups, such as fish and crustacean species, often have a planktonic larval stage following which they assume a free-swimming or benthic existence. The larval fish community within the Operational Area was relatively diverse and abundant; however, species composition was primarily dominated by neritic species, which have little or no commercial value (Shell 2009). Commercial species identified came from groups typical of a range of marine habitats including pelagic shelf systems and both coastal and deep sea demersal habitats. Larvae were identified from the following groups which have commercially targeted species: Berycidae, Carangidae (trevally and jacks), Lutjanidae (tropical snappers), Serranidae (cods), and Scombridae (mackerels and tunas).

7.2.2.2 Pelagic Fish & Invertebrates

Free swimming pelagic fauna within the Operational Area and EMBA are expected to include pelagic fishes, marine turtles, seasnakes, squid, and cetaceans. Several of these fauna groups (e.g. whale sharks, several cetacean species, marine turtles) are listed threatened and / or migratory under the EPBC Act; these species are considered in Section 7.2.4 Threatened Ecological Communities.

Small pelagic fishes, such as sardines and anchovies, form an important trophic link between microscopic planktonic communities (e.g. zooplankton feeding on phytoplankton) and larger consumers (e.g. tunas). Small pelagic fishes are expected to be broadly distributed throughout the tropical pelagic environment given the relatively homogeneous nature of the open sea, with food availability and predation also influencing the distribution and abundance of these species.

The distribution of larger pelagic fishes (e.g. tunas, bonito, blue sharks etc.) are expected to mirror the distribution of small pelagic fishes, as small pelagic fishes are the primary prey of these larger species. Several pelagic fish species, such as marlin, swordfish and mackerel, are important for commercial and recreational fisheries, although fishing effort in the Operational Area and much of the EMBA is very low. The commercially important southern bluefin tuna is thought to spawn in the north-eastern Indian Ocean, although this species is not fished within the Operational Area or EMBA.

7.2.3 Key Ecological Features

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. There are no KEFs present within the Operational Area; several KEFs have been identified within the EMBA. A summary of the KEFs overlapped by the EMBA are shown in Figure 7-6 and listed in Table 7-4.

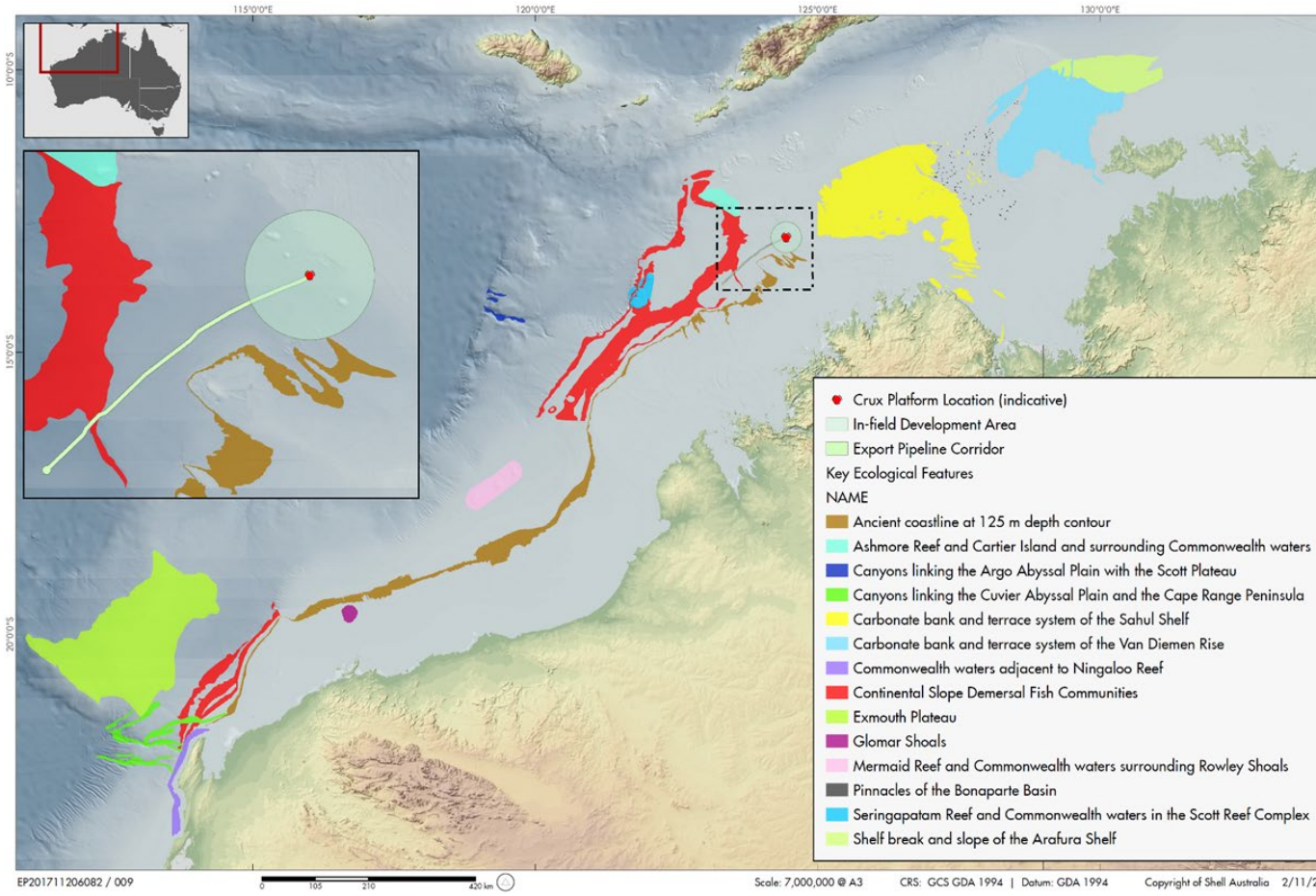


Figure 7-6: Locations of KEFs within the EMBA

Table 7-4: KEFs Relevant to the Project

KEF	Relevance to Operational Area	Summary of Key Values
Ancient coastline at 125 m depth contour	Located 12km to the SE of the pipelines corridor at its closest point.	*Unique seafloor feature with ecological properties of regional significance* The areas of hard substrate along this ancient coastline, which follows the 125 m depth contour, are thought to provide biologically important habitats in areas otherwise dominated by soft sediments; thereby providing for higher species diversity and richness relative to the wider region. The topographic complexity of these escarpments may also facilitate vertical mixing of the water column providing a relatively nutrient-rich environment for species present on the escarpment. The KEF encompasses an area of approximately 16,190 km^2.
Ashmore Reef and Cartier Islands and surrounding Commonwealth waters	Located 80 km north-west of the Operational Area and occurs within the EMBA	*High productivity and aggregations of marine life* Ashmore Reef is the largest of only three emergent oceanic reefs present within the north-eastern Indian Ocean and is the only oceanic reef in the region with vegetated islands. The emergent reefs are known to provide areas of enhanced primary productivity in otherwise oligotrophic environments. Ashmore Reef and Cartier Islands and the surrounding Commonwealth waters are regionally important for feeding

KEF	Relevance to Operational Area	Summary of Key Values
		and breeding aggregations of seabirds and shorebirds, and other marine life. Ashmore Reef regularly supports more than 40,000 waterbirds (those ecologically dependant on wetlands) and is estimated to support as many as 100,000 seabirds in a twelve month period (Hale 2013). The marine habitats supported by the reefs are nationally and internationally significant, providing habitat for diverse and abundant marine reptile (including feeding, nesting and internesting areas for green, hawksbill and loggerhead turtles) and marine mammal populations, including dugongs. Species at Ashmore and Cartier include more than 225 reef-building corals, 433 molluscs, 286 crustaceans, 192 echinoderms, and 709 species of fish. Thirteen species of sea snakes occur in high numbers at Ashmore and Cartier reefs but are in decline. Additionally, Ashmore Reef supports the highest number of coral species of any reef off the WA coast and plays a primary role in the maintenance of the biodiversity of reef systems in the region.
Canyons linking the Argo Abyssal Plain with Scott Plateau	Located 525 km south-west of the Operational Area and occurs within the EMBA	*High productivity and aggregations of marine life* Canyons linking the Argo Abyssal Plain with Scott Plateau covers an area of approximately 836 km^2. The Bowers and Oats canyons are major canyons on the slope between the Argo Abyssal Plain and Scott Plateau and deeply cut into the Scott Plateau at depths of approximately 2,000 m – 3,000 m. The ocean area above the canyons is thought to be an area of moderately enhanced productivity, attracting aggregations of fish, sharks, toothed whales and dolphins.
Carbonate bank and terrace system of the Sahul Shelf	Located 60 km north-east of the Operational Area and occurs within the EMBA	*Unique seafloor feature with ecological properties of regional significance* While little is known about this KEF, the carbonate banks and terrace system of the Sahul Shelf is considered regionally important because of their role in enhancing biodiversity and local productivity relative to their surrounds, largely due to the presence of elevated hard substrates. The seabed features are thought to create enhanced productivity and biodiversity as a result of upwellings of cold nutrient-rich water at the heads of the channels. The KEF covers an area of approximately 41,158 km^2. The banks rise to depths of 150 m – 300 m and are separated from each other by narrow meandering channels which are up to 150 m deep. The hard substrates of the banks are thought to support a high diversity of organisms including reef-fish, sponges, soft and hard corals, gorgonians, bryozoans, ascidians and other sessile filter feeders.
Continental slope demersal fish communities	Intersected by a small portion of the Operational Area (about 7km of the pipeline corridor).	*Communities with high species biodiversity and endemism* There is a high diversity of demersal fish assemblages on the Australian continental slope from the North West Cape to the edge of the NMR. Specifically, the continental slope between North West Cape and the Montebello Trough has more than 500 fish species, 76 of which are endemic, which makes it the most diverse slope bioregion in the whole of Australia (DEHWA 2008). The Timor Province and Northwest Transition bioregions, in which the Crux project is located, are the second-richest areas for demersal fish across the entire continental slope. The KEF covers a vast area of approximately 33,182 km^2.

KEF	Relevance to Operational Area	Summary of Key Values
Glomar Shoals	Located 950 km south-west of the Operational Area and occurs within the EMBA	*High productivity and aggregations of marine life* The Glomar Shoals (approximately 786 km2) are a submerged littoral feature located approximately 150 km north of Dampier on the Rowley shelf at depths of 33 m – 77 m. While biological data is limited, the fish of Glomar Shoals are believed to be a subset of reef-dependent species. The shoals are known to be an important area for a number of commercial and recreational fish species such as rankin cod, brown-striped snapper, red emperor, crimson snapper, bream and yellow-spotted triggerfish.
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	Located 526 km south-west of the Operational Area and occurs within the EMBA	*High productivity and aggregations of marine life* The Rowley Shoals consist of three atoll reefs; Clerke, Imperieuse and Mermaid Reef which support 214 coral species and around 530 species of fish. The steep changes in slope around the reef also attract a range of migratory pelagic species such as dolphins, tuna, billfish and sharks. The coral communities of Mermaid Reef are also an important feature. The enhanced productivity at the shoals is thought to be facilitated by the breaking of internal waves in the waters surrounding the reefs, causing mixing and re-suspension of nutrients from water depths of 500–700 m into the photic zone.
Pinnacles of the Bonaparte Basin	Located 310 km from the Operational Area and occurs within the EMBA	*Unique seafloor feature with ecological properties of regional significance* The limestone pinnacles in the western Bonaparte Depression are expected to support a diverse community in an otherwise oligotrophic system. More than 110 pinnacles occur in the Bonaparte Depression, covering a total area of more than 520 km^2. The pinnacles are thought to be the eroded remnants of underlying strata and can be up to 50 m high and 50 km–100 km long.
Seringapatam Reef and Commonwealth waters in the Scott Reef complex	Located 143 km from the Operational Area and occurs within the EMBA	*High productivity and aggregations of marine life* The coral communities at Seringapatam and Scott Reefs play a key role in maintaining species richness and aggregations of marine life. The reefs and the waters surrounding them attract aggregations of marine life including humpback whales on their northerly migration, Bryde's whales, pygmy blue whales, Antarctic minke whales, dwarf minke whales, minke whales, dwarf sperm whales, spinner dolphins and whale sharks. Green and hawksbill turtles nest during the summer months on Sandy Islet on South Scott Reef. These species also internest and forage in the surrounding waters. Scott Reef is a particularly biologically diverse system and includes more than 300 species of reef-building corals, approximately 400 mollusc species, 118 crustacean species, 117 echinoderm species, around 720 fish species and several species of sea snakes.
Exmouth Plateau	Located 1,127 km from the Operational Area and occurs within the EMBA	*Unique seafloor feature with ecological properties of regional significance* Due to its large size (approximately 49,310 km^2), the plateau is thought to modify deep-water flow and be associated with the generation of internal tides in the Exmouth region. These oceanic processes may contribute to the upwelling of nutrients, which result in areas of increased productivity. The plateau ranges in depth between 800 m to 4,000 m and features valleys and channels that support a range of benthic environments. These features are also thought to provide conduits for the transport of sediment and other materials from the plateau surface to deeper areas.

KEF	Relevance to Operational Area	Summary of Key Values
		While the Exmouth Plateau has low habitat heterogeneity, it is likely to be an important area of biodiversity as it provides an extended area for communities adapted to depths of around 1,000 m.
Shelf break and slope of the Arafura Shelf	Located 626 km from the Operational Area and occurs within the EMBA	*Unique seafloor feature with ecological properties of regional significance* The shelf break and slope of the Arafura Shelf is described as a biogeographic crossroad of biota from the Timor-Indonesian-Malay region. Whilst there is limited information about the ecosystem processes of the area, it is thought that the ITF current and surface wind-driven circulation from the north-west monsoon are a strong influence. These oceanic processes are likely to drive pelagic dispersal of nutrients, species and biological productivity and, in turn, the long term patterns in transport and dispersal of larvae juvenile and migrating adult organisms through the area. Demersal fish communities are diverse and the area is likely to support whale sharks, sharks and marine turtles.
Carbonate bank and terrace system of the Van Diemen Rise	Located 430 km from the Operational Area and occurs within the EMBA	*Unique seafloor feature with ecological properties of regional significance* The bank and terrace system of the Van Diemen Rise covers approximately 31,278 km^2 and forms part of the larger system associated with the Sahul Banks to the north and Londonderry Rise to the east. The complex topographic features of the area consist largely of raised geomorphic features (e.g. terraces and banks) with relatively high proportions of hard substrate, supporting sponge and octocoral gardens. These sponge and coral communities in turn provide habitat for epifauna. Infauna, including polychaetes and ascidians, are also scattered throughout the KEF. Variability in water depth and substrate composition is thought to contribute to the richness in benthic epifauna and the unique ecosystems found in the area. The carbonate banks and shoals found within the Van Diemen Rise make up 80% of the banks and shoals, 79% of the channels and valleys, and 63% of the terrace found across the NMR. The carbonate banks and shoals rise from depths of 100 m–200 m to within 10 m–40 m of the sea surface (Anderson et al. 2011).
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	Located 1,404 km from the Operational Area and occurs within the EMBA	*Unique seafloor features with ecological properties of regional significance* The nutrient-rich and high productivity waters of the KEF are associated with aggregations of whale sharks, manta rays and sharks, humpback whales, sea snakes, sharks, large predatory fish and seabirds. The canyons are thought to connect to the Commonwealth waters adjacent to Ningaloo Reef, as well as the Exmouth Plateau. The KEF also supports unique seafloor features of a regional significance with regards to both benthic and pelagic ecological habitats.
Commonwealth waters adjacent to Ningaloo Reef	Located 1,451 km from the Crux platform and occurs within the EMBA	*High productivity and aggregations of marine life* Ningaloo Reef is of global significance as it is the only coral reef in the world that fringes the west coast of a continent and is a seasonal aggregation site for the whale shark. The high degree of interconnectivity with regional canyons and plateau contributes to high levels of productivity and species richness of the Ningaloo Reef. The reef supports aggregations and migration pathways of whale sharks, manta rays, humpback whales, sea snakes, sharks, large predatory fish

KEF	Relevance to Operational Area	Summary of Key Values
		and seabirds. The deep-water biodiversity includes unique assemblages of sponge and filter-feeder communities (compared with the Dampier Archipelago and Abrolhos Islands) which are indicative of areas of potentially high and unique sponge biodiversity.

7.2.4 Threatened Ecological Communities

Threatened Ecological Communities (TECs) are protected under Part 3 of the EPBC Act and are MNES. The PMST report for the EMBA indicated that the monsoon vine thickets on the coastal sand dunes of the Dampier Peninsula TEC lies within the EMBA, approximately 285 km from the Operational Area at the closest point.

The identification of this TEC by the PMST report is an artefact of the method used to derive the search area for the PMST. This TEC lies entirely above the high water mark and will not credibly be impacted by a worst-case hydrocarbon spill. Hence, this TEC is not considered further in this EP.

No other TECs were identified that may credibly be affected by the petroleum activities considered in this EP.

7.2.5 Ramsar Wetlands

Sites recognised under the Convention on Wetlands of International Importance (the Ramsar Convention), referred to as Ramsar wetlands, are protected under Part 3 of the EPBC Act and are MNES. Several Ramsar wetlands were identified within the EMBA; the environmental values for these Ramsar wetlands are shown in Figure 7-7 and summarised in Table 7-5.

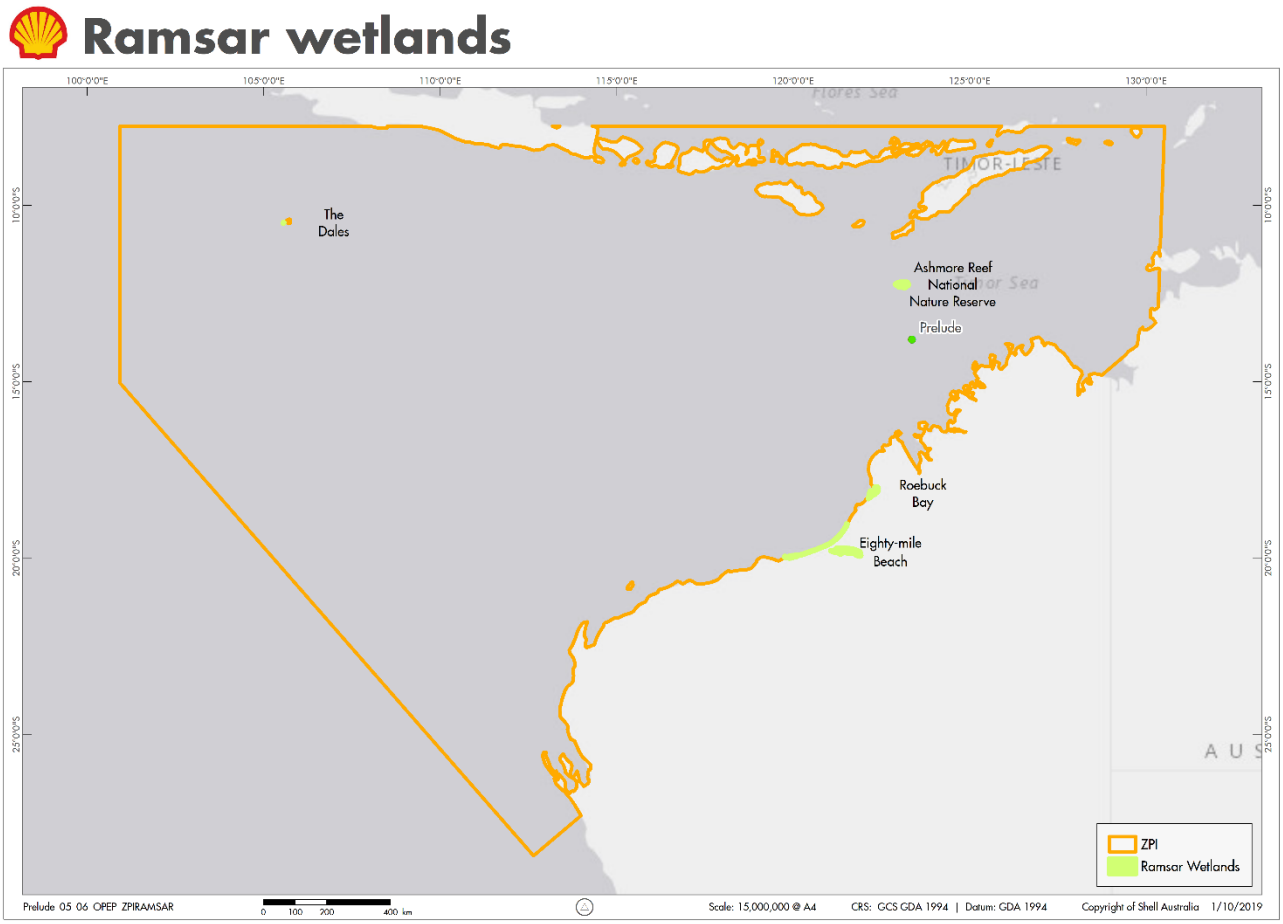


Figure 7-7: Ramsar Wetlands within the EMBA

Table 7-5: Descriptions of Ramsar Wetlands within the EMBA, including distance from Operational Area

Ramsar Wetland	Distance from Operational Area (km)	Description
Ashmore reef national nature reserve	128	Ashmore Reef supports an abundance and diversity of birds; 72 species have been recorded at this Ramsar site, with 12 recorded breeding (Hale and Butcher 2013). Ashmore Reef was designated as a Ramsar wetland based on the following characteristics: • Ashmore is the largest of the atolls in the region and has been managed for the purposes of conservation for three decades. • Each of the wetland types is in near natural condition, with low densities of coral predators and disease. • The three islands represent the only vegetated island within the Timor Province bioregion. • It supports 64 threatened species.

Ramsar Wetland	Distance from Operational Area (km)	Description
		• It is considered a true 'hotspot' of biological diversity within the Timor Province bioregion and within the broader north-west marine region. • It supports 47 species of waterbird listed as migratory under international treaties and three species of migratory turtle (green, hawksbill and loggerhead). It also supports breeding of green and hawksbill turtles, dugongs and 20 species of waterbird. • It regularly supports over 40,000 waterbirds including large numbers of migratory shorebirds and breeding seabirds (Hale and Butcher 2013). Ashmore Reef is also recognised as a KEF and is within the Ashmore Reef Australian Marine Park (AMP) (refer to 7.2.3).
Roebuck bay	474	The Roebuck Bay Ramsar site is located at Roebuck Bay near Broome in north Western Australia. Roebuck Bay has a very large tidal range which exposes around 160 square kilometres of mudflat, covering most of the Ramsar site. The eastern edge of the site is made up of microscale linear tidal creeks. The intertidal mud and sand flats support a high abundance of bottom dwelling invertebrates, which are a key food source for waterbirds. The site is one of the most important migration stopover areas for shorebirds in Australia and globally. For many shorebirds, Roebuck Bay is the first Australian landfall they reach on the East Asian Australasian Flyway. The total numbers of waders using the site each year is estimated at over 300 000. The northern beaches and Bush Point provide important high tide roost sites.
Eighty-mile beach	610	Eighty-mile Beach Ramsar site, located between Port Hedland and Broome in north Western Australia, is made up of Eighty-mile Beach and, 40 km to the east, Mandora Salt Marsh. Eighty-mile Beach is a 220 km section of coastline and adjacent intertidal mudflats. Eighty-mile Beach is characterised by extensive mudflats supporting an abundance of macroinvertebrates which provide food for large numbers of shorebirds. More than 472,000 migratory waders have been counted on the mudflats during the September to November period. The site is considered to be one of the major arrival and departure areas for migratory shorebirds visiting Australia, particularly on southward migration. It is one of the most important sites in the world for the migration of the Great Knot.
The dales	1,994	The Ramsar site has a near-pristine system of seven watercourses collectively known as The Dales. The Dales includes permanent and perennial streams, permanent springs, and include the majority of surface water on the Island. Most rainfall on Christmas Island filters down through the soil and limestone, and surface runoff only occurs after heavy rain. The Dales contain numerous wetland types including surface and karst features, and inland and coastal wetlands. The Dales support a number of unique ecological and geomorphic features including anchialine cave communities, surface karst including the unique stepped tufa deposits at Hugh's waterfall, a stand of Tahitian chestnuts, a large number of endemic terrestrial species and a significant number of seabirds including Abbott's

Ramsar Wetland	Distance from Operational Area (km)	Description
		booby, red-footed booby and the brown booby, all of which breed at the site.

7.2.6 Commonwealth Marine Area

The Operational Area is located within the Commonwealth marine area, which includes 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 NT waters. The Commonwealth marine area stretches from three to 200 nm from the coast.

7.2.7 WA Mainland Coastline

The WA mainland coastline lies over 200 km from the Operational Area at the closest point, with several parts of the Kimberley and Pilbara coastlines within the outer edge of the EMBA. These coastlines support a diverse array of coastal and nearshore marine habitats including coral reefs, sandy beaches, rocky shores, seagrass meadows, mangroves, wetlands, estuaries, creeks and rivers. These environments in turn support a number of fauna, including EPBC listed seabirds and migratory shorebirds, turtles, sea snakes, dugongs, cetaceans, fish, sharks and rays (refer to Section 7.2.8).

The WA nearshore and coastal areas provide Indigenous and European heritage value, as well as cultural, social and economic values such as local tourism and recreation (refer to Section 7.3). The nearshore and coastal habitats also support a number of culturally and commercially significant marine fauna species such as marine turtles, dugongs, fish and prawns.

7.2.8 Threatened and Migratory Species

An online EPBC Protected Matters Database Search was conducted for the in-field development area, export pipeline corridor and area of influence (**Table 7-6**; DoEE 2018a). A summary of the results is presented below:

- in-field development area – the search identified 20 listed threatened fauna species and 33 listed migratory species (17 of which are also listed as threatened) that may occur or have habitat in the area (DoEE 2018b),
- export pipeline corridor – the search identified 20 listed threatened fauna species and 33 listed migratory species (17 of which are also listed as threatened) that may occur or have habitat in the area (DoEE 2018c). All listed threatened and migratory species in the in-field development area were also identified as occurring in the export pipeline corridor, and
- Area of influence – the search identified 41 listed threatened fauna species and 89 listed migratory species (27 of which are also listed as threatened) that may occur or have habitat in the area (DoEE 2018d).

Forty-three species were excluded from **Table 7-6** as they are not considered relevant to the project, given they are commonly associated with terrestrial habitats that are generally not present on shorelines (e.g. wetlands, forests).

The EPBC Protected Matters results also lists a number of marine and other cetacean species, which are not listed as MNES under the EPBC Act. Refer to **Appendix J** for further details. With regards to marine mammals, a sub-set of these species, and an additional cetacean species (pantropical spotted dolphin; *Stenella attenuata*), have been observed in the NWMR region through surveys and opportunistic observations (pers. comm. R. Clarke, Monash University, 2018). An additional four marine bird species are also known to breed at Ashmore Reef; the eastern great egret (*Ardea modesta*), little egret (*Egretta garzetta*), eastern reef egret (*Egretta sacra*) and nankeen night-heron (*Nycticorax caledonicus*) (Clarke et al. 2011).

A further seven listed migratory species have been noted as potentially transiting the Barossa project area (approximately 713 km north-east of the Crux platform) on an annual basis as part of their migration, and therefore may also transit the project area; wedge-tailed shearwater (*Ardenna pacifica*), Bulwer's petrel (*Bulweria bulwerii*), Matsudaira's storm-petrel (*Hydrobates matsudairae*), Swinhoe's storm-petrel (*Hydrobates monorhis*), Wilson's storm-petrel (*Oceanites oceanicus*), red-tailed tropicbird (*Phaethon rubricauda*), white-winged black tern (*Chlidonias leucopterus*), bridled tern (*Onychoprion anaethetus*) and common tern (*Sterna hirundo*) (ConocoPhillips 2018).

Table 7-6: EPBC Listed Threatened and Migratory Species of Potentially Occurring in the EMBA and Operational Area.

Species	**Threatened Status**	**Listed as Migratory**	**Search Area**	
			Export Pipeline Corridor (Operational Area)	**EMBA**
Marine Mammals				
Sei whale (*Balaenoptera borealis*)	Vulnerable	X	X	X
Blue whale (*Balaenoptera musculus*)	Endangered	X	X	X
Fin whale (*Balaenoptera physalus*)	Vulnerable	X	X	X
Southern right whale (*Eubalaena australis*)	Endangered	X		X
Humpback whale	Vulnerable	X	X	X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
(*Megaptera novaeangliae*)				
Antarctic minke whale (*Balaenoptera bonaerensis*)		X		X
Bryde's whale (*Balaenoptera edeni*)		X	X	X
Killer whale (*Orcinus orca*)		X	X	X
Sperm whale (*Physeter macrocephalus*)		X	X	X
Spotted bottlenose dolphin (*Tursiops aduncus*)		X	X	X
Dugong (*Dugong dugon*)		X		X
Australian snubfin dolphin (*Orcaella heinsohni*) (formally known as the Irrawaddy dolphin)		X		X
Indo-pacfic humpback dolphin (*Sousa chinensis*)		X		X
Marine Reptiles				
Loggerhead turtle	Endangered	X	X	X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
(*Caretta caretta*)				
Green turtle (*Chelonia mydas*)	Vulnerable	X	X	X
Leatherback turtle (*Dermochelys coriacea*)	Endangered	X	X	X
Hawksbill turtle (*Eretmochelys imbricata*)	Vulnerable	X	X	X
Olive ridley turtle (*Lepidochelys olivacea*)	Endangered	X	X	X
Flatback turtle (*Natator depressus*)	Vulnerable	X	X	X
Short-nosed sea snake (*Aipysurus apraefrontalis*)	Critically Endangered			X
Leaf-scaled sea snake (*Aipysurus foliosquama*)	Critically Endangered			X
Birds				
Australian lesser noddy (*Anous tenuirostris melanops*)	Vulnerable		X	X
Red knot	Endangered	X	X	X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
(*Calidris canutus*)				
Curlew sandpiper (*Caladris ferruginea*)	Critically Endangered	X	X	X
Great knot (*Calidris tenuirostris*)	Critically Endangered	X		X
Greater sand plover (*Charadrius leschenaultii*)	Vulnerable	X		X
Lesser sand plover (*Charadrius mongolus*)	Endangered	X		X
Christmas Island frigatebird (*Fregata andrewsi*)	Endangered	X		X
Western Alaskan Bar-tailed Godwit (*Limosa lapponica baueri*)	Vulnerable			X
Northern siberian bar-tailed godwit (*Limosa lapponica menzbieri*)	Critically Endangered			X
Southern giant-petrel (*Macronectes giganteus*)	Endangered	X		X
Eastern curlew (*Numenius madagascariensis*)	Critically Endangered	X	X	X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
Abbott's booby (*Papasula abbotti*)	Endangered		X	X
Christmas Island white-tailed tropicbird (*Phaethon lepturus fulvus*)	Endangered			X
Round Island petrel (*Pterodroma arminjoniana*)	Critically Endangered			X
Soft-plumaged petrel (*Pterodroma mollis*)	Vulnerable			X
Australian fairy tern (*Sternula nereis nereis*)	Vulnerable			X
Tasmanian shy albatross (*Thalassarche cauta cauta*)	Vulnerable	X		X
White capped albatross (*Thalassarche cauta steadi*)	Vulnerable	X		X
Campbell albatross (*Thalassarche impavida*)	Vulnerable	X		X
Black-browed albatross (*Thalassarche melanophris*)	Vulnerable	X		X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
Common noddy (*Anous stolidus*)		X	X	X
Fork-tailed swift (*Apus pacificus*)		X		X
Flesh-footed shearwater (*Ardenna carneipes*)		X		X
Wedge-tailed shearwater (*Ardenna pacifica*)		X		X
Streaked shearwater (*Calonectris leucomelas*)		X		X
Lesser frigatebird (*Fregata ariel*)		X	X	X
Greater frigatebrd (*Fregata minor*)		X	X	X
Caspian tern (*Hydroprogne caspia*)		X		X
Bridled tern (*Onychoprion anaethetus*)		X		X
White-tailed tropicbird (*Phaethon lepturus*)		X		X
Red-tailed tropicbird (*Phaethon rubricauda*)		X		X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
Roseate tern (*Sterna dougallii*)		X		X
Little tern (*Sterna albifrons*)		X		X
Masked booby (*Sula dactylatra*)		X		X
Brown booby (*Sula leucogaster*)		X		X
Red-footed booby (*Sula sula*)		X		X
Oriental reed-warbler (*Acrocephalus orientalis*)		X		X
Common sandpiper (*Actitis hypoleucos*)		X	X	X
Ruddy turnstone (*Arenaria interpres*)		X		X
Sharp-tailed sandpiper (*Calidris acuminata*)		X	X	
Sanderling (*Calidris alba*)		X		X
Pectoral sandpiper (*Calidris melanotos*)		X	X	
Red-necked stint (*Calidris ruficollis*)		X		X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
Long-toed stint (*Calidris subminuta*)		X		X
Little ringed plover (*Charadrius dubius*)		X		X
Oriental plover (*Charadrius veredus*)		X		X
Swinhoe's snipe (*Gallinago megala*)		X		X
Pin-tailed snipe (*Gallinago stenura*)		X		X
Oriental Pratincole (*Glareola maldivarum*)		X		X
Broad-billed sandpiper (*Limocola falcinellus*)		X		X
Asian dowitcher (*Limnodromus semipalmatus*)		X		X
Bar-tailed godwit (*Limosa lapponica*)		X		X
Black-tailed godwit (*Limosa limosa*)		X		X
Little curlew (*Numenius minutus*)		X		X
Whimbrel		X		x

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
(*Numenius phaeopus*)				
Osprey (*Pandion haliaetus*)		X		X
Pacific Golden Plover (*Pluvialis fulva*)		X		X
Grey plover (*Pluvialis squatarola*)		X		X
Crested tern (*Thalasseus bergii*)		X		X
Grey-tailed tattler (*Tringa brevipes*)		X		X
Wood sandpiper (*Tringa glareola*)		X		X
Wandering tattler (*Tringa incana*)		X		X
Common greenshank (*Tringa nebularia*)		X		X
Marsh sandpiper (*Tringa stagnatilis*)		X		X
Common redshank (*Tringa totanus*)		X		X
Terek sandpiper (*Xenus cinereus*)		X		X
Sharks and Rays				

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
Grey nurse shark (*Charcharius taurus*)	Vulnerable			X
Great white shark (*Carcharodon carcharias*)	Vulnerable	X	X	X
Northern river shark (*Glyphis garricki*)	Endangered		X	X
Speartooth shark (*Glyphis glyphis*)	Critically Endangered			X
Dwarf sawfish (*Pristis clavata*)	Vulnerable	X		X
Largetooth sawfish (*Pristis pristis*)	Vulnerable	X	X	X
Green sawfish (*Pristis zijsron*)	Vulnerable	X	X	X
Whale shark (*Rhincodon typus*)	Vulnerable	X	X	X
Shortfin mako (*Isurus oxyrinchus*)		X	X	X
Longfin mako (*Isurus paucus*)		X	X	X
Reef manta ray (*Manta alfredi*)		X	X	X
Giant manta ray (*Manta birostris*)		X	X	X

Species	Threatened Status	Listed as Migratory	Search Area	
			Export Pipeline Corridor (Operational Area)	EMBA
Narrow sawfish (*Anoxypristis cuspidata*)		X	X	X
Mackeral shark (*Lamna nasus*)		X		X

7.2.8.1. Listed Threatened Species Conservation Advice & Species Recovery Plans

The Commonwealth publishes recovery plans and conservation advice for a number of species listed as threatened under the EPBC Act. These documents are intended to assist in preventing the decline, and enhance the recovery, of threatened species. The requirements of the species recovery plans and conservation advice (Table 7-7) for threatened species identified within the EMBA were considered to identify any aspects that may be applicable to the impact and risk assessment (Section 9.3 to Section 9.13).

Table 7-7: Conservation advice for EPBC Act listed threatened species identified within the EMBA considered during environmental risk assessment

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
All Vertebrate Fauna			
All vertebrate fauna	Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (Commonwealth of Australia 2018)	Marine debris	No explicit management actions for non-fisheries related industries (note that management actions in the plan relate largely to management of fishing waste (e.g. “ghost” gear), and state and Commonwealth management through regulation.
Mammals			
Sei whale	Approved conservation advice *Balaenoptera borealis* (sei whale) (Threatened Species Scientific Committee 2015a)	Noise interference	Assess and manage acoustic disturbance
		Vessel disturbance	Assess and manage physical disturbance and development activities
Blue whale	Conservation management plan for the blue whale: A recovery plan under the Environment Protection and	Noise interference	Assessing and addressing anthropogenic noise
		Vessel disturbance	Minimising vessel collisions

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
	Biodiversity Conservation Act 1999 2015-2025 (Commonwealth of Australia 2015a)		
Fin whale	Approved conservation advice for *Balaenoptera physalus* (fin whale) (Threatened Species Scientific Committee 2015b)	Noise interference	Assessing and addressing anthropogenic noise
		Vessel disturbance	Minimising vessel collisions
Humpback whale	Approved conservation advice for *Megaptera novaeangliae* (humpback whale) (Threatened Species Scientific Committee 2015c)	Noise interference	For actions involving acoustic impacts (example pile driving, explosives) on humpback whale calving, resting, feeding areas, or confined migratory pathways site specific acoustic modelling should be undertaken (including cumulative noise impacts)
		Vessel disturbance	Ensure the risk of vessel strike on humpback whales is considered when assessing actions that increase vessel traffic in areas where humpback whales occur and, if required appropriate mitigation measures are implemented to reduce the risk of vessel strike
Southern right whale	Conservation management plan for the southern right whale: a recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* 2011-2021 (DSEWPaC 2012c)	Vessel disturbance	Addressing vessel collisions
		Noise interference	Assessing and addressing anthropogenic noise
Reptiles			
Loggerhead turtle, green turtle, leatherback turtle, hawksbill turtle, flatback turtle, olive ridley turtle	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017)	Light pollution	Minimise light pollution
		Chemical and terrestrial discharge (oil pollution)	Ensure that spill risk strategies and response programs include management for turtles and their habitats
		Vessel disturbance	Vessel interactions identified as a threat; no specific management actions in relation to vessels prescribed in the plan
		Noise interference	No explicit relevant management actions; noise interference identified as a threat
Leatherback turtle	Approved conservation advice for *Dermochelys coriacea* (Leatherback Turtle) (Threatened Species Scientific Committee 2008a)	Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat
Short-nosed seasnake	Approved conservation advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (Threatened Species Scientific Committee 2010a)	No additional threats identified (ex. marine debris)	None applicable

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
Leaf-scaled seasnake	Approved conservation advice for *Aipysurus foliosquama* (leaf-scaled sea snake) (Threatened Species Scientific Committee 2010b)	No additional threats identified (ex. marine debris)	None applicable
Sharks and Rays			
White shark	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013)	No additional threats identified (ex. marine debris)	None applicable
Northern river shark	Approved conservation advice for *Glyphis garricki* (northern river shark) (Threatened Species Scientific Committee 2014a)	Habitat degradation / modification	Implement measures to reduce adverse impacts of habitat degradation and/or modification
	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks
Green sawfish	Approved conservation advice for green sawfish (Threatened Species Scientific Committee 2008b)	Habitat degradation / modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat
	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks
Whale shark	Approved conservation advice *Rhincodon typus* whale shark (Threatened Species Scientific Committee 2015d)	Vessel disturbance	Minimise offshore developments and transit time of large vessels in areas close to marine features likely to correlate with whale shark aggregations and along the northward migration route that follows the northern Western Australian coastline along the 200 m isobath
Grey nurse shark (west coast population)	Recovery plan for the grey nurse shark (*Carcharias taurus*) (Department of the Environment 2014)	No additional threats identified (ex. marine debris)	None applicable
Dwarf sawfish	Approved conservation advice for *Pristis clavata* (dwarf sawfish) (Threatened Species Scientific Committee 2009)	Habitat degradation / modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat
	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks
Freshwater sawfish	Approved conservation advice for *Pristis* (largetooth sawfish) (Threatened Species Scientific Committee 2014b)	Habitat degradation / modification	No explicit relevant management actions; habitat loss, disturbance and modification identified as a threat

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b)		Identify risks to important sawfish and river shark habitat and measures need to reduce those risks
Birds			
Migratory shorebird species[3]	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia 2015c)	Habitat degradation / modification	Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes
Albatrosses and giant petrels[4]	National recovery plan for threatened albatrosses and giant petrels (DSEWPaC 2011)	Marine pollution	No explicit relevant management actions; pollution identified as a threat
Australian lesser noddy	Approved Conservation Advice for *Anous tenuirostris melanops* (Australian lesser noddy) (Threatened Species Scientific Committee 2015e)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Red knot, knot	Approved Conservation Advice for *Calidris canutus* (Red knot) (Threatened Species Scientific Committee 2016a)	Pollution / contamination	No explicit relevant management actions; pollution identified as a threat
Curlew sandpiper	Conservation advice *Calidris ferruginea* curlew sandpiper (Threatened Species Scientific Committee 2015f)	Pollution / contamination	No explicit relevant management actions; pollution identified as a threat
Eastern curlew	Conservation advice *Numenius madagascariensis* eastern curlew (Threatened Species Scientific Committee 2015g)	Pollution / contamination	No explicit relevant management actions; pollution identified as a threat
Abbott's booby	Approved Conservation Advice for *Papasula abbotti* (Abbott's booby) (Threatened Species Scientific Committee 2015h)	No threats identified	None applicable
Great knot	Conservation advice *Calidris tenuirostris* great knot (Threatened Species Scientific Committee 2016b)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Greater sand plover	Approved Conservation Advice for *Charadrius leschenaultii* (Greater sand plover)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat

[3] Red knot, great knot, greater sand plover, lesser sand plover and bar-tailed godwit.

[4] Several albatrosses and giant petrels were identified as potentially occurring: Amsterdam albatross, southern royal albatross, wandering albatross, southern giant-petrel, northern giant petrel, soft-plumaged petrel, Indian yellow-nosed albatross, Tasmanian shy albatross, white-capped albatross, Campbell albatross, black-browed albatross, white-capped albatross.

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
	(Threatened Species Scientific Committee 2016c)		
Lesser sand plover	Approved Conservation Advice for *Charadrius mongolus* (Lesser sand plover) (Threatened Species Scientific Committee 2016d)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Soft-plumaged petrel	Conservation advice *Pterodroma mollis* soft-plumage petrel (Threatened Species Scientific Committee 2015i)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Bar-tailed godwit (baueri)	Approved Conservation Advice for *Limosa lapponica baueri* (Bar-tailed godwit (western Alaskan) (Threatened Species Scientific Committee 2016e)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Australian painted snipe	Approved Conservation Advice on *Rostratula australis* (Australian Painted Snipe) (Threatened Species Scientific Committee 2013)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat

7.2.8.2 Biologically Important Areas & Habitat Critical for the Survival of a Species

BIAs are defined by DoEE as *"spatially defined areas where aggregations of individuals of a regionally significant species are known to display biologically important behaviours such as breeding, foraging, resting or migration"* (DoEE 2018e). BIAs provide a tool for defining areas of importance for marine fauna species.

A review of the DoEE National Conservation Values Atlas (an interactive web-based tool which supports the implementation of Marine Bioregional Plans) (DoEE 2018f) determined that the in-field development area is located within a biologically important area for whale sharks. The whale shark is listed as vulnerable under the EPBC Act and is discussed in detail in Section 0. No other BIAs are intersected or overlapped by the project area.

The EMBA includes a number of BIAs including migration corridors for pygmy blue whales and humpback whales; breeding, calving and foraging areas for the three nearshore dolphin species; nursing/foraging areas for dugongs; foraging and nesting/internesting areas for marine turtles; breeding/foraging/resting areas for a number of seabird species; a migration corridor for whale sharks; and foraging and nursing/pupping areas for three sawfish species. These BIAs are discussed under the relevant species-specific sections in Section 7.2.8.

7.2.8.3 Seasonal Sensitivities of Threatened Species

Periods of the year coinciding with key environmental sensitivities for the Operational Area and the wider regional context (EMBA), including EPBC Act listed threatened and/or migratory species potentially occurring within the Operational Area are presented in Table 7-8. These relate to breeding, foraging or migration of the indicated fauna.

Table 7-8: Key environmental sensitivities and indicative timings for migratory fauna within the Operational Area and EMBA (North-west Marine Region)

Species	January	February	March	April	May	June	July	August	September	October	November	December
Mammals												
Blue whale[1,2]												
Humpback whale[3,4]												
Reptiles												
Loggerhead turtle[5]	H	H	H							N	N	H
Green turtle[6,7]	N,H	N,H	H	H	H							N
Hawksbill turtle[8]	N,H	H	H							N	N	N,H
Olive ridley turtle[9]												
Flatback turtle[10]	N					N	N	N	N	N	N	N
Birds												
Migratory shorebirds[11]												

	Species likely to be present
	Peak period. presence of animals reliable and predictable each year
N	Peak Turtle Species Nesting
H	Peak Turtle Species Hatching

1 - Commonwealth of Australia (2015a), 2 - Double et al. (2014), 3 - Jenner and Jenner (2001), 4 - Double et al. (2012a), 5 - Limpus (2008a), 6 - Limpus (2008b), 7 - Guinea (2010), 8 - Limpus (2009a), 9 - Limpus (2008c), 10 - Limpus (2007), 11 - Rogers et al. (2011)

7.2.8.4 Marine Mammals

Sei Whale

Sei whales (*Balaenoptera borealis*) have a global distribution. Though sightings are uncommon, the species may be seen in coastal and offshore waters throughout Australia, as well as the waters surrounding Christmas and Cocos Keeling Islands (Bannister et al. 1996, DoEE 2019). The species utilises a range of marine habitats, which has been attributed to a combination of dynamic physical and prey processes (DoEE 2019).

Sei whale migratory movements are well defined (distinctly north-south) with the species moving between polar, temperate and tropical waters for foraging and breeding. The species feeds intensively between the Antarctic and sub-Antarctic boundary on planktonic crustaceans (Bannister et al. 1996, DoEE 2019). The species does not dive, rather it sinks, and tends to swim at shallower depths comparative to other species (DoEE 2019).

There are no mating or calving areas in Australian waters, nor are there any recognised BIAs or critical habitat. Sei whales may occur within the Operational Area and EMBA, but are expected to occur only in low numbers.

Bryde's Whale

The Bryde's whale was identified as potentially occurring within the Operational Area and EMBA. The Bryde's whale occurs in tropical and temperate waters (Bannister et al. 1996). Bryde's whales occur in both oceanic and inshore waters with the only key localities recognised in Western Australia being in the Abrolhos Islands and north of Shark Bay (Bannister et al. 1996). Two forms are recognised: inshore and offshore Bryde's whales. It appears that the offshore form may migrate seasonally, heading towards warmer tropical waters during the winter, however, behaviour of the offshore form in the Indian Ocean is not well documented.

Bryde's whales may occur through a broad area of the continental shelf in the region, including the Operational Area and the EMBA. The noise monitoring study undertaken for the Barossa project detected Bryde's whales in the Timor Sea almost year-round (January to October) (McPherson et al. 2016). Bryde's whales have also been detected on the North West Shelf (south-west of the Operational Area) from mid-December to mid-June, peaking in late February to mid-April (RPS Environment and Planning 2012).

Bryde's whale may be encountered within the Operational Area and EMBA year-round in low numbers, particularly in oceanic and continental slope waters.

Blue Whale

There are two recognised subspecies of blue whale in the Southern Hemisphere, both of which are recorded in Australian waters. These are the southern (or 'true') blue whale (*Balaenoptera musculus*) and the 'pygmy' blue whale (*Balaenoptera musculus brevicauda)* (Commonwealth of Australia 2015a). Both are listed as Endangered under the EPBC Act. In general, southern blue whales occur in waters south of 60 °S and pygmy blue whales occur in waters north of 55 °S (i.e. not in the Antarctic) (Department of the Environment and Heritage 2005). On this basis, nearly all blue whales sighted are likely to be pygmy blue whales. The *Conservation Management Plan for the Blue Whale* (Commonwealth of Australia 2015a) has delineated the distribution area of blue whales in Australian waters and identified a number of BIAs for blue whales for Commonwealth waters (migratory corridor and foraging areas) (Table 7-8).

Recent tagging studies (Double et al. 2014) indicate the general migration pattern, timing and key areas for pygmy blue whales in Commonwealth waters are the Perth Canyon/Naturaliste Plateau and Ningaloo Reef/North West Cape (beyond the EMBA). Satellite tagging of pygmy blue whales off the Perth Canyon confirmed the general distribution of migrating pygmy blue whales was offshore in water depths over 200 m and commonly over 1,000 m (Double et al. 2012b). These data showed that whales tagged during March and April migrated northwards post tag deployment. The tagged whales travelled relatively near to the Australian coastline (100 ± 2 km) until reaching North West Cape after which they travelled offshore (238 ± 14 km). Whales reached the northern terminus of their migration and potential breeding grounds in Indonesian waters by June (Double et al. 2014). The southbound migration is thought to occur between September and December and terminate in the Southern Ocean, where the species feeds and slowly moves northwards towards the Perth Canyon by March/April (Double et al., 2014).

No pygmy blue whale BIAs overlap the Operational Area; two BIAs were identified within the EMBA (Table 7-8). These are:

- A broad migration corridor along the coast of Western Australia, approximately 78 km west of the Operational Area; and
- A potential foraging area around Scott Reef, approximately 132 km west of the Operational Area.

Based on these tagging studies and the locations of the BIAs relative to the Operational Area, pygmy blue whales are unlikely to occur in the Operational Area due to their preference for deeper waters, but are expected to be seasonally present within the EMBA.

BIAs for blue and pygmy blue whales within the ZPI

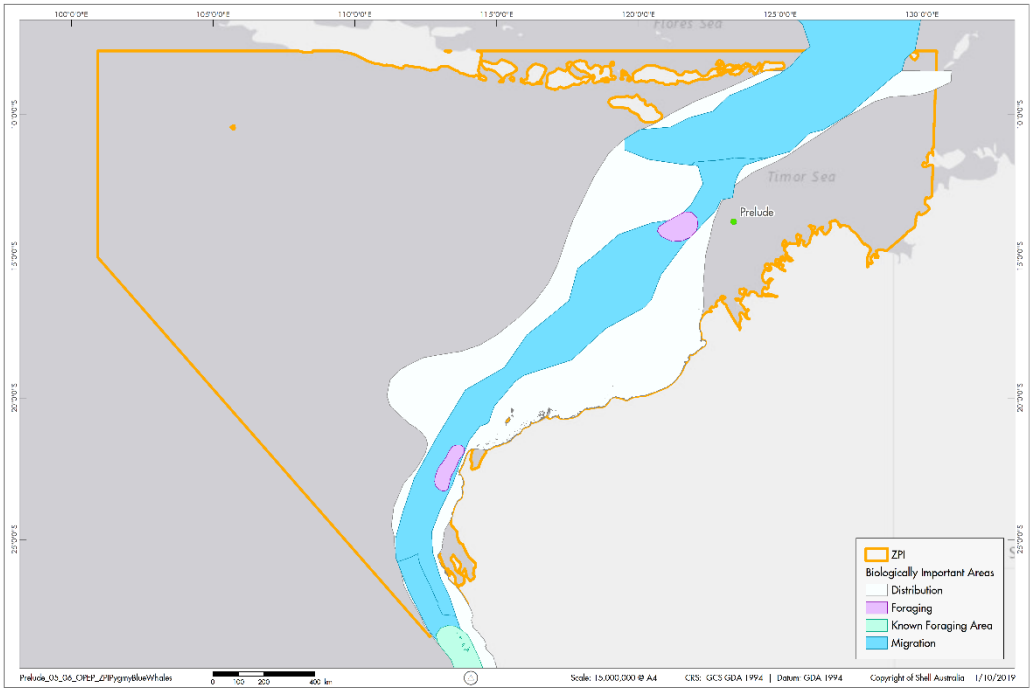


Figure 7-8: BIAs for blue and pygmy blue whales within the EMBA

Fin Whale

Fin whales (*Balaenoptera physalus*) are widely distributed from polar to tropical waters and have been recorded in all Australian states, other than New South Wales and the Northern Territory (Bannister et al. 1996). The species is listed as Vulnerable under the EPBC Act.

Fin whales are rarely observed in inshore waters and displays migratory movements (essentially north-south) between polar, temperate and tropical waters (Bannister et al. 1996). Migration within Australian waters does not appear to follow a clear route and is thought to occur in summer and autumn. Breeding in the Southern hemisphere occurs in tropical and sub-tropical latitudes between May and July.

Fin whales feed on planktonic crustacea, such as Antarctic krill, and primarily forage in high latitudes (Bannister et al. 1996). Within Australian waters, Antarctic waters and the Bonney Upwelling are thought to be important foraging grounds for this species.

There are no recognised BIAs or critical habitats for fin whales within the Operational Area or the EMBA. The species may occur within the Operational Area or EMBA, but is not expected to be particularly abundant.

Humpback Whales

The humpback whale (*Megaptera novaeangliae*) has a wide distribution, with recordings throughout Australian Antarctic waters and offshore from all Australian states (Bannister et al. 1996). Humpback whales are listed as Vulnerable under the EPBC Act.

Humpback whales migrate between summer feeding grounds in Antarctica and winter breeding and calving grounds in the sub-tropical and tropical inshore waters of north-west Australia (Jenner et al. 2001). Humpback whales breed and calve in continental shelf waters off northern Western Australia, with the area between Broome and the northern end of Camden Sound hosting large numbers of humpback whales from June to September each year (Double et al. 2012a, 2010). Camden Sound is considered to be the northern limit of most migrating humpback whales; hence the species is unlikely to occur within the Operational Area but will be seasonally present within the EMBA.

Within the wider EMBA, a BIA area has been identified for the humpback whale. The behaviour of the humpback whale within this BIA, located approximately 145 km south of the Operational Area is resting, calving, migrating and nursing (Figure 7-9).

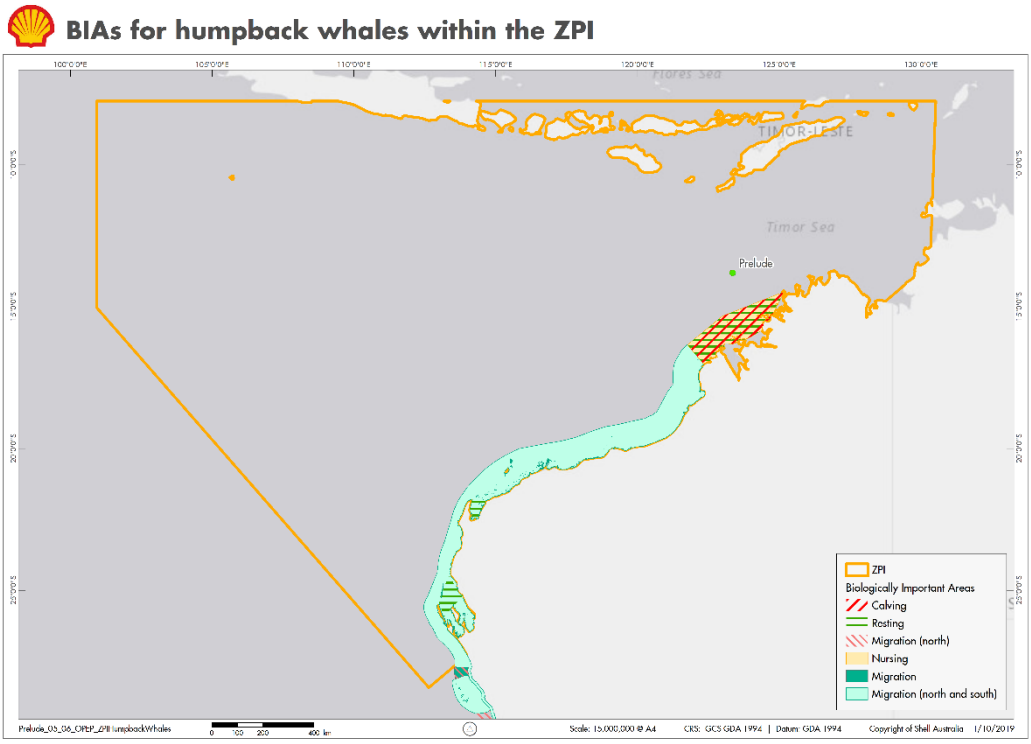


Figure 7-9: BIAs for humpback whales within the EMBA

Killer Whale

Killer whales (*Orcinus orca*) have a global distribution and utilise a wide range of habitats. However, they appear to be primarily concentrated in temperate coastal waters and cooler regions of high productivity (Bannister et al. 1996).

This species is distributed throughout Australian waters, in particular in Tasmanian waters and the waters surrounding Macquarie Island (1,500 km south-south-east of Tasmania) (Bannister et al. 1996). Off Australia, the species is typically observed moving along the continental slope and shelf, and near seal colonies (Bannister et al. 1996). There are no key localities identified within continental Australian waters for this species. Killer whales are carnivores and their diet varies seasonally and regionally (Bannister et al. 1996).

Globally killer whales are known to migrate; however, specific routes and seasonal movement patterns are not known in detail and are thought to relate to prey availability (Bannister et al. 1996). Mating occurs year-round and there are no known calving areas in Australian waters (Bannister et al. 1996).

Based on their known distribution and movements, killer whales may be encountered in within the Operational Area and EMBA in low numbers.

Sperm Whale

Sperm whales (*Physeter microcephalus)* occur in deep waters in all oceans, typically remaining at depths of 200 m or greater, and are known to occur throughout Australian waters (Bannister et al. 1996). Key areas for sperm whales occur in continental shelf waters approximately 20 nautical miles (nm) to 30 nm offshore between Cape Leeuwin and Esperance (Bannister et al. 1996), several thousand kilometres from the EMBA.

Sperm whales have a diverse diet, although they primarily feed on oceanic squid (Bannister et al. 1996). Migration patterns vary between sex. Mature females and juveniles are thought to be resident in tropical and subtropical waters throughout the year, whereas mature males are thought to migrate between the tropics and Antarctic (Bannister et al. 1996).

Considering the known distribution of the species, sperm whales may transit through the Operational Area and EMBA in low numbers.

Spotted Bottlenose Dolphin

The spotted bottlenose dolphin (Arafura/Timor Sea populations) (*Tursiops aduncus*) occurs primarily in continental shelf waters (< 200 m deep), nearshore and in areas with rocky or coral reefs, sandy or soft sediments, or seagrass beds (DSEWPaC 2012d). Small populations also occur in the inshore waters of some oceanic and continental shelf islands, such as the Rowley Shoals and Scott Reef (DSEWPaC 2012d). No BIAs occur within the Operational Area. Several BIAs occur within the EMBA (primarily within the Lalang-garram / Camden Sound Marine Park), including foraging and calving (190 km south of the Operational Area) and breeding (239 km south of the Operational Area).

Migration patterns for the species in Australia are variable, including of year-round residency in small areas, long-range movements and migration. Due to their tendency to shallow water areas it is unlikely that the species will occur in the Operational Area, but is likely to occur in coastal waters in the EMBA.

Antarctic Minke Whale

The Antarctic minke whale is distributed worldwide and has been recorded off all Australian states, feeding in cold waters and migrating to warmer waters to breed. It is not expected to occur in the Operational Area, but may occur within the EMBA. It is thought that the Antarctic minke whale migrates up the WA coast to approximately 20°S to feed and possibly breed (Bannister et al. 1996); however, detailed information on timing and location of migrations and breeding grounds is not well known. No critical habitats or BIAs for Antarctic minke whales occur within the Operational Area or EMBA.

Given the wide distribution of Antarctic minke whale, the EMBA is unlikely to represent an important habitat for this species. Antarctic minke whales are not expected to occur within the Operational Area or EMBA in large numbers.

Dugong

Dugongs (*Dugong dugon*) occur in tropical and sub-tropical coastal and island waters broadly coincident with the distribution of seagrasses (Marsh et al. 2002), which typically occur in shallow intertidal zone areas to water depths of around 25 m. Dugong feeding aggregations tend to occur in large seagrass meadows within wide shallow protected bays, shallow mangrove channels and in the lee of large inshore islands. The movements of most individuals are limited to within tens of kilometres within the vicinity of seagrass beds (Marsh et al. 2002). However, some individuals have been observed to travel large distances of up to 600 km over a few days (Marsh et al. 2002).

Dugongs and areas of potential dugong habitat exist along the majority of northern Australian coastline from Shark Bay in Western Australia to Moreton Bay in Queensland. A small population of approximately 50 individuals exists at Ashmore Reef, which is considered to be genetically distinct from other nearby Australian or Indonesian populations (Commonwealth of Australia 2002).

Several BIA's for dugong overlap the EMBA, the nearest of which is the foraging (high density seagrass beds BIA around Cartier Island approximately 80 km north-west of the Operational Area. Other BIAs for foraging, breeding, calving and nursing occur within the EMBA around Ashmore Reef and the Dampier Peninsula.

Considering the habitat preference of the species, dugongs are very unlikely to occur within the Operational Area but are expected to occur in coastal waters and around islands in the EMBA.

Southern Right Whale

The southern right whale occurs primarily in waters between approximately 20° and 60°S and moves from high latitude feeding grounds in summer to warmer, low latitude, coastal locations in winter (Bannister et al. 1999). These latitudes are far to the south of the Operational Area, which is at approximately 13.7°S. Southern right whales aggregate in calving areas along the south coast of Western Australia, such as Doubtful Island Bay, east of Israelite Bay and to a lesser extent Twilight Cove (DSEWPaC 2012b). During the calving season, between May and November, female southern right whales that are either pregnant or with calf can be present in shallow protected waters along the entire southern Western Australian coast and west up to approximately Two Rocks, north of Perth. Sightings in more northern waters are relatively rare; however, they have been recorded as far north as Exmouth (Bannister et al. 1996). There are no southern right whale BIAs within the Operational Area or EMBA.

Given the species prefers temperate waters and has rarely been recorded north of Exmouth, southern right whales will not occur in the Operational Area and are very unlikely to occur in the EMBA.

Australian Snubfin Dolphin

The Australian snubfin dolphin (*Orcaella heinsohni*, also known as the Irrawaddy dolphin, *O. brevirostris*) shares similar habitat preferences with the Indo-Pacific humpback dolphin, occurring in shallow coastal and estuarine waters (typically less than 20 m deep) (DSEWPaC 2012d). However, as with the Indo-pacific humpback dolphin, the species has also been recorded up to 23 km offshore. In Australia, the species distribution covers the coastal waters of Queensland, the Northern Territory and northern Western Australia. The population in Australian waters is thought to be continuous with the Papua New Guinea species but separate from populations in Asia.

This species is not expected to occur within the Operational Area due to its preference for coastal habitats, but may be present in coastal areas of the EMBA. No BIAs occur within the Operational Area. Several BIAs occur within the EMBA (primarily within the Lalang-garram / Camden Sound Marine Park), including foraging, breeding, resting and calving (190 km south of the Operational Area).

Indo-Pacific (Australia) Humpback Dolphin

The Indo-Pacific humpback dolphin has been recognised as two distinct species; the Indo-Pacific humpback dolphin (*Sousa chinensis*) and the Australian humpback dolphin (*S. sahulensis*) (Jefferson and Rosenbaum 2014). Only the Australian humpback dolphin is considered here. Humpback dolphins inhabit shallow coastal, estuarine habitats in tropical and subtropical regions generally in depths of less than 20 m (Corkeron et al. 1997, Jefferson 2000, Jefferson and Rosenbaum 2014).

The Australian humpback dolphin (*Sousa sahulensis*) occurs along the northern Australian coastline from Exmouth in Western Australia to the Queensland/New South

Wales border (Bannister et al. 1996). The species' preferred habitat is shallow (generally < 20 m in depth) coastal, estuarine and riverine (occasional) waters. However, individuals have been observed in shallow waters up to 55 km offshore (Bannister et al. 1996).

Given the species' preferred habitat is relatively shallow coastal waters, Australian humpback dolphins are very unlikely to occur in the Operational Area, but may be present in coastal areas of the EMBA. There are several BIAs within the EMBA along the Kimberley coast, including foraging, breeding, calving and resting, the closest of which is approximately 190 km from the Operational Area.

7.2.8.5 Reptiles

Loggerhead Turtle

The loggerhead turtle (*Caretta caretta*) is distributed throughout tropical and sub-tropical and temperate waters in all ocean basis. In Australia, the species ranges along most of the coastline, but is rare in temperate waters (Commonwealth of Australia 2017). Nesting in Australia is concentrated in southern Queensland and from Shark Bay to the North West Cape in Western Australia. Foraging areas are more widely distributed with the Western Australian stock foraging from Shark Bay through to Arnhem Land, Gove and into the Java Sea of Indonesia (Limpus 2008a). Loggerhead turtles are carnivorous and mainly feed on benthic invertebrates in a wide range of habitats ranging from nearshore to 55 m in depth (Commonwealth of Australia 2017).

Loggerhead turtles may occur within the Operational Area and the EMBA. A foraging BIA for the loggerhead turtle lies within the EMBA approximately 344 km east from the Operational Area. The nearest critical habitat for loggerhead turtles defined by the Recovery plan for marine turtles in Australia 2017-2027 (Commonwealth of Australia 2017) is the nesting habitat around North West Cape, approximately 1,285 km south-west from the Operational Area.

Green Turtle

The green turtle (*Chelonia mydas*) is distributed in tropical and sub-tropical waters in the Pacific, Atlantic and Indian oceans. Within Australian waters, the species is predominately found off the Western Australia, Northern Territory and Queensland coastlines (Commonwealth of Australia 2017). The population at Ashmore Reef and Cartier Island is thought to nest year-round, with a peak in nesting during December and January; hatchling emergence is thought to be highest during May (Limpus 2008b).

The species is primarily herbivorous and forages on algae, seagrass and mangroves, including where these habitats exist at offshore coral reef habitats (Commonwealth of Australia 2017). Tagging studies have shown that green turtles can move considerable distances between nesting, with movements of 100's to 1,000's of kilometres recorded (Limpus 2008b).

No BIAs or habitats critical for the survival of green turtles overlap the Operational Area. The nearest habitat critical for the survival of green turtles is the nesting habitat around Browse Island; this habitat lies approximately 23 km south-east of the Operational Area at the closest point. Other critical nesting habitat within the EMBA is distributed around offshore islands in the Timor Sea and along the Kimberley coast (Figure 7-10). There are also a number of BIAs for green turtles within the EMBA, none of which overlap the Operational Area:

- Foraging and inter-nesting buffer (23 km south-east of the Operational Area)

- Inter-nesting buffer (121 km north of the Operational Area)
- Nesting (141 km north of the Operational Area)
- Inter-nesting (169 km west of the Operational Area)
- Mating (174 km north of the Operational Area).

Green turtles may occur throughout the Operational Area, but would only be expected to occur in low numbers due to the absence of foraging or nesting habitat. Green turtles may be present throughout the EMBA, and are likely to be more abundant around nesting beaches and shallow foraging habitats.

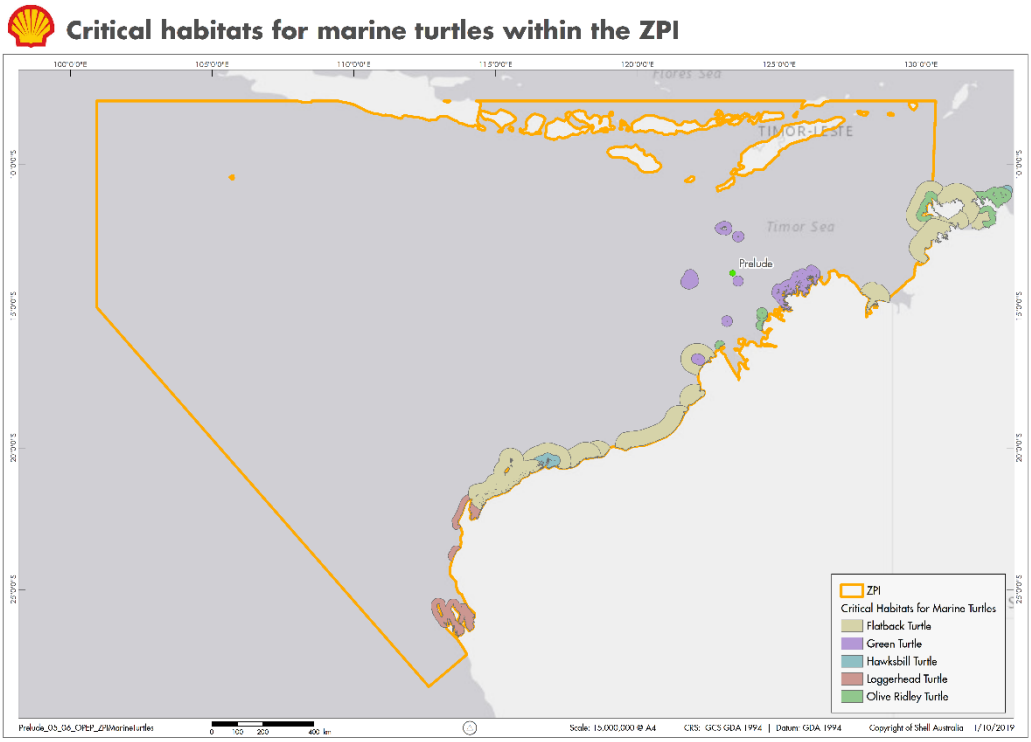


Figure 7-10: Critical habitats for marine turtles within the EMBA

Leatherback Turtle

The leatherback turtle (*Dermochelys coriacea*) is distributed in tropical and temperate oceans worldwide. The species is known to forage and migrate throughout the open offshore waters of Australia, with a distribution that extends further south into temperate waters than other marine turtle species (Limpus 2009b). Records of leatherback turtle nesting in Australia are sparse and limited to the Cobourg Peninsula and Queensland coast (Limpus 2009b). There have been no confirmed accounts of nesting on beaches along Western Australia's coastline. Leatherback turtles eat almost exclusively jellyfish and are pelagic throughout their life in oceanic waters around Australia (Limpus 2009b).

There are no BIAs or habitats critical for the survival of leatherback turtles within the Operational Area and EMBA. Leatherback turtles may occur within the Operational Area and EMBA in low numbers throughout the year.

Hawksbill Turtle

The hawksbill turtle (*Eretmochelys imbricata*) has a worldwide distribution in tropical and sub-tropical waters. In Australia, hawksbill turtles predominately occur along the northern Western Australia, Northern Territory and northern Queensland coastlines (Limpus 2009a).

This species is typically associated with rocky and coral reef habitats and is expected to be found foraging within these habitats along the Western Australian coastline, from Shark Bay to the northern extent of the North West Marine Region (Commonwealth of Australia 2017a). Hawksbill turtles are omnivorous and feed on algae, sponges, soft corals and soft bodied-invertebrates.

The population in Western Australia is thought to nest primarily between October and January, while there is evidence of year-round breeding and nesting in the Northern Territory and northern Queensland stocks (Limpus 2009a).

There are no habitats critical for the survival of hawksbill turtles within the Operational Area or the EMBA. There are a number of BIAs for hawksbill turtles within the EMBA:

- Foraging (141 km north of the Operational Area)
- Inter-nesting buffer (150 km west of the Operational Area)
- Nesting (169 km west of the Operational Area).

Hawksbill turtles may occur throughout the Operational Area, but would only be expected to occur in low numbers due to the absence of foraging or nesting habitat. Hawksbill turtles may be present throughout the EMBA, and are likely to be more abundant around nesting beaches and shallow foraging habitats.

Olive Ridley Turtle

The olive ridley turtle (*Lepidochelys olivacea*) has worldwide tropical and sub-tropical distribution. In Australia, the species primarily occurs primary in the Northern Territory and Queensland; the component of the Australian population in Western Australian waters is relatively small (Limpus 2008c).

The olive ridley turtle is primarily carnivorous and feed predominantly on soft-bodied invertebrates (Commonwealth of Australia 2017). The species is known to feed in water depths between 15 m and 200 m, and may make movements > 1,000 km between their nesting and foraging grounds (Whiting et al. 2007).

Nesting is known to occur in the Northern Territory and on western Cape York (Queensland) (Commonwealth of Australia 2017, Limpus 2008c); low density nesting has also been described on the Kimberley coast (Limpus 2008c).

No BIAs or habitats critical for the survival of the olive ridley turtle occur within the Operational Area. Nesting habitat critical for the survival of the olive ridley turtle does occur within the EMBA (Figure 7-10), centred on several islands along the Kimberley coastline, the nearest of which is approximately 177 km south of the Operational Area. The nearest olive ridley BIA to the Operational Area is a foraging BIA, which lies approximately 344 km to the east.

Olive ridley turtles may occur within the Operational Area and the EMBA, but are only expected to be present in low numbers.

Flatback Turtle

The flatback turtle (*Natator depressus*) is known to occur along the Western Australia, Northern Territory and Queensland coastlines, and forages widely across the Australian continental shelf and into the continental waters off Indonesia and Papua New Guinea (Commonwealth of Australia 2017). Unlike other species of marine turtle, the flatback turtle does not have a global tropical distribution, with all recorded nesting beaches within Australian waters (Limpus 2007).

Flatback turtles nest throughout tropical Australia, although there are several distinct populations (Limpus 2007). The northerly populations in Queensland and the Northern Territory nest year-round with a peak during winter months. Populations at higher latitudes off central Queensland and Western Australia's Pilbara coast tend to have a nesting peak in summer (Limpus 2007).

Flatback turtles are primarily carnivorous and feed predominantly on soft-bodied invertebrates in relatively shallow waters (Limpus 2007). Their distribution is largely restricted to continental shelf waters (< 200 m).

There are no BIAs or habitats critical for the survival of flatback turtles within the Operational Area. Habitat critical for the survival of flatback turtles does occur within the EMBA, the closest of which is the inter-nesting habitat on the western Dampier Peninsula, approximately 302 km south of the Operational Area. There are several BIAs within the EMBA, including:

- Inter-nesting buffer (268 km south of the Operational Area)
- Foraging (344 km east of the Operational Area)
- Inter-nesting (360 km south of the Operational Area)
- Nesting (360 km south of the Operational Area).

Flatback turtles are unlikely to occur within the Operational Area, but are expected to occur within the EMBA, particularly in suitable foraging habitat in coastal waters and around nesting beaches.

Short-nosed Seasnake

The short-nosed seasnake (*Aipysurus apraefrontalis*) is a slender marine snake with a small head and pointed snout. This species has primarily been recorded at Ashmore Reef and Cartier Island on the Sahul Shelf, which lie approximately 80 km north-west of the Operational Area. The species has also been recorded along the Pilbara coast between Exmouth Gulf and Broome (Threatened Species Scientific Committee 2010a).

Like all seasnakes, the short-nosed seasnake must come to the surface to breathe at intervals anywhere between 30 minutes and two hours. The species has been recorded primarily in reef flats or in shallow waters (< 10 m). The short-nosed seasnake has apparently experienced a decline in numbers, with recent surveys of Ashmore Reef failing to observe the species (Threatened Species Scientific Committee 2010a).

The short-nosed seasnake is unlikely to occur within the Operational Area, but may occur within shallow reef habitat within the EMBA.

Leaf-scaled Seasnake

The leaf-scaled seasnake (*Aipysurus foliosquama*) is a slender marine snake growing up to 60 cm in total length with some specimens found up to 90 cm. Like the short-nosed seasnake, the leaf-scaled seasnake is thought to be largely restricted to the reefs of the Sahul Shelf in Western Australia, especially on Ashmore and Hibernia Reefs (Threatened Species Scientific Committee 2010b).

The short-nosed seasnake is unlikely to occur within the Operational Area, but may occur within shallow reef habitat within the EMBA.

Saltwater Crocodile

The salt-water crocodile occurs within the nearshore marine and estuarine waters throughout southern Asia and Northern Australia. Large populations within the major river systems of the Kimberley occur in the rivers draining into the Cambridge Gulf, the Prince Regent and Roe River systems of the east and northwest Kimberley. There are no BIAs for the species within the Operational Area or EMBA. Saltwater crocodiles are very unlikely to occur in the Operational Area, but may be present within the coastal waters, estuaries and tidal creeks of the Kimberley region within the EMBA.

7.2.8.6 Sharks and Rays

Narrow Sawfish

The narrow sawfish is widely distributed throughout the Indo-Pacific region, with records spanning from the Arabian Gulf to Japan. In Australia, the species may have a broad tropical distribution from approximately North West Cape in Western Australia to southern Queensland. Like other sawfish species, the narrow sawfish has experienced considerable decline in numbers due to human activities, including fishing and habitat loss / damage (Cavanagh et al. 2003).

Like other sawfish in the family Pristidae, the narrow sawfish prefers shallow coastal, estuarine and riverine habitats, although may occur in waters up to 40 m deep (D'Anastasi et al. 2013). There are no BIAs for this species within the Operational Area or the EMBA. Given the water depth (>230 m) and distance from preferred habitats, narrow sawfish are not expected to occur within the Operational Area. However, the species may be found in shallow coastal waters and estuaries within the EMBA.

White Shark

The white shark (*Carcharodon carcharias*) has a circumglobal distribution primarily in temperate waters. In Australian waters, the species typically occurs in temperate and sub-tropical waters between the shore and the 100 m depth contour; however, adults and juveniles have been recorded diving to depths of 1,000 m (Bruce 2008, Bruce et al. 2006). Tagging studies indicate white sharks may move as far north as Rockhampton on the Queensland coast, however they are thought to be very uncommon in tropical waters (Bruce et al. 2006), such as the Timor Sea.

There are no BIAs for white sharks within the Operational Area or EMBA; given the anti-tropical distribution of this species, white sharks are unlikely to occur in the Operational Area or EMBA.

Northern River Shark

The northern river shark (*Glyphis garricki*) is a medium-sized shark which can tolerate both marine and freshwater. The species has a tropical distribution and is believed to be endemic to northern Australia and southern New Guinea (Stevens et al. 2005). In Western Australia, the majority of records of the species are from King Sound. The species is most commonly encountered in tidal creeks and estuaries (Morgan et al. 2010), hence it is unlikely to occur within the Operational Area but may be present in Kimberley coastal waters in the EMBA. There are no BIAs for this species within the Operational Area or EMBA.

Shortfin Mako

The shortfin mako shark is a pelagic species with a circumglobal, wide-ranging oceanic distribution in tropical and temperate seas (Mollet et al. 2000). The shortfin mako is commonly found in water with temperatures greater than 16 °C. Tagging studies indicate shortfin makos spend most of their time in water less than 50 m deep but with occasional dives up to 880 m (Abascal et al. 2011, Stevens et al. 2010).

The species can grow to almost 4 m in length. Females mature later (19 to 21 years) than males (7 to 9 years) and adults have moderate longevity estimates of 28 to 29 years (Bishop et al. 2006).

The shortfin mako shark is an apex and generalist predator that feeds on a variety of prey, such as teleost fish, other sharks, marine mammals and marine turtles (Campana et al. 2005). Little is known about the population size and distribution of shortfin mako sharks in Western Australia; they may occur in both the Operational Area and EMBA.

Longfin Mako

The longfin mako is a widely distributed, but rarely encountered, oceanic shark species. The species can grow to just over 4 m long and is found in northern Australian waters, from Geraldton in Western Australia to at least Port Stephens in New South Wales and is uncommon in Australian waters relative to the shortfin mako (Bruce 2013, Department of the Environment, Water, Heritage and the Arts 2010).

There is very little information about these sharks in Australia, with no available population estimates or distribution trends. A study from southern California documented juvenile longfin mako sharks remaining near surface waters, while larger adults were frequently observed at greater maximum depths of about 200 m (Sepulveda et al. 2004).

Longfin mako may occur in the Operational Area and EMBA, but given their widespread distribution and apparent low density they are likely to be uncommon.

Giant Manta Ray

The giant manta ray is broadly distributed in tropical waters of Australia. The species primarily inhabits near-shore environments along productive coastlines with regular upwelling, but they appear to be seasonal visitors to coastal or offshore sites including offshore island groups, offshore pinnacles and seamounts (Marshall et al. 2011). Giant manta rays have been recorded regularly off the Ningaloo Coast (Preen et al. 1997), well beyond the EMBA.

The Operational Area is not located in, or adjacent to, any known aggregation areas for the species (e.g. feeding or breeding). Occurrence of giant manta rays within the Operational Area is likely to be infrequent, and restricted to individuals transiting the area.

Green Sawfish

The green sawfish (*Pristis zijsron*) were once widely distributed in coastal waters along the northern Indian Ocean, although it is believed that northern Australia may be the last region where significant populations exist (Stevens et al. 2005). Within Australia, green sawfish are currently distributed from about Cairns in Queensland across northern Australian waters to Broome in Western Australia (Threatened Species Scientific Committee 2008b).

Despite records of the species in deeper offshore waters, green sawfish typically occur in the inshore fringe with a strong associated with mangroves and adjacent mudflat habitats (Commonwealth of Australia 2015b, Stevens et al. 2005). Movements within these preferred habitats is correlated with tidal movements (Stevens et al. 2008).

No BIAs for the green sawfish overlap the Operational Area. BIAs in the EMBA include foraging (203 km south of the Operational Area) and pupping (294 km south of the Operational Area) BIAs along the Kimberley coast to the south of the Operational Area. Given the habitat preferences of the green sawfish, the species is unlikely to occur within the Operational Area, but is likely to occur with the EMBA along nearshore waters and tidal creeks of the Kimberley coastline.

Whale Shark

The whale shark (*Rhincodon typus*; vulnerable) is globally distributed in tropical and warm temperate waters, and it is thought individuals form one single genetic population (DoE 2015l). Key areas of concentration within Australian waters include the Ningaloo coast (March – July), Christmas Island (December – January) and the Coral Sea (November – December), with the timing of the aggregations thought to be linked to seasonal fluctuations in prey abundance (DoE 2015l). The species is an epipelagic filter feeder; therefore, their diet typically consists of planktonic and nektonic species, including small crustaceans and smaller schooling fish species (DoEE 2018aa; DoE 2015l).

Whale sharks are known to be highly migratory with migrations of 13,000 km being recorded (Eckert and Stewart 2001). Migration along the northern WA coastline broadly follows the 200 m isobath and typically occurs between July and November (DoE 2015l).

A biologically important area for whale sharks is located in northern WA, offshore of the Pilbara and Kimberley coastline, and broadly follows the 200 m isobath (DoEE 2018aa). The BIA is listed as a foraging habitat, however the Conservation Advice (DoE 2015l) for this species indicates this BIA up the north west coast is a migration corridor than significant foraging habitat. This is consistent with tagging studies; Meekan and Radford (2010) showed that whale sharks migrated up the coast from Ningaloo Reef and dispersed individually over a broad migratory area either north-west into the open Indian Ocean, northward towards Sumatra and Java, or north-east towards the Timor Sea. The operational area intersects a portion of this BIA. Therefore, whale sharks are expected to transit through the project area as part of their broad migratory movement.

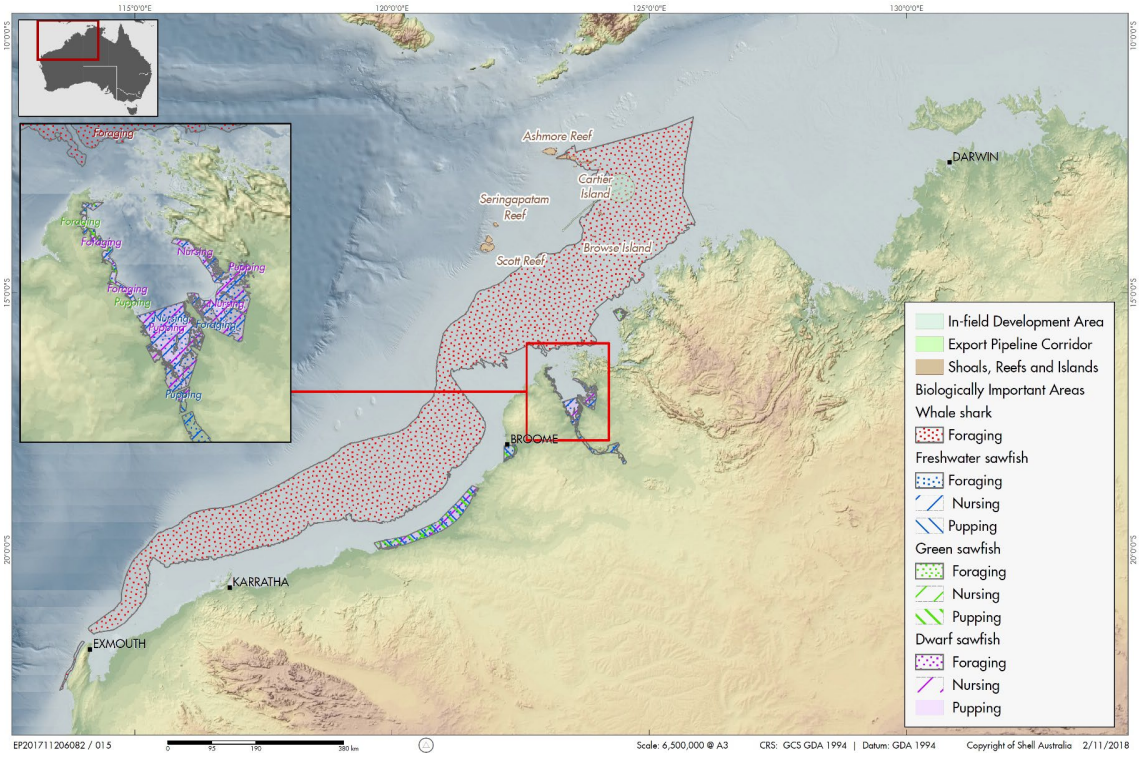


Figure 7-11: Whale shark foraging BIA within the EMBA

Grey Nurse Shark (West Coast Population)

The grey nurse shark (*Carcharus taurus*) has a broad distribution in inner continental shelf waters, primarily in sub-tropical to cool temperate waters. The species occurs primarily in south-west coastal waters between 20 and 140 m depth off Western Australia (Chidlow et al. 2006). Grey nurse sharks have been documented as aggregating in specific areas (typically reefs), however no clear aggregation sites have been identified off Western Australia (Chidlow et al. 2006).

No BIAs for grey nurse sharks occur within the Operational Area or the EMBA. Given the species' preference for temperate waters, it is unlikely to occur within the Operational Area or EMBA.

Porbeagle

The porbeagle is a species of lamnid shark found in temperate, sub-Arctic and sub-Antarctic waters worldwide. The species can thermos-regulate physiologically, allowing it to occupy cooler waters than other shark species. The porbeagle has a wide vertical range within the water column, with tagging studies recording the species between the surface and > 700 m water depth (Saunders et al. 2011). Given its preference for cooler waters (Bruce 2013), the porbeagle is unlikely to be encountered within the Operational Area, but may occur in the southern portion of the EMBA. There are no critical habitats or BIAs for the porbeagle in the Operational Area or EMBA.

Reef Manta Ray

The taxonomy of the reef manta ray (*Manta alfredi*) was revised relatively recently, with this species being recognised as distinct from the giant manta ray (*M. birostris*) (Marshall et al. 2009). The species is occurs in inshore waters, but also found around offshore coral reefs, rocky reefs and seamounts (Marshall et al. 2009). In contrast to the giant manta ray, long-term sighting records of the reef manta ray at established

aggregation sites suggest that this species is more resident in tropical waters and may exhibit smaller home ranges, philopatric movement patterns and shorter seasonal migrations than the giant manta ray (Deakos et al. 2011, Marshall et al. 2009). A resident population of reef manta rays has been recorded at Ningaloo Reef, and the species has been shown to have both resident and migratory tendencies in eastern Australia (Couturier et al. 2011).

Reef manta rays may occur in the Operational Area, but is only expected to occur in low numbers. The species is likely to be present in the EMBA where suitable habitat is available (e.g. coastal waters and offshore reefs).

Dwarf Sawfish

The dwarf sawfish (*Pristis clavata*) is found in Australian coastal waters extending north from Cairns around the Cape York Peninsula in Queensland to the Pilbara coast (Kyne et al. 2013).

Dwarf sawfish typically inhabit shallow (2 to 3 m) silty coastal waters and estuarine habitats, occupying relatively restricted areas and moving only small distances (Stevens et al. 2008). Juvenile dwarf sawfish utilise estuarine habitats in north-western Western Australia as nursery areas and migrate to deeper waters as adults (Thorburn et al. 2008, Threatened Species Scientific Committee 2009). The majority of capture locations for the species in Western Australia waters have occurred within King Sound (beyond the EMBA) and the lower reaches of the major rivers that enter the sound, including the Fitzroy, Mary and Robinson rivers (Morgan et al. 2010). Individuals have also been recorded from Eighty Mile Beach, and occasional individuals have also been taken from considerably deeper water by trawl fishers (Morgan et al. 2010).

Dwarf sawfish are very unlikely to occur within the Operational Area, but may be present in coastal waters within the EMBA.

Freshwater Sawfish

The freshwater sawfish (*Pristis pristis*) inhabits both riverine and marine environments in northern Australia. While primarily associated with rivers, tidal creeks and estuaries, the freshwater sawfish has been recorded up to 100 km offshore (Commonwealth of Australia 2015b).

In Western Australia, the species is known from riverine and coastal environments in the Kimberley region. Riverine habitats are particularly important as pupping habitats.

The freshwater sawfish is very unlikely to occur within the Operational Area, but may occur in coastal waters, estuaries and tidal creeks along the Kimberley coastline within the EMBA.

7.2.8.7 Birds

The Operational Area may be visited by migratory and oceanic birds but does not contain any emergent land that could be utilised as roosting or nesting habitat and contains no known critical habitats (including feeding) for any species. Observations onboard the Prelude FLNG facility indicate that seabirds and migratory shorebirds opportunistically roost onboard the facility.

Threatened and migratory bird species that may occur within the Operational Area and EMBA can broadly be classified into two groups – seabirds and migratory shorebirds. The descriptions below of the species in the Operational Area have been based on these groups.

Seabirds

Seabirds are birds that are highly adapted to the marine environment. Characteristics of many seabird species include webbed feet, dense water-resistant plumage that protects birds from becoming soaked, a diet comprising marine biota (typically fish), and nesting on offshore islands or inaccessible coastlines. Many seabird species spend relatively little time on land and forage at sea for extended periods. Some species may undertake long migrations; however, unlike migratory shorebirds, they do not typically follow the East Asian-Australasian flyway.

Seabirds that may occur within the Operational Area and EMBA include:

- noddies:
  - common noddy
  - Australian lesser noddy.
- shearwaters:
  - streaked shearwater
  - flesh-footed shearwater
  - wedge-tailed shearwater.
- terns:
  - Caspian tern
  - bridled tern
  - roseate tern
  - little tern
  - Australian fairy tern
  - crested tern.
- frigatebirds:
  - lesser frigatebird
  - great frigatebird
  - Christmas island frigatebird.
- tropicbirds:
  - white-tailed tropicbird
  - Christmas Island white-tailed tropicbird
  - red-tailed tropicbird.
- petrels:
  - southern giant-petrel
  - northern giant petrel
  - soft-plumaged petrel.
- albatrosses:
  - Amsterdam albatross
  - southern royal albatross
  - wandering albatross

  - Indian yellow-nosed albatross
  - Tasmanian shy albatross
  - white-capped albatross
  - Campbell albatross
  - black-browed albatross
  - white-capped albatross.
- boobies:
  - Abbott's booby
  - masked booby
  - brown booby
  - red-footed booby.
- ospreys.

Many of the seabird groups listed, such as noddies, terns, frigatebirds, tropicbirds and boobies above are typically found in tropical areas. These species may transiently occur within the Operational Area, however they are more likely to occur in the vicinity of offshore islands in the EMBA, such as Browse Island and Ashmore Reef, particularly during breeding seasons.

Many of the seabird groups listed above have temperate or sub-Antarctic distributions, such as shearwaters, petrels and albatrosses. These species are very unlikely to occur within the Operational Area, although may be present in the southern portion of the EMBA.

Migratory Shorebirds

Migratory shorebirds and wading birds include many species of birds that breed in northern Asia during the northern hemisphere summer (particularly eastern Russia and China) and migrate to Australasia during the southern hemisphere summer to feed. Many of these species follow the East Asian-Australasian flyway and are protected by migratory bird agreements between counties along this route, including Australia.

Migratory shorebirds typically do not nest within Australia, but do make extensive use of wetland and coastal habitats as feeding and resting areas during their migration. Several of these areas are listed under the Ramsar Convention and are protected under the EPBC Act (Section 7.2.5).

Migratory shorebirds that may occur within the Operational Area and EMBA include:

- sandpipers, curlews, stints, knots and turnstones (genus Calidris):
  - common sandpiper
  - sharp-tailed sandpiper
  - curlew sandpiper
  - pectoral sandpiper
  - broad-billed sandpiper
  - wood sandpiper
  - marsh sandpiper

  - Terek sandpiper
  - eastern curlew
  - whimbrel
  - ruddy turnstone
  - sanderling
  - ruff (reeve)
  - red-necked stint
  - red knot
  - great knot.
- shanks and tattlers:
  - grey-tailed tattler
  - common greenshank
  - common redshank.
- plovers:
  - double-banded plover
  - greater sand plover
  - lesser sand plover
  - oriental plover
  - pacific golden plover
  - grey plover.
- godwits:
  - bar-tailed godwit
  - bar-tailed godwit (baueri)
  - Northern Siberian bar-tailed godwit
  - Black-tailed godwit.
- Oriental Pratincole
- Asian Dowitcher
- Australian Painted-snipe.

Many of the species listed above are closely related and within the family Scolopacidae, and share very similar life histories. All of these migratory shorebird species may transit through the Operational Area during migration. They are likely to occur seasonally along coastlines, in estuaries and wetlands throughout the EMBA, particularly Ramsar sites (Section 7.2.5).

7.3 Socio-Economic Environment

7.3.1 Heritage

7.3.1.1 World Heritage Properties

There are no World Heritage properties within the Operational Area. Two World Heritage properties occur within the far southern portion of the EMBA:

- the Ningaloo Coast (approximately 1,283 km south of the Operational Area)
- Shark Bay, Western Australia (approximately 1,651 km south of the Operational Area).

The Ningaloo Coast

The Ningaloo Coast World Heritage Area (WHA) includes North West Cape and the Muiron Islands, and was inscribed, under criteria (vii) and criteria (x) by the World Heritage Committee onto the World Heritage Register in June 2011. The statement of Outstanding Universal Value for the Ningaloo coast was based on the natural criteria and recognised the following:

- Criterion (vii): The landscapes and seascapes of the property are comprised of mostly intact and large-scale marine, coastal and terrestrial environments. The lush and colourful underwater scenery provides a stark and spectacular contrast with the arid and rugged land. The property supports rare and large aggregations of whale sharks (*Rhincodon typus*) along with important aggregations of other fish species and marine mammals. The aggregations in Ningaloo following the mass coral spawning and seasonal nutrient upwelling cause a peak in productivity that leads approximately 300-500 whale sharks to gather, making this the largest documented aggregation in the world.
- Criterion (x): In addition to the remarkable aggregations of whale sharks the Ningaloo Reef harbours a high marine diversity of more than 300 documented coral species, over 700 reef fish species, roughly 650 mollusc species, as well as around 600 crustacean species and more than 1000 species of marine algae. The high numbers of 155 sponge species and 25 new species of echinoderms add to the significance of the area. On the ecotone, between tropical and temperate waters, the Ningaloo Coast hosts an unusual diversity of marine turtle species with an estimated 10,000 nests deposited along the coast annually.

The dominant feature of the Ningaloo Coast WHA is Ningaloo Reef, the largest fringing reef in Australia. Ningaloo Reef supports both tropical and temperate species of marine fauna and flora and more than 300 species of coral (Department of Conservation and Land Management 2005).

The Ningaloo Coast WHA is entirely overlapped by the Commonwealth Ningaloo Australian Marine Park and State Ningaloo Marine Park and Muiron Islands Marine Management Area; refer to Section 7.3.2 for further information on these marine protected areas.

Shark Bay, Western Australia

The Shark Bay WHA includes Bernier Island, Dorre Island and Dirk Hartog's landing site. Shark Bay was inscribed under all four natural criteria (criterion vii, viii, ix, and x) by the World Heritage Committee onto the World Heritage Register in 1991. The statement of Outstanding Universal Value for the Shark Bay WHA was based on natural criteria and recognised the following:

- Stromatolites, in the hypersaline Hamelin Pool, which represent the oldest form of life on earth and are comparable to living fossils.
- One of the few marine areas in the world dominated by carbonates not associated with reef building corals.
- One of the largest seagrass meadows in the world, covering 103,000 ha, with the most seagrass species recorded in one area.
- Marine fauna such as dugong, dolphins, sharks, rays, turtles, fish, and migratory seabirds which occur in great numbers.
- The hydrologic structure of Shark Bay, altered by the formation of the Faure Sill and a high evaporation, has produced a basin where marine waters are hypersaline (almost twice that of seawater) and contributed to extensive beaches consisting entirely of shells.
- The Wooramel Seagrass Bank is also of great geological interest due to the extensive deposit of limestone sands associated with the bank, formed by the precipitation of calcium carbonate from hypersaline waters.

The Shark Bay WHA is partially overlapped by the State Shark Bay Marine Park and Hamelin Pool Marine Nature Reserve.

7.3.1.2 Commonwealth Heritage Places

The Commonwealth Heritage List is a list of Indigenous, historic and natural heritage places owned or controlled by the Australian Government. The Operational Area is not located in, or in the immediate surrounds of, any Commonwealth Heritage places. There are a number of Commonwealth Heritage Places within the EMBA. These are listed in Table 7-9, with a supporting summary of their key values as Commonwealth Heritage Places.

Table 7-9: Commonwealth Heritage Places within the EMBA

Commonwealth Heritage Place	Approximate Distance from Operational Area (km)	Description
Scott Reef and surrounds	155	Scott Reef is considered regionally important for the following features: • high diversity of marine fauna, including corals, fish and marine invertebrates; • physical characteristics of the reefs create environmental conditions which are rare for shelf atolls, including clear deep oceanic water and large tidal ranges that provide a high physical energy input to the marine ecosystem; • high representation of species not found in coastal waters off WA and for the unusual nature of their fauna which has affinities with the oceanic reef habitats of the Indo-West Pacific, as well as the reefs of the Indonesian region; and • important for scientific research and benchmark studies into long term geomorphological and reef formation processes due to the age of the reef and the documentation of its geophysical and physical environmental characteristics.

Commonwealth Heritage Place	Approximate Distance from Operational Area (km)	Description
Ashmore Reef National Nature Reserve	128	The Ashmore Reef National Nature Reserve protects Ashmore Reef, a large platform reef with coral reefs, sand flats and three vegetated islands. Specific values of this site include: • breeding and foraging habitat for marine turtles • considered to have the world's greatest abundance and diversity of sea snakes • habitat for 569 species of fish, 255 species of corals and 433 species of mollusc, as well as species not previously recorded or rarely recorded in Australia • an important seabird rookery and provides an important staging/feeding area for many seabirds and migratory shorebirds (Environment Australia 2002) • breeding and feeding habitat for a small dugong population (< 50 individuals).
Mermaid Reef – Rowley Shoals	535	Mermaid Reef is one of three reef systems, located 30 – 40 km apart, which make up the Rowley Shoals. The shoal consists of a reef flat roughly 500 to 800 m wide, shallow back reefs and a large lagoon. The Rowley Shoals have been described as the most perfectly formed shelf atolls in Australian waters, and the clear, deep water and large tidal range of the atolls are considered rare environmental conditions for shoals. The specific values of Mermaid Reef include: • high diversity of marine reef fauna, including corals, fish and marine invertebrates • important area for sharks, marine turtles and toothed whales, dolphins, tuna and billfish • important resting and feeding site for migratory seabirds • regionally significant due to the presence of many species not found in inshore tropical waters of Northern Australia, and species that are close to their geographical ranges. Includes 216 species of fish, 39 species of mollusc and seven species of echinoderms • considered a genetic stepping stone between the Indonesian archipelago and reefs to the south.
Ningaloo Marine Area - Commonwealth Waters	1,304	The Ningaloo Marine Area – Commonwealth Waters lies within the Commonwealth waters section of the Ningaloo Coast World Heritage Property – refer to Section 7.3.1.1 World Heritage Properties for further information about the environmental values within the Ningaloo Marine Area – Commonwealth Waters.
HMAS Sydney II and HSK Kormoran Shipwreck Sites	1,877	The HMAS Sydney II and HSK Kormoran Shipwreck Sites Commonwealth Heritage Place covers the historic wrecks that resulted from a battle during the Second World War. Both wrecks are located in over 2,000 m of water. The battle between HMAS Sydney and HSK Kormoran resulted in the largest single loss of life in Australian naval history.

7.3.1.3 National Heritage Places

The National Heritage List is Australia's list of natural, historic and Indigenous places of outstanding significance to the nation. There are no National Heritage properties in, or

in the immediate surrounds of, the Operational Area. National Heritage Places in the EMBA are described in Table 7-10.

Table 7-10: National Heritage Places within the EMBA

National Heritage Place	Approximate Distance from Operational Area (km)	Description
The West Kimberley	171	The West Kimberley is known for its ancient geology, Aboriginal culture, stunning landscapes, and biological richness. The West Kimberley coastline includes a range of landforms, including cliffs, rocky headlands, sandy beaches, rivers, waterfalls and numerous islands located off the coast. The West Kimberley holds extensive history of Aboriginal people who have lived in the area for at least 40,000 years. The West Kimberley also provides remnant habitats for many native animals and plants which are now absent elsewhere in Australia. Many of the national heritage values of the West Kimberley are located away from the coastline will not credibly be affected by the petroleum activities considered in this EP.
Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves	1,097	Barrow Island and the Montebello / Barrow Islands Marine Conservation Reserves are of national and international significance as a diverse region of high conservation value terrestrial and aquatic habitats, and high species diversity and endemism. Barrow Island hosts a range of terrestrial and subterranean species that are unique, including species that are extinct, or threatened with extinction, on mainland Australia. The marine environment within the reserves has complex bathymetry with many reefs and a diverse assemblage of corals. Significant marine turtle nesting activity occurs on sandy beaches throughout the reserves, including significant flatback and green turtle rookeries.
The Ningaloo Coast	1,283	Refer to The Ningaloo Coast World Heritage Area description in Section 7.3.1.1 World Heritage Properties
Shark Bay, Western Australia	1,651	Refer to Shark Bay, Western Australia World Heritage Area description in Section 7.3.1.1 World Heritage Properties
HMAS Sydney II and HSK Kormoran Shipwreck Sites	1,877	Refer to HMAS Sydney II and HSK Kormoran Shipwreck Sites description in Section 7.3.1.3 National Heritage Places

7.3.1.4 Cultural Heritage

There are no known sites of Indigenous or European cultural significance within the Operational Area. The Australian coastline and nearshore islands have a long history of Indigenous occupation and host many culturally significant sites. The EMBA partially overlaps parts of the Kimberley, Pilbara and Gascoyne coastlines, which host numerous culturally significant sites, including sites that contribute to the national heritage value of the West Kimberley National Heritage Place.

7.3.1.5 Underwater Cultural Heritage

Information on underwater cultural heritage, including historic shipwrecks, is maintained in the Australasian Underwater Cultural Heritage Database, a searchable

database of records provided by the Australian DAWE. A search of the database revealed no known shipwrecks or other underwater cultural heritage sites within the Operational Area. The nearest historic shipwreck is the wreck of the sailing vessel Berteaux, which lies approximately 18 km south-east of the Operational Area.

7.3.2 Marine Protected Areas

The Operational Area does not overlap any Marine Protected Areas (MPAs), such as Commonwealth Australian Marine Parks (AMPs) or state marine parks. There are a number of Commonwealth AMPs and Western Australian MPAs in the EMBA (Figure 7-12) Each of these MPAs is described in Table 7-11.

All AMPs and many state MPAs have management plans in place, which outline the objectives for the management of the protected area. These objectives have been considered where applicable in the environmental impact and risk assessment in Section 9.12.

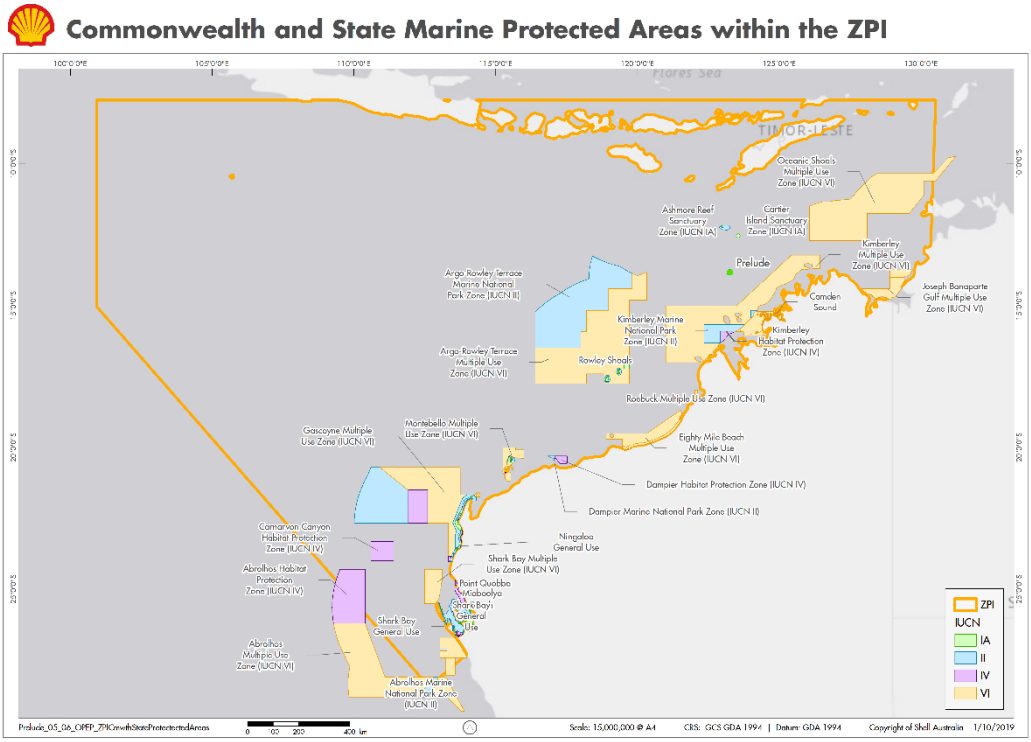


Figure 7-12: Commonwealth and State Marine Protected Areas within the EMBA

Table 7-11: MPAs within the EMBA

Marine Protected	Distance from Operational Area (km)	Description
Commonwealth AMPs		
Kimberley	111	The Kimberley AMP covers approximately 74,469 km^2 and ranges in water depth from less than 15 m to approximately 800 m. The AMP lies from the Lacepede Islands in the north to the Holothuria Banks offshore from Cape Bougainville. The Kimberley AMP contains the following conservation values (Director of National Parks 2018a): • Important foraging areas for migratory seabirds, dugongs, dolphins and marine turtles • Important migration pathway and nursery areas for the humpback whale • Adjacent to important foraging and pupping areas for sawfish and important nesting sites for green turtles • Features such as the continental shelf, slope, plateau, pinnacles, terraces, banks and shoals and deep holes/valleys • Examples of the communities and seafloor habitats of the Northwest Shelf Transition, North West Shelf province and Timor Province provincial bioregions along with the Kimberley, Canning, Northwest Shelf and Oceanic Shoals meso-scale bioregions. The AMP provides protection for two KEFs; an ancient coastline (a unique seafloor feature that provides areas of enhanced productivity) and continental slope demersal fish communities (the second richest area for demersal fish species in Australia), refer to Section 7.2.3. The Kimberley meso-scale bioregion in particular has been reported to be one of the most diverse coral areas in WA. In addition, the reserve is adjacent to the listed West Kimberley National Heritage place and Western Australian Lalang-garram / Camden Sound Marine Park.
Cartier Island	80	Cartier Island AMP is considered to be a biodiversity hotspot (like nearby Ashmore Reef) and is thought to be a source of larvae of marine biota such as corals which are transported south by the Leeuwin Current. The AMP covers an area of approximately 172 km^2. Key conservation values include (Director of National Parks 2018a): • An unvegetated sand island • High diversity and abundance of hard and soft corals, gorgonians, sponges and a range of encrusting organisms • Algae and seagrasses • Important breeding and foraging habitat for seabirds • Foraging habitat for whale sharks • Nesting, inter-nesting and foraging habitat for marine turtles • High diversity and abundance of seasnakes.
Ashmore Reef	127	The Ashmore Reef AMP covers an area of 583 km^2 and is a designated Ramsar Wetland (Section 7.2.5). Key conservation values of the AMP include (Director of National Parks 2018a):

Marine Protected	Distance from Operational Area (km)	Description
		• Regionally significant as contains ecosystems, habitat and communities representative of the NWS, Timor Province and emergent oceanic reefs • Biologically rich habitat including primary producer habitat (mangroves, seagrass beds and coral reefs) and their associated benthic communities, fishes and other biota • Regionally important nesting, inter-nesting, foraging areas for marine turtles (particularly green but also hawksbill and loggerhead turtles). An estimated 11,000 marine turtles feed in the area throughout the year • Isolated, small dugong population of less than 50 individuals that breeds and feeds around the reef. This population is thought to be genetically distinct from other Australian populations • Important seabird rookeries and staging points/feeding areas for migratory sea/shorebirds including colonies of bridled terns, common noddies, brown boobies, eastern reef egrets, frigatebirds, tropicbirds, red-footed boobies, roseate terns, crested terns and lesser crested terns • International significance for seasnake abundance and diversity • Importance cultural and heritage sites: Indonesian artefacts and grave sites.
Oceanic Shoals	183	The Oceanic Shoals AMP comprises a 71,743 km^2 area, with a large proportion (39,964 km^2) designated as Multiple Use Zone (IUCN Category VI). There are smaller areas designated for National Park Zone (Category II, 406 km^2), Habitat Protection Zone (Category IV, 6,929 km^2), and Special Purpose Zone for Trawling (Category VI, 10,461 km^2). The AMP has several conservation values (Director of National Parks 2018a): • important inter-nesting area for the flatback and olive ridley turtles • an important foraging area for loggerhead and olive ridley turtles • examples of the ecosystems of both the Northwest Shelf Transition and Timor Transition provinces. KEFs represented in the reserve are carbonate banks, pinnacles and the shelf break and slope of the Arafura Shelf. (Refer to Section 7.2.3.)
Argo-Rowley Terrace	323	The Argo-Rowley Terrace AMP covers 146,099 km^2 of the MPA network, including the Commonwealth waters surrounding the Rowley Shoals (each reef managed as separate state and Commonwealth marine parks). The Argo-Rowley Terrace Commonwealth Marine Park encompasses water depths from approximately 220–6000 m. The ecological and conservation values include (Director of National Parks 2018a): • Important foraging areas for migratory seabirds and, reportedly, the loggerhead turtle • Support for relatively large populations of sharks (compared with other areas in the region) • A range of seafloor features such as canyons, continental rise and the terrace, among others • Connectivity between the reefs of the Rowley Shoals

Marine Protected	Distance from Operational Area (km)	Description
		• Linkage of the Argo Abyssal Plain with the Scott Plateau through canyons. The AMP is contiguous with the Western Australian Rowley Shoals Marine Park.
Roebuck	480	The Roebuck Marine Park is located approximately 12 km offshore of Broome, and is adjacent to the Western Australian Yawuru Nagulagun/Roebuck Bay Marine Park. The Marine Park covers an area of 304 km² and a water depth range of less than 15 m to 70 m. The ecological and conservation values include (Director of National Parks 2018a): • The park is adjacent to the Eighty Mile Beach Ramsar wetland • Representative ecosystems of the Northwest Shelf Province • Breeding and resting habitat for seabirds • foraging and inter-nesting habitat for marine turtles • migratory pathway for humpback whales • foraging habitat for dugong.
Mermaid Reef	523	The Mermaid Reef Commonwealth Marine Park encompasses Mermaid Reef and covers 540 km^2; it is classified as an IUCN protected area category 1a, Sanctuary Zone (Strict Nature Reserve). Mermaid Reef is one of the best geological examples of a shelf-edge reef in Australian waters (one of three oceanic reefs that form the Rowley Shoals). It is the only reef of the Rowley Shoals located entirely in Commonwealth waters. Mermaid Reef supports (Director of National Parks 2018a): • rich coral communities (216 species of hard coral, 12 genera of soft corals) • a high diversity of associated sessile and mobile invertebrates (echinoderms, molluscs and crustaceans) • more than 390 reef and pelagic fish species • a variety of sharks that frequent the reef habitats. The Mermaid Reef AMP also includes the Mermaid Reef and Commonwealth Waters surrounding Rowley Shoals KEF.
Joseph Bonaparte Gulf	411	The Joseph Bonaparte Gulf Marine Park is located approximately 15 km west of Wadeye, Northern Territory, and approximately 90 km north of Wyndham, Western Australia, in the Joseph Bonaparte Gulf. It is adjacent to the Western Australian North Kimberley Marine Park. The Marine Park covers an area of 8,597 km² and water depth ranges between less than 15 m and 100 m (Director of National Parks 2018b). Environmental values within the Park include (Director of National Parks 2018b): • species and communities associated with the Northwest Shelf Transition bioregion • carbonate bank and terrace system of the Sahul Shelf KEF

Marine Protected	Distance from Operational Area (km)	Description
		• prominent shallow seafloor features, including emergent reef, shoals and sand banks • biologically important areas including foraging habitat or marine turtles and the Australian snubfin dolphin.
Eighty Mile Beach	788	Eighty Mile Beach AMP comprises a 10,785 km^2 Multiple Use Zone. Environmental values within the AMP include (Director of National Parks 2018a): • examples of ecosystems representative of the Northwest Shelf Province • diverse benthic and pelagic fish communities • and ancient coastline thought to be an important seafloor feature and migratory pathway for humpback whales • a range of fauna threatened, migratory, marine and cetacean under the EPBC Act. The AMP is adjacent to the Eighty Mile Beach Ramsar wetland (which is beyond the EMBA).
Dampier	950	The Dampier Marine Park is located approximately 10 km north-east of Cape Lambert and 40 km from Dampier extending from the Western Australian state water boundary. The Marine Park covers an area of 1,252 km² and a water depth range between less than 15 m and 70 m (Director of National Parks 2018a). Environmental values within the Park include (Director of National Parks 2018b): • representative ecosystems and communities of the Northwest Shelf Province • breeding and foraging habitat for seabirds • inter-nesting habitat for marine turtles • migratory pathway for humpback whales.
Montebello	1,047	The Montebello Marine Park is located offshore of Barrow Island and 80 km west of Dampier extending from the Western Australian state water boundary, and is adjacent to the Western Australian Barrow Island and Montebello Islands Marine Parks. The Marine Park covers an area of 3,413 km² and water depths from less than 15 m to 150 m (Director of National Parks 2018a). Environmental values within the Park include (Director of National Parks 2018b): • habitats, species and ecological communities associated with the Northwest Shelf Province • ancient coastline at the 125 m depth contour KEF • breeding habitat for seabirds • inter-nesting, foraging, mating and nesting habitat for marine turtles • migratory pathway for humpback whales • foraging habitat for whale sharks.

Marine Protected	Distance from Operational Area (km)	Description
Gascoyne	1,277	The Gascoyne Marine Park is located approximately 20 km off the west coast of the Cape Range Peninsula, adjacent to the Ningaloo Reef Marine Park and the Western Australian Ningaloo Marine Park, and extends to the limit of Australia's exclusive economic zone. The Marine Park covers an area of 81,766 km² and water depths between 15 m and 6,000 m (Director of National Parks 2018a). Environmental values within the Park include (Director of National Parks 2018b): • four KEFs: – canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula – Commonwealth waters adjacent to Ningaloo Reef – continental slope demersal fish communities – the Exmouth Plateau. • diverse continental slope habitats • breeding habitat for seabirds • inter-nesting habitat for marine turtles • migratory pathway for humpback whales • foraging habitat and migratory pathway for pygmy blue whales.
Ningaloo	1,304	The Ningaloo Marine Park stretches approximately 300 km along the west coast of the Cape Range Peninsula, and is adjacent to the Western Australian Ningaloo Marine Park and Gascoyne Marine Park. The Marine Park covers an area of 2,435 km² and a water depth range of 30 m to more than 500 m (Director of National Parks 2018a). Environmental values within the Park include (Director of National Parks 2018b): • representative ecosystems of the: – Central Western Shelf Transition – Central Western Transition – Northwest Province – Northwest Shelf Province. • KEFs: – canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula – Commonwealth waters adjacent to Ningaloo Reef – continental slope demersal fish communities • breeding habitat for seabirds • inter-nesting habitat for marine turtles • migratory pathway for humpback whales • foraging habitat and migratory pathway for pygmy blue whales • breeding, calving, foraging and nursing habitat for dugong

Marine Protected	Distance from Operational Area (km)	Description
		• foraging habitat for whale sharks.
Shark Bay	1,588	The Shark Bay Marine Park is located approximately 60 km offshore of Carnarvon, adjacent to the Shark Bay world heritage property and national heritage place. The Marine Park covers an area of 7,443 km², extending from the Western Australian state water boundary, and a water depth range between 15 m and 220 m (Director of National Parks 2018a). Environmental values within the Park include (Director of National Parks 2018b): • representative ecosystems of the Central Western Shelf and Central Western Transition bioregions • connectivity between deeper Commonwealth waters and inshore waters of Shark Bay • breeding habitat for seabirds • inter-nesting habitat for marine turtles • migratory pathway for humpback whales. The Park is adjacent to the Shark Bay World Heritage Area.
Abrolhos	1,781	The Abrolhos Marine Park is located adjacent to the Western Australian Houtman Abrolhos Islands, covering a large offshore area extending from the Western Australian state water boundary to the edge of Australia's exclusive economic zone. It is located approximately 27 km south-west of Geraldton and extends north to approximately 330 km west of Carnarvon. The northernmost part of the shelf component of the Marine Park, north of Kalbarri, is adjacent to the Shark Bay World Heritage Area. The Marine Park covers an area of 88,060 km² and a water depth range between less than 15 m and 6,000 m (Director of National Parks 2018c). Environmental values within the Park include (Director of National Parks 2018c): • KEFs: – Commonwealth marine environment surrounding the Houtman Abrolhos Islands – demersal slope and associated fish communities of the Central Western Province – mesoscale eddies – Perth Canyon and adjacent shelf break, and other west-coast canyons – western rock lobster – ancient coastline between 90 m and 120 m depth – Wallaby Saddle. • high biodiversity due to the southwards flowing Leeuwin Current supplying tropical species • foraging and breeding habitat for seabirds • foraging habitat for Australian sea lions and white sharks • migratory pathway for humpback and pygmy blue whales.

Marine Protected	Distance from Operational Area (km)	Description
		The Marine Park is adjacent to the northernmost Australian sea lion breeding colony in Australia on the Houtman Abrolhos Islands.
Western Australian Marine Parks		
Lalang-garram / Camden Sound	182	The Lalang-garram / Camden Sound Marine Park provides protection for a large, biologically diverse part of the Kimberley coastal waters. The park is contiguous with the Commonwealth Kimberley AMP, which is described above. The environmental and social values within the park include: • habitat for a range of marine species, including marine turtles, coastal dolphins and dugong • important calving and resting areas for humpback whales • sanctuary zones which prohibit most activities, including fishing • important cultural heritage sites for the traditional owners. The Lalang-garram / Camden Sound Marine Park is jointly managed by WA government agencies and the traditional owners of the land.
North Kimberley	188	The North Kimberley Marine Park covers an area of approximately 1,845,000 hectares, which is currently zoned as IUCN Category VI – multiple use. The park is remote and contains a range of outstanding natural and cultural values, such as a complex coastline with many small islands and cultural heritage sites for Aboriginal saltwater people. The Marine Park contains habitats such as coral reefs, seagrasses and mangroves. Fauna include dugong, birds, marine turtles, fishes, cetaceans and saltwater crocodiles.
Rowley Shoals	567	The Rowley Shoals Marine Park protects two of the three oceanic shoals (Clerke Reef and Imperieuse Reef) that constitute the Rowley Shoals. The third shoal (Mermaid Reef) is protected by the Argo-Rowley Terrace AMP. The Rowley Shoals Marine Park is characterised by intertidal and subtidal coral reefs, with rich and diverse marine fauna and high water quality. The reefs within the park may act as a source of recruits for habitats further south, via the Leeuwin Current, and hence are considered to be regionally significant (MPRA 2007).
Eighty Mile Beach Marine Park	612	Eighty Mile Beach is an extensive stretch of remote and remarkable coastal country located between Port Hedland and Broome, stretching for some 220 km from Cape Missiessy to Cape Keraudren. The marine park includes Eighty Mile Beach, Cape Keraudren and the diverse marine environments west of Cape Keraudren to Mulla Down Creek. it is jointly managed with the traditional owners of the area (Department of Parks and Wildlife 2014). The marine park contains vast intertidal sand and mudflats that extend up to 4 km wide at low tide and provide a rich source of food for many species. Eighty Mile Beach is one of the world's most important feeding grounds for migratory shorebirds and is a major nesting site for flatback turtles, which are only found in northern Australia. Both are critical components of the Eighty Mile Beach Ramsar site, and the management plan seeks to maintain its ecological character (Department of Parks and Wildlife 2014).

Marine Protected	Distance from Operational Area (km)	Description
		The Park is adjacent to the Commonwealth Eighty Mile Beach AMP.
Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area	1,097	The Montebello Islands Marine Park, Barrow Island Marine Park and Barrow Island Marine Management Area are jointly managed and cover a combined area of 1,770 km^2, located approximately 170 km from the Operational Area at the closest point. A sanctuary zone covers the entire 4,100 ha Barrow Island Marine Park. The Barrow Island Marine Management Area covers 114,500 ha and includes most of the waters surrounding Barrow Island and Lowendal Islands, except for the port areas around Barrow and Varanus Islands. Key conservation and environmental values within the reserves include (Department of Environment and Conservation 2007): • a complex seabed and island topography consisting of subtidal and intertidal reefs, sheltered lagoons, channels, beaches, cliffs and rocky shores • pristine sediment and water quality, supporting a healthy marine ecosystem • undisturbed intertidal and subtidal coral reefs and bommies with a high diversity of hard corals • important mangrove communities, particularly along the Montebello Islands, which are considered globally unique as they occur in offshore lagoons • extensive subtidal macroalgal and seagrass communities • important habitat for cetaceans and dugongs • nesting habitat for marine turtles • important feeding, staging and nesting areas for seabirds and migratory shorebirds • rich finfish fauna with at least 456 species • historical culture of the pearl oyster (Pinctada maxima) in the reserves produces some of the highest quality pearls in the world. These islands support significant colonies of wedge-tailed shearwaters and bridled terns. The Montebello Islands support the biggest breeding population of roseate terns in Western Australia. Ospreys, white-bellied sea-eagles, eastern reef egrets, Caspian terns, and lesser crested terns also breed in this area. The Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area is contiguous with the Montebello Commonwealth Marine Park.
Muiron Islands Marine Management Area and Ningaloo Marine Park	1,283	The Ningaloo Marine Park (State waters) was established in 1987 and stretches 300 m from the North West Cape to Red Bluff. It encompasses the State waters covering the Ningaloo Reef system and a 40 m strip along the upper shore. The Muiron Islands Marine Management Area is managed under the same management plan as for the Ningaloo State Marine Park (Department of Conservation and Land Management 2005). The Ningaloo Marine Park is part of the Ningaloo Coast WHA. Ecological and conservation values of the Ningaloo Marine Park and Muiron Islands are summarised below. The ecological and conservation values include (Department of Conservation and Land Management 2005): • Unique geomorphology, which has resulted in a high habitat and species diversity

Marine Protected	Distance from Operational Area (km)	Description
		• High sediment and water quality • Subtidal and intertidal coral reef communities providing food, settlement substrate and shelter for marine flora and fauna • Filter feeding communities (sponge gardens) in the northern part of the North West Cape and the Muiron and Sunday Islands • Soft sediment communities found in deeper waters, characterised by a surface film of microorganisms that provide a rich source of food for invertebrates • Macroalgae and seagrass communities, which are an important primary producer providing habitat for vertebrate and invertebrate fauna • Diverse fish fauna (approximately 460 species) • Foreshores and nearshore reefs of the Ningaloo coast and Muiron/Sunday islands provide inter-nesting, nesting and hatchling habitat for several species of marine turtles including the loggerhead, green, flatback and hawksbill turtles • Whale sharks aggregate annually to feed in the waters around Ningaloo Reef • Nesting and foraging habitat for seabirds and shorebirds.
Shark Bay Marine Park	1,691	The Shark Bay Marine Park was gazetted in 1990 as an A Class Marine Park Reserve and encompasses and area of 7,487 km^2. The values of the Marine Park are consistent with those of the World Heritage Area, which are described in Section 7.3.1.1 World Heritage Properties.

7.3.3 Fishing Industry

7.3.3.1 Traditional Fishing

In 1974, Australia recognised access rights for traditional Indonesian fishers in shared waters to the north of Australia, granting long-term fishing rights in recognition of the long history of traditional Indonesian fishing in the area. A Memorandum of Understanding (MOU) between the Governments of Australia and Indonesia enables Indonesian traditional fishers to continue their customary practices. This area is known as the 'MOU Box' and the Operational Area lies within it.

This MOU box covers Scott Reef and surrounds, Seringapatam Reef, Browse Island, Ashmore Reef and Cartier Island, representing an area of approximately 50,000 km^2. Trochus, sea cucumbers (holothurians), abalone, green snail, sponges, giant clams and finfish, including sharks, are targeted by the fishers. Given the shallow water target species, these traditional Indonesian fishermen are only likely to be found in deep water areas during transit to and from the reef locations.

7.3.3.2 Recreational Fishing

Currently, there are no known recreational fishing activities in the Operational Area as the site is too far from shore to be accessed by recreational fishermen in small boats. Even at relatively high speed (30 km/hour), it would take at least fifteen hours for a recreational boat to reach the project area from the nearest port of Broome.

Recreational fishing, particularly boat-based angling, occurs throughout the EMBA. Recreational angling is expected to be centred around access nodes, such as marinas and boat launching facilities, found at towns across the Kimberley region. Recreational anglers typically target demersal and pelagic fish species for consumption and sport.

7.3.3.3 Commonwealth Fisheries

Commonwealth fisheries that overlap the Operational Area and EMBA are described in Table 7-12.

Table 7-12: Commonwealth fisheries within the EMBA

Fishery Name	Distance from Operational Area (km)	Description
North-west slope trawl fishery	0	The North West Slope Trawl Fishery extends from 114°E to 125°E, from the 200 m isobath to the outer limit of the Australian exclusive economic zone (EEZ). The fishery traditionally targets scampi and deep-water prawns. Fishing for scampi occurs over soft, muddy sediments or sandy habitats, typically at depths of 200–400 m using demersal trawl gear on the continental slope. Activity in the fishery commenced in 1985, peaking at 21 active vessels in 1986-87 (Woodhams and Bath 2017). There are currently very few licence holders active in the fishery and fishing activity has steadily declined since establishment of the fishery. Two vessels operated in the fishery in the 2016-17 season, which is the same as the 2015-16 season. The total area of waters fished in 2016-17 did not include the Operational Area.
Southern bluefin tuna fishery	0	The Southern Bluefin Tuna Fishery is not active within Operational Area or the EMBA; all activity in this fishery occurs well south of the EMBA, primarily off South Australia. As such, the Southern Bluefin Tuna Fishery is not discussed further.
Western tuna and billfish fishery	0	The West Tuna and Billfish Fishery is currently active, running throughout the year. The fishery zoning extends to the Australian EEZ boundary in the Indian Ocean, overlapping the Operational Area. The fishery targets four pelagic species, which are all highly mobile: • broadbill swordfish (*Xiphias gladius*) • bigeye tuna (*Thunnus obesus*) • yellowfin tuna (*T. albacares*) • albacore tuna (*T. alalunga*). The methods used by the fishery are mainly pelagic longline and some minor-line. The number of vessels operating in the fishery has declined in recent years, with less than five vessels operating in the fishery since 2005 (Williams et al. 2017). Effort data shows fishing effort is concentrated off south-west Western Australia and South Australia (Williams et al. 2017).
Skipjack fishery	0	The combined western and eastern skipjack tuna (*Katsuwonus pelamis*) fisheries encompass the entire EEZ, including the Operational Area. The target species has historically been used for canning, and with the closure of canneries at Eden and

		Port Lincoln effort in the fishery has declined and there have been no active vessels operating since 2009 (Patterson & Bath 2017). Given the fishery has been inactive for a number of years and given the distribution of fishing effort when the fishery was active, fishing for skipjack tuna in the Operational Area is highly unlikely. Should the fishery commence efforts in the area in the future, fishing effort in the Operational Area is unlikely given the historical fishery was concentrated off southern Australia.
Northern prawn fishery	395	The Northern Prawn Fishery is located off Australia's northern coast from Cape York, Queensland to Cape Londonderry, Western Australia. It is Australia's second most valuable Commonwealth fishery. The fishery targets six species of prawn: • Red-legged banana prawn (*Penaeus indicus* and *P. merguiensis*) • White banana prawn (*Fenneropenaeus merguiensis*) • Brown tiger prawn (*P. esculentus*) • Grooved tiger prawn (*P. semisulcatus*) • Blue endeavour prawn (*Metapenaeus endeavouri*) • Red endeavour prawn (*M. ensis*). The fishery method is bottom trawling during two seasons – April to June and August to November, with the season end dates depending on the catch rates. In 2017, there were 52 vessels with fishing rights, which is the maximum number of vessels active at one time. The Northern Prawn Fishery management area is located approximately 433 km from the Operational Area.
Western deep-water trawl fishery	1,072	The Western Deepwater Trawl Fishery is permitted to operate only in deep waters from the 200 m isobath, as far north as the North West Cape. This fishery targets a number of deep water demersal finfish and crustacean species. The nominated fishing grounds are extensive. However, most of the fishing effort is south and offshore of the North West Cape, with areas of medium and high-density fishing activity located to the south of Ningaloo Reef and west of Shark Bay. No vessels were active in the fishery in 2014-15 or 2015-16 seasons (Woodhams and Bath 2017).

7.3.3.4 Western Australian Managed Fisheries

State-based Western Australian commercial fisheries that overlap the EMBA are described in Table 7-13.

Table 7-13: Western Australia fisheries within the EMBA

Fishery Name	Distance from Operational area at Prelude (km)	Description
Mackerel Fishery	0	The Mackerel Managed Fishery targets Spanish mackerel (*Scomberomorus commerson*) using near-surface trawling gear from small vessels in coastal areas around reefs, shoals and headlands. Jig fishing is also used to capture grey mackerel (*S. semifasciatus*) (Molony et al. 2015). The commercial fishery extends from Geraldton to the Northern Territory border. There are three managed fishing areas: Kimberley (Area 1), Pilbara (Area 2), and Gascoyne and West Coast (Area 3). The majority of the catch is taken from waters off the Kimberley coasts (Lewis and Jones 2017), reflecting the tropical distribution of mackerel species (Molony et al. 2015). The majority of fishing activity occurs around the coastal reefs of the Dampier Archipelago and Port Hedland area, with the seasonal appearance of mackerel in shallower coastal waters most likely associated with feeding and gonad development prior to spawning (Mackie et al. 2003).
West Coast Deep Sea Crustacean	0	The West Coast Deep Sea Crustacean Managed Fishery extends north from Cape Leeuwin to the WA/NT border in water depths great than 150 m within the Australian Fishing Zone, including the Operational Area. The fishery targets deep water crustaceans, with the vast majority (>99%) of the catch landed in 2015 comprised of crystal crabs (How and Yerman 2017). Two vessels operated in the fishery in 2015, using baited pots operated in a longline formation in the shelf edge waters mostly in depths between 500 and 800 m (How and Yerman 2017). Fishing effort was concentrated between Fremantle and Carnarvon.
South West Coast Salmon	0	The South West Coast Salmon Managed Fishery operates on various beaches south of the metropolitan area and includes all Western Australian waters north of Cape Beaufort except Geographe Bay. No fishing takes place north of the Perth metropolitan area (well beyond the EMBA), despite the managed fishery boundary extending to Cape Beaufort (Western Australia / Northern Territory border).

Fishery Name	Distance from Operational area at Prelude (km)	Description
Northern Demersal Scalefish	0	The Northern Demersal Scalefish Managed Fishery operates off the northwest coast of Western Australia in the waters east of 120°E longitude. The permitted means of operation within the fishery include handline, dropline and fish traps; since 2002 it has essentially been a trap-based fishery. Gear restrictions and spatial zones as the primary management measures. The main species landed by this fishery are red emperor and goldband snapper (Newman et al. 2017b). In 2015, there were 7 vessels with fishing rights (Newman et al. 2017b). The Northern Demersal Scalefish Managed Fishery overlaps the Operational Area.
Marine Aquarium and Specimen Shell	28	The Marine Aquarium and Specimen Shell managed fisheries are largely diver-based, with effort concentrated around the Capes region, Perth, Geraldton, Exmouth and Dampier. Effort in these fisheries is relatively low and spread over a large geographic area. Given the nature of the fisheries, effort is expected to be largely restricted to coastal waters < 30 m water depth.
Abalone	28	The Western Australian abalone fishery includes all coastal waters from the Western Australian and South Australian border to the Western Australian and Northern Territory border. The fishery is concentrated on the south coast (greenlip and brownlip abalone) and the west coast (Roe's abalone). Abalone are harvested by divers, limiting the fishery to shallow waters (typically < 30 m). No commercial fishing for abalone north of Moore River (zone 8 of the managed fishery) has taken place since 2011/2012 (Strain et al. 2017).
Broome Prawn	28	The Broome Prawn Managed Fishery is one of the four northern managed prawn fisheries (the others are the Kimberley, Nickol Bay and Onslow prawn managed fisheries). It is the least active of these four fisheries, with 0.3 tonnes of western king prawns and 0.8 tonnes of coral prawns landed in 2015 (Sporer et al. 2017). The extent of the Broome Prawn Managed Fishery is approximately 28 km from the Operational Area.
Kimberley Prawn	47	The Kimberley Prawn Managed Fishery operates between Koolan Island and Cape Londonderry. Its target catch is banana prawns (*Penaeus merguiensis*) but also catches tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus endeavouri*) and western king prawns (*Penaeus latisulcatus*). Landings in 2016 (Sporer et al. 2017) season were 155 tonnes. The catch season is from early April to late November. The extent of the Kimberley Prawn Managed Fishery is located approximately 47 km from the Operational Area.

Fishery Name	Distance from Operational area at Prelude (km)	Description
Kimberley Gillnet and Barramundi	213	The limited entry Kimberley Gillnet and Barramundi Fishery operates from the Western Australian/Northern Territory border to the northern end of Eighty Mile Beach in the nearshore and estuarine zones. The managed fishery boundary extends approximately 3 nm from the shoreline. In 2013, six vessels fished in the Kimberley Gillnet and Barramundi Fishery. The fishery targets barramundi (*Lates calcarifer*), blue threadfin *(Polydactylus macrochir*) and king threadfin (*Eleutheronema tetradactylum*) (Newman et al. 2017a). The extent of the fishery is located approximately 213 km to the east (near to the shoreline) of the Operational Area.
Pearl Oyster Fishery	0	The Western Australian Pearl Oyster Fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. Pearl oysters (Pinctada maxima) are collected by divers in shallow coastal waters along the Northwest Shelf and Kimberley, which are mainly for use in the culture of pearls. The fishery is separated into four management zones; the Operational Area lies within management zone 3, however the Operational Area is much deeper than safe diving depths in which pearl oyster fishing occurs. Most pearl fishing occurs in inner continental shelf waters (< 30 m) along the Kimberley and Pilbara coastlines. Given the fishery is diver-based (i.e. restricted to safe diving depths) interaction with fishery participants from the petroleum activity are very unlikely.
Pilbara Trap	477	The Pilbara Trap Managed Fishery is one of three fisheries (Pilbara Fish Trawl (Interim) Managed Fishery, Pilbara Line Fishery) that make up the Pilbara Demersal Scalefish Fisheries. The main species that are caught in this subregion are bluespotted emperor (*Anax nigrofasciatus*), red emperor (*Lutjanus seba)* and rankin cod (*Epinephelus multinotatus*). There are six licences in the Pilbara Trap Managed Fishery that are operated across three vessels. Fishing in this area is not restricted by seasons. The extent of the Pilbara Trap Managed Fishery is located approximately 477 km south-west of the Operational Area.
Pilbara Fish Trawl	560	The Pilbara Fish Trawl (Interim) Managed Fishery is one of three fisheries (Pilbara Trap Managed Fishery and Pilbara Line Fishery) that make up the Pilbara Demersal Scalefish Fisheries. The main species that are caught in this subregion are bluespotted emperor (*Anax nigrofasciatus*), red emperor (*Lutjanus seba)* and rankin cod (*Epinephelus multinotatus*). The fishery is restricted to less than approximately 2% of the North West Shelf. The trawling method uses a single net with

Fishery Name	Distance from Operational area at Prelude (km)	Description
		extension sweeps. The extent of the Pilbara Fish Trawl (Interim) Managed Fishery is located approximately 560 km south-west of the Operational Area.
Nickol Bay Prawn	560	The Nickol Bay Prawn Managed Fishery targets penaeid prawns (primarily banana prawns) using trawl gear. The target species typically inhabits sandy and muddy substrate in < 45 m water depth. Landings in the fishery in 2015 were approximately 87 tonnes, comprised largely of banana prawns (Sporer et al. 2017). The annual landing in 2015 was approximately 87 tonnes. The catch effort from the 2016 season was 17 tonnes. The extent of the Nickol Bay Prawn Managed Fishery is approximately 560 km from the Operational Area.
Onslow Prawn	920	The Onslow Prawn Managed Fishery is one of five prawn fisheries that are collectively referred to as the North Coast Prawn Managed Fisheries. The North Coast Prawn Managed Fisheries produced approximately 200-300 t annually. These fisheries all use low opening, otter prawn trawl systems. The catch effort from the 2016 season was negligible; only one boat fished in the Onslow Prawn Managed Fishery area in 2016. The extent of the fishery is located approximately 920 km south-west of the Operational Area.
Exmouth Gulf Prawn	1,263	The Exmouth Gulf Managed Fishery targets penaeid prawns (primarily banana prawns) using trawl gear within Exmouth Gulf. The target species typically inhabits sandy and muddy substrate in < 45 m water depth. The fishery is of high value, with approximately 1,067 tonnes landed in 2015, with the town of Exmouth the main port for participants in the fishery. The fishery is managed based on input controls, temporal closures and spatial closures (Kangas et al. 2017c).
West Coast Rock Lobster	1,272	The West Coast Rock Lobster Fishery targets the western rock lobster (*Panulirus cygnus*) from Shark Bay south to Cape Leeuwin using baited traps (pots). In 2008, it was determined that the allocated shares of the West Coast Rock Lobster resource would be 95% for the commercial sector, 5% to the recreational sector, and one tonne to customary fishers. The commercial fishery has been Australia's most valuable single-species wild capture fishery. In 2010/2011, the fishery moved to an individually transferable quota fishery. The fishery is managed using zones, seasons and total allowable catch. Landings in 2015 were 6,416 tonnes (de Lestang and Rossbach 2017).

Fishery Name	Distance from Operational area at Prelude (km)	Description
Gascoyne Demersal Scalefish	1,470	The Gascoyne Demersal Scalefish Fishery comprises commercial and recreational fishing for demersal scalefish in the continental waters of the Gascoyne Coast Bioregion. The fishery is located between the southern Ningaloo coast to south of Shark Bay with a closure area from Point Maud to Tantabiddi. Commercial vessels have traditionally targeted the oceanic stocks of pink snapper (*Pagrus auratus*) during the winter months (fishing spawning aggregations in peak season of June to July). The present fishery also targets other demersal species including the goldband snapper (*Pristipomoides* spp.), red emperor (*Lutjanus sebae*), other emperors and cod.
Shark Bay Scallop	1,512	The Shark Bay Scallop Managed Fishery targets saucer scallops (*Ylistrum balloti*) using otter trawls. The stock is currently recovering after sustained poor recruitment since 2010 (Kangas et al. 2017a). Annual catches in the fishery are highly variable due to recruitment. Scallops occur on sandy and muddy sediments, which may also host commercially exploited prawns; a number of vessels participate in both the Shark Bay Scallop Managed Fishery and the Shark Bay Prawn Managed Fishery (Kangas et al. 2017a).
Shark Bay Prawn	1,512	The Shark Bay Prawn Managed Fishery is the highest producing Western Australian fishery for prawns. It targets the western king prawn (*Penaeus latisulcatus*) and brown tiger prawn (*P. esculentus*) and takes a variety of smaller prawn species including endeavour prawns (*Metapenaeus* spp.) and coral prawns (various species). Prawns are caught using otter trawls over sandy or muddy substrates, with over 2,000 tonnes landed in 2015 (Kangas et al. 2017b). A number of vessels active in the Shark Bay Prawn Managed Fishery also fish in the Shark Bay Scallop Managed Fishery.
Shark Bay Crab	1,670	The blue swimmer crab (*Portunus armatus*) resource in Shark Bay is harvested commercially by the Shark Bay crab trap, prawn trawl and scallop trawl fisheries. Commercial fishing for blue swimmer crabs in Shark Bay was voluntarily halted by industry in April 2012 to facilitate stock rebuilding. The fishery was reopened in 2013/14, with a 450 tonne catch limit instituted for the 2015 season.
Shark Bay Beach Seine and Mesh Net	1,685	The Shark Bay Seine and Mesh Net Managed Fishery operates from Denham and used a combination of beach seine and mesh net gears to mainly take four species/groups including whiting (mostly yellowfin with some goldenline), sea mullet (*Mugil cephalus*), tailor (*Pomatomus saltatrix*) and western yellowfin bream (*Acanthopagrus morrisoni*).

Fishery Name	Distance from Operational area at Prelude (km)	Description
		This fishery is managed by limited entry, gear restrictions (e.g. vessel size, net length and mesh size) and permanently closed waters (e.g. Hamelin Pool, Big Lagoon, Denham foreshore).
West Coast Demersal Scalefish	1,765	The West Coast Demersal Scalefish Fishery comprises inshore and offshore suites of demersal scalefish species that are exploited by different commercial fisheries, recreational and charter fishers operating in the West Coast Bioregion. The West Coast Inshore Demersal suite occurs in waters < 250 m deep and is comprised of approximately 100 different species, the most important of which are West Australian dhufish (*Glaucosoma hebraicum*) and pink snapper (*Pagrus auratus*). Less important species include redthroat emperor (*Lethrinus miniatus*), bight redfish (*Centroberyx gerrardi*) and baldchin groper (*Choerodon rubescens*). The West Coast Offshore Demersal suite occurs in waters < 250 m deep and includes eightbar groper (*Hyporthodus octofasciatus*), hapuka (*Polyprion oxygeneios*), blue-eye trevalla (*Hyperoglyphe antactica*) and ruby snapper (*Etelis carbunculus*). Access to the fishery is limited. Gear and other restrictions apply in the form of maximum number of lines and hooks and arrangements regulating the carriage of lines and fish.

7.3.3.5 Northern Territory Managed Fisheries

7.3.3.1 Northern Territory-based commercial fisheries that overlap the EMBA are described in Table 7-14.

Table 7-14: Northern Territory fisheries within the EMBA

Fishery Name	Distance from Operational Area	Description
Aquarium Fishery	537	The Northern Territory Aquarium Fishery targets a range of marine, estuarine and freshwater species for the aquarium trade, including finfish (e.g. freshwater rainbowfish), invertebrates (e.g. hermit crabs) and plants. Fishing is typically either

Fishery Name	Distance from Operational Area	Description
		from boat or shore by diving, nets and hand collection. These methods restrict fishing activity in shallow coastal, estuarine and riverine waters. There are approximately 11 licences and three boats active in the fishery each year. The managed fishery area extends to the edge of the Australian fishing zone (200 NM from the coast) and is partially overlapped by the EMBA. Given activity in the fishery is restricted to coastal waters, the operation of the Petroleum Activity is unlikely to impact upon the fishery.
Offshore Net and Line Fishery	537	The Offshore Net and Line Fishery covers an area of over 522,000 km^2 and extends from the NT high water mark to the boundary of the Australian fishing zone (NT Government 2017). The fishery permits both pelagic gillnets and longline gear and targets Australian and common blacktip sharks, spottail sharks and grey mackerel; however, longlines have not been used since 2013 due to a drop in shark fin price (NT Government 2017). The majority of the fishing effort is in the coastal zone (within 12 NM of the coast) and immediately offshore in the Gulf of Carpentaria (NT Government 2017). Effort beyond 12 NM from shore is typically very low The number of licences for the fishery is restricted to 17 and generally 11 licences are active in any given year (NT Government 2017).
Spanish Mackerel Fishery	537	The fishery extends from the NT high water mark to the outer limit of the Australian fishing zone (NT Government 2017). The fishery employs troll lines, floating handlines and rods. The majority of the fishing effort occurs in the vicinity of reefs, headlands and shoals and includes waters near Bathurst Island, New Year Island, the Wessel Islands around to Groote Eylandt and the Sir Edward Pellew Group of islands (NT Government 2017). The target species of the fishery is the narrow-barred Spanish mackerel, however a small number of other mackerels are also taken.
Demersal Fishery	540	The Demersal Fishery boundary extends from 15 nautical miles from the NT coastal waters mark to the outer limit of the Australian fishing zone, excluding the area of the Timor Reef Fishery. The fishery employs trawl, hand and drop lines, and trap fishing methods. The main target species of the fishery are red snappers, goldband snappers, saddletail, and crimson snapper. There are currently 18 licences issued for the fishery (NT Government 2017).
Timor Reef Fishery	569	The Timor Reef Fishery operates in remote offshore waters in the Timor Sea in a defined area approximately 370 km north-west of Darwin. The fishery extends north-west of Darwin to the WA-NT border and to the outer limit of the AFZ and covers an area of ~28,811 km^2 (NT Government 2017). The target species is goldband snapper, with other tropical snappers such

Fishery Name	Distance from Operational Area	Description
		as crimson snapper and saddletail snapper also consisting part of the catch. The majority of the fishing effort is undertaken using drop-lines and occurs primarily in the 100 – 200 m depth range.
Pearl Oyster Fishery	537	The Northern Territory pearl oyster fishery is currently a small diver-based fishery collecting pearl shell for mother-of-pearl. Most pearl oysters used in aquaculture in the Northern Territory are reared from hatchery stock, which are grown at farms locations are in waters around Darwin and East Arnhem Land (beyond the EMBA). Fishing for pearl oysters is diver-based, with five licences currently issued to fishers. The managed fishery area extends from the Australian coastline to the edge of the Australian fishing zone. As the fishery is diver-based, fishing activity is likely to be restricted to occupational diving depths (< 30 m). Hence, fishing activity may only occur in a very limited part of the managed fishery area. Given activity in the fishery is restricted to coastal waters, the petroleum activities are unlikely to impact upon the fishery.
Coastal Line Fishery	618	The Coastal Line fishery extends 15 nautical miles from the low water mark around the entire NT coastline. The fishery is divided into two zones, which divide the coastline at Vashon Head on the Cobourg Peninsula (NT Government 2017). The majority of fishing effort is focused around rocky reefs within 150 km of Darwin where Black Jewfish are targeted using mainly hook and line gear (NT Government 2017). Fish traps and droplines are also permitted beyond 2 NM from the coastline in the Eastern Zone of the fishery, and gillnets with a maximum drop of 5 m are also permitted (NT Government 2017). Catch from droplines and traps account for less than 7% of the total reported catch (NT Government 2017).

7.3.3.6 Aquaculture

There are no aquaculture operations within the Operational Area; aquaculture is typically restricted to shallow coastal waters. Aquaculture in the region consists primarily of culturing hatchery reared and wild caught oysters (*Pinctada maxima*) for pearl production, which is primary centred around Broome and the Dampier Peninsula. Leases typically occur in shallow coastal waters at depths of less than 20 m (Fletcher et al. 2006).

7.3.4 Tourism and Recreation

No tourism activities are known to occur within the Operational Area, but tourism activities occur widely in the EMBA. Most tourism in the EMBA is nature-based and hence is typically associated with outstanding natural features such as the Kimberley coastline and the offshore reefs and islands (e.g. Rowley Shoals). The remoteness of the region results in most offshore tourism activities being conducted from organised expeditions based on larger vessels.

Tourism makes a significant contribution to the regional economy, with the town of Broome (beyond the EMBA) providing a central node for many tourism-related activities in the region.

7.3.5 Defence

There are no defence exercise areas within the Operational Area or the EMBA, but defence activities may occur within the EMBA.

7.3.6 Shipping

Shipping activity in the vicinity of the Operational Area is considered high. However, almost all vessel activities in the Operational Area are associated with the operation of the Prelude FLNG facility and Ichthys facilities (e.g. offtake tankers, support vessels etc.).

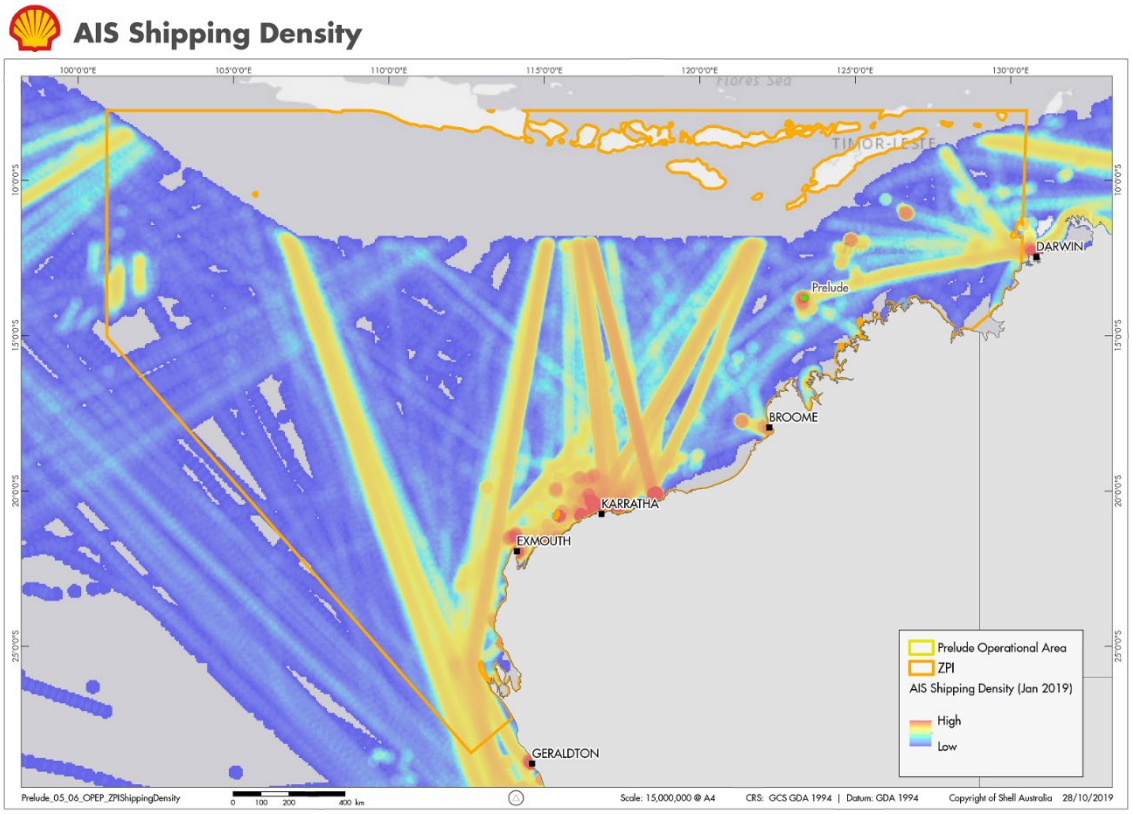


Figure 7-13: Shipping levels within the operational area and broader EMBA

7.3.7 Indonesian Coastline

The Indonesian is located over 300 km north of the Operational Area at the closest point, near the limits of the EMBA.

Indonesia is the world's largest archipelagic state and Indonesian waters play an important role in the global water mass transport system (Asian Development Bank ADB] et al. 2014). Indonesia has some of the most biologically rich coral reefs in the world with over 590 coral species having been identified. Coastal reefs are a primary source of food and income for coastal communities, as well as forming an integral part of the countries tourism industry (ADB et al. 2014). Coastal areas also support aquaculture production of algae, finfish and crustaceans. In addition to coral reefs, coastal habitats include sandy beaches, rocky shorelines, seagrass meadows, and mangroves.

7.3.8 Oil and Gas Industry

Oil exploration activities in the Timor Sea commenced in the late 1960s. Since this time numerous wells have been drilled throughout the region. Petroleum exploration has been active in the Browse Basin since the 1980s, with several commercial discoveries since that time. It is expected that petroleum exploration and development activities will continue in the region into the future.

There are several operating petroleum production facilities in the vicinity of the Operational Area, with the Prelude FLNG facility being adjacent to the activity. The Ichthys facilities are the next closest, situated approximately 20 km south of the Operational Area. The Montara facility is located approximately 188 km north-east of the Operational Area.

7.4 Timing of Key Ecological Sensitivities

A matrix of environmental sensitivities (Table 7-15) was generated to understand the timing of key life stages of fauna species and to identify the optimal window for acquiring the seismic data required under Shell's petroleum title commitments to the Australian Federal Government. In using the sensitivity matrix in Shell's business decision making process, Shell also must consider safety, operational and commercial constraints.

Table 7-15 – Timing of Key Ecological Sensitivities; Nesting, Migration, Spawning, Weather Events

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Coral spawning												
Key Commercial Demersal Fish Species Spawning												
Humpback whale – north and south migration												
Pygmy blue whale migration												
Bryde's whale												
Fin whale												
Turtle nesting												
Whale shark migration												
Migratory shorebirds												
Cyclone season (NWMR)												

8 Acceptable Levels of Impact and Risk for the Petroleum Activities

The OPGGS (E) Regulations require the titleholder include an evaluation of all the impacts and risks that determined whether these will be of an 'acceptable' or 'unacceptable' level. To this end, Shell has determined acceptable levels of impact to the environmental receptors that may credibly be impacted by the petroleum activities considered within this EP. The process by which Shell has determined the acceptability of risks and impacts is detailed below.

8.1 Considerations in Developing Defined Acceptable Levels of Impact and Risk

Shell has established defined acceptable levels of impacts and risks for the petroleum activities considered in this EP relating to all the environmental receptors that were identified as being credibly impacted, or at risk of being impacted. The outcomes of the evaluation of environmental impacts and risks were assessed against these defined acceptable levels to determine if the impacts or risks were acceptable.

The following were considered when establishing the acceptable levels of impacts and risks:

- The principles of Ecologically Sustainable Development (ESD)
- Other requirements applicable to the Crux project (e.g. laws, policies, standards, conventions etc.)
- Significant impacts[5] to MNES
- Internal context
- External context.

Each of these considerations are elaborated on below.

8.1.1 Principles of Ecologically Sustainable Development

Shell has considered the principles of **Ecologically Sustainable Development** (ESD)in defining acceptable levels of impacts and risks, as defined in Section 3A of the EPBC Act. The principles of ESD are summarised as:

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

8.1.2 Other Relevant Requirements

Shell considered other relevant requirements that apply to the environmental management of the petroleum activities considered in this EP, including legislation, policies, standards and guidelines in establishing acceptable levels of impacts and risks (Refer to Section 3).

[5] Significant impacts refer specifically to the levels of impacts defined in the Matters of National Environmental Significance - Significant impact guidelines 1.1. Any subsequent reference in this EP to significant impacts refers to these levels unless stated otherwise.

8.1.3 Significant Impacts to MNES

Given this EP forms the basis for NOPSEMA's assessment of matters protected under Part 3 of the EPBC Act in Commonwealth waters, Shell has given specific attention to the acceptability of impacts and risks to MNES. Where a potential interaction between the relevant MNES and an aspect of the petroleum activities covered by this EP was identified, the criteria provided are listed in Table 8-1.

Potential impacts and risks to MNES from aspects of the petroleum activities were deemed inherently acceptable if:

- The significant impact criteria in relation to the MNES are not anticipated to be exceeded
- The management of the aspect is aligned with published guidance material from the DAWE, including threat abatement plans, recovery plans and conservation advice.

Table 8-1: MNES Significant impact criteria applied to the petroleum activities considered in this EP

Category	Significant Impact Criteria
Listed Critically Endangered and Endangered species	An action is likely to have a significant impact on critically endangered or endangered species if there is likelihood that it will: • Lead to a long-term decrease in the size of a population • Reduce the area of occupancy of the species • Fragment an existing population • Adversely affect habitat critical to the survival of a species • Disrupt the breeding cycle of a population • Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat • Introduce disease that may cause the species to decline, or interfere with the recovery of the species.
Listed Vulnerable Species	An action is likely to have a significant impact on vulnerable species if there is a likelihood that it will: • Lead to a long-term decrease in the size of an important population • Reduce the area of occupancy of and important population • Fragment an existing important population into two or more populations • Adversely affect habitat critical to the survival of a species • Disrupt the breeding cycle of a population • Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat • Introduce disease that may cause the species to decline • Interfere substantially with the recovery of the species.
Listed Migratory Species	An action is likely to have a significant impact on migratory species if there is likelihood that it will: • Substantially modify, destroy or isolate an area of important habitat for a migratory species

Category	Significant Impact Criteria
	• Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species • Seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.
Wetlands of International Importance	An action is likely to have a significant impact on a wetland of international importance if there is likelihood that it will result in: • Areas of wetland being destroyed or substantially modified • A substantial and measurable change in the hydrological regime of the wetland • The habitat or lifecycle of native species dependent upon the wetland being seriously affected • A substantial and measurable change in the water quality of the wetland which may adversely impact on the biodiversity, ecological integrity, social amenity or human health • An invasive species that is harmful to the ecological character of the wetland being established in the wetland.
Commonwealth Marine Area	An action is likely to have a significant impact on the environment in a Commonwealth Marine Area if there is likelihood that it will: • Result in a known or potential pest species becoming established in the Commonwealth marine area • Modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity on a Commonwealth marine area results • Have a substantial adverse effect on a population of a marine species or cetacean including its life cycle and spatial distribution • Result in a substantial change in air quality or water quality which may adversely impact on biodiversity, ecological integrity[6], social amenity or human health • Result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity[2], social amenity or human health may be adversely affected • Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

8.1.4 Internal Context

Shell considered its internal requirements when establishing acceptable levels of impacts and risks. This context included Shell's environment policy, environmental risk management framework, internal standards, procedures, technical guidance material and opinions of internal stakeholders.

The following outlines Shell's internal impact and risk assessment defined acceptable levels:

[6] In the context of the Prelude FLNG, a change to ecological integrity is considered to take into account broadscale, long term impacts to the ecosystem. With regards to the Commonwealth marine environment, the operational area is located in open offshore waters and the seabed is generally characterised by soft sediments. These characteristics are typical of the offshore Browse Basin."

- Residual planned impacts that are ranked as minor or less (i.e. minor, slight, no effect or positive effect) and residual risks for unplanned events ranked light or dark blue, are inherently 'acceptable', if they meet legislative and Shell requirements and the established acceptable levels of impacts and risks.
- Moderate residual impacts, and yellow and red residual risks, are ‘acceptable’ with appropriate controls in place and if good industry practice can be demonstrated.
- Major and massive residual impacts from planned activities, and massive residual risks from unplanned activities, are ‘unacceptable’. The activity (or element of) should not be undertaken as the impact or risk is serious and does not meet the principles of ESD, legal requirements, Shell requirements or regulator and stakeholder expectations. The activity requires further assessment to reduce the risk to an acceptable level.

Table 8-2 provides a summary of the acceptability statements, as correlated to the rankings presented in the environmental impact and risk assessments in Section 9

Table 8-2: Acceptability Categories

Acceptability Statement	Residual Impact (Planned)	Residual Risk (Unplanned)
Inherently acceptable - Manage for continuous improvement through effective implementation of the HSSE and SP management system	• Positive Impact Consequence • No Impact Consequence • Slight Impact Consequence • Minor Impact Consequence	• Light Blue • Dark Blue
Acceptable with controls - Apply the hierarchy of control to reduce the risks to ALARP	• Moderate Impact Consequence	• Yellow • Red
Unacceptable	• Major Impact Consequence • Massive Impact Consequence	• Red - X

8.1.5 External Content

Shell also considered the external context when establishing acceptable levels of impacts and risks. This includes information provided by stakeholders during the preparation of the EP and the Crux OPP. Shell routinely implements an ongoing stakeholder engagement program managed by Shell’s External Relations team. Reference is made to Section 5 for further information on the stakeholder engagement process and a summary of responses and objections/claims made by Relevant Persons is included in *Table 5-3* and *Table 5-4* which have informed the defined acceptable levels of impact.

8.1.6 Defined Acceptable Levels of Impact and Risk

The acceptable levels of impacts and risks to environmental receptors from the petroleum activities considered in this EP are summarised in Table 8-3.

Table 8-3: Summary of acceptable levels of impact for environmental receptors that may be affected by the petroleum activities and the broader Crux project, considered in this EP

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
Physical Environment	**Water quality**	No significant impacts to water quality during the Crux project.	The routine discharge of PFW at the Crux platform may result in impacts in the immediate area of the Crux platform. Modelling studies indicate the impacts will be localised around the Crux platform (characterised as open offshore waters, typical of the offshore Browse Basin) and will persist during the operational phase of the Crux project. Liquid discharges from the Crux project cannot be avoided. However, the area influenced from routine operational discharges is expected to be limited to within 1 km of the liquid discharge locations. The potential magnitude of impacts to marine ecosystems is very low. Given the offshore location and absence of particularly sensitive marine ecosystems at the Crux platform location and immediate surrounds, potential impacts within 1 km of the Crux platform are considered acceptable. Bakke et al. (2013) states that typically no impacts are detected beyond 2 km from offshore facilities around the world. The nearest sensitive habitat to the Crux platform is Goeree Shoal, approximately 13 km away. Other discharges, such as hydrotest water and utility discharges from vessels, are of typically short duration and will not have the potential for significant impacts over an extended period.
	Sediment quality	No significant impacts to sediment quality during the Crux project.	The discharge of drill cuttings and fluids may result in elevated levels of potential contaminants near wells, such as the foundation wells at the Crux platform, or the Crux platform foundations. Additionally, the discharges from the Crux platform (e.g. drainage water) may also increase the concentration of potential contaminants around the Crux platform.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
			Sediment quality in the vicinity of the Crux in-field development area is characteristic of the sediment quality conditions of the offshore region. Bakke et al. (2013) states that typically no impacts are detected beyond 2 km from offshore facilities around the world. Impacts to sediment quality from the Crux project cannot be avoided. However, the area influenced is expected to be limited to within 1 km of sources of potential sediment contamination (e.g. drilling locations and the Crux platform). The potential magnitude of impacts to marine ecosystems is very low and localised. These impacts are considered to be acceptable when considering the seabed is smooth and bare of hard substrates, with predominantly sandy sediments observed.
	Air quality	No significant impacts to air quality during the Crux project.	Planned atmospheric emissions from the Crux project consist primarily of combustion engine exhaust emissions (e.g. gas turbine generators on the Crux platform, vessel engines etc.). Small quantities of fugitive emission from hydrocarbon processing infrastructure will also occur. These emissions will be in accordance with relevant requirements, such as Australian GHG reporting and MARPOL air pollution requirements. The Crux project is located in the open ocean, and is well-removed from nearest residential or sensitive populations of the WA coast, with limited interaction with regional airsheds.
Ecosystems, Communities and Habitats	**Benthic communities**	No significant impacts to benthic habitats and communities. No direct loss of coral communities on the outcropping reef as a result of future tie-backs to the Crux platform.	With the exception of banks and shoals, the benthic habitats and communities within the Crux project area are widely represented in the Timor Sea, with millions of hectares of broad soft benthic habitats occurring in the region and they are not of high environmental value. The outcropping reef feature, identified within the Crux in-field development area, forms part

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
		Impacts to non-sensitive benthic communities limited to a maximum of 5% of the project area.	of an extensive seabed ridge and surveys indicate this feature does not support highly diverse benthic communities, such as those characteristic of shoals and banks within the region. With the exception of banks and shoals, impacts to benthic habitats within the Crux project area are acceptable if the area impacted is < 5% of the total project area.
	Shoals and banks	No direct impacts to named banks and shoals. No loss of coral communities at named banks or shoals as a result of indirect/offsite[7] impacts associated with the Crux project.	The shoals and banks of the Timor Sea, including the three shoals within the boundary of the Crux in-field development area, are of high environmental value. Shell considers direct impacts to these features unacceptable. Indirect impacts are considered acceptable (e.g. minor pulsed turbidity events) if they do not result in any loss of coral communities, i.e. the loss of a coral colony that occurs on the shoal (noting, there is both temporal and spatial variability of corals as a result of natural environment influences, such as storms/cyclones and coral bleaching). The representativeness of coral communities is considered an indicator contributing to high biological diversity and ecological value. In the context of this assessment, a coral colony is considered integral to maintaining the ecological function and integrity of a coral community in a spatial and temporal context.
	Offshore reefs and islands	No impacts to offshore reefs and islands.	Offshore reefs and islands would only be impacted by a large-scale hydrocarbon spill, such as a well blowout. Shell considers any large-scale hydrocarbon spill to be unacceptable.

[8] Advice from the Registered Organisation will be followed where there is any variation to the this EPS for the Prelude FLNG.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
	WA and NT mainland coastline	No impacts to WA and NT mainland coastline.	The WA and NT mainland coastline would only be impacted by a large-scale hydrocarbon spill, such as a well blowout. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Key Ecological Features	No significant impacts to environmental values of KEFs.	KEFs in the Timor Sea are largely geomorphic features that provide important ecosystem services primarily as a result of their unique physical features (e.g. provision of hard substrates, facilitation of upwelling etc.). These are geographically diverse features that cover a large extent. Only one KEF is intersected by the Crux project, with the export pipeline intersecting a small portion of the continental slope demersal fish communities (0.04%). Given the nature and scale of the planned impacts to KEFs from the Crux development, impacts to KEFs will be below the significant impact threshold. Shell considers impacts to KEFs below this threshold to be acceptable.
Threatened Species and Ecological Communities	**Marine mammals**	No mortality or injury of threatened or migratory MNES fauna from the Crux project. Management of aspects of the Crux project must be aligned to conservation advice, recovery plans and threat abatement plans published by the DoEE. No significant impacts to threatened or migratory MNES fauna.	Shell considers any mortality or injury of threatened species that are MNES to be unacceptable for the Crux project. Impacts that are below the significant impact threshold are acceptable.
	Marine reptiles		
	Birds		
	Fish		
	Sharks and rays		

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
Socio-economic and Cultural Environment	**Commonwealth Marine Area**	No significant impacts to the Commonwealth marine area beyond 1 km from the Crux platform or drilling locations.	Discharges at the Crux platform may result in impacts to water and sediment quality, both of which are components of the Commonwealth marine environment, within 1 km of the Crux platform or drilling locations. As outlined above in the Water Quality and Sediment Quality sub-categories, routine impacts to water and sediment quality are expected to be limited to within 1 km and are considered acceptable as the potential impacts to the marine ecosystem (functioning and integrity) is very low when considering the discharge location and the nature of the receiving environment (open offshore waters, and with seabed characterised to be smooth and bare of hard substrates, with predominantly sandy sediments observed). Impacts beyond this range are unacceptable.
	World Heritage Properties	No impacts to world heritage values.	World heritage values would only be impacted by a large-scale hydrocarbon spill, such as a well blowout. In a regional environmental context, the nearest world heritage property is 800 km away. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	National Heritage Places	No impacts to national heritage values.	National heritage values would only be impacted by a large-scale hydrocarbon spill, such as a well blowout. In a regional environmental context, the nearest national heritage place is 170 km away. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Commonwealth Heritage Places	No impacts to Commonwealth heritage values	Commonwealth heritage values would only be impacted by a large-scale hydrocarbon spill, such as a well blowout. In a regional environmental context, the nearest Commonwealth heritage place is 149 km away. Shell considers any large-scale hydrocarbon spill to be unacceptable.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
	Declared Ramsar Wetlands	No impacts to ecological values of Ramsar wetlands	Ramsar wetlands would only be impacted by a large-scale hydrocarbon spill, such as a well blowout. In a regional environmental context, the nearest Ramsar wetland is 149 km away. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Marine Parks	No impacts to the values of marine parks	The environmental values within Australian marine parks would only be impacted by a large-scale hydrocarbon spill, such as a well blowout. In a regional environmental context, the nearest Marine Park is 95 km away. Shell considers any large-scale hydrocarbon spill to be unacceptable.
	Commercial fisheries	No negative impacts to exploited fisheries resource stocks which result in a demonstrated direct loss of income. Temporary displacement of commercial fishing activities within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of commercial fishing activities from gazetted petroleum exclusion zones is acceptable.	Impacts to commercially exploited fish stocks may measurably reduce the potential revenue for commercial fishers. Shell considers this to be unacceptable. In a regional context, commercial fishing is typically concentrated mostly in coastal waters and minimum fishing effort is known to occur within the vicinity of the project area, given its remoteness offshore. Shell considers the displacement of other users (e.g. commercial fishers) from relatively small areas of the open ocean environment in the Crux project area to be acceptable.
	Traditional Indigenous fishing	No negative impacts to exploited fisheries resource stocks. Temporary displacement of traditional fishing activities within the Crux project	Impacts to traditionally exploited fish stocks may deprive traditional fishers of the benefits provided by the environment. Shell considers this to be unacceptable.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
		area (excluding petroleum safety zones) is acceptable. Permanent exclusion of traditional fishing activities from gazetted petroleum exclusion zones is acceptable.	In a regional context, the in-field development area is located 40 km outside of the edge of the MoU Box for traditional indigenous fishing, while the export pipeline will lie within this area. Shell considers the displacement of other users (e.g. traditional indigenous fishers) from relatively small areas of the open ocean environment in the Crux project area to be acceptable.
	Marine archaeology	No disturbance to historical shipwrecks is acceptable.	Shell considers any disturbance of historical shipwrecks to be unacceptable. In a regional context, the nearest known historical shipwreck is 108 km away from the Crux platform, and 78 km from the export pipeline corridor at its nearest point.
	Tourism and recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income. Temporary displacement of tourism activities within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of tourism activities from gazetted petroleum exclusion zones is acceptable.	Impacts to nature-based tourism resources may deprive the tourism industry of revenue. Shell considers this to be unacceptable. In a regional context, there are no known tourist attractions or destinations within the project area or surrounding marine waters, however charter vessels may transit the broader regional waters. Shell considers the displacement of other users (e.g. tourism operators) from the Crux project area, which is a relatively small area of the open ocean environment where existing tourism and recreation use is very low, to be acceptable.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
	Military/defence	Temporary displacement of defence activities within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of defence activities from gazetted petroleum exclusion zones is acceptable.	Shell considers the displacement of other users (e.g. defence vessels and aircraft) from relatively small areas of the open ocean environment in the Crux project area to be acceptable. In a regional context, there are no designated military/defence exercise areas in the Crux project area and surrounds, however there are regional defence exercise areas with large geographic extents.
	Ports and commercial shipping	Temporary displacement of commercial shipping within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of commercial shipping from gazetted petroleum exclusion zones is acceptable.	Shell considers the displacement of other users (e.g. commercial shipping) from relatively small areas of the open ocean environment in the Crux project area to be acceptable. In a regional context, there are no major shipping routes traversing the in-field development area or export pipeline corridor. The nearest major shipping channel is approximately 560 km to the west of the proposed Crux platform.
	Offshore petroleum exploration and operations	Temporary displacement of petroleum exploration activities and operations within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of petroleum exploration activities and operations from gazetted petroleum exclusion zones is acceptable.	Shell considers the displacement of other users (e.g. petroleum exploration and operations) from relatively small areas of the open ocean environment in the Crux project area to be acceptable. In a regional context, the nearest operational facility to the Crux platform is the Montara production FPSO facility, approximately 36 km away.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
	Indonesian and Timor-Leste coastlines	No impacts to Indonesian or Timor-Leste coastlines are acceptable.	The Indonesian and Timor-Leste coastlines could only be impacted by a large-scale hydrocarbon spill, such as a well blowout. In a regional context, these coastlines are located a minimum 280 km away. Shell considers any large-scale hydrocarbon spill to be unacceptable.

9 Evaluation of Environmental Impacts and Risks

9.1 Introduction

This section documents the process that identifies and evaluates potential environmental impacts and risks and develops means of mitigating the effects of planned activities and the likelihood of unplanned activities of the petroleum activity on the environment, including socio-economic and cultural impacts. It describes the approach undertaken to evaluate the magnitude and severity of impact to environmental and social receptors from activities associated with the petroleum activities. The resulting proposed management controls form the basis of the Implementation Strategy (refer Section 10) which will be implemented during the petroleum activity.

9.1.1 Shell Company Approach to Risk Management

At a corporate level, Shell has a standardised Hazards and Effects Management Process (HEMP), as the process by which Shell identifies and assesses hazards and implements measures to manage them. This process is consistent with the principles outlined in the Australian Standard AS/NZS ISO 31000:2009 Risk Management and Handbook 203:2006 Environmental Risk Management (Figure 9-1). HEMP is a fundamental element of the Shell Group HSSE and SP Control Framework and is a process that is applied at every phase of projects and operations.

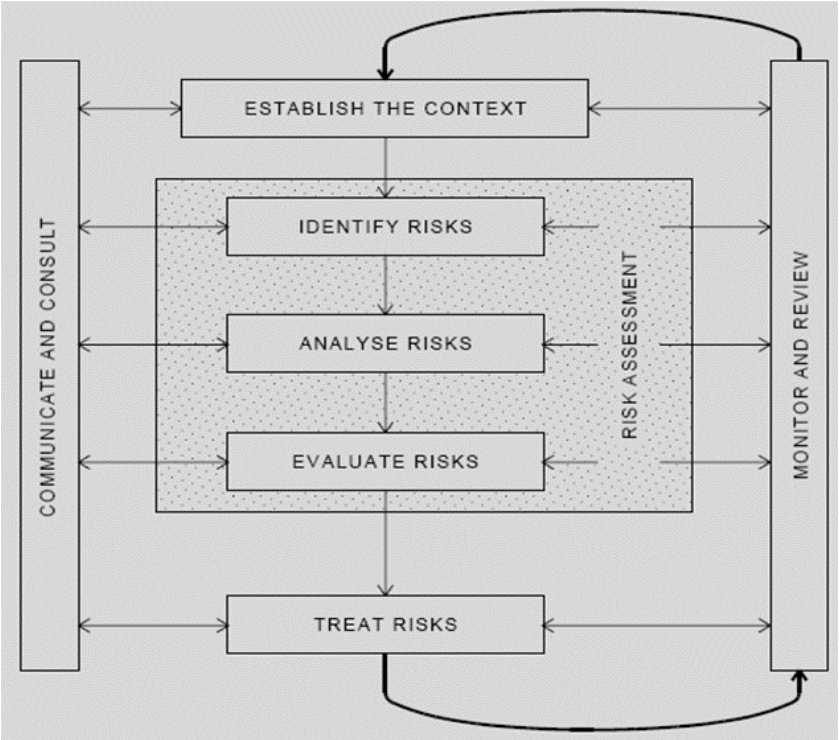


Figure 9-1: Risk Management Framework (AS/NZS 4360:2004 Risk Management)

Shell's HSSE and SP Management System is a system that is continually improving due to incorporation of legislative requirements, changing community expectations, improved available technology, ongoing stakeholder engagement, learning from incidents industry wide and within Shell, and regular management review. Assurance

that the HSSE and SP Management System is working, continually improving and that each Shell company is correctly applying new Shell standards occurs via local self-assurance and the Shell Global auditing process, which is ongoing and serves to identify gaps and drive gap closure.

Company standards are at least equal to, but in many cases more stringent than local legislation, and aligned with global good industry practice benchmarks such as those published by the IFC and World Bank. Both legislation and company standards are continually being updated and requiring a higher level of performance over time. Concurrently new technologies are becoming available and making improved performance possible and more affordable. This continual improvement is reflected in more challenging ALARP and acceptability benchmarks, leading to better environmental outcomes over time.

The OPGGS (E) Regulations 13(5)(b) requires that the Environment Plan includes 'an evaluation of all the impacts and risks, appropriate to the nature and scale of each impact or risk'. This is further clarified by Reg. 13(6) which states that: 'To avoid doubt, the evaluation mentioned in paragraph (5)(b) must evaluate all environmental impacts and risks arising directly or indirectly from (a) all operations of the activity; and (b) potential emergency conditions, whether resulting from accident or any other reason.' Based on this, Shell has chosen to present ALARP demonstrations for all identified impacts and risks, regardless of their ranking.

The succeeding sections detail the environmental impacts and risks of the petroleum activities on the local and wider environment, including socio-economic considerations. Activities are described in terms of magnitude/sensitivity and ranking of planned impacts and unplanned risks. A description of management actions proposed to reduce any effect on the environment to As Low As Reasonably Practicable (ALARP) is also presented.

In preparation of this EP a detailed desktop review of the impact and risks assessments were carried out by various environment professionals.

9.2 Impact Assessment Methodology

This section describes the approach adopted for identifying and assessing impacts on the environment as relevant to the petroleum activities. Planned activities give rise to environmental impacts, while unplanned and accidental events pose a risk of environmental impact, if they occur. The risk ranking of environmental impacts resulting from unplanned or accidental events is evaluated by identifying the worst-case credible consequence (without controls) and then assessing the likelihood for the event occurring (with confirmed controls in place).

The approach aligns with Shell's methodology that enables a balanced assessment of planned impacts and unplanned risks, noting that there are some difficulties in relying solely on the corporate Shell Risk Assessment Matrix (RAM) for assessment of planned environmental impacts. Therefore, an adapted methodology has been developed by Shell (United Kingdom), for use across Shell Group companies, that ties together both potential 'Magnitude' of a predicted impact and the 'Receptor Sensitivity' as shown in a summary impact ranking matrix (see Section 9.2.2). The matrix is used for the assessment of impacts consequences for both planned and unplanned events. However, for the assessment of unplanned events, the additional likelihood of occurrence of an event is taken into account to determine the risk ranking (See Section 9.2.4).

For the purpose of this assessment, key terminology is defined in Table 9-1.

Table 9-1: Definition of Key Terminology for Impact Assessment

Term	Definition
Acceptable	The level of impact and risk to the environment that may be considered broadly acceptable with regard to all relevant considerations.
Activity	Components or elements of work associated with the project. All activities associated with the project have been considered at a broad level (as outlined in Section 6).
ALARP	The point at which the cost (in time, money and effort) of further Risk or Impact reduction is grossly disproportionate to the Risk or Impact reduction achieved
Aspect	Elements of the proponent's activities or products or services that can interact with the environment. These include planned and unplanned (including those associated with emergency conditions) activities.
Control	A measure which prevents and/or mitigates risk by reducing the overall likelihood of a worst-case credible consequence occurring. Controls include existing controls (i.e. Company management controls or industry standards) or additional controls (i.e. additional measures identified during the risk assessment processes).
Event	An occurrence of a particular set of circumstances. An event can be one or more occurrences and can have several initiating causes.
Factor	Relevant physical, biological, socio-economic and cultural features of the environment. These are also referred to as values, sensitivities and/or receptors.
Hazard	A substance, situation, process or activity that has the ability to cause harm to the environment.
Impact	Any change to the environment from a planned activity, whether adverse or beneficial, wholly or partially resulting from a proponent's environmental aspects.
Impact Consequence	The outcome of a planned or unplanned event, which can lead to a range of worst case, credible consequences. A consequence can be certain or uncertain and can have positive or negative effects. Consequences can be expressed qualitatively or quantitatively.
Inherent risk	The potential exposure defined as the plausible worst-case event in the absence of controls
Likelihood	Description of probability or frequency of a consequence occurring with controls in place.
Residual risk	The level of risk remaining after risk treatment, i.e. application of controls (inclusive of unidentified risk).
Residual Impact	The level of impact remaining after impact treatment, i.e. application of controls (inclusive of unidentified impact).

9.2.1 Aspects and Impact/Risk Identification

The initial identification of aspects and potentially associated impacts/risks is carried out prior to any detailed assessment of the relative importance of each issue, the sensitivity of the existing environmental and/or socio-economic values, or the magnitude of the potential impact, and does not take into account potential control measures.

The key aspects arising from the petroleum activities have been identified as:

- Physical presence
- Lighting
- Underwater noise

- Seabed disturbance
- Vessel movements (unplanned)
- Liquid discharges
- Atmospheric emissions
- Waste (unplanned)
- IMS (unplanned)
- Loss of containment (including unplanned spills).

9.2.2 Evaluation of Impacts

9.2.2.1 Impact Consequence Assessment

The ranking of environmental impact consequence is assessed in terms of:

- magnitude based on the size, extent and duration/frequency of the impact; and
- the sensitivity of the receiving receptors.

These are described further below.

9.2.2.2 Magnitude

Levels of magnitude of environmental impacts are outlined in Table 9-2. The magnitude of an impact or predicted change takes into account the following (shown descriptively in Figure 9-2):

- nature of the impact and its reversibility
- duration and frequency of an impact
- extent of the change
- potential for cumulative impacts.

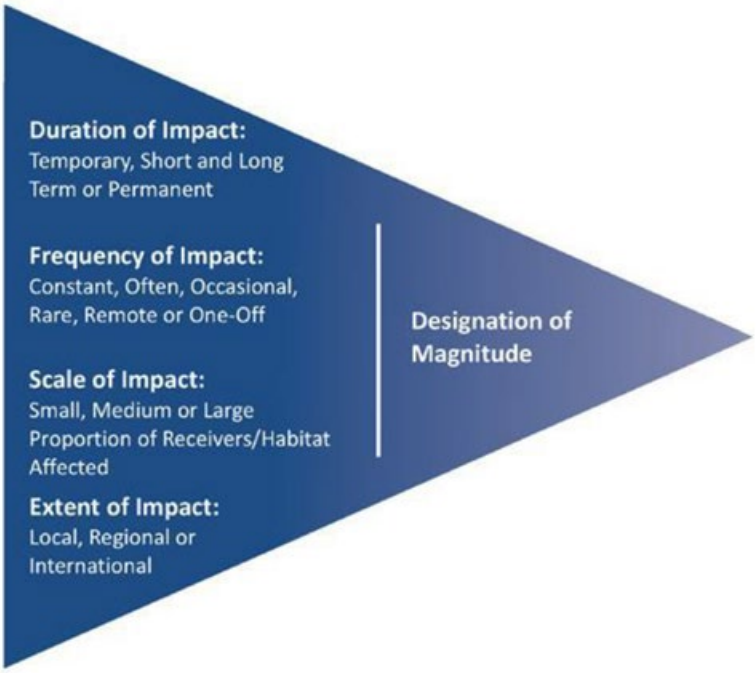


Figure 9-2: Definition of Magnitude in the Context of Impact Identification and Classification

The impact magnitude is defined differently according to the type of impact. For readily quantifiable impacts, such as noise or liquid discharge plume extent, numerical values can be used whereas for other topics (e.g. communities and habitats) a more qualitative definition is applicable. These criteria capture high level definitions, adapted as appropriate to the offshore context of the Crux project.

Table 9-2: Magnitude Criteria

+1	• Net positive effect arising from a proposed aspect of the petroleum activity
0	• No environmental damage or effects
-1	• Slight environmental damage contained within the Operational Area • Effects unlikely to be discernible or measurable • No contribution to trans-boundary or cumulative effects • Short-term or localised decrease in the availability or quality of a resource, not effecting usage
-2	• Minor environmental damage, no lasting effects or persistent effects are highly localised • Minor change in habitats or species • Unlikely to contribute to trans-boundary or cumulative effects • Short-term or localised decrease in the availability or quality of a resource, likely to be noticed by users
-3	• Moderate environmental damage that will persist or require cleaning up • Widespread change in habitats or species beyond natural variability • Observed off-site effects or damage, e.g. fish kill or damaged habitats • Decrease in the short-term (1–2 years) availability or quality of a resource affecting usage • Local or regional stakeholders' concerns leading to complaints

	• Minor trans-boundary and cumulative effects
-4	• Severe environmental damage that will require extensive measures to restore beneficial uses of the environment • Widespread degradation to the quality or availability of habitats and/or wildlife requiring significant long-term restoration effort • Major oil spill over a wide area leading to campaigns and major stakeholders' concerns • Trans-boundary effects or major contribution to cumulative effects • Mid-term (2–5 year) decrease in the availability or quality of a resource affecting usage • National stakeholders' concern leading to campaigns affecting Company's reputation
-5	• Persistent severe environmental damage that will lead to loss of use or loss of natural resources over a wide area • Widespread long-term degradation to the quality or availability of habitats that cannot be readily rectified • Major impact on the conservation objectives of internationally/nationally protected sites • Major trans-boundary or cumulative effects • Long-term (> 5 year) decrease in the availability or quality of a resource affecting usage • International public concern

9.2.2.3 Receptor Sensitivity

For this EP, receptors are grouped into the following primary categories (as described further in Section 7 and further broken down into sub-categories):

- Physical environment
- Biological environment
- Socio-economic and cultural environment.

Receptor sensitivity criteria are based on the following key factors:

- Importance of the receptor at local, national or international level – for instance, a receptor will be of high importance at international level if it is categorised as a designated protected area (such as a Ramsar site). Areas that may potentially contain high value habitats are of medium importance if their presence/extent have not yet been confirmed.
- Sensitivity/vulnerability of a receptor and its ability to recovery – for instance, certain species could adapt to changes easily or recover from an impact within a short period of time. Thus, as part of the receptor sensitivity criteria (Table 9-3) professional judgement considers recovery time of a receptor from identified impacts. This also considers if the receptor is under stress already.
- Sensitivity of the receptor to certain impacts – for instance, flaring emissions will potentially cause air quality impacts and do not affect other receptors such as seabed.

Table 9-3: Receptor Sensitivity Criteria

Sensitivity	Environmental Impact
L	Receptor with low value or importance attached to them, e.g. habitat or species which is abundant and not of conservation significance, or immediate to short-term recovery and easily adaptable to changes.
M	Receptor of Medium importance, e.g. recognised as an area/species of potential conservation significance for example, KEF or listed threatened species, or Recovery likely within 1–2 years following cessation of activities, or localised medium-term degradation with recovery in 2–5 years.
H	Receptor of High importance, e.g. recognised as an area/species of potential conservation significance with development restrictions for example marine parks or conservation reserves, or habitat critical to the survival of a species, or Recovery not expected for an extended period (> 5 years following cessation of activity) or that cannot be readily rectified.

Impact Consequence Ranking

The magnitude of the impact and sensitivity of receptor are then combined to determine the impact consequence ranking in accordance with Table 9-4 below. Key management controls are subsequently identified to reduce the magnitude for such an event occurring in order to determine the final residual impact ranking.

Table 9-4: Impact Consequence Ranking Matrix

Magnitude	Sensitivity: L	M	H
+1			
0			
-1			
-2			
-3			
-4			
-5			

Residual Impact Consequence Ranking	Residual Impact Acceptability Categories
Positive Impact Consequence	Inherently acceptable - Manage for continuous improvement through effective implementation of the HSSE and SP management system
No Impact Consequence	
Slight Impact Consequence	
Minor Impact Consequence	
Moderate Impact Consequence	Acceptable with controls - Apply the hierarchy of control to reduce the risks to ALARP
Major Impact Consequence	Unacceptable
Massive Impact Consequence	

9.2.3 Unplanned Risks (Addition of Likelihood Criteria)

For unplanned/emergency events, the likelihood of such an event occurring also requires assessment in association with the impact consequence to determine the risk ranking. For example, based on magnitude and sensitivity alone a hydrocarbon spill associated with a long-term well blowout would be classed as having a major impact consequence; however, the inherent likelihood of such an event occurring would

typically be in the range of unlikely to remote. In addition, the mitigation measures for such impacts focusses on reducing the likelihood of the impact occurring as opposed to reducing the magnitude of the impact itself. Thus, unplanned events also require assessment in terms of residual risk.

As with planned activities, the potential impacts of unplanned events are initially identified, and the impact consequence ranking is determined, which inherently takes into account the magnitude of the event and sensitivity of the relevant receptor(s). The impact consequence ranking is then combined with the likelihood of the event occurring (Table 9-5) in order to determine the overall environmental risk ranking via Table 9-6. Controls are then identified to reduce the risk of such an event occurring in order to determine residual risk.

Table 9-5: Likelihood Criteria

A	• Never heard of in the industry – **extremely remote** • < 10^{-5} per year • Has never occurred within the industry or similar industry but theoretically possible
B	• Heard of in the industry – **remote** • 10^{-5} – 10^{-3} per year • Similar event has occurred somewhere in the industry or similar industry but not likely to occur with current practices and procedures
C	• Has happened in the Company or more than once per year in the industry – **unlikely** • 10^{-3} – 10^{-2} per year • Event could occur within lifetime of similar facilities. Has occurred at similar facilities
D	• Has happened at the location or more than once per year in the Company – **possible** • 10^{-2} – 10^{-1} per year • Could occur within the lifetime of the development
E	• Has happened more than once per year at the location – **likely** • 10^{-1} – > 1 per year • Event likely to occur more than once at the facility

Table 9-6: Environmental Risk Matrix (Unplanned Events)

Residual Impact Consequence	Likelihood A	B	C	D	E
No Impact Consequence					
Slight Impact Consequence					
Minor Impact Consequence					
Moderate Impact Consequence					
Major Impact Consequence					
Massive Impact Consequence			X	X	X

	Residual Risk Acceptability Categories
Light Blue / Dark Blue	Inherently Acceptable - Manage for continuous improvement through effective implementation of the HSSE and SP management system
Yellow / Red	Acceptable with Controls - Apply the hierarchy of control to reduce the risks to ALARP
Red - X	Unacceptable

For the purpose of the petroleum activities risk review, the following key risks were assessed in accordance with the risk-based approach summarised in this section:

- Vessel movements, in the context of unplanned interactions with marine fauna
- IMS
- Atmospheric emissions
- Greenhouse gas emissions
- Unplanned release of wastes
- Unplanned (spill) events.

9.2.4 Assessment of Residual Impacts and Risks

The risk assessment methodology applied ensured the following key steps were completed throughout scenario development:

1. hazards identified
2. initiating causes determined
3. worst case credible scenarios agreed (without controls in place)
4. release of hazards understood (i.e. top events)
5. preventative controls listed
6. mitigative controls listed
7. likelihood determined (with confirmed controls in place)
8. risk ranking attributed.

In the evaluation of residual impacts and risks, all controls are assumed to be implemented effectively and functioning as intended.

The residual impacts and risks detailed in Sections 9.3-9.13 represent a discussion of the various sub-category environmental value/receptor rankings as determined. The residual rankings displayed in the summary tables in the respective sections represents the highest residual impact or risk for each primary receptor category where relevant (i.e. physical environment, biological environment, and socio-economic/cultural environment), and therefore can be considered a conservative assessment for some individual environmental values/sensitivities. These residual impacts and risks are then compared to the acceptability categories outlined in Section 7.4, Table 9-4 and Table 9-6 to determine a final ALARP and acceptability statement.

Cumulative environmental impacts and risks are also considered and discussed where relevant through the impact and risk assessment process taking into account current and foreseeable pressures on the environment including other petroleum activities, other marine industries and users, and other ecosystem pressures.

9.2.5 ALARP Assessment

ALARP for Shell means, the point at which the cost (in time, money and effort) of further risk or impact reduction is grossly disproportionate to the risk or impact reduction achieved.

ALARP can be demonstrated through a number of mechanisms via:

- a quantitative method, such as via technical assessments (e.g. modelling studies) or where the costs of the various options can be compared with the respective impact/risk reduction
- semi-quantitative method where impacts/risks within a certain level require a pre-defined number of barriers of a certain effectiveness in place to prevent this hazard being released, or via
- qualitative analysis, whereby ALARP is established using standards, legislative requirements and judgement based on experience.

Shell applies the following hierarchy of control process to demonstrate ALARP as shown in Figure 9-3.

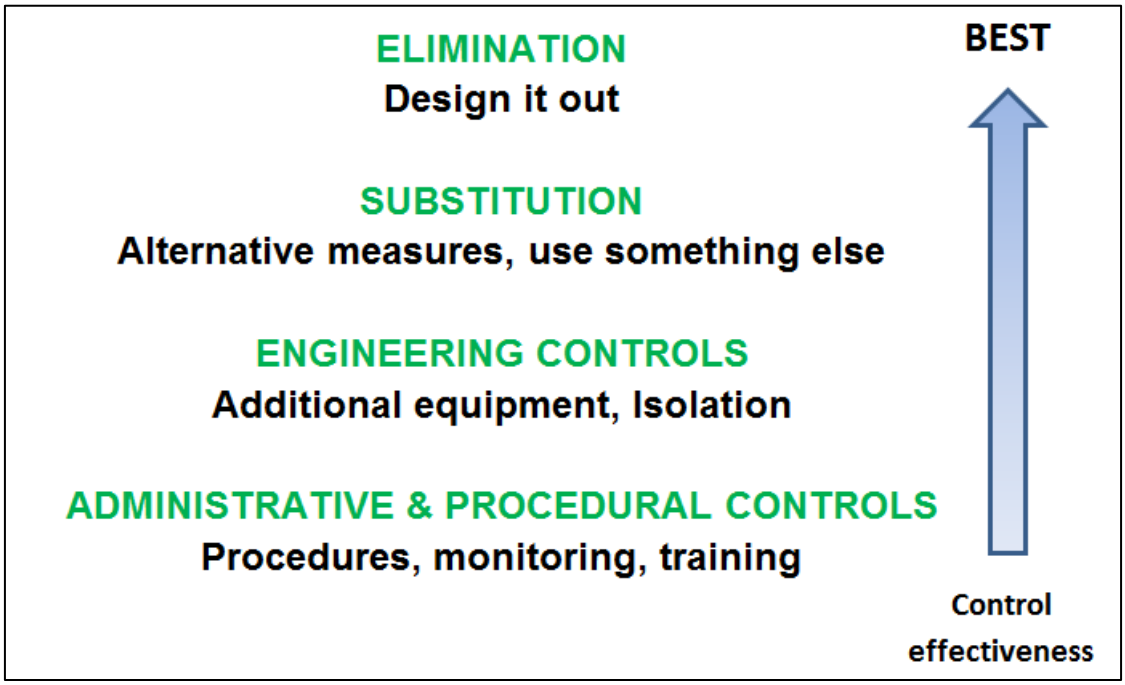


Figure 9-3: Hierarchy of Controls

9.3 Physical Presence

9.3.1 Aspect Context

The physical presence of survey vessel could potentially affect activities and access to areas associated with fishing, tourism, defence, commercial shipping and the oil and gas industry in the region. Refer to Section 6 for a description of the activity.

9.3.2 Description and Evaluation of Impacts

Socio-Economic Environment

The expected impact of the activities on the fishing industry (commercial, recreational and traditional), is expected in the worst case scenario to be slight due to the significant water depth and low fishing effort in the region and the limited extent in relation to the area available for fishing and limited duration.

There are no known tourism activities in the area due to the considerable water depths and distance offshore. Therefore, no impacts to tourism are expected.

There are no known defence exercise areas or planned activities within the Operational Area. Therefore, no impacts to defence are expected.

The closest permanent petroleum infrastructure to the activity is the Prelude FLNG, which Shell also operate. Inpex activities are over 20km away from the Operational area at its closest point. Exploration activities undertaken by other operators in the region within other permit areas are also possible and likely however, petroleum activities are not expected to affect these.

Commercial shipping activity in the vicinity of the Operational Area is high and the petroleum activities are not expected to significantly affect these other activities. Overall the worst-case residual impact ranking is assessed as Slight (Magnitude -1, Sensitivity L).

9.3.3 Impact Assessment Summary

Table 9-7: Physical Presence Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Socio-Economic Environment	-1	L	Slight

9.3.4 ALARP Assessment and Environmental Performance Standards

Table 9-8: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	N/A	N/A	Physical Presence cannot be eliminated for activities.	N/A	N/A	N/A
Substitution	N/A	N/A	No additional or alternative control measures have been identified for this risk for the activities.	N/A	N/A	N/A
Engineering	N/A	N/A	No additional or alternative control measures have been identified for this risk for the activities.	N/A	N/A	N/A
Administrative and Procedural Controls	For specific vessel based campaigns, the Australian Hydrographic Service (AHS) is given advance notification before arrival on location to enable a 'Notice to Mariners' to be issued prior to petroleum activities outside of the PSZ but within the Operational Area.	Yes	Allows notifications to be made to other marine users in the area to minimise disruption to their activities. A 'Notice to Mariners' may be issued by the relevant authority before the activity. However, routine activities undertaken by support vessels to existing offshore infrastructure or facilities do not warrant promulgation of a 'Notice to Mariners'. Similarly, activities occurring within NOPSEMA's gazetted Petroleum Safety Zones do not require promulgation of a 'Notice to Mariners'.	1.1	AHS is given notification in advance to enable a 'Notice to Mariners' to be issued prior to vessel based petroleum activities outside of the Prelude PSZ but within the Operational Area.	Records available of advance notification to the AHS which enables issuing of Notice to Mariners' or the relevant Notice to Mariners.
Administrative and Procedural Controls	Stakeholder engagement	Yes	Consultation with relevant stakeholders has been undertaken during the preparation of the EP and also is an ongoing process. Shell will ensure all Relevant Persons are provided with sufficient information and have the opportunity to raise any objections or claims regarding potential disruption from the petroleum activities.	1.2	Disruption to other marine users will be managed during ongoing stakeholder consultation.	Stakeholder engagement records
Administrative and Procedural Controls	PSZ	Yes	A PSZ of 500 m has been established and gazetted around the FLNG mooring chain touchdown locations and well centre (DC-1P), in accordance	1.3	Compliance with petroleum safety zone as per Section 616 of the OPGGS Act.	Gazette notice of PSZ

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			with the OPGGS Act (NOPSEMA 2015). Unauthorised marine users are prohibited from entering the PSZ and therefore it is a key safety measure to reduce potential interactions with the FLNG facility and associated subsea infrastructure.			Incident report form used to record breaches of PSZ requirements.
Administrative and Procedural Controls	Reduce size of the PSZ	No	A smaller PSZ would result in a smaller area from which other marine users are displaced. However, the size of the PSZ is determined by legislation (OPGGS Act) and therefore it is not able to be reduced. In relation to available space in WA-44-L, the PSZ represents a small portion of total navigable space.	N/A	N/A	N/A

9.3.5 Acceptability of Impacts

Table 9-9: Acceptability of Impacts – Physical Presence

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Socio-economic and Cultural Environment	Fishing Industry	No interference with fishing to a greater extent than is necessary for the exercise of right conferred by the titles granted to carry out petroleum activities.	Yes	Given the lack of objections or claims by relevant persons and the short duration of the survey activities, the impacts to socio-economic receptors are considered acceptable.
	Tourism and Recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income.	Yes	
	Defence	No interference with defence activities as directed by the Department of Defence.	Yes	
	Shipping	No interference with navigation to a greater extent than is necessary for the exercise of right conferred by the titles granted to carry out petroleum activities.	Yes	
	Oil and Gas Industry	No interference with other titleholders to a greater extent than is necessary for the exercise of right conferred by the titles granted to carry out the petroleum activities.	Yes	

The assessment of impacts from physical presence determined the residual impact rating of slight (Table 9-4). As outlined above, the acceptability of the impacts from physical presence associated with the petroleum activities has been considered in the following context.

Principles of ESD

The impacts from physical presence are consistent with the principles of ESD based on the following points:

- The physical presence aspect does not degrade the biological diversity or ecological integrity of the Commonwealth marine area in the Browse Basin.
- Significant impacts to MNES will not occur.

- The health, diversity and productivity of the marine environment will be maintained for future generations.
- The project does not significantly impinge upon the rights of other parties to access environmental resources (e.g. commercial and traditional fishers).
- The precautionary principle has been applied, and studies undertaken where knowledge gaps were identified. This knowledge has been applied during the evaluation of environmental impacts and risks.

Relevant Requirements

Management of the impacts from physical presence are consistent with relevant legislative requirements, including:

- Section 616 of the OPGGS Act
- Compliance with international maritime conventions, including:
  - STCW Convention
  - SOLAS Convention
  - COLREGS.
- Compliance with Australian legislation and requirements, including:
  - Navigation Act 2012:
    - Marine Order 21 (Safety of Navigation and Emergency Procedures)
    - Marine Order 30 (Prevention of Collisions)
    - Marine Order 71 (Masters and Deck Officers).

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of impacts from the physical presence of the survey vessel indicates no potential for significant impacts to threatened and migratory species.

Commonwealth Marine Environment

The evaluation of impacts from the physical presence of the survey vessel indicates significant impacts to the Commonwealth Marine Environment are not credible.

External Context

There have been no objections or claims raised by Relevant Persons to date around the physical presence aspect. Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking the assessment of impacts.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Crux Project and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from physical presence determined the residual impact rankings were slight or lower (Table 9-4 Impact Consequence Ranking Matrix).

As outlined above, the acceptability of the impacts have been considered in the context of:

- The established acceptability criteria for the physical presence aspect
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Shell considers residual impacts of slight or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the physical presence aspect.

Based on the points discussed above, Shell considers the impacts from physical presence associated with the petroleum activities to be ALARP and acceptable.

9.3.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No adverse interactions between Survey activities and other marine users. Displacement of other marine users is limited to temporary displacement due to the survey.	No supported claims reported which demonstrate direct loss of income or other impacts to marine users as a result of undertaking the petroleum activities.

9.4 Lighting

9.4.1 Aspect Context

The survey activities require 24-hour external illumination to meet maritime and operational safety standards. Artificial light emissions will be generated from navigational and operational lighting required for safe function of the survey vessel.

9.4.2 Description and Evaluation of Impacts

Lighting can create light spill, which has the potential to impact on marine fauna populations for animals that show avoidance or attraction to lights by potentially changing navigational cues that ultimately affect energy expenditure or alter predation and/or feeding rates. Impacts may include the following:

- Disorientation, misorientation, attraction or repulsion
- Disruption to natural behavioural patterns and cycles
- Secondary impacts such as increased predation
- Reduced fitness.

Biological Environment

Reptiles

Of the turtle species identified as protected under the EPBC Act, only green turtles (Scott-Browse Stock) are known to nest on Browse Island (~ 40km to the southeast of the Operational Area), with important internesting habitat located within ~20km of Browse Island (Commonwealth of Australia 2017).

Light pollution on nesting beaches can alter critical nocturnal behaviours in adult and hatchling turtles (Commonwealth of Australia 2019). Research suggests that artificial lighting can disrupt or affect the choice of nesting location by female turtles, particularly light visible on the landward side of nesting beaches (Salmon 1992). Turtle hatchlings leaving nesting beaches are particularly sensitive to artificial lighting as they use celestial cues to orientate (Limpus 2008, Salmon et al. 1992; cited in Lorne et al. 1997).

Marine turtle hatchlings may use celestial lights as navigational markers during oceanic migrations and are attracted towards bright lights. Hatchlings can become disorientated and trapped within light spill around platforms and vessels, resulting in increased energy expenditure, increased predation and decreased survival rates (Witherington & Martin 1996; cited in Lorne et al. 1997; Commonwealth of Australia 2019). However, as hatchlings swim offshore from their natal beach, they become less influenced by light cue and rely predominantly by wave motion, currents and the earth's magnetic field (Lohmann and Lohmann 1992).

Extensive light attraction studies have been conducted on turtle hatchlings, including at Barrow Island (Pendoley 2005), approximately 1,000 km southwest of the Operational Area. These studies demonstrated that hatchlings crawl away from tall, dark horizons (sand dunes and vegetation) towards lower and lighter horizons (the sea and stars), and that artificial lighting can alter this response.

Turtles in the nearshore or on the beaches of Browse Island may be able to see the lighting of the Prelude FLNG facility, however, it is unlikely they will be measureably affected by the survey vessel because it will be lower and much smaller than the Prelude FLNG.

Once in the water, hatchling navigation is influenced predominantly by wave motion, currents and the earth's magnetic field. Hence, there is no expected impact of lighting from petroleum activities on hatchlings once in the water.

Studies also suggest that light generated by flares may not affect hatchlings as much as other light sources. Witherington and Bjorndal (1991) examined the roles of light wavelength and intensity in the sea-finding mechanisms of loggerhead and green turtle hatchlings and found the most disruptive wavelengths to be in the range of 300 to 500 nanometres (nm) (blue – green wavelengths). Spectral analysis of flares at Thevenard Island (Pendoley 2000) suggests that flare light typically does not contain a high proportion of light wavelengths within this range.

There are no important habitat for listed turtle species that are known to be affected by artificial light within 20km of the Operational Area. Important habitats are those areas necessary for an ecologically significant proportion of a listed species to undertake important activities such as foraging, breeding, roosting or dispersal. The applied 20 km threshold is in alignment and provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15-18 km (Commonwealth of Australia 2019). Therefore, any light generated from within the Operational Area will not result in any environmental damage or effects given the separation distance to the nearest sensitive habitats as follows:

- 23 km to the Green Turtle critical internesting habitat

- 40 km to Browse Island – Turtle nesting and hatchlings.

Given the large separation distance of the Operational Area from Browse Island and the closest turtle critical habitat and the unaltered landward horizon at Browse Island, there is no expected residual impact consequence from petroleum activities' light spill on turtle hatchlings and adult turtles (Magnitude 0, Sensitivity – M).

There is no literature available on the effects of light on sea snakes. However, anecdotal evidence based on absence of observed sea snakes in waters in the Operational Area suggest that sea snakes are not attracted to artificial light sources.

Birds

Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around lit offshore infrastructure (Marquenie et al. 2008) and that lights can attract birds from large catchment areas (Wiese et al. 2001). Either birds may be attracted by the light source itself or indirectly as structures in deep water environments tend to attract marine life at all trophic levels, creating food sources and shelter for birds (Surnam 2002). The light from operating production facilities may also provide enhanced capability for birds to forage at night. Negative potential impacts to birds attracted by artificial lighting are limited but include collisions with infrastructure and alteration of normal behaviours (Commonwealth of Australia 2019).

When considering line of sight with respect to light assessment for birds, the factors that need to be considered include:

- the distance between the light source and the receptor
- the potential elevation of the receptor (birds).

If migratory birds are reliant on visual cues in addition to their magnetic compass, such as ambient light, moonlight and starlight to navigate, then artificial light could alter their natural migratory patterns, particularly in the absence of terrestrial landmarks. Light emissions from offshore platforms in the North Sea have been shown to attract migrating birds and birds that migrate during the night are especially affected (Verheijen 1985). During other studies conducted in the North Sea (Marquenie et al. 2008), it was noted that birds travelling within a 5km radius of illuminated offshore platforms may deviate from their intended route and either circle or land on the nearby platform. Beyond this distance, it is assumed that light source strengths were not sufficient to attract birds away from their preferred migration route.

Injuries and mortalities to birds occur through direct collisions with infrastructure and the rate of collision is (as inferred from literature) relates to weather conditions, the cross-sectional area of the obstacle, amount of light and number of birds travelling through an area. Where bird collision incidents have been reported, low visibility weather conditions (cloudy, overcast and foggy nights) have usually been implicated as the major contributing factor, in contrast there are seldom collision incidents on clear nights (Avery 1976; Elkins 1988; Weise et al. 2001). It should be noted that conditions in the Operational Area are not conducive to significant fog formation, however most rainfall is seasonal associated with summer monsoon and cyclones in November to April which does overlap with the peak migratory period for birds as indicated in Section 7.2.8.3 Seasonal Sensitivities of Threatened Species.

According to Bamford et al. (2008), 33 species of migratory birds that use the East Asian-Australian Flyway (EAAF) are regularly present within Australia. The EPBC listed

streaked shearwater was not identified as using the EAAF in Bamford's study. Migratory shorebird species are mostly present in Australia during the non-breeding period, from as early as August to as late as April/May each year (DoEE 2017b) As defined previously, the documented zone of impact for migratory birds that resulted in a recorded change in natural behaviour (Marquenie et al. 2008) is two orders of magnitude smaller than the limit of visibility, at a radius of 5 km from an artificial light source.

There are no important habitats for listed bird species that are known to be affected by artificial light within 20 km of the Operational Area. Important habitats are those areas necessary for an ecologically significant proportion of a listed species to undertake important activities such as foraging, breeding, roosting or dispersal. The applied 20 km threshold provides a precautionary limit based on observed effects of sky glow on fledgling seabirds grounded in response to artificial light 15 km away (Commonwealth of Australia 2019). Therefore, any light generated from within the Operational Area will not result in any environmental damage or effects given the separation distance to the nearest sensitive habitats as follows:

- 59km to the nearest bird breeding BIA.

It is considered possible that small numbers of mature birds may be attracted to the lighting of the vessel. Within the first two years of the adjacent Prelude FLNG being on location in the Operational Area, there had been recorded observations of one live bird resting on the FLNG and 8 deceased birds of unknown cause, none of which were listed as Threatened. Even if all of the recorded birds could be attributed to a single species with lighting as the key cause, this number would represent a very low proportion of the total number of birds that would have flown through the area within the same timeframe and would be well below what would be considered an ecologically significant proportion. Therefore, it is concluded that under the worst case conditions, there are no expected residual impact consequence (Magnitude – 0, Sensitivity – M).

Pelagic Communities

Fish and zooplankton may be directly or indirectly attracted to lights. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al. 2001), with traps drawing catches from up to 90 m (Milicich et al. 1992). Lindquist et al. (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by platform light fields.

The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. Shaw et al. (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas. The intensity of lights may potentially result in a concentration of some marine fauna.

The potential for increased predator activity is unlikely to result in a significant impact on the plankton or fish populations. Given the relatively small impact area surrounding the petroleum activities in respect to zooplankton and fish habitat, the potential impacts are expected to be highly localised and unlikely to have discernible consequences at the population level. The distances from Operational Area to the closest island (Browse Island) and shoal (Echuca Shoal) are approximately 40 km and 61 km from the

Operational Area respectively. Therefore, it is unlikely that artificial lighting will impede or disturb natural lighting cycles that may affect coral spawning.

The range of attraction for fish and invertebrates to lighting from the vessel is expected to be localised with no discernible residual impact consequence (Magnitude – 0, Sensitivity - L) and is not expected to attract individuals away from any named shoals/banks, offshore reefs/islands or KEFs. Considering a low receptor sensitivity to such impacts, there are no credible residual impacts at a population level.

9.4.3 Impact Assessment Summary

Table 9-10 lists the highest impact consequence rating in the relevant environmental receptor groups.

Table 9-10: Light Emissions Evaluation of Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Physical Environment	N/A	N/A	N/A
Biological Environment	0	M	No Impact
Socio-Economic Environment	N/A	N/A	N/A

9.4.4 ALARP Assessment and Environmental Performance Standards

Table 9-11: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	No lighting	N/A	No additional or alternative control measures have been identified for this impact for the activities, given the requirement for a well-lit work area.	N/A	N/A	N/A
Administrative and Procedural controls			No additional or alternative control measures have been identified for this impact for the activities, given the requirement for a well-lit work area.	N/A	N/A	N/A

9.4.5 Acceptability of Impacts

Table 9-12: Acceptability of Impacts - Lighting

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	N/A	N/A	N/A	N/A
Biological Environment	Threatened and Migratory Species	No significant impacts to listed Threatened (Endangered and Vulnerable) or Migratory MNES fauna populations. Management of aspects of the project must be aligned to conservation advice, recovery plans and threat abatement plans, including for bird and marine turtle species.	Yes	Light from the vessel may attract threatened and migratory birds, which may roost on the structures. Given there are no important habitats within 20 km of the facilities (20 km being a conservative threshold distance for impacts), light emissions are not expected to result in significant impacts at a population level. Light emissions are not anticipated to have a significant impact on marine turtle species given the separation distance of the facilities from any sensitive habitat, and are therefore not inconsistent with the requirements of the relevant recovery plan.
	Pelagic communities (Non-Threatened or Migratory)	No significant adverse effect on pelagic communities, populations, habitats or spatial distribution of a species.	Yes	The range of attraction for fish and invertebrates to lighting from the vessel is expected to be localised and no discernible impacts are expected. The facility is also not expected to attract individuals away from any named shoals/banks, offshore reefs/islands or KEFs. Considering a Low receptor sensitivity to such impacts, there is no credible potential for residual impacts at a population level.
Socio-economic and Cultural Environment	N/A	N/A	N/A	N/A

The assessment of impacts from light emissions determined no residual worst case impact (Table 9-10). As outlined above, the acceptability of the impacts from light emissions associated with vessel operations has been considered in the following context.

Principles of ESD

The impacts from light emissions are consistent with the principles of ESD based on the following points:

- The light emissions aspect does not degrade the biological diversity or ecological integrity of the Commonwealth Marine Area and significant impacts to MNES are not anticipated to occur.
- The precautionary principle has been applied, and studies/reviews undertaken (ERM 2009b; Imbricata 2018) where knowledge gaps were identified. This knowledge has been applied during the evaluation of environmental impacts.

Relevant Requirements

Management of impacts from light emissions are consistent with relevant legislative requirements, including:

- Draft National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds (Commonwealth of Australia 2019).
- Management of impacts are consistent with policies, strategies, guidelines, conservation advice, and recovery plans for threatened species (Table 9-13).

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of lighting impacts indicates significant impacts to threatened and migratory species will not credibly result from the light emissions aspect of vessel operations.

Alignment of vessel operations with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-13.

Commonwealth Marine Environment

The impacts from the light emissions aspect of vessel operations on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-13: Summary of Alignment of the Impacts from Light Emissions Aspect of the petroleum activities with Relevant Requirements for EPBC Threatened Fauna

Matters of National Environmental Significance	MNES Acceptability Considerations (Significant Impact Criteria, EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory species - Birds	Significant impact criteria for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	The evaluation of environmental impacts indicates that impacts from artificial light emissions on threatened or migratory species are likely to be minor and would not constitute a significant impact to populations. As such, residual impacts from artificial light associated with the petroleum activities does not exceed any of the significant impact criteria for Threatened and Migratory marine species provided in Table 8-1.
	Wildlife Conservation Plan for Migratory Shorebirds (DoE 2015a)	Managing the light aspect of vessel operations has been aligned to 'Objective 4' of the Plan by ensuring that anthropogenic disturbance was considered in development assessment

		processes. Migratory birds have been considered as an environmental receptor in the evaluation of lighting impacts.
	Draft National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2019).	Seabirds and migratory birds have been identified in the draft National Light Pollution Guidelines to be affected by artificial light sources. The management of light emissions for vessel operations has considered the light management actions described in the guidelines and the impact assessment/thresholds have been based on the precautionary limits referenced in the guidelines (Section 9.4.2).
Threatened and Migratory species - Marine Reptiles	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	The evaluation of environmental impacts indicates that impacts from artificial light emissions on threatened or migratory marine reptiles are slight and would not constitute a significant impact. As such, residual impacts from artificial light associated with vessel operations do not exceed any of the significant impact criteria for Threatened and Migratory marine reptile species provided in Table 8-1.
	Recovery Plan for Marine Turtles (Commonwealth of Australia 2017)	Light pollution has been identified as a threat in the Recovery Plan for Marine Turtles (Commonwealth of Australia 2017). Nesting females and hatchling turtles are at greatest risk of light impacts; however, the nearest potential nesting habitat is Browse Island (approximately 40 km from the FLNG). Potential light-related impacts to turtles on nesting beaches is considered to be slight. Actions in the Recovery Plan for Marine Turtles (Commonwealth of Australia 2017) relating to the threat of artificial light include: • Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats • Develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches • Identify the cumulative impacts on turtles from multiple sources of onshore and offshore light pollution Given the Operational Area is beyond any BIAs or habitat critical for the survival of marine turtles (e.g. nesting, inter-nesting or foraging areas) and the light modelling and other studies indicate that impacts to marine turtles will be nil, the actions listed above are not applicable to vessel operations.
	Draft National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2019).	Marine turtles have been identified in the draft National Light Pollution Guidelines to be affected by artificial light sources. The management of light emissions for vessel operations has considered the light management actions described in the guidelines and the impact assessment/thresholds have been based on the precautionary limits referenced in the guidelines (Section 9.4.2).
Commonwealth marine area	Significant Impact Guidelines for the Commonwealth marine environment (Table 8-1)	The evaluation of environmental impacts indicates that the light emissions aspect of vessel operations will not exceed the Commonwealth marine environment significant impact criteria provided in Table 8-1.

External Context

There have been no objections or claims raised by Relevant Persons to date around the lighting aspect. Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking the assessment of impacts and risks.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls

which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from light emissions determined the residual impact ratings were Nil (Table 9-10) given that any visible light (including sky glow) will not displace or disrupt any MNES listed species from important habitat, nor will it prevent these species from being able to undertake critical behaviours such as foraging, reproduction and dispersal. Shell considers residual impacts of nil to be acceptable if they meet legislative and Shell requirements. To this effect, the acceptability of these impacts have been considered in the context of:

- The established acceptability criteria for the light emissions aspect
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Based on the discussion of these considerations presented above, Shell considers impacts from light emissions associated with vessel operations to be acceptable.

9.4.6 Environment Performance Outcomes

Environment Performance Outcome	Measurement Criteria
No injury or mortality of listed Threatened or Migratory MNES species as a result of artificial light emissions. Management of artificial light emissions associated with the project must be aligned to conservation advice, recovery plans and threat abatement plans, including for bird and marine turtle species.	Fauna observations and incident reports demonstrate no mortality of listed Threatened species as a result of artificial light emissions.

9.5 Noise

9.5.1 Aspect Context

Airborne and marine noise emissions from the seabed survey operations are generated from the following operational sources and activities:

- Geophysical survey activities such as MBES, SSS and SBP.
- Vessel operations, including operating on dynamic position (DP).
- Geotechnical survey activities including core drilling and penetration cores.

Table 9-14: Typical sound pressure levels for site survey activities

Activity	Sound Pressure Level	Reference
Impulsive sound		
MBES	~218 dB re 1 µPa RMS @ 1 m	(MacGillivray, Racca and Zizheng 2013)
SSS	~229 dB re 1 µPa RMS @ 1 m	(Geoscience Australia n.d.) (Tritech n.d.) (MacGillivray, Racca and Zizheng 2013)
SBP	~200 dB re 1 µPa RMS @ 1 m	(Geoscience Australia n.d.) (MacGillivray, Racca and Zizheng 2013)
Transponders	183–202 dB re 1 µPa RMS @ 1 m	(Sonardyne 2018) (Sonardyne 2021)
Continuous sound		
Vessel operations	165–192 dB re 1 µPa RMS @ 1 m	(Hannay, et al. 2004) (Richardson, et al. 1995)

Underwater acoustic emissions associated with the vessel and geotechnical survey will be continuous while the underwater acoustic emissions associated with the geophysical survey will be impulsive.

To assess potential impacts to receptors from underwater acoustic emissions associated with the geophysical, vessel and geotechnical survey activities, published literature was used.

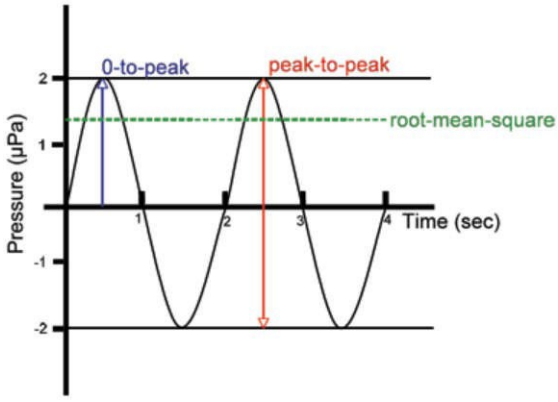


Figure 6-1: Representative sound wave and sound measures

Table 6-3: Sound terminology

Term	Definition
0-to-peak or Peak sound pressure level (PK)	The peak pressure, also called the 0-to-peak pressure, is the range in pressure between zero and the greatest pressure of the signal. It is represented by PK and the unit dB re 1 µPa and summarised as dB PK.
Peak-to-peak sound pressure level (PK-PK)	The peak-to-peak pressure is the range in pressure between the most negative pressure and the most positive pressure of the signal. It is represented by PK-PK and the unit dB re 1µPa or dB re 1 µPa2m2 and summarised as dB PK-PK.
Permanent threshold shift (PTS)	Permanent loss of hearing sensitivity caused by excessive noise exposure.
Received sound levels	The sound level measured at a receiver.
Root mean square sound pressure level (RMS)	The root-mean-square pressure is the square root of the average of the square of the pressure of the sound signal over a given duration. It is represented by sound pressure level (SPL) and the unit dB re 1 µPa and summarised as dB SPL.
Sound exposure level (SEL)	A measure of the sound energy that considers both received level and duration of exposure. SEL is specified in terms of either single pulse (SEL) or a defined accumulation period (SELcum). For this assessment 24hrs has been used for the accumulation period and is shown as SEL24h. Units are dB re 1 µPa2·s or dB re 1 µPa2m2s.
Source sound level	The sound pressure level or sound exposure level measured 1 metre from a theoretical point source that radiates the same total sound power as the actual source.
Temporary threshold shift (TTS)	Temporary loss of hearing sensitivity caused by excessive noise exposure.

Underwater Noise Impact Levels

Marine species with the greatest sensitivity to underwater noise are marine mammals (whales and dolphins), turtles and fish (including larvae). Other species that could be affected by underwater noise include sea snakes, sharks and rays and invertebrates.

Impacts to marine fauna can be grouped in the following decreasing order of effect:

- mortality or potential mortal injury – physical injury that may result in the death of an animal
- impairment:

- permanent threshold shift (PTS) – a permanent reduction in the ability of an animal to perceive sound. Recovery is not expected to occur.
- temporary threshold shift (TTS) – a temporary reduction in the ability of an animal to perceive sound. Recovery to pre-exposure levels is expected to occur.
- masking – no change in the ability for an animal to perceive sound, but biologically meaningful sounds may be "drowned out" by anthropogenic noise.

- behavioural impacts – typically short-term behavioural responses such as avoidance, surfacing etc. Behaviour will return to normal following cessation of the anthropogenic noise.

Table 9-15: Effect criteria used and the applicable results for representative single pulse sites and for accumulated SEL scenarios

Receptor	***Noise Effect Criteria***	***Noise Effect Criteria Reference***
***Fish** (swim bladder):* *mortality/potential mortal injury*	*>207 dB PK or* *207 dB SELcum[1]*	*Popper et al. 2014*
***Fish** (swim bladder): recoverable* *injury*	*>213 dB PK or* *>216 dB SELcum[1]*	*Popper et al. 2014*
***Fish** (no swim bladder): mortality/* *potential mortal injury*	*>213 dB PK or* *>219 dB SELcum[1]*	*Popper et al. 2014*
***Fish** (no swim bladder):* *recoverable injury*	*>213 dB PK or* *>216 dB SELcum[1]*	*Popper et al. 2014*
***Fish** (swim bladder or no swim bladder): TTS*	*>186 dB SELcum[1]*	*Popper et al. 2014*
***Turtle**: behavioural*	*166 dB SPL*	*NSF 2011*
***Turtle**: mortality/potential mortal* *injury*	*>207 dB PK or* *210 dB SELcum[1]*	*Popper et al. 2014*
***Marine mammals**: behavioural*	*160 dB SPL*	*NMFS 2013*
***Low-frequency cetaceans**: PTS* *(humpback and pygmy blue whales)*	*219 dB PK* *183 dB SEL_{24h}*	*NMFS 2018*
***Low-frequency cetaceans**: TTS*	*213 dB PK*	*NMFS 2018*

Receptor	*Noise Effect Criteria*	*Noise Effect Criteria Reference*
(humpback and pygmy blue whales)	*168 dB SEL_{24h}*	
***Mid-frequency cetaceans**: PTS* *(dolphins, beaked whales, sperm whales)*	*230 dB PK* *185 dB SEL_{24h}*	*NMFS 2018*
***Mid-frequency cetaceans:** TTS* *(dolphins, beaked whales, sperm whales)*	*224 dB PK* *170 dB SEL_{24h}*	*NMFS 2018*
***High-frequency cetaceans:** PTS* *(pygmy and dwarf sperm whales)*	*202 dB PK* *155 dB SEL_{24h}*	*NMFS 2018*
***High-frequency cetaceans:** TTS* *(pygmy and dwarf sperm whales)*	*196 dB PK* *140 dB SEL_{24h}*	*NMFS 2018*

Note 1: Popper et al. 2014 do not defined an accumulation period. For this assessment 24 hours was used based on the independent, expert peer review by Popper (Santos, 2018) that concluded that a 24-hour period to assess SELcum and any associated effects is likely to be conservative for assessing the potential effects to fish.

Noise modelling carried out by Prelude FLNG has been used an adopted for the noise impact assessment for this petroleum activity given the proximity to Prelude FLNG and the conservative nature of the outcomes of noise modelling compared to modelling and measurements of activities specifically for MBES, SSS and SBP activities.

Prelude FLNG Modelling Results vs Threshold Levels

The adjacent Prelude FLNG activities have the potential for localised and temporary noise impacts on marine fauna, including fish, marine turtles and cetaceans. Based on the thresholds outlined above and the hearing bands for different fauna, underwater noise levels would:

- fall below the relevant cumulative permanent hearing damage criteria for all marine fauna except high frequency cetaceans, at all locations.
- fall below the permanent hearing damage criteria for high frequency cetaceans (24-hour cumulative exposure period) within tens of metres of the facility.
- fall below the relevant temporary hearing threshold shift criteria for fish (12-hour exposure period) beyond 60 metres from the facility.

- fall below the relevant temporary hearing threshold shift criteria for cetaceans beyond 150 metres from the facility during offloading operations.
- fall below the relevant behavioural disturbance criteria for cetaceans at ranges beyond 9 km during Prelude offtake operations (cavitation noise) and 1.3 km during normal Prelude production operations (plant noise).

9.5.2 Description and Evaluation of Impacts

Measurements conducted as part of monitoring programs in the Arctic (Chukchi and Beaufort Seas), detailed in Reiser et al (2011) and Warner and McCrodan (2011) present measured results (as opposed to modelling) for geophysical equipment. These data illustrate that the sound levels generated by geophysical equipment rapidly attenuates within hundreds of metres of the sound source. These studies were carried out in shallow water, <50m, whereas the proposed activities occur in water depths between 160-250m, therefore noise attenuation will not be as significant (Reiser et al 2011).

Physical Environment

There are no impacts on the physical environment protected under the EPBC Act such as air or water quality. Noise impacts are limited to the biological environment as discussed below.

Biological Environment

Ecosystems, Communities and Habitats

Benthic Communities

Given the frequency spectrum and intensity of noise generated during the petroleum activity, no impacts to benthic communities as a consequence of underwater noise are expected to occur.

Islands, shoals, banks and near the Operational Area may potentially be exposed to increased underwater noise levels as a result of vessels using DP, MBES, SSS and SBP use. These host relatively diverse fauna communities, such as demersal fish and marine turtles (see Threatened Species and Ecological Communities below for further discussion). However, given the distance of these islands, shoals and banks from the noise sources in the Operational Area and the consequent reduction in noise intensity, the received noise levels will be significantly lower than the source levels. The nearest island to the Operational Area is Browse Island, which lies approximately 39 km to the southeast. The nearest shoal, Echuca Shoal, is 61 km east. At these distances noise emissions from the activities would have fallen to within background noise levels, hence there are no credible potential impacts to island communities (Refer to Threatened Species and Ecological Communities below for further discussion of noise impacts on marine turtles).

Pelagic Communities

Pelagic communities in the Operational Area include planktonic communities and pelagic fish and invertebrates. The effects of noise on free swimming pelagic fish are assessed below with Threatened Species and Ecological Communities and are not addressed further in this section.

Planktonic communities comprise a diverse range of taxa, which will differ in their potential to be impacted by underwater noise. Many species of pelagic and demersal fish have a planktonic larval stage.

Modelling studies by the CSIRO indicate that planktonic communities are highly dynamic and have the potential to recover rapidly following disturbance (Richardson et al. 2017). Experiments have shown mixed results of larval stages to underwater noise. For example, experiments on several species of fish larvae and lobster larvae did not detect significant effects as a result of high intensity impulsive noise (Bolle et al. 2012; Day et al. 2016; Payne et al. 2009).

Impacts to planktonic larvae have not been reliably demonstrated under conditions analogous to those that will be encountered during petroleum activities, being orders of magnitude less than that of experimental designs referenced above. The more intensive noise sources are of limited duration (e.g. vessels using DP and survey duration), which limits the exposure of planktonic organisms. As such, the residual impact consequence to planktonic communities are considered to be Slight (Magnitude -1, Sensitivity – L).

The Operational Area is not expected to host highly abundant or diverse assemblages of fish, sharks or rays. The Prelude noise modelling indicates that no exceedance of the permanent injury threshold for any category of fish would occur in the Operational area and underwater noise levels would fall below the relevant temporary hearing threshold shift criteria for fish (12 hr exposure period) within 60 m from the facility. The approximate received level threshold for behavioural disturbance in fish is variable but indicated to be greater than 90dB re 1µPa above hearing thresholds (Popper et al. 2003, Scholik and Yan 2002a, 2002b, Xodus 2009, Hastings et al. 1996; cited in Woodside Energy Limited 2011). The cumulative effect of the survey activities occurring near Prelude FLNG, are not expected to significantly add to the predicted noise impacts. Therefore, the highest impact on masking vocalisation and changes to behaviour will occur within tens and hundreds of metres from the petroleum activities for pelagic fish and sharks and rays.

Given the highly mobile nature of fish, sharks and rays and their continual sightings in the Operational Area around the hull, it is concluded that continuous noise sources from the petroleum activity will have at most a slight residual impact consequence (Magnitude -1, Sensitivity – L) on these resident and transient populations.

Key Ecological Features

The only KEF occuring within the Operational Area is the Continental Slope Demersal Fish Communities, covering a vast area of approximately 33,182 km^2, located along a 7km section of the KEF. These are a high diversity of demersal fish assemblages on the Australian continental slope featuring more than 500 fish species, 76 of which being endemic, which makes it the most diverse slope bioregion in the whole of Australia.

The noise levels at the closest point of this KEF will be between 120 and 110 dB re: 1uPa in the 10 Hz to 2 KHz band. At these water depths (>200m) there is no potential for permanent, temporary or behavioural impact to demersal fish with moderate potential for masking fish choruses only. Potential impacts to the demersal fish communities are therefore considered slight. Other KEFs are too distant from the Operational Area to be credibly impacted by underwater noise from the petroleum activity.

Threatened and Migratory Species

Marine Mammals

Most cetacean species use sound to communicate (e.g. humpback whale calls) or perceive their environment (e.g. echolocation of prey). This reliance on underwater noise, and their high conservation value, makes cetaceans of concern when assessing

potential impacts from underwater noise. Low frequency cetaceans are expected to be most vulnerable to underwater noise from vessel operations (cavitation and plant noise) due to the frequency spectra of these noise sources overlapping the functional hearing range of these species (approximately 7 Hz to 30 kHz). Several low frequency cetaceans (blue, humpback, sei, fin and Bryde's whales) were identified as potentially occurring within the Operational Area (Section 7.2.3). Noise monitoring in the Timor Sea for the Barossa development indicated pygmy blue and Bryde's whales are the most likely to occur (McPherson et al. 2016). Detection of low-frequency cetaceans calls were not constant, but occurred sporadically, often in groups or sets of calls.

Mid frequency cetaceans are also vulnerable to underwater noise, although their hearing range means they are more vulnerable to noise frequencies overlapping their functional hearing range (approximately 150 Hz to 160 kHz). Mid frequency cetaceans include most toothed whales, dolphins and porpoises and a number of species of mid frequency cetaceans were identified as potentially occurring within the Operational Area and adjacent EMBA (Section 7.2.3). Noise monitoring in the Timor Sea indicates mid-frequency cetaceans are present year-round (McPherson et al. 2016).

Given that modelling indicates underwater noise levels fall below the relevant cumulative permanent hearing damage criteria for low and mid frequency cetaceans at all locations within the Operational Area and fall below the relevant TTS criteria for cetaceans beyond 150 m from the facility during offloading operations it is considered that the potential for significant impacts to cetaceans within the Operational area is not credible. Given also that noise levels from the petroleum activities fall below the relevant behavioural disturbance criteria for cetaceans at ranges beyond 9 km (cavitation noise) and 1.3 km during normal production operations (plant noise), the overall impact to marine mammals is considered to be Slight (Magnitude -1, Sensitivity -M).

Other sources of noise, associated with short term operations, such as operational flaring or helicopter operations, will be short in duration and largely reflected off the seawater air barrier to be causing any greater impact on cetaceans than a temporary behavioural response. A similar level of impact is expected from use of side scan sonars during subsea infrastructure IMR activities, which due to being high-frequency sounds are known to be outside the hearing thresholds of cetaceans. Impacts from side scan sonars are therefore expected to cause no greater than slight impacts to marine mammals.

Marine vessel underwater noise emissions are of frequencies detectable by marine mammals however the sound levels at the source itself will be of magnitude that could cause at worst a TSS for an animal happening to be in a very close proximity (within tens of meters of the vessel). The most likely impact consequence at these levels is a behavioural response such as avoidance. For a PTS impact to occur, the mammal should be swimming within metres of the vessel for more than 24 hours, which is a non-credible scenario. It is therefore concluded that noise emissions from marine vessels could potentially cause only a slight residual impact on marine mammals (Magnitude -1, Sensitivity - M).

Marine Reptiles

Marine reptiles such as turtles and sea snakes are not known to be particularly sensitive to underwater noise. Research on marine turtles suggests that functional hearing is concentrated at frequencies between 100 and 600 Hz (which is a subset of the low frequency cetacean range). Several turtle species were identified as likely to occur within the Operational Area (Section 7.2.3), although no critical habitat or BIAs

overlap the Operational Area. The closest critical marine turtle habitats include green turtle nesting habitat some 17 km from the Operational Area and foraging habitat some 39 km from the Operational Area. Noise levels at the 17 km distance from the Operational Area are approximately 110 dB re 1uPa during offloading operations only (24 to 48 hrs per week on average) and 90dB re 1uPa for the rest of the time (background plant operations noise) and impacts to marine turtles at this distance are expected to be slight. All other marine turtle habitats are more than 100 km away from the Operational Area, hence there are no potential for impacts to those. Impacts from marine vessel noise emissions are also expected to be Slight (Magnitude -1, Sensitivity - M) due to the large separation distance between the Operational Area and the closest marine turtle habitats and the continuous nature and sound levels of marine vessel noise at source. Impacts on sea snakes from all sources discussed above are similarly expected to be slight with reference to response levels for fish.

Whale Sharks

Whale sharks may traverse the Operational Area and broadly the EMBA with a BIA for foraging whale sharks located 33 km from the Operational Area at the Prelude end and overlapping the Operational Area in the northern part. However, it is expected that whale shark presence within the close vicinity of the vessel where the activity is occurring would be transitory and of short duration. This is consistent with tagging studies of whale shark movements which show continual movement of whale sharks in deeper, open offshore waters (Meekan & Radford 2010). Whale sharks are also not considered to be particularly vulnerable to noise related impacts (refer to response levels for fish in Table 9-15).

Overall, the worst-case residual impact consequence to biological communities is assessed as Slight (Magnitude -1, Sensitivity - M).

Socio-Economic Environment

No reasonably foreseeable adverse impacts from noise emissions, including consideration of supply vessel and helicopter operations and impacts on commercial fishing stocks (discussed in Biological Environment), have been identified on the socio-economic environment.

Survey activities will not overlap with or exclude fishers from fishing areas known to be used by Indonesian traditional fishers within the MOU 74BOX at Scott or Seringapatam Reef.

Ashmore Reef and Carter Island AMP boundaries are located 127 km and 80 km, respectively from the Operational Area. Additionally, single impulse sound levels of the amplitude used during the activities used in this survey will not result in accumulated SEL from the petroleum activity at these locations to approach the acoustic impact threshold for TTS onset in fish (186 dB re 1 µPa2.s), therefore, acoustic impacts are not expected to impact target fish species and thus Indonesian traditional fisheries catch.

The estimated received sound levels within the reef are not likely to exceed acoustic impact thresholds for divers [i.e. 145 dB re 1 µPa (SPL) as they are too distant from the noise source to be potentially impacted.

At most, the impact to any social receptor is considered to be slight from the petroleum activities described in Section 6.

9.5.3 Impact Assessment Summary

Table 9-16 lists the highest residual impact consequence ranking of the relevant environmental receptor groups.

Table 9-16: Noise Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Physical Environment	N/A	N/A	N/A
Biological Environment	-1	M	Slight
Socio-Economic Environment	-1	M	Slight

9.5.4 ALARP Assessment and Environmental Performance Standards

Table 9-17: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	Timing the activity to eliminate sound impacts to pygmy blue whales and humpback whales.	No	The activity must be carried out in the 2nd half of 2022, subject to vessel availability and environmental approvals. The activity cannot be carried out later than this as it will impact project schedules which significantly affects the value the project can deliver. Subject to approvals being granted in time, it is possible the timing may be suitable to avoid migration period for the pygmy blue whale. Regardless, the operational area is not within the Blue Whale BIA.	N/A	N/A	N/A
Substitution	N/A	N/A	No additional or alternative control measures have been identified for this risk for the activities.	N/A	N/A	N/A
Engineering	N/A	N/A	No additional or alternative control measures have been identified for this risk for the activities.	N/A	N/A	N/A
Administrative and Procedural Controls	Marine support vessel interactions with threatened and migratory species to follow the of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017).	Yes	The EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017) are recognised as the industry standard for minimising disturbance due to physical presence and noise to whales and dolphins and will be applied to other species as relevant, .i.e. turtles and whale sharks.	3.1	Vessels will comply with EPBC Regulations 2000 Part 8, Division 8.1 Interacting with cetaceans and the Australian National Guidelines for Whale and Dolphin Watching.	Incident report form used to record breaches of requirements outlined in the EBPC Regulations 2000 and Australian National Guidelines for Whale and Dolphin Watching.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural Controls	EPBC Policy Statement 2.1 – Part B (Additional management measures) – use of a Marine Mammal Observer (MMO) for the geophysical investigations	No	Improved ability to spot and identify marine fauna at risk of impact from underwater sound generated by activity equipment. Several thousand dollars to contract an MMO (based on day rate, travel and accommodation and activity duration). The use of MMOs is covered by Part B (Additional Management Procedures) of the policy statement. Adoption of Part B (either all or parts thereof) is recommended in areas and/or seasons that have a moderate to high likelihood of encountering whales. The likelihood of encountering whales in the activity area during the activity window is low (outside of the known pygmy blue whale and humpback whale migration periods with no whale BIAs within the Operational Area), so the use of an MMO is not considered necessary. Part A.2 of the policy statement states that vessel crew on the vessel can implement EPBC Policy Statement 2.1.	N/A	N/A	N/A
Administrative and Procedural Controls	EPBC Policy Statement 2.1 – Part B (Additional management measures) – implemented by trained crew members	Yes	Part A.2 of the policy statement states that vessel crew on the vessel can implement EPBC Policy Statement 2.1.	3.2	A.3.1: Pre Start-Up Visual Observations •Pre-start visual observations out to 3 km for 30 minutes. •If a whale or turtle is observed during the pre- start observations, delay start up for 30 minutes. •If no whales or turtles are observed, activate acoustic equipment (soft start is not possible on the MBES, SSS or	Daily operations reports verify procedure was followed as required.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					SBP, nor is it possible for the shallow seismic source).	
				3.3	A.3.4: Operations procedure •If a whale or turtle is observed within the shutdown zone of the source (500 m), the acoustic source will be shut down. •Acoustic equipment can be reactivated after the whale or turtle has been observed to move outside the low power zone or if the whale has not been sighted for 30 minutes.	Daily operations reports verify procedure was followed as required.
				3.4	A.3.6 Night-time and low visibility procedure •Wherever practicable, commence operations during daylight hours. •Night-time and low visibility operations will not commence if there have been 3 or more whale-instigated shutdown in the preceding daylight hours.	Daily operations reports verify procedure was followed as required.
				3.5	Environmental awareness induction will be provided to vessel crew by Shell prior to start of the activity regarding their EPBC Policy Statement 2.1 obligations. This includes: •Providing the policy statement to the vessel Master for reference.	Induction presentation and signed attendance sheet. Photos of educational material on the vessel.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					•Providing photos/pictures of the different megafauna expected in the area at the time of the geophysical activity, including in the form of posters for display on the vessel. •Instructions on the pre-start, shut-down and re-start requirements. •Instructions on distance estimation, including the specification that marine binoculars with reticles are used. •Instructions on how to detect marine megafauna based on observations on the water surface and surrounds. •Instructions on data to be recorded for marine megafauna sightings, including time of observation, type and number of species observed and estimated location coordinated. •Provision of shutdown and observation reporting forms and instructions on completing the forms.	
				3.6	EPBC Act Policy 2.1 – Part A.4 Shell will report cetacean sightings online to the DAWE within 2 months of activity completion (through the online	Evidence of submission of completed records to DAWE within 2 months of activity completion.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					Cetacean Sightings Application where possible or via email).	
	Undertake site- specific acoustic modelling as per the Approved Conservation Advice for Megaptera noveangliae (humpback whale)	No	Increase the knowledge of potential impacts. Several thousand dollars to undertake site-specific acoustic modelling. There is no environmental benefit with this control measure as there are no humpback whale BIAs in or near the activity area.	N/A	N/A	N/A
Administrative and Procedural Controls	Infield environmental noise monitoring	No	Marine noise monitoring alone will not prevent impact to marine fauna, but will provide the noise signature of the petroleum activities.	N/A	N/A	N/A

9.5.5 Acceptability of Impacts

Table 9-18: Acceptability of Impacts - Noise

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	N/A	N/A	N/A	N/A
Biological Environment	Benthic Communities	No significant impacts to benthic habitats and communities. • No direct loss of coral communities on the outcropping reef as a result of future tie-backs to the Crux platform. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the project area.	Yes	Benthic habitat surveys in the Operational Area did not indicate the presence of particularly diverse or sensitive benthic communities. Benthic habitats associated with high value sensitive benthic communities e.g. named reefs, banks and shoals are too distant to be affected by noise (i.e. Browse Island is approximately 39 km from the Operational Area and Echuca Shoal is approximately 61 km from the Operational Area). Given the frequency spectrum and intensity of noise generated during production operations and the large separation distances to the nearest high value sensitive benthic communities, no impacts to benthic communities as a result of underwater noise are expected to occur.
	Pelagic Communities including planktonic communities and pelagic fauna	No significant adverse effect on pelagic communities, populations, habitats or spatial distribution of a species.	Yes	No exceedance of the permanent injury threshold for any category of fish is predicted to occur in the Operational area and beyond and ambient underwater noise levels would fall below the relevant temporary hearing threshold shift criteria for fish (12 hr exposure period)

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
				beyond 60 metres from the facility. Masking vocalisation and changes to behaviour could occur only within tens and hundreds of metres from the facility. Impacts to widely distributed planktonic communities in the Operational Area have been assessed as 1-Slight.
	KEFs	No significant impacts to environmental values of KEFs.	Yes	The nearest KEF is the Continental Slope Demersal Fish Communities, located approximately 14 km in their closest point to Prelude end of the survey. The noise levels at this point indicate no potential for permanent, temporary or behavioural impact to fish with moderate potential for masking fish choruses only. Other KEFs are too distant from the Operational Area to be credibly impacted by underwater noise.
	Threatened and Migratory Species	No mortality or injury of threatened or migratory MNES fauna from the Crux project. Management of aspects of the Crux project must be aligned to conservation advice, recovery plans and threat abatement plans published by the DoEE. No significant impacts to threatened or migratory MNES fauna.	Yes	Noise levels emitted from the seabed survey activities have been assessed as potentially able to cause a slight impact on threatened or migratory marine fauna. Side scan sonar sources are of frequencies outside of hearing range of cetaceans. Turtle nesting and inter-nesting habitats are at least 20 km from the Operational area and known whale migration routes and congregation areas are hundreds of kilometres away.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
				Noise emissions would therefore have no significant impact on threatened and migratory species.
Socio-economic and Cultural Environment	Commonwealth Marine Area	No significant impacts to the Commonwealth marine area beyond 1 km from the Crux platform or drilling locations.	Yes	No significant impacts will occur to commonwealth marine areas as result of the petroleum activities.
	World Heritage Properties	No impacts to world heritage values.	Yes	No impacts to world heritage values will occur as a result of the petroleum activities.
	National Heritage Places	No impacts to national heritage values.	Yes	No impacts to national heritage values will occur as a result of the petroleum activities.
	Commonwealth Heritage Places	No impacts to Commonwealth heritage values	Yes	No impacts to Commonwealth heritage values will occur as a result of the petroleum activities.
	Declared Ramsar Wetlands	No impacts to ecological values of Ramsar wetlands	Yes	No impacts will occur to Ramsar wetlands
	Marine Parks	No impacts to the values of marine parks	Yes	No impacts will occur to values of marine parks nearest to the petroleum activities.
	Commercial fisheries	No negative impacts to exploited fisheries resource stocks which result in a demonstrated direct loss of income. Temporary displacement of commercial fishing activities within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of commercial fishing activities from gazetted petroleum exclusion zones is acceptable. No negative impacts to exploited fisheries resource stocks.	Yes	No negative impacts to exploited fisheries resource stocks which result in demonstrated direct loss of income given the short duration of the survey, deep depths of the survey – distant from high activity fishery areas and limited footprint (mostly within ~100m or so of the source) of noise impacts from the geophysical survey activities.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
	Traditional Indigenous fishing	Temporary displacement of traditional fishing activities within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of traditional fishing activities from gazetted petroleum exclusion zones is acceptable.	Yes	No displacement of commercial fishing will occur as a result of the petroleum activities.
	Marine archaeology	No disturbance to historical shipwrecks is acceptable.	Yes	No disturbance to historical shipwrecks will occur as a result of the petroleum activities
	Tourism and recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income. Temporary displacement of tourism activities within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of tourism activities from gazetted petroleum exclusion zones is acceptable.	Yes	No impacts to tourism and recreation activities will occur as a result of the activities due to the distant offshore nature, limited duration (<30 days) and limited tourism activities within the broader region which exists.
	Military/defence	Temporary displacement of defence activities within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of defence activities from gazetted petroleum exclusion zones is acceptable.	Yes	No impacts to defence activities will occur as a result of the activities due to the distant offshore nature, limited duration (<30 days) and limited defence activities within the broader region which exists.
	Ports and commercial shipping	Temporary displacement of commercial shipping within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of commercial shipping from gazetted	Yes	No impacts to commercial shipping activities will occur as a result of the activities due to the distant offshore nature, limited duration (<30 days) and low shipping activity within the

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		petroleum exclusion zones is acceptable.		operational area which exists.
	Offshore petroleum exploration and operations	Temporary displacement of petroleum exploration activities and operations within the Crux project area (excluding petroleum safety zones) is acceptable. Permanent exclusion of petroleum exploration activities and operations from gazetted petroleum exclusion zones is acceptable.	Yes	No impacts to other petroleum activities will occur as a result of the petroleum activities in this EP.
	Indonesian and Timor-Leste coastlines	No impacts to Indonesian or Timor-Leste coastlines are acceptable.	Yes	No impacts to Indonesian or Timor-Leste coastlines will occur as a result of the petroleum activities.

The assessment of impacts from noise determined the worst-case residual ranking of Slight or lower (Table 9-18). As outlined above, the acceptability of the impacts from noise associated with the petroleum activities have been considered in the context of:

Principles of ESD

Impacts from noise emissions are consistent with the principles of ESD based on the following points:

- The noise emissions aspect does not degrade the biological diversity or ecological integrity of the Commonwealth Marine Area and significant impacts to MNES are not anticipated to occur.
- The precautionary principle has been applied, and since the last revision of this EP the most recent and comprehensive scientific literature compilation (Kent et al, 2016) and the most recent international guidelines on noise impacts (Popper et al. 2014) have been reviewed and referenced to ensure latest research and knowledge are taken into account in the evaluation of environmental impacts.

Relevant Requirements

Management of impacts from noise emissions is consistent with relevant legislative requirements, including:

- Assessment of noise impacts is guided by the latest scientific research in defining impact thresholds.
- Management of noise impacts is consistent with policies, strategies, guidelines and conservation advice (refer to Table 9-19).
- Vessel interactions with threatened and migratory species to follow the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017), i.e.

- Vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300m for a whale calf; and 150m for a dolphin calf.
- If the whale, dolphin, turtle or whale shark shows signs of being distressed, marine support vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots.

- EPBC Policy Statement 2.1 – Part B (Additional management measures)

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of noise impacts indicates significant impacts to threatened and migratory species will not credibly result from noise emissions from production, offloading, materials and personnel transfer and subsea infrastructure operations and maintenance aspects of the petroleum activities.

Alignment of petroleum activities with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-19.

Commonwealth Marine Environment

Impacts from the noise aspect of the petroleum activity on the Commonwealth Marine Environment will not exceed any of the significant impact criteria provided in Table 9-18.

Table 9-19: Summary of Alignment of the Impacts from the Noise Aspect of the petroleum activities with Relevant Requirements for EPBC Threatened Fauna

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species - Marine Mammals	Conservation advice on sei whale (Balaenoptera borealis) (DoE 2015c)	Vessel interactions with threatened and migratory species to follow the of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017). Activities carried out consistent with EPBC Policy Statement 2.1 – Part B (Additional management measures). A noise assessment consistent with the recommendations of the Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NOAA 2018) was undertaken.
	Conservation advice on fin whale (Balaenoptera physalus) (DoE 2015d)	
	Conservation management plan for the blue whale: A recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 2015–2025 (Commonwealth of Australia 2015a)	
	Conservation advice on humpback whale (Megaptera novaeangliae) (DoE 2015b)	
Threatened and Migratory Species - Marine Reptiles	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1).	The evaluation of environmental impacts indicates that impacts from noise emissions on threatened or migratory marine reptiles are slight and would not constitute a significant impact. As such, the petroleum activities do not exceed any of the significant impact criteria for Threatened and Migratory marine reptile species provided in Table 8-1.
	Recovery Plan for Marine Turtles in Australia 2017–2027	Acute and chronic noise pollution has been identified as a threat in the Recovery Plan for Marine Turtles (DoEE

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
	(Commonwealth of Australia 2017)	2017), however there are no specific actions in the Plan in relation to noise pollution, except a recognised need to conduct additional research on impacts of noise on turtles. A noise assessment consistent with the recommendations of the Sound exposure guidelines for fishes and sea turtle was undertaken.
Other Species – Sharks and Rays	Conservation advice on whale shark (*Rhincodon typus*) (DoE 2015e)	A noise assessment consistent with the recommendations of the Sound exposure guidelines for fishes and sea turtle was undertaken. This considered the potential impacts of underwater noise on whale sharks.
Commonwealth Marine Environment	Significant Impact Guidelines for the Commonwealth marine environment (Table 8-1)	The evaluation of environmental impacts indicates that the noise emissions aspect of petroleum activities will not exceed the Commonwealth marine environment significant impact criteria provided in Table 8-1.

External Context

There have been no objections or claims raised by Relevant Persons to date on the noise aspect. Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking further assessment of impacts and risks.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from noise determined the residual impact rankings were Slight (Table 9-17). As outlined above, the acceptability of impacts from noise have been considered in the context of:

- The established acceptability criteria for the noise aspect
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Shell considers residual impacts of noise of Slight or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to noise.

Based on the points discussed above, Shell considers the impacts from noise associated with the petroleum activities to be acceptable.

9.5.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No injury or mortality to listed Threatened or Migratory MNES species as a result of noise emissions.	Fauna observations and incident reports demonstrate no injury or mortality of listed Threatened or Migratory species as a result of noise emissions within the Operational Area.

9.6 Disturbance to Seabed

9.6.1 Aspect Context

During the seabed survey activities, numerous activities will impact the seabed. This includes activities which involve drilling, coring and related activities.

9.6.2 Description and Evaluation of Impacts

Physical Environment

Seabed survey activities such as drilling and coring type activities will impact <1ha in total.

Water Quality

The potential for activities to increase turbidity is based on the possibility of sediment resuspension.

Any impacts to water quality (turbidity) from seabed disturbance are expected to be restricted to highly localised and short-term sediment plumes. Sediment plumes may result in a slight and temporary decrease in water quality due to increase in suspended sediments. These temporary impacts to water quality are expected to have no credible environmental damage or effects.

Sediment Quality

Impacts to sediment quality from seabed disturbance are considered to have no environmental damage or effects. Significant changes to physical properties, such as particle size distribution and geological origin, are not expected to occur due to the small-scale, localised and infrequent nature of the associated activities.

Biological Environment

The seabed within the Operational Area has low density of epibenthic communities due to the low variance of sea floor topography and absence of hard substrates limiting habitat for epibenthic organisms (Baker et al. 2008; Heyward & Smith 1997). This has been determined for the operational area from benthic surveys, side scan sonar, 3D seismic survey and geotechnical data collected across the permit area (Shell 2009 and 2018).

The soft seabed comprises of very soft siliceous carbonate silts, which has been shown to support a high diversity but low abundance community of infaunal assemblages. The likely impacts to the benthic communities from seabed disturbance include smothering and temporary disturbance but soft sedimentary communities have been shown to respond rapidly to disturbance and impacts are thus expected to be slight and short-lived (Shell 2009).

The habitats associated with these communities are broadly distributed in the wider region and are not considered to be unique or highly sensitive. The installation of additional infrastructure associated with the petroleum activities (including stabilisation or span rectification using grout bags/mattresses) may result in the disruption of a relatively small area of soft sediment habitats, which will then become hard substrate habitats due to the presence of subsea infrastructure.

Given the widespread extent of similar habitat, the low sensitivity of the benthic habitat within the Operational Area, and the high likelihood that temporarily affected areas will recover in a short timeframe, the environmental effects are considered to be of minimal ecological significance. Thus, the overall residual impact consequence level is ranked as Slight (Magnitude -1, Sensitivity – L).

9.6.3 Impact Assessment Summary

Table 9-20: Benthic Disturbance Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Physical Environment	0	L	No Impact
Biological Environment	-1	L	Slight
Socio-Economic Environment	N/A	N/A	N/A

9.6.4 ALARP Assessment and Environmental Performance Standards

Table 9-21: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	N/A	N/A		N/A	N/A	N/A
Substitution	N/A	N/A		N/A	N/A	N/A
Engineering	N/A	N/A		N/A	N/A	N/A
Administrative and Procedural Controls	Anchoring in the Operational Area for support vessels is prohibited except in emergency situations or under issuance of a specific permit by Shell	Yes	No alternative control measures have been identified.	4.2	No support vessel anchoring in the Operational Area except in emergency situations or under issuance of a specific permit by Shell	Records verify no breaches of anchoring procedures in the Operational Area.

9.6.5 Acceptability of Impact

Table 9-22: Acceptability of Impact – Disturbance to Seabed

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	N/A	N/A	N/A	N/A
Biological Environment	Benthic Communities – Bare Sediment	No significant direct impacts to bare sediment benthic habitats outside of the Operational Area as a result of the petroleum activities	Yes	No significant impacts are expected, given the Operational Area represents a small portion of a large regional bare sediment benthic environment. Habitats associated with these communities are broadly distributed in the wider region and are not considered to be unique or highly sensitive. Any seabed disturbance within the Operational Area will be small in scale, infrequent and represent a small fraction of the overall Operational Area and therefore any impacts are not expected to affect ecosystem function or connectivity of communities.
	Commonwealth Marine Environment	No significant impacts to the Commonwealth Marine Environment	Yes	
Socio-economic and Cultural Environment	N/A	N/A	N/A	N/A

The assessment of impacts from seabed disturbance determined the residual ranking of Slight or lower. As outlined above, the acceptability of the impacts associated with the petroleum activity have been considered in the following context.

Principles of ESD

The impacts from seabed disturbance are consistent with the principles of ESD based on the following points:

- Seabed disturbance on such a small scale will not degrade the biological diversity or ecological integrity of the Commonwealth Marine Environment and therefore significant impacts to MNES will not occur.
- The health, diversity and productivity of the marine environment will be maintained for future generations.
- The precautionary principle has been applied, and studies undertaken where knowledge gaps were identified (Refer to Section 7.2.1). This knowledge has been applied during the evaluation of environmental impacts.

Relevant Requirements

Management of the impacts from seabed disturbance are consistent with relevant legislative requirements, including:

- Management of impacts are consistent with guidelines for the protection of MNES (Table 8-1).

Matters of National Environmental Significance

Commonwealth Marine Environment

The impacts from the seabed disturbance aspect of the petroleum activities on the Commonwealth Marine Environment will not exceed any of the significant impact criteria provided in Table 9-23.

Table 9-23: Summary of Alignment of the Impacts from the Seabed Disturbance Aspect of the Petroleum Activities with Relevant Requirements for MNES

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Commonwealth Marine Environment	Significant Impact Guidelines for the Commonwealth Marine Environment (Table 8-1)	The impact assessment indicates that the seabed disturbance aspect will not exceed the Commonwealth Marine Environment significant impact criteria provided in Table 8-1.

External Context

There have been no objections or claims raised by Relevant Persons to date around the seabed disturbance aspect. Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking further assessment of impacts.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from seabed disturbance determined the residual impact rankings were Slight or lower Table 9-20). As outlined above, the acceptability of the impacts have been considered in the context of:

- The established acceptability criteria for the seabed disturbance aspect
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Shell considers residual impacts of Slight or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the seabed disturbance aspect.

Based on the points discussed above, Shell considers the impacts from seabed disturbance associated with the petroleum activities to be ALARP and acceptable.

9.6.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No direct disturbance to benthic habitats outside of the Operational Area as a result of the petroleum activities.	Records demonstrate there has been no significant direct disturbance to bare sediment benthic habitats outside of the Operational Area as a result of the petroleum activities, that is activities associated with inspection, maintenance and repair.

9.7 Vessel Movements

9.7.1 Aspect Context

Marine vessels moving in the Operational Area may present a hazard to threatened and migratory fauna, such as whales, turtles and whale sharks (though the abundance of such fauna in and around the Operational Area has been observed to be low). Vessel movements can result in collisions between the vessel and marine fauna, potentially resulting in injury or death. Factors affecting the likelihood and severity of impacts from collisions include vessel type, vessel speed, water depth and the behaviours of animals present (Commonwealth of Australia 2017).

9.7.2 Description and Evaluation of Risks

The risks of vessel collisions with marine fauna, particularly threatened and migratory species (i.e. MNES), described below are consistent with the acceptable levels of impacts defined in Section 7.4. Shell's environmental management of the vessel movements aspect of the petroleum activities is aligned with conservation advice, recovery plans and threat abatement plans published by the DAWE; refer to discussion of MNES in the discussion of acceptability below.

Potential risks associated with vessel movements within the operational area are discussed below. As outlined in Section 9.2.4, the assessment considers only the residual risks following the application of controls.

Biological Environment

Threatened and Migratory Species

The Operational Area is not adjacent to or in close proximity to any known important habitats for threatened or migratory species or the humpback whale migration routes. There are no BIAs or critical habitats within the Operational Area with the closest such areas located 23 km away for turtles, 33 km away for whale sharks and 78 km for marine mammals. Therefore, the abundance of threatened or migratory species in the Operational Area is expected to be low and their presence transient.

Turtles: The Operational Area does not represent important habitat for marine turtles given the absence of potential nesting. Much of the project area is in water depths exceeding 90 m, which is deeper than typical foraging dives by marine turtles (e.g.

Hays et al. 2001; Polovina et al. 2003). As such, the presence of marine turtles within the Operational Area is likely to be restricted to individual turtles transiting the area. As with cetaceans, the risk of collisions between turtles and vessels increases with vessel speed (Hazel et al. 2007). The typical response from turtles on the surface to the presence of vessels is to dive (a potential "startle" response), which decreases the risk of collisions (Hazel et al. 2007). Given the low speeds of vessels in the operational area, along with the expected low numbers of turtles in the area, the likelihood of collisions between vessels and turtles is assessed as remote.

Whale sharks: These are at risk from vessel strikes when feeding at the surface. Whale sharks have been observed traversing the Operational Area however, it is expected that whale shark presence would not comprise of significant numbers given there is no main aggregation area within the vicinity, and their presence would be transitory. This is consistent with tagging studies of whale shark movements which show continual movement of whale sharks in deeper, open offshore waters (Meekan & Radford 2010). There are no constraints preventing whale sharks from moving away from vessels (e.g. shallow water or shorelines).

Whales and Dolphins: Whales are particularly vulnerable to collisions with vessels due to their large size and the relatively high proportion of time spent at or near the sea surface. The likelihood and consequence of vessel collisions with whales are influenced by vessel speed; the greater the speed at impact, the greater the risk of mortality (Jensen and Silber 2004; Laist et al. 2001). 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 20% at 8.6 knots to 80% at 15 knots. According to the data of Vanderlaan and Taggart (2007), it is estimated that the risk is less than 10% at a speed of 4 knots. Although dolphins are at much lower risk from collision due their small size, manoeuvrability and echolocation abilities compared to whales, they are still included in this assessment given they surface to breathe and are known to feed near the surface at times.

Marine vessels within the Operational Area, carrying out petroleum activities, are likely to be travelling at speed less than 8 knots; much of the time vessels are holding station or moving very slowly under Dynamic Positioning (DP) due to operational safety requirements. Therefore, the likelihood of a vessel collision with threatened or migratory species is remote (B).

Marine mammals, turtles and sharks are expected to alter course away from the vessel in the Operational Area. The cruising speed of the vessel is relatively low and a watch is maintained at all times and any interactions will be managed in line with the requirements of the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017).

This activity is identical to vessel movements for other offshore activities along the Western Australian coastline where the incidence of vessel strike is remote. Any collisions are only likely to affect fauna at an individual scale rather than at a population or species scale. Therefore, an injury or death of an individual from a threatened or migratory species from a collision is considered to be of minor impact consequence (Magnitude -2, Sensitivity – M) and remote (B) likelihood with a residual risk assessed as Dark Blue.

9.7.3 Risk Assessment Summary

Table 9-24: Vessel Collision with Marine Life Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Biological Environment	Minor	B - Remote	**Dark Blue**

9.7.4 ALARP Assessment and Environmental Performance Standards

Table 9-25: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	Elimination	N/A	No appropriate control measures have been identified to eliminate this risk from petroleum activities. The timing of the activities cannot be avoided, as the execution of the survey is time critical to the detailed design of the Crux pipeline and due to availability of vessel under contract and environmental approvals constraints. Therefore, important animal timings may not be able to be avoided.	N/A	N/A	N/A
Substitution	Substitution	No	The number of vessels used is already considered minimal. Any fewer vessels will not meet operational needs.	N/A	N/A	N/A
Engineering	Engineering	No	No appropriate control measures have been identified to reduce noise through engineering means.	N/A	N/A	N/A
Administrative and Procedural Controls	Vessel interactions with threatened and migratory species to follow the of EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and	Yes	The EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017) are recognised as the industry standard for minimising disturbance due to physical presence and noise to whales and dolphins and will be	3.1	Vessels will comply with EPBC Regulations 2000 Part 8, Division 8.1 Interacting with cetaceans and the Australian National Guidelines for Whale and Dolphin Watching.	Incident report form used to record breaches of requirements outlined in the EBPC Regulations 2000 and Australian National Guidelines for Whale and Dolphin Watching.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	Dolphin Watching 2017 (DoEE 2017).		applied to other species as relevant, .i.e. turtles and whale sharks.			
Administrative and Procedural Controls	Dedicated Marine Fauna Observers (MFOs) on vessels	No	The cost to have dedicated trained MFOs on vessels represents a disproportionate cost given the low likelihood of the event occurring due to the absence of critical habitats or BIA's for cetaceans within the Operational Area.	N/A	N/A	N/A

9.7.5 Acceptability of Risks

Table 9-26: Acceptability of Risks – Vessel Movements

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	N/A	N/A	N/A	N/A
Biological Environment	Threatened and Migratory Species	No significant impacts to listed Threatened (Endangered and Vulnerable) or Migratory MNES fauna populations (Refer to Table 8-1)	Yes	Vessel movement risks are of an acceptable level, given the Operational Area is not located in any BIAs or habitat critical to the survival of a species. Given the low speeds of vessels, along with the expected low abundance of threatened and migratory species within the Operational Area, significant impacts to Threatened and Migratory Species are not anticipated.
Socio-economic and Cultural Environment	N/A	N/A	N/A	N/A

The assessment of risks from vessel movements determined the residual ranking of Dark Blue (Table 9-6), deemed as Inherently Acceptable. As outlined above, the acceptability of risks from vessel movements associated with the petroleum activities has been considered in the following context.

Principles of ESD

Risks from vessel movement are consistent with the principles of ESD based on the following points:

- The vessel movements aspect does not degrade the biological diversity or ecological integrity of the Commonwealth marine area in the Browse Basin. Significant impacts to MNES will not occur.
- The health, diversity and productivity of the marine environment will be maintained for future generations.
- The precautionary principle has been applied, and studies undertaken where knowledge gaps were identified. This knowledge has been applied during the evaluation of environmental risks.

Relevant Requirements

Management of risks from vessel movements are consistent with relevant legislative requirements, including:

- Marine support vessel interactions with threatened and migratory species to follow the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017 (DoEE 2017), i.e.
    - Marine support vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300m for a whale calf; and 150m for a dolphin calf.
    - If the whale, dolphin, turtle or whale shark shows signs of being distressed, marine support vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots.
- Management of risks are consistent with policies, strategies, guidelines, conservation advice, and recovery plans for threatened species (refer to Table 9-27 below).

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of risks indicates significant impacts to threatened and migratory species will not credibly result from the vessel movements aspects of the petroleum activities.

An unplanned collision between project vessels and threatened or migratory fauna is unlikely to occur and may result in injury to or death of individual animals. This unplanned event is not considered to have the potential for significant impacts to threatened or migratory species at the population level.

Alignment with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-27.

Commonwealth Marine Environment

The impacts and risks from the vessel movements aspect of petroleum activities on the Commonwealth marine environment will not credibly exceed any of the significant impact criteria provided in Table 8-1.

Table 9-27: Summary of Alignment of the Risks from the Vessel Movements Aspect of the Petroleum Activities with Relevant Requirements for EPBC Threatened Fauna

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species – Marine Mammals	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	The risk assessment indicates that the likelihood of vessel collisions with threatened or migratory marine mammals is remote, and the consequence of any such collision would be restricted to an individual animal. As such, the petroleum activities do not exceed any of the significant impact criteria for Threatened and Migratory marine species provided in Table 8-1.
	National Strategy for Reducing Vessel Strikes on Cetaceans and other Marine Megafauna (Commonwealth of Australia 2017a)	Vessel movements will be aligned to 'Objective 3: Mitigation' of the Strategy by: • Maintaining separation of vessels and whales; • Maintaining slow vessel speeds; and • Avoidance manoeuvres. This will be met by marine support vessels adhering to Part 8 (Interacting with cetaceans and whale watching) of the EPBC Regulations.

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
		Note the other objectives of the Strategy relate to actions for Government agencies.
	Conservation advice on sei whale (Balaenoptera borealis) (DoE 2015c)	The risk of vessel strikes will be managed by marine support vessels adhering to the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017.
	Conservation advice on fin whale (Balaenoptera physalus) (DoE 2015d)	
	Conservation management plan for the blue whale: A recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 2015-2025 (Commonwealth of Australia 2015)	
	Conservation advice on humpback whale (Megaptera novaeangliae) (DoE 2015b)	
Threatened and Migratory species - marine reptiles	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	The risk assessment indicates that the likelihood of vessel collisions with threatened or migratory marine reptiles is remote, and the consequence of any such collision would be restricted to an individual animal. As such, the petroleum activities do not exceed any of the significant impact criteria for Threatened and Migratory marine species provided in Table 8-1.
	Recovery Plan for Marine Turtles in Australia 2017-2027 (Commonwealth of Australia 2017b)	Marine support vessel collisions with turtles are inherently unlikely due to the offshore location (and resultant low densities of turtles), slow speeds of vessels and diving startle response of turtles. Furthermore, the risk of a vessel collision with a turtle will be further reduced via the implementation of the EPBC Regulations 2000 – Part 8 Division 8.1 (Regulations 8.05 and 8.06) and the Australian National Guidelines for Whale and Dolphin Watching 2017.
	Conservation advice on leatherback turtle (Dermochelys coriacea) (DEWHA 2009a)	
Threatened and Migratory species - sharks and rays	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	The risk assessment indicates that the likelihood of vessel collisions with threatened or migratory sharks and rays is remote, and the consequence of any such collision would be restricted to an individual animal. As such, the petroleum activities do not exceed any of the significant impact criteria for Threatened and Migratory marine species provided in Table 8-1.
	Conservation advice on whale shark (*Rhincodon typus*) (DoE 2015e)	The Operational Area is not recognised as a BIA or habitat critical to the survival of whale sharks. The conservation advice recommends minimising offshore developments close to marine features that may aggregate whale sharks and cites Ningaloo Reef and Christmas Island as examples. Studies of whale sharks tagged while aggregating at Ningaloo Reef have shown individuals transiting through the Timor Sea (Meekan & Radford 2010) but showed no evidence of aggregation around particular marine features in the open offshore waters within or in the vicinity of the Operational Area.

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Wetlands of International Importance	N/A	N/A
Commonwealth Marine Environment	Significant Impact Guidelines for the Commonwealth marine environment	The impact assessment indicates that vessel movements will not exceed the Commonwealth Marine Environment significant impact criteria provided in Table 8-1 as the aspect does not pose a credible risk.

External Context

There have been no objections or claims raised by Relevant Persons to date around the vessel movement aspect. Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking further assessment of the risks.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activities and Shell's internal requirements.

Acceptability Summary

As outlined above, the acceptability of the associated risks have been considered in the context of:

- The established acceptability criteria for the vessel movements aspect
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

The residual risks have been assessed as Dark Blue (minor). Shell considers residual risks of minor or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the vessel movements.

Based on the points discussed above, Shell considers the risks from vessel movements associated with the petroleum activities to be ALARP and acceptable.

9.7.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No injury or mortality of listed Threatened or Migratory MNES species associated with vessel collisions within the Operational Area.	Fauna observations and incident reports demonstrate no injury or mortality of listed Threatened or Migratory MNES marine species as a result of vessel movements within the Operational Area.

9.8 Introduction of Invasive Marine Species from Vessels

9.8.1 Aspect Context

Invasive Marine Species (IMS) are non-indigenous marine fauna or flora that have been introduced into an area beyond their natural geographical range, and may have the ability to survive, reproduce and establish a population such that they threaten native species through increased competition for resources and/or increased predation.

The vessels and equipment sourced from outside Australian waters have the potential to introduce or transfer IMS to the Operational Area, which may potentially spread to new areas or increase the impact of IMS already established in the wider region through oceanic currents and transport via activities such as support vessel movements. There are two primary mechanisms which may cause the inadvertent introduction and spread of IMS; hull fouling (biofouling) and ballast water discharges.

Establishment of IMS in the Operational Area requires a sequence of events to occur:

- the potential IMS must be present on (e.g. biofouling) or in (e.g. ballast water) the vector; and
- the potential IMS must be released into the environment (e.g. ballast water discharge, release of propagules from biofouling); and
- the potential IMS must survive, reproduce (either sexual or vegetative reproduction) and subsequently persist in the environment.

The introduction of IMS is recognised globally as a threat to marine biodiversity, and the International Maritime Organisation (IMO) has developed guidelines for the management of biofouling and ballast water. Commonwealth, State and Territory authorities also regulate the risk of IMS from biofouling and ballast water. Vessels operating in Australia are required to meet these requirements, and vessels meeting these requirements pose an inherently lower risk of harbouring IMS or releasing IMS into the environment.

The likelihood of this sequence of events is considered extremely remote given the controls that are routinely applied to vessels (e.g. anti-fouling coating, inspections, hull cleaning etc.), the remote offshore location and nature of typical vessel activities (e.g. short periods >500m Prelude FLNG).

Most native fouling species likely to be encountered within or transiting through the Operational Area will be widely distributed as similar habitats are broadly represented in the Timor Sea and Browse Basin. An IMS may compete with these native species if it were to become established in the Operational Area or wider region. This may decrease the species diversity of benthic communities.

IMS are typically extremely difficult to eradicate once established and reproducing in an area. In the highly unlikely event an IMS becomes established and reproductively viable, it would be almost impossible to eradicate.

Ballast water exchange needs for the support vessels are expected to be limited. All vessels operating in the Operational Area are obliged to conduct ballast tank operations in line with IMO guidelines and, where applicable, comply with the Biosecurity Act 2015.

All known and potential introduced marine pests listed by Australian agencies are nuisance foulers, predators, invasive seaweeds or noxious dinoflagellates that inhabit harbours, embayment's, estuaries, shorelines and/ or shallow coastal waters less than 200m deep (Hayes et al. 2004, Barry et al. 2006). The water depth in the Operational Area is in excess of 240 m.

The offshore environment of the Operational Area is relatively deep, oligotrophic (nutrient-poor) and hard substrate habitats do not naturally occur. Many potential IMS are sessile invertebrates that require hard substrate for attachment. In the unlikely event potential IMS are released into the Operational Area, the IMS are highly unlikely to encounter suitable substrate for settlement and establishment. Most potential IMS are adapted to coastal waters, such as ports and harbours. If a potential IMS were to become established in the field, it is unlikely to survive in the relatively deep water offshore environment. The deep water, low nutrient and open ocean environment in Operational Area provides minimal larval retention times or suitable habitat for coastally adapted IMS.

9.8.2 Description and Evaluation of Impacts and Risks

A range of environmental sensitivities within the following groups may be at risk from the introduction of potential IMS, including:

- Biological Environment
- Socio-economic environment.

Potential risks associated with IMS establishment as a result of the petroleum activities are discussed below.

Biological Environment

The introduction and subsequent establishment of IMS could result in changes to the structure of benthic communities leading to a change in ecological function due to predation of native marine organisms and/or competition for resources. Once IMS establish, spread and become abundant in coastal waters some species could have Major ecological, economic, human health and social/cultural consequences (Hewitt et al. 2011;Pimental et al. 2000).

Shallow water, coastal marine environments are susceptible to the establishment of invasive populations, with most IMS associated with artificial substrates in disturbed shallow water environments such as ports and harbours (e.g. Glasby et al. 2007; Dafforn et al. 2009a, 2009b).

Benthic communities within the operational area are characterised by low density epibenthic communities of deposit and filter feeders on bare sediments. The seabed within the entire Operational Area does not receive sufficient sunlight to support benthic primary producer habitat, such as macroalgae and zooxanthellate corals. Very few

potential IMS identified can credibly survive in the water depths of the Operational Area. For example, the non-oceanic species identified in the Australian Marine Pest Monitoring Manual (Department of Agriculture, Fisheries and Forestry 2010) indicated very few IMS (aside from planktonic oceanic species such as dinoflagellates) could credibly survive in the Operational Area; only three (European clam, soft-shell clam and Northern Pacific sea star) were identified as potentially surviving in > 90 m water depth; none were identified as credibly surviving at > 200 m water depth. These three species are typically found in shallower, coastal waters. The Operational Area is all between 160-250 m water depth. In the highly unlikely event these species were introduced into the Operational Area, they are unlikely to survive or become established on natural substrate due to the water depth alone.

With the stated controls in place, the likelihood of introduction of IMS associated with specific vessel-based campaigns is considered extremely remote as the potential vectors (e.g. support vessels) will typically be near the FLNG for relatively short periods (up to a week). Further, general support vessels will typically be sourced from Australian waters and will undertake the required assessments described in the Prelude FLNG Biosecurity Management Plan.

The waters associated with benthic communities (shoals, banks reefs and island surrounds), some KEFs (e.g. ancient coastline), WA mainland coastline and some of the Commonwealth Marine Environment in the wider region are typically shallower than those of the Operational Area. As outlined above, most potential IMS require shallower habitats than those found in the Operational Area. Hence, these shallower habitat waters in the region may be more vulnerable to introduction of IMS, however it is completely dependent on the extremely rare event of subsequent transport by support vessels.

With consideration of the habitat preferences of IMS (shallow water environments), the closest shallow water habitat to the Operational Area is Browse Island, located some 40 km south-southeast of the Operational Area, and it is neither disturbed nor contains artificial structures that IMS are reported to prefer. Although not part of the petroleum activity, support vessels may spend some time during cyclone season or inclement weather to seek shelter near Browse Island (or other banks, shoal or islands in the area) for safety reasons. With the stated controls in place to minimise potential IMS risk, direct introduction of IMS to a shoal, bank or island during these short-duration and infrequent sheltering events is considered extremely remote.

Socio-economic Environment

The socio-economic receptors from IMS introduction / establishment risk are industries outside of the Operational Area such as fishing, tourism/recreation, marine protected areas or other oil and gas operators (e.g. Inpex Ichthys). The likelihood for IMS introduction, establishment and survival at or within these receptors is extremely remote with the stated controls in place.

9.8.3 Risk Assessment Summary

Table 9-28: IMS Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Biological Environment	Major effect	A - Extremely remote	Dark Blue
Socio-Economic Environment	Major effect	A - Extremely remote	Dark Blue

9.8.4 ALARP Assessment and Environmental Performance Standards

Table 9-29: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	No vessels	No	Vessels are essential for supply, standby safety support, and operations.	N/A	N/A	N/A
Substitution	Only use local support vessels	No	Although the use of local vessels is preferred, there are cases when this is impracticable due to availability of specialised vessels for the activities.	N/A	N/A	N/A
Engineering	Anti-foul coating/anti-foul system	Yes	Anti-foul coating/system on the FLNG/ vessels will help prevent biofouling accumulation on the hull. It is noted that anti-foul systems must be maintained in good condition in order to be an effective control for the management of marine pests. Therefore, the implementation of the Prelude FLNG Biosecurity Management Plan will confirm that vessels maintain Low Risk with respect to IMS, in conjunction with the presence of valid anti-foul coating/system documentation.	6.1	Vessels (of appropriate class) will have an anti-foul coating applied in accordance with the prescriptions of the International Convention on the Control of Harmful Antifouling Systems on Ships (2001) and the Protection of the Sea (Harmful Antifouling systems) Act 2006 direction[8].	Valid International anti-fouling systems certificate or a Declaration on anti-fouling systems. Records of implementation of the Prelude FLNG Biosecurity Management Plan.
Administrative and Procedural controls	Ballast Water Management Plan and Certificate	Yes	Vessels that are intending to discharge internationally sourced ballast water within Australian waters must submit a	6.2	Vessels coming from overseas will have required DAWE	Records of the Maritime Arrivals Reporting System (MARS) or

[8] Advice from the Registered Organisation will be followed where there is any variation to the this EPS for the Prelude FLNG.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			Ballast Water Report through Maritime Arrivals Reporting System (MARS) at least 12 hours prior to arrival to gain DAWE clearance. The acceptable area for a ballast water exchange between an offshore oil and gas installation and an Australian port is in areas that are no closer than 500 m from the offshore installation and no closer than 12 NM from the nearest land and in water at least 50 m deep. Ballast tank sediment must be disposed of in an area outside 200 nautical miles from the nearest land, and in at least a depth of 200 metres, or at an approved land-based reception facility. The Biosecurity Act 2015 requires that vessels have a Ballast Water Management Certificate and Ballast Water Management Plan (BWMP), and undertake reporting and management of ballast in accordance with the Act. The BWMP must: • be vessel specific (vessel name and International Maritime Organization (IMO) number) • be approved by a survey authority, recognised organisation, or the vessel's flag administration • nominate the rank(s) of the responsible officer and crew		clearance including the Ballast Water Certificate and Ballast Water Management Plan if the vessel is required to discharge ballast in Australian waters. All vessels (incl. domestic) shall have a Ballast Water Management Plan in place consistent with the IMO Ballast Water Convention's Guideline.	equivalent demonstrate the vessel has sufficient DAWE clearance to operate within the Operational Area and Australian Territorial Waters. Vessel Ballast Water Management Plan Vessel Ballast Water Certificate

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			• contain the ballast water management method and pumping rates. BWMPs should be consistent with the IMO Ballast Water Convention's Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (G4 Guidelines). A valid Ballast Water Certificate must be issued by either a survey authority, classification society, or the administration of the vessel, and be in accordance with Regulation E-1 of the Ballast Water Convention.			
	Ballast water management within the Operational Area	Yes	Only low risk ballast water will be discharged within the Operational Area. Although the Operational Area is classified as a suitable location for ballast exchange per the Australian Ballast Water Management Requirements i.e. will occur > 12 Nm from land and in water depths > 50m deep, no ballast water (originating from outside Australian waters) exchange will occur within the Operational Area of the FLNG. The product carriers and other international vessels will exchange their ballast before arriving at the Operational Area, therefore, they will discharge only low risk ballast water at the facility.	6.3	Only low risk ballast water will be discharged within the Operational Area.	Sample ballast exchange logs for internationally sourced vessels demonstrate only low risk ballast water has been discharged within the Operational Area.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural controls	Vessel Specific Biofouling Management Plans	Yes	IMO biofouling guidelines - Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species is considered 'best practice' for mitigation of transfer of invasive aquatic species to ALARP. Vessel specific (as per IMO guidance) Biofouling Management Plan (BMP) and Biofouling Record Book (BRB) recording implementation of BMP.	6.4	Vessels will have a Biofouling Management Plan as per IMO guidance.	Vessel-specific Biofouling Record Book (BRB) recording implementation of BMP.
Administrative and Procedural controls	Prelude FLNG Biosecurity Management Plan	Yes	The Prelude FLNG Biosecurity Management Plan applies to the Crux Project petroleum activities. The plan details preventative controls measures to cover aspects of biofouling management, ballast water management and non-marine biosecurity risk. These controls include; • biofouling management record book • biofouling risk assessments for vessels operating within the Prelude PSZ • valid anti-foul coating certifications • ballast exchange logs • treatment of internal seawater systems • vessel sharing biofouling risk assessment for domestic movements. The following FLNG-to-vessel interactions are exempted from this exposure:	6.5	Adhere to class requirements for marine vessel hull integrity inspection frequency (In-water every 2.5 years, Dry-dock every 5 years). Carry out the required Marine Vessel Biofouling Risk Assessments aligned with National Biofouling Guidelines for the Petroleum Production and Exploration Industry – for vessels originating from overseas or vessels being shared between operators.	Records of hull inspections Prelude Biosecurity LOW risk status from DAWE Vessel Low Risk Biosecurity Status Biofouling Risk Assessments for vessels operate within Prelude PSZ

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			• Offloading of products (ex. LNG, condensate, diesel) via the offloading arms or hoses. • Offloading of equipment from another vessel onto the FLNG, but the equipment will be deployed directly to the seabed. • Transfer of pilots to support vessels during pilotage of product offtake tankers. Consistent with the published Biosecurity Reference Case by Maritime Industry Australia (Oct 2020), biofouling risk assessments shall include considerations of: • periods of layup/inactivity since last dry dock • details of antifouling system applied • presence or absence of MGPS • information about previous vessel locations. Risk results: • Low risk: vessel can be hired for normal operations • Uncertain/high risk: not to be used for normal operations Under unplanned or emergency circumstances where there is potential for escalated safety or environmental risk, uncertain/high risk vessels may be used as part of the response. In which case IMS risk assessments shall be conducted retrospectively and risk managed accordingly.			

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural controls	Conduct opportunistic 3rd Party IMS Review during supply vessel class Underwater Inspection In Lieu of Drydocking (UWILD).	Yes	UWILD as required by Class ensures the functionality of antifouling coating and systems of vessels. A 3rd party IMS review of the footage and photos taken during the UWILD will provide even more certainty on the vessel's biofouling status.	6.6	Conduct a 3rd Party IMS review associated with support vessel UWILD and dry docking.	3rd Party IMS review report associated with support vessel UWILD and Dry Docking.
Administrative and Procedural controls	Limit time for support vessels to be alongside the FLNG and in ports, if all deemed low risk.	No	The latest Biosecurity Reference Case (Oct 2020) states that vessels with low risk biofouling status (such as the supply vessels and ISVs) do not require a time limit for operating alongside a facility with low risk biofouling status (such as the FLNG); unless the biofouling status is uncertain or high. Therefore, limiting the time spent by supply vessels and ISVs alongside the FLNG is not considered an effective control.	N/A	N/A	N/A
Administrative and Procedural controls	eDNA water sampling within Ports visited by vessels going to and from the Operational Area	No	eDNA analysis of water samples from the port will be inconclusive as to whether the risk has originated from the petroleum activities due to the number of users of the port. As agreed by the State marine biosecurity agencies, this is the responsibility of the State agencies.	N/A	N/A	N/A
Administrative and Procedural controls	Further investigation of biology, method of reproduction, propagule pressure/competency periods and behaviour, ability for adults to depart the FLNG, oceanic currents, interaction	No	The biology of each species needs to be considered to determine the likelihood of the species reproducing, spreading and contaminating both nearby and distant sensitive receptors and/or anthropogenic structures. This might involve investigating each species' methods of	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	with vessels and domestic ports		reproduction (e.g. sexual and asexual), potential larval/propagule pressure based on assessed abundance and density witnessed on the Prelude FLNG, larval/propagule competency periods and behaviour, ability for adults and/or fragments to depart the vessel, strength, direction and prevailing oceanic currents, interaction with domestic conveyances, and their interaction with domestic ports of Australia. Such an assessment is complex, time-consuming and will suffer from significant knowledge gaps/uncertainty.			
Administrative and Procedural controls	Develop specific IMS response plans and carry out training and drills to prepare for the need to respond to an IMS incident	No	The resources and time that would be needed for a mitigative control such as this is significant and considered grossly disproportionate to the benefit gained since the time it would take to prepare a response plan in the event of an incident is not considered to be significant in the context of breeding and reproductive cycles of most potential IMS species. Furthermore, IMS response plans are planned to be developed by government as outlined in the National Strategic Plan for Marine Pest Biosecurity 2018-2023.	N/A	N/A	N/A

9.8.5 Acceptability of Impacts and Risks

Table 9-30: Acceptable Levels of Risks - IMS

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Biological Environment	Benthic communities	Limited environmental impact which directly impacts bare sediment benthic habitats outside of the Operational Area as a result of the petroleum activities which adversely effects biological diversity or ecological integrity. Limited environmental impacts to high-value sensitive benthic communities (corals, macroalgae, seagrasses and mangroves) associated with named reefs, banks and shoals.	Yes	The introduction of an IMS as a result of the petroleum activities is unlikely to survive given the water depth in the Operational Area. However, surrounding shallower habitats in the wider region such as Browse Island (the closest receptor to the Operational Area, approx. 40 km away) are likely to be more susceptible to an IMS becoming established due to their relatively shallow depth. Based on ongoing controls such as using a risk-based approach to manage the pathways and vectors that are responsible for the establishment of an IMS, the likelihood of an IMS becoming established is extremely remote. Shell will take industry-standard measures to reduce the likelihood of an IMS being introduced at the Operational Area or to new areas as a result of petroleum activity. If an IMS were to be become established, it would be very difficult to eliminate, however there is an extremely remote likelihood of significant impacts to the identified potential receptors.
	KEFs	No impacts to environmental values of KEFs	Yes	
	Commonwealth Marine Area	No significant impacts to the Commonwealth Marine Environment (Refer to Table 8-1).	Yes	
	WA Mainland Coastline	No impacts to mainland coastline.	Yes	
Socio-economic and Cultural Environment	Marine Protected Areas	No impacts to ecological values of Marine Protected Areas	Yes	Based on ongoing controls such as using a risk-based approach to manage the pathways and vectors that are responsible for

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
	Fishing Industry	No negative impacts to exploited fisheries resource or aquaculture stocks which result in a demonstrated direct loss of income or other benefits.	Yes	the establishment of an IMS, the likelihood of an IMS becoming established is extremely remote. Shell will take industry-standard measures to reduce the likelihood of an IMS being introduced at the Operational Area or to new areas as a result of petroleum activity.
	Tourism and Recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income.	Yes	

The assessment of risks from IMS determined a residual risk ranking of Dark Blue (Table 9-28).As outlined above, the acceptability of the risks from the introduction of IMS associated with the petroleum activities has been considered in the context of:

Principles of ESD

The inherent risks from the introduction of IMS resulting from the petroleum activities are inconsistent with some of the principles of ESD based on the following:

- The introduction of an IMS poses a risk to the diversity and ecological integrity of the biological and socio-economic environments in the vicinity of the Operational Area and the wider region.

However, Shell will apply a range of controls to ensure that the risk of IMS introduction is reduced to a level that is acceptable and ALARP. Following successful application of these controls, Shell considers the residual risk to be consistent with the principles of ESD.

Relevant Requirements

Management of the risks from an introduction of IMS resulting from the Crux project are consistent with relevant legislative requirements, including:

- compliance with international maritime conventions, including
  - The International Convention for the Control and Management of Ships' Ballast Water and Sediments
  - The International Convention on the Control of Harmful Anti-Fouling Substances
  - IMO 2011 Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species.
- compliance with Australian legislation and requirements, including:
  - Protection of the Sea (Harmful Anti-fouling Systems) Act 2006:
    - Marine Order 98 – Marine Pollution prevention – anti-fouling systems.
  - Biosecurity Act 2015:

- National Biofouling Management Guidelines
- Australian Ballast Water Management Requirements.

- NT Fisheries Act
- WA Fish Resources Management Act 1994, subsequent Fish Resources Management Regulations 1995 and the Aquatic Resources Management Act 2016
- the WA DPIRD Biofouling Biosecurity Policy*.

*The WA DPIRD Biofouling Biosecurity Policy (WA Department of Fisheries Jan 2017) specifies the objective to minimise the adverse impacts of aquatic pests and diseases in WA through "1. Preventing the establishment of aquatic pests and diseases in new locations" and "2. Minimising the impact of established aquatic pests and diseases". As such, the acceptable level of risk for IMS (stated in the EPO) is consistent with this policy.

Matters of National Environmental Significance

Threatened and Migratory Species

The policies, strategies, guidelines, conservation advice and recovery plans for MNES that may occur within the potential area affected by an IMS do not identify IMS as a threat.

Commonwealth Marine Environment

The impacts and risks from the introduction of IMS will not result in significant impacts to the Commonwealth Marine Environment.

Table 9-31: Summary of Alignment of the Risks from the IMS Aspect of the Petroleum Activities with Relevant Requirements for EPBC Threatened Fauna

Matters of National Environmental Significance	MNES Acceptability Considerations (Significant Impact Criteria, EPBC Management Plans/Recovery Plans/Conservation Advices)	Threats Relevant to the Project	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species	N/A	N/A	N/A
Commonwealth Marine Area	Significant Impact Guidelines for the Commonwealth marine environment (Table 8-1)	Introduction of IMS	The residual risk assessment indicates that the petroleum activities will not exceed the Commonwealth marine environment significant impact criteria provided in Table 8-1.
Wetlands of International Importance	N/A	N/A	N/A

External Context

Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking the assessment of impacts and risks. No claims or objections from relevant persons related to this petroleum activity related to invasive marine species were made.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of risks from IMS determined the residual risk rankings were Dark Blue (Table 9-28). As outlined above, the acceptability of the impacts and risks from IMS associated with the petroleum activity has been considered in the context of:

- The established acceptability criteria for the IMS aspect of the Operational Area
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Given the considerable water depth (160-250 m), potential IMS species which may be present on survey vessel would not be able to settle and establish on the available natural substrate within the Operational Area and the nearest shallow water sensitive receptor, Browse Island, is located approximately 40km away. Considering all of the controls which are in place, the residual risk of potential species of IMS persisting on the survey vessel, spreading and establishing in new areas such as high value areas and/or inshore coastal waters of Australia such as at ports following a long distance vessel transit is Moderate given the potential consequences following the very remote likelihood of establishment.

Shell considers residual risks of moderate to be acceptable with controls if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the IMS aspect of the petroleum activities.

Based on the points discussed above, Shell considers the risks from IMS associated with the petroleum activities to be acceptable.

9.8.6 Environment Performance Outcomes

Environment Performance Outcomes	Measurement Criteria
No IMS of concern[9] established in the natural environment as a result of the petroleum activities. No introduction of IMS to the marine environment from ballast water exchange operations undertaken or biofouling by project vessels.	No confirmed and externally reported instances of IMS establishment in the natural environment as a result of the petroleum activities.

[9] IMS of concern are species that are listed on the Western Australian Prevention List for Introduced Marine Pests or Commonwealth National Introduced Marine Pest Information System, and could survive in the natural environment beyond the Prelude FLNG and installed infrastructure.

9.9 Discharge of Liquid Effluent

Liquid discharges from the petroleum activity are limited to typical vessel discharges plus the potential for water based drilling fluid discharges associated with the drill cores. These aspects include:

- Drainage and bilge effluent
- Food waste, greywater and sewage
- Water based drill fluid

9.9.1 Aspect Context

9.9.1.1 Drainage (Slops) and Bilge Wastes

Marine Vessels

Deck drainage and bilge from Marine support vessels consists mainly of wash down water, seawater spray and rainwater and may contain small quantities of oil, grease, metals, detergents (surfactants) and other residual chemicals present on the deck, which has the potential to create surface sheens and short term, localised reduction in water quality if it enters the marine environment.

9.9.1.2 Food Waste, Sewage and Greywater

Vessels

Vessel activities within the Operational Area will require planned discharges that will likely include sewage, greywater and food waste.

9.9.2 Description and Evaluation of Impacts

Planned liquid discharges to marine waters creates a potential for the localised decline in water and sediment quality and for biota in those environments to be exposed to physical characteristics and contaminants at concentrations that may cause acute or chronic effects.

The identified effect pathway associated with the planned liquid discharges can be summarised by the following:

- Changes to physical and/or chemical water quality resulting in:
  - Impacts to sensitive biological receptors.

Any effects on water quality are expected to be within the surface layers only and have no effect on or damage to seabed/benthic receptors (refer to Section 9.9.2.2 Biological Environment for further details).

The magnitude and sensitivity of any impacts on the identified sensitive receptors varies according to multiple factors, including discharge composition, plume dilution/dispersion, bioavailability, duration of exposure and marine species physiology and behaviour. A detailed description and evaluation of these impacts is provided in the subsections below. A summary presenting credible interactions associated with the various liquid discharges is provided in Table 9-32 assessed per environmental receptor category. Where credible interactions have been identified these have been discussed in further detail in the subsequent impact assessment sections and are

broken down further into receptor sub-category where relevant. The subsequent impact assessment also provides justification on why certain receptors, e.g. sediments and benthic habitats, have been assessed as having no credible interaction and/or where no environmental damage or effects have been identified for the duration of this EP.

Table 9-32: A matrix summarising credibility of interactions with the identified environmental receptors from the various planned liquid discharge streams

	Drainage (Slops) and Bilge	Sewage, Greywater and Food Waste,	Cooling Water	Brine, Boiler Blowdown and MBP Effluent	Produced Water	Ad-Hoc Discharges
Water Quality	✓	✓	✓	✓	✓	✓
Sediment Quality	×	×	×	×	×	×
Benthic Communities	×	×	×	×	×	×
Pelagic Communities	✓	✓	✓	✓	✓	✓
KEFs	×	×	×	×	×	×
Threatened Ecological Communities	×	×	×	×	×	×
Ramsar Wetlands	×	×	×	×	×	×
Commonwealth Marine Area	✓	✓	✓	✓	✓	✓
WA Mainland Coastline	×	×	×	×	×	×
Threatened and Migratory Species	✓	✓	✓	✓	✓	✓
Heritage	×	×	×	×	×	×
Marine Protected Areas	×	×	×	×	×	×
Fishing Industry	×	×	×	×	×	×
Tourism and Recreation	×	×	×	×	×	×
Defence	×	×	×	×	×	×
Shipping	×	×	×	×	×	×
Indonesian Coastline	×	×	×	×	×	×
Oil and Gas Industry	×	×	×	×	×	×

× **Interaction Assessed as Non-Credible and/or No Environmental Damage or Effects**

✓ **Interaction Considered Credible - Discussed Through Relevant Impact Assessment Sections Below**

9.9.2.1 Physical Environment

Drainage (Slops) and Bilge Effluent

Open Drainage (slops) and bilge waste discharges are intermittent discharges which can result in water quality changes immediately surrounding the discharge point, with the spatial extent of changes to water quality remaining very localised. It is recognised that there may be various minor quantities of metal and chemical constituents that may not be captured as a part of the oil treatment systems associated with the bilge system. This may result in the discharge of minor quantities of diluted toxicants into the ocean

which may cause localised and temporary reductions in water quality. Overall, the residual impact of the discharge of open drainage and bilge effluent to water and sediment quality is considered of slight impact consequence (Magnitude – 1, Sensitivity – L).

Food Waste, Sewage and Greywater

Discharge of sewage, greywater and food waste into the marine environment may impact on water quality, including eutrophication, increased turbidity, increased pathogens (bacteria, viral agents and/or parasites), and increased biological oxygen demand (BOD), with the associated impacts on marine biota as discussed further in Section 9.9.2.2 Biological Environment below. These discharges can contain a variety of substances typically at very low concentrations, including oil/grease, some organic compounds, detergents, metals, suspended solids, chemicals, personal hygiene products and pathogens.

Discharges of food waste, sewage and grey water can cause some temporary localised nutrient enrichment of the surface waters around the discharge point and have the potential to attract marine fauna that feed on the particulate material. Such low volume outputs of nutrients relative to the receiving environment presents no environmental damage or effects to water quality associated with eutrophication, increased BOD and/or decreased dissolved oxygen concentrations. The BOD of the sewage, greywater and food waste effluent is unlikely to lead to oxygen depletion of the receiving waters as highly oxygenated receiving waters will rapidly assist with oxygenation of the discharge in such a dynamic offshore environment.

At a discharge release depth of >11 m, the positively buoyant sewage and greywater effluent plumes are typically heavily diluted by the time they reach the surface of the water column. Therefore no detectable impacts to marine sediment quality are forecast for sewage or grey water due to the significant water depth, buoyant nature of the plumes and highly dispersive and dilutive environment. For food discharges, based on biodegradability and water depth in the open-ocean currents, the discharges are expected to be rapidly diluted and dispersed by the open-ocean ambient currents, with no detectable impacts to marine sediment quality predicted.

In 2008, Woodside conducted monitoring of 10 m^3 of sewage discharged at distances of 50 m, 100 m and 200 m downstream of a platform and at five different water depths over a period of 24 hrs (Woodside 2008). This monitoring confirmed that discharges of macerated sewage were rapidly diluted or nutrients rapidly metabolised. No elevations in water quality monitoring parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station.

The Woodside (2008) study demonstrated that a 10 m^3 sewage discharge over 24 hrs from a stationary source in shallow water, reduced to approximately 1% of its original concentration within 50 m of the discharge location. In addition to this, monitoring at distances 50, 100 and 200 m downstream of the platform and at five different water depths confirmed that discharges were rapidly diluted or nutrients rapidly metabolised and no elevations in water quality monitoring parameters (e.g. total nitrogen, total phosphorous and selected metals) were recorded above background levels at any station. As sewage discharge from the vessel is <10 m^3/day as well, this study provides confidence to the residual impact ranking given the deep water and highly dispersive offshore environment where the Operational Area is located.

Given the volume and properties of the discharged effluent which are highly biodegradable, low toxicity and low persistence, the rapid dilution in the open ocean

environment, localised impact area, and distance from the nearest value (Continental Slope Demersal Fish Communities ~ 14 km and Browse Island ~40 km away), the residual impact consequence to water quality is assessed as slight (Magnitude -1, Sensitivity – L).

9.9.2.2 Biological Environment

Drainage (Slops) and Bilge Effluent

Discharges of oily water will be treated to <15 ppm (v) in accordance with MARPOL requirements. The discharge of these effluents have the potential to adversely affect water quality which may impact some biological receptors in the immediate area through acute or chronic toxicity. This is given the similarities in the cause and effect pathways and that impacts are not anticipated to be greater than those presented in the PW assessment from these smaller volume and infrequent discharge streams.

Most threatened fauna species potentially exposed to drainage (slops) and bilge effluent discharges are air breathing vertebrates, which are unlikely to be directly affected as their skin is relatively impermeable. Given the low concentrations of oil (<15 ppm) no surface expressions is expected and therefore damage to eyes and lungs from exposure to oil on the sea surface is not anticipated. Overall, the residual impact of the discharge of treated drainage (slops) and bilge effluent to the biological environment with the stated controls in place is considered to be of slight impact consequence (Magnitude – 1, Sensitivity – L).

Food Waste, Sewage and Greywater

Nutrients in sewage greywater and food waste, such as phosphorus and nitrogen can contribute to eutrophication of receiving waters. However, this is only likely in still, calm, inland waters, where it can cause algal blooms, which in turn degrades aquatic habitats by reducing light levels and producing certain toxins, some of which are harmful to marine life and humans. Nutrient levels from these discharges are not expected to result in levels or conditions that could result in excessive algal, phytoplankton or cyanobacterial growth or associated depletion reduction in oxygen levels. Sewage and greywater can also contain hazardous pathogens (including faecal coliform bacteria), intestinal parasites and viral agents that, if released, may cause contamination to the food chain and/or other marine users. This is further addressed in Section 9.9.2.3 Socio-Economic Environment, under the socio-economic environment impact assessment and will not result in environmental damage or effects.

The overboard discharge of sewage and food wastes creates a localised and temporary increase in particulates on or near the surface waters. This may in turn act as a food source for scavenging marine fauna and seabirds, whose numbers may temporarily increase as a result. The ingestion of small (macerated or reduced to <25mm) particle sizes within the effluent is not anticipated to have an adverse physical or toxic impact on resident and transient marine fauna, including listed threatened and migratory species, e.g. cetaceans or whale sharks.

Open marine waters are typically influenced by regional wind and large scale current patterns resulting in the rapid mixing of surface and near surface waters where sewage, greywater and food waste discharges will occur. Therefore, nutrients from these discharges will not accumulate or lead to eutrophication due to the highly dispersive environment. As such, the receptors with the greatest potential to be impacted are those in the immediate vicinity of the discharge. Effects on environmental receptors along the food chain, namely, fish, reptiles, birds and cetaceans are therefore not expected beyond the immediate vicinity of the discharges.

Although the Timor Sea is characterised as a low nutrient environment (Brewer et al, 2007), natural seasonal upwelling can result in localised and sporadic high phytoplankton productivity along the Sahul Shelf including immediately offshore of the shelf. The estimated daily loading from sewage, grey water and food waste (Approximately 37 kg/day of TN and 7 kg/day of TP) is considered inconsequential in comparison to the daily turnover of nutrients in the area.

The rapid consumption of macerated food and sewage waste by scavenging fauna, combined with physical and microbial breakdown, ensures that any impacts of sewage, greywater and food waste discharges are short-lived, localised and negligible. There are no nearby sensitive or high environmental value habitats or biological communities that are at risk from temporary increases in nutrient levels, particulates and/or increased numbers of scavenging fauna. The volume of these discharges is small relative to daily nutrient turnover in the given area of ocean and the associated assimilative capacity of the receiving offshore environment. Therefore, the environmental impact associated with the discharge of sewage, greywater and food waste is considered to be slight (Magnitude -1, Sensitivity – L).

9.9.2.3 Socio-Economic Environment

Impacts on social receptors such as recreational users and commercial operators of fishing, aquaculture, diving and boating operations, are not predicted nor are credible due to exclusions in place via the gazetted PSZ, the localised nature of the discharges and the rapid dispersion and dilution in open offshore waters.

There are no known sensitive receptors to human pathogens in the vicinity of the liquid discharges location. It is expected that any discharged pathogens will be susceptible to rapid mortality following exposure to natural levels of UV radiation, oxygen, increased salinity and natural predation resulting in their reduction and ultimate destruction (ANZECC & ARMCANZ 1997). Regardless, transference of human pathogens into marine fauna resulting in adverse impacts to the organism itself, fishermen or consumers is not anticipated to occur and/or is not considered a feasible cause and effect pathway due to the inherent biological and physiological differences in the host species' and is therefore considered to present a non-credible impact. There are no identified recreational uses within the vicinity and therefore any impacts associated with human primary/secondary contact and the presence of 'nuisance' organisms is considered as non-credible.

9.9.3 Impact Assessment Summary

Table 9-33 lists the highest residual impact consequence rankings of the relevant environmental receptor groups.

Table 9-33: Liquid Discharges Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Physical Environment	-1	L	Slight

Biological Environment	-1	L	Slight
Socio-economic and Cultural Environment	NA	NA	NA

9.9.4 ALARP Assessment and Environmental Performance Standards

Table 9-34: Drainage (Slops) and Bilge Waste Discharges ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	Eliminate discharges by storing all open drainage and bilge effluent to be transported and treated /disposed onshore.	No	There are significant costs and HSE risks associated with storing and transporting onshore all open drainage and bilge effluent on the marine support vessels and the FLNG. It is grossly disproportionate to the environmental impacts of onboard treatment prior to discharging overboard.	N/A	N/A	N/A
Substitution	Alternative technology to oil-water separator system.	No	The oil-water separator systems on the FLNG and vessels are standard MARPOL-compliant systems for management of accidentally-oil contaminated drainage and bilge in offshore installations and vessels. On the FLNG there is also an option available to direct off-specification drainage effluent through the MPPE system if required.	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Engineering	FLNG: Monitoring of drainage and bilge discharges.	Yes	As per MARPOL requirements.	7.1	Bilge and slops effluent will not be discharged if the 15 mg/L oil in water limit is exceeded.	Records demonstrate no exceedances of the 15 mg/L oil in water discharge limit.
Engineering	Vessels Compliance with Marine Order 91 (International Oil Pollution Prevention [IOPP] certificates).	Yes	The marine assurance system is administered by Shell's Marine team and, amongst other requirements, ensures compliance of contract vessels with MARPOL and Marine Order 91. This control measure is in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and the relevant AMSA Marine Orders.	7.3	Assurance will be undertaken for vessels, including a check for valid and in date International Oil Pollution Prevention (IOPP) certificates as required by vessel class requirements[10].	Assurance records

[10] Advice from the Registered Organisation will be followed where there is any variation to the this EPS for the Prelude FLNG.

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural Controls	Spill kits onboard vessels.	Yes	Storage and use of spill adsorbent and clean-up kits are inexpensive and low-maintenance. Accumulations of oil, grease and other contaminants will be collected and removed from the decks.	7.4	Spill kits are available on vessels to clean up small accumulations of contaminants.	Records indicating spill kits are in place.
Administrative and Procedural Controls	Shell Chemical Management Process.	Yes	Shell has adopted a chemical selection and approval process in accordance with Shell's chemical selection and approval guidelines as indicated in Shell Chemical Management Process (HSE_GEN_007879) and Shell Global Product Stewardship guidelines to assess chemicals than may pose environmental impact via planned discharges.	7.5	Chemicals selected for use in accordance with the Shell Chemical Management Process to minimise potential environmental risks.	Records demonstrating the chemical selection process outlined in the Chemical Management Process have been followed.
Administrative and Procedural Controls	Shell Chemical Management Process.	Yes	Following the chemical management process as detailed within Section 10.1.5 will minimise the impact of those chemicals which are used and discharged to ALARP levels.	7.6	Chemicals that are planned for discharge to sea are substitution warning free and Gold, Silver, D, or E rated through the OCNS, or are PLONOR (listed by the OSPAR Commission), or have a complete ALARP assessment.	Records demonstrating the chemical selection process outlined in the Chemical Management Process have been followed.

Table 9-35: Sewage, Grey Water and Food Waste Discharges ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	On board storage of sewage, greywater and food wastes for transport to and disposal at an onshore facility.	No	Offers limited environmental benefit, as any changes to water quality beyond a localised mixing zone are likely to have no environmental effect. Is likely to increase operational costs associated with additional transits to and from port and introduce additional safety and environmental risks related to increased transit time and operation of additional vessels, plant and equipment.	N/A	N/A	N/A
Substitution	Use of sewage treatment system to treat all sewage prior to disposal	No	Offers limited environmental benefit, as the addition of chemicals (such as flocculants and defoaming agents) would be required to treat the effluent. Though some reduction in area impacted may occur this benefit is offset against the detrimental addition and increased cost of refined chemicals. Therefore the available environmental impact reduction is negligible to non-existent.	N/A	N/A	N/A
Engineering	FLNG: Food waste will be reduced to <25mm particle size prior to discharge to sea	Yes	Food wastes are macerated to less than 25mm diameter prior to discharge within 500 m of the FLNG.	7.7	Food macerator is maintained in accordance with the MMS to reduce food waste to < 25 mm particle size prior to discharge to sea.	Maintenance Records
Engineering	Further treatment e.g. disinfection of the waste-stream prior to discharge	No	There are no known sensitive receptors to human pathogens in the vicinity of the discharge location that may be impacted therefore disinfection of the waste stream is not considered to provide a reduction in the impact. Additionally, not dosing the waste	N/A	N/A	N/A

			stream with a disinfectant such as chlorine will avoid potential cumulative impacts with other chlorine dosed streams such as cooling water. Furthermore, the consumption of disinfection chemicals, the resources consumed to transport the chemicals, and the risk of excess chlorine being released into the sea outweighs the negligible environmental benefits of disinfecting treated sewage effluent prior to discharge.			
Engineering	Marine vessels compliance with Marine Order 96 (International Sewage Pollution Prevention [ISPP] certificates)as relevant to vessel class, size and type.	Yes	This control measure is in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and the relevant AMSA Marine Orders.	7.9	Assurance will be undertaken on vessels to check for valid and in date International Sewage Pollution Prevention (ISPP) Certificates (or equivalent voluntary statement of compliance audits where relevant) , as required by vessel class requirements[11].	Assurance records
Administrative and Procedural Controls	Required marine vessels and will maintain a Garbage Management Plan (or equivalent) as required by vessel class, size and type.	Yes	Each required vessel has its own Garbage Management Plan/Procedure (or equivalent) to manage wastes generated and stored onboard. All wastes that are not permitted for discharge are sent ashore for reuse, treatment, recycling and/or disposal as appropriate. This control measure is in accordance with Protection of the Sea	7.10	Marine support vessels (to which MARPOL Annex V / Marine Order 95 applies) have a current Garbage Management Plan (or equivalent)[12].	Garbage Management Plan (or equivalent) is sighted onboard marine support vessels and are maintained up to date.

[11] Advice from the Registered Organisation will be followed where there is any variation to the this EPS for the Prelude FLNG.

[12] Advice from the Registered Organisation will be followed where there is any variation to the this EPS for the Prelude FLNG.

			(Prevention of Pollution from Ships) Act 1983 and AMSA Marine Order 95.			

9.9.5 Acceptability of Impacts

Table 9-36: Acceptability of Impacts – Discharge of Liquid Effluent

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	Water Quality	No significant impacts to water quality and quality is maintained so that biodiversity, ecological integrity, social amenity and human health values are protected.	Yes	Liquid discharges have the potential to result in reduced water quality in the immediate vicinity of the discharge location, however discharges will rapidly dilute and disperse in the open ocean environment. Modelling studies indicate impacts to water quality are likely to be highly localised around the discharge locations, which is consistent with industry monitoring studies and demonstrates high confidence in the assessment that ecological integrity, social amenity and human health values will not be significantly impacted. The potential magnitude of impacts to marine ecosystems is slight. Given the offshore location and absence of particularly sensitive marine ecosystems at the operational area and immediate surrounds, potential impacts are considered acceptable.
	Sediment Quality	No significant impacts to sediment quality and quality is maintained so that biodiversity, ecological integrity, social amenity and human health values are protected.	Yes	Liquid discharges may result in a slight decrease in sediment quality at locations around the petroleum activity. However, there is high confidence in the assessment that biodiversity, ecological integrity, social amenity and human health values will be protected at all times. Liquid discharges from the vessel cannot be avoided. However, the area influenced from routine operational discharges is expected to be limited to within immediate surrounds of the liquid discharge locations. The potential magnitude of impacts to marine ecosystems is slight. Given the offshore location and absence of particularly sensitive marine ecosystems at the operational area and immediate surrounds, potential impacts are considered acceptable.
Biological Environment	Benthic communities	No significant direct impacts to bare sediment benthic habitats as a result of the petroleum activities which adversely effects biological diversity or ecological integrity. No direct impacts to high-value sensitive benthic communities (corals, macroalgae, seagrasses and mangroves) associated with named reefs, banks and shoals.	Yes	
	Pelagic communities (Non-Threatened or Migratory)	No significant adverse effect on pelagic communities, populations, habitats or spatial distribution of a species.	Yes	Given the transient nature and absence of important habitat and ecological assemblages of pelagic species, there is high confidence that potential impacts to pelagic communities within a localised mixing zone are considered acceptable given there will not be any significant adverse effect on pelagic

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
				communities, populations, habitats or spatial distribution of a species.
	Threatened and Migratory Species	No significant impacts to listed Threatened (Endangered and Vulnerable) or Migratory MNES fauna populations (Refer to Table 8-1).	Yes	Most threatened and/or migratory fauna species within the area predicted to be influenced by the planned liquid discharges are air breathing vertebrates, which are unlikely to be directly affected as their skin is relatively impermeable and they breathe air. Hence, direct impacts are not considered credible. Non-air breathing species are not anticipated to be present in significant numbers nor be exposed to levels that may adversely impact on individuals and therefore there will be no significant impacts.
	Commonwealth Marine Area	No significant impacts to the Commonwealth Marine Area (Refer to Table 8-1).	Yes	Liquid discharges may result in a slight decrease in water quality in the immediate surrounds of the discharge points. Therefore, there is high confidence in the assessment that the following relevant significant impact criteria will not be breached: • Substantial change in water quality which may adversely impact on biodiversity, ecological integrity, social amenity or human health; or • Persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected. Hence, the highly localised impacts predicted from liquid discharges will not credibly exceed the MNES significant impact criteria for the Commonwealth Marine Area as listed in Table 8-1.
Socio-economic and Cultural Environment	N/A	N/A	N/A	N/A

The assessment of impacts from liquid discharges determined the residual impact consequence of slight for physical environment and biological environment (per Table 9-33). As outlined above, the acceptability of the impacts from liquid discharges associated with the petroleum activity have been considered in the context of:

Principles of ESD

The impacts from liquid discharges are consistent with the principles of ESD based on the following points:

- The environmental receptors within the Operational Area and defined mixing zones are not expected to be significantly impacted; and
- The precautionary principle has been applied.

Relevant Requirements

Management of the impacts from liquid discharges are consistent with relevant legislative requirements, including:

- Compliance with international maritime conventions, including:
  - MARPOL:
    - Annex I: regulations for the prevention of pollution by oil
    - Annex II: regulations for the control of pollution by noxious liquid substances in bulk
    - Annex III: regulations for the prevention of pollution by harmful substances carried by sea in packaged form, and
    - Annex IV: regulations for the prevention of pollution by sewage from ships
    - Annex V: (regulation for the prevention of pollution by garbage from ships).
- Compliance with Australian legislation and requirements, including:
  - Navigation Act 2012 and Protection of the Sea (Prevention of Pollution from Ships) Act 1983:
    - Marine Order 91 (Marine pollution prevention – oil)
    - Marine Order 93 (Marine pollution prevention – noxious liquid substances)
    - Marine Order 94 (Marine pollution prevention – packages harmful substances)
    - Marine Order 95 (Marine pollution prevention – garbage)
    - Marine Order 96 (Marine pollution prevention – sewage).
- Management of impacts and risks are consistent with policies, strategies, guidelines, conservation advice, and recovery plans for threatened species (Table 9-37)

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of liquid discharges impacts indicates significant impacts to threatened and migratory species will not credibly result from the liquid discharges aspect of the petroleum activities.

Alignment of the petroleum activities with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-37.

Commonwealth Marine Area

The impacts and risks from the liquid discharges aspect of the petroleum activities on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 9-37.

Table 9-37: Summary of Alignment of the impacts from the Liquid Discharges Aspect of the Petroleum Activities with Relevant Requirements for MNES

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species Table 8-1)	The application of the Shell Chemical Management Process and proposed management controls for liquid discharges reduces the impact of toxic pollutants being introduced into and/or persisting in the marine environment. An environmental monitoring adaptive management program has been developed for liquid discharges as described in Section 10.4.1. This program will seek to demonstrate that the actual levels of recorded impacts for key discharges do not exceed those which were predicted within the impact assessment presented in this EP. If recorded impact levels do exceed those described, this would trigger the adaptive management process and assessment under the Shell MOC Manual (Refer to Section 10.1.4)
	Conservation advice on Balaenoptera borealis (sei whale) (DoE 2015c)	
	Conservation advice fin whale (Balaenoptera physalus) (DoE 2015d)	
	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017a)	
	Conservation advice on Rhincodon typus (whale shark) (DoE 2015e)	
Wetlands of International Importance	N/A	N/A
Commonwealth Marine Area	Significant impact guidelines for Commonwealth marine environment	Water quality impacts by planned liquid discharges are expected to be limited to the immediate surrounds of the vessel for all discharge streams. Impacts confined within this area are not considered to be significant in the context of the significant impact criteria for the Commonwealth Marine Area given the nature and scale of the impacts and the characteristics of the local receiving environment (open offshore waters with regionally well represented soft and bare sandy sediments). The impact assessment indicates the impacts associated with the discharge of liquid discharges will not result in a significant adverse impact on marine ecosystem functioning/integrity, social amenity or human health. Shell has sought to reduce potential impacts through the selection and implementation of the controls and EPSs listed in Section 9.9.4.

External Context

There have been no objections or claims raised by Relevant Persons in preparation of this EP around the liquid discharges aspect. Shell's ongoing consultation program will consider objections and claims made by stakeholders when undertaking further assessment of impacts.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from liquid discharges determined the residual impacts rankings were slight or lower (Table 9-33). As outlined above, the acceptability of the impacts have been considered in the context of:

- The established acceptability criteria for the liquid discharges aspect
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Shell considers residual impacts of slight or lower to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the liquid discharges aspect.

Based on the points discussed above, Shell considers the impacts from liquid discharges associated with the petroleum activity to be acceptable.

9.9.6 Environment Performance Outcomes

Environment Performance Outcomes	Measurement Criteria
No significant impacts to water quality from liquid discharges.	Demonstrated implementation of EPSs for discharge of liquid effluents
No impacts to sediment quality from liquid discharges.	
No impact to water quality beyond 1 km from liquid discharges.	
No impacts to any KEFs surrounding the activity.	
No injury or mortality of listed Threatened or Migratory MNES species as a result of discharge of liquid effluent.	
No impacts to coral reefs occurring at Browse Island or nearby Shoals (Echuca/Heywood).	

9.10 Atmospheric Emissions

9.10.1 Aspect Context

Emissions of atmospheric pollutants (e.g. nitrogen oxides, sulphur oxides, carbon monoxide and particulate matter (PM, PM_{10} and $PM_{2.5}$), air toxics which includes mainly volatile organic compounds (VOCs) (e.g. benzene, toluene, xylenes, formaldehyde, etc), greenhouse gases and other harmful to human health gases (e.g. hydrogen sulphide) have the potential to impact local and regional air quality and climate change. The list of sources of such emissions for vessel activities include:

- Combustion of fuel for power generation
- Combustion of fuel for transportation purposes

Sources of internal combustion emissions in the Operational Area include:

- Propulsion and electricity generation engines on marine vessels.

9.10.2 Description and Evaluation of Impacts

Physical Environment

Air Quality

Minor emissions are predicted from the vessel due to the use of diesel combustion engines. The operational area does not contain any species BIA's which could be affected by atmospheric pollutants.

The extent of the area of impact is predicted to be localised to the emission point as offshore winds will rapidly disperse atmospheric emission to background levels close to the source for a duration of the activity. The residual impact is assessed as slight based on emissions will rapidly disperse to background levels close to the emission source.

9.10.3 Impact Assessment Summary

Table 9-38: Atmospheric Pollutant and Air Toxics Emissions Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Physical Environment (Impacts on Air Quality)	-1	M	Slight
Physical Environment (Impacts on Visual Amenity)	-1	M	Slight
Biological Environment	N/A	N/A	N/A
Socio-Economic Environment	N/A	N/A	N/A

Table 9-39: Atmospheric Pollutant and Air Toxic Emissions Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Physical Environment	Slight	C	Dark Blue
Biological Environment	N/A	N/A	N/A

Socio-Economic Environment	N/A	N/A	N/A

9.10.4 ALARP Assessment and Environmental Performance Standards

Table 9-40: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural Controls	Use low sulphur fuel oil/ diesel (< 0.5% m/m S) for boilers and marine support vessels supporting operations	Yes	This MARPOL Annex VI requirement, enforced by AMSA Marine Order 97, came into force from 1 January 2020 and applies to all marine vessels operating in the Operational Area.	8.6	Use only low sulphur fuel oil/ diesel (<0.5% m/m S) for vessels.	Sulphur content of diesel, % w/w as verified in bunker receipts delivered to the vessel on loading and bunker receipts for marine support vessels
Administrative and Procedural Controls	Specified vessels comply with AMSA Marine Order 97 (Marine Pollution Prevention – Air Pollution) and the requirements of the Shell Marine Assurance Process and procedures regarding management of air pollution as required by vessel class, size and type.	Yes	AMSA Marine Order 97 requires specified marine vessels to possess the applicable pollution prevention and energy efficiency certificates. These certificates include Engine International Air Pollution Prevention Certificate (EIAPP), International Air Pollution Prevention Certificate (IAPP) and an International Energy Efficiency (IEE) Certificate. In addition all vessels with a gross tonnage of 400 or more are required to carry a Ship Energy Efficiency Management Plan (SEEMP). These requirements are also recognised and enforced in the Shell Marine Assurance Process and procedures.	8.7	Specified vessels are required to have the following valid documentation as required by vessel class, size and type: • EIAPP certificate; • IAPP certificate; • IEE certificate; and • SEEMP.	Assurance records confirming SEEMP and IAPP, EIAPP, IEE certificates are in place for specified vessels.

9.10.5 Acceptability of Impacts

Table 9-41: Acceptability of Impacts – Atmospheric Emissions

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	Air Quality	No significant impacts to air quality defined as no substantial change in air quality which may adversely impact on biodiversity, ecological integrity, social amenity or human health.	Yes	Given the short duration of the activity (<30 days), no significant impacts to air quality defined as no substantial change in air quality which may adversely impact on biodiversity, ecological integrity, social amenity or human health.
Biological Environment	N/A	N/A	N/A	N/A
Socio-economic and Cultural Environment	N/A	N/A	N/A	N/A

The assessment of atmospheric pollutant emissions determined the impact magnitude to be minor. Given that air quality in the area is generally expected to be very high and the lack of sensitive human receptor populations in the petroleum activity airshed as defined in the Air Quality NEPM (NEPC, 1998), the residual impact consequence ranking is assessed as Slight (Magnitude -1, Sensitivity – M) and therefore acceptable (Table 9-38). Impacts on air quality have also been considered in the following context.

Principles of ESD

The impacts from atmospheric pollutant and air toxics emissions are acceptable and consistent with the principles of ESD based on the following points:

- The environmental values/sensitivities within the Operational Area and the regional airshed are not expected to be significantly impacted.
- The precautionary principle has been applied to the impact modelling study and in the impact assessment.

Relevant Requirements

Management of impacts from atmospheric emissions is consistent with relevant legislative requirements, including:

- Marine fuel oil used by marine vessels supporting operations complies with 1 January 2020 MARPOL Annex VI requirement for 0.5% m/m S content in marine fuel oil and diesel.

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of atmospheric pollutant emissions from the vessel operations indicates significant impacts and risks to threatened and migratory species will not credibly result from combustion of fuels aspects of the petroleum activities.

Alignment of the petroleum activities with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-42.

Commonwealth Marine Environment

The impacts and risks from atmospheric pollutant emissions from the petroleum activities on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 9-42.

Table 9-42: Summary of Alignment of the Impacts from the Atmospheric Pollutant Emissions Aspect of the petroleum activities with Relevant Requirements for EPBC Threatened Fauna

Matters of National Environmental Significance	MNES Acceptability Considerations (Significant Impact Criteria, EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species	None applicable to atmospheric pollutant emissions	N/A
Wetlands of International Importance	None applicable to atmospheric pollutant emissions	N/A
Commonwealth marine area	No significant impacts on Air Quality	Criteria for significant impacts and risks to air quality over the Commonwealth Marine area where the petroleum activity will occur have not been triggered by atmospheric pollutant emissions.

Internal and External Context

There have been no objections or claims raised by Relevant Persons in preparation of this EP related to atmospheric pollutant and air toxics emissions aspect.

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts from atmospheric pollutant and air toxics emissions determined the residual impact rankings to be Slight (Table 9-4). As outlined above, the acceptability of the impacts and risks from this aspect have been considered in the context of:

- The established acceptability criteria for impacts and risks for this aspect
- ESD
- Relevant legislative requirements
- MNES

- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

The residual impacts are slight which Shell considers to be inherently acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the atmospheric pollutant emissions aspect.

Based on the points discussed above, Shell considers the impacts from atmospheric pollutant emissions associated with the petroleum activity to be acceptable and ALARP.

9.10.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
Avoid significant impacts to the airshed surrounding the Operational Area of the petroleum activity.	Low sulphur diesel or fuel oil used in vessel combustion a per MARPOL requirements.

9.11 Waste Management

9.11.1 Aspect Context

Many activities on the vessel results in the generation of a variety of hazardous and non-hazardous waste streams. Non-hazardous wastes include domestic and industrial wastes, such as aluminium cans, bottles, paper and cardboard and scrap steel. Hazardous wastes include oil contaminated materials (e.g. sorbents, filters and rags), spent chemical containers, paint solvents and containers, light tubes and batteries. All wastes generated (other than permitted waste discharge streams addressed elsewhere within this EP) are transported to shore for reuse, recycling, treatment or disposal by a licensed waste contractor. Note that any waste management and disposal within international jurisdictions is out of scope of this EP.

The management of wastes will not result in any planned impacts to the offshore marine environment given there is no planned release; however, improper storage and handling of wastes may result in accidental losses to the marine environment. These unplanned events may result in impacts to the marine environment. Shell's extensive operational experience indicates most accidental releases of wastes to the marine environment are typically relatively small scale and infrequent events.

Waste segregation is established and maintained through the provision of labelled bins, skips or other appropriate receptacles used to comingle similar waste streams in accordance with their classification to realise efficiencies in storage, transport, treatment, recycling and/or disposal.

9.11.2 Description and Evaluation of Impacts and Risks

Physical Environment

Improper management of hazardous or non-hazardous wastes and/or accidental release may result in pollution of and contamination in the marine environment via reduction in water and sediment quality. This may result in toxic effects, however given the dynamic nature of the offshore receiving environment and the small nature and

scale of most potential waste spills/releases, any such effects will be of short duration and highly localised. The implications to potentially sensitive receptors due to a reduction in water and sediment quality are discussed further in the Biological Environment assessment below and are not assessed further in the context of the physical environment.

Biological Environment

There is the potential for impacts on marine fauna that may interact with wastes, such as packaging and binding, should these enter the ocean as marine fauna can become entangled and waste plastics can be ingested when mistaken as prey (Ryan et al. 1988). Marine debris has been identified as a threat for a range of vertebrate fauna species, including marine turtles, birds, marine mammals and sharks and rays. Marine debris is listed as a key threatening process under the EPBC Act. Persistent wastes such as plastics are of particular concern, as the threat to fauna may remain long after the waste is released. Potential impacts of marine debris on key fauna species include (DEWHA 2009c):

- Entanglement, potentially resulting in restricted mobility, drowning, starvation, smothering and wounding
- Ingestion (particularly of plastics) leading to physical blockage of digestive systems, leading to starvation
- Acute or chronic toxic effects.

Plastic debris can also act as a concentrator of Persistent Organic Pollutants (POPs) that occur universally in seawater at very low concentrations as they get picked up by meso/microplastics via partitioning. The hydrophobicity of POPs can facilitate concentration in the meso/microplastic litter at a level that is several orders of magnitude higher than that in seawater. When ingested by marine species, contaminated plastics present a credible route by which the POPs can enter the marine food web.

Habitats within the Operational Area are not considered to be particularly sensitive or of high conservation value and are well represented in the region. Given the typically small volumes of wastes that may be released during any given event, potential impacts to sensitive species are expected to be restricted to individual animals. Many of the vertebrate species considered vulnerable to waste impacts occur seasonally or are expected to occur in low densities (e.g. transiting the area).

Apart from waste streams that are permitted for discharge in accordance other sections of this EP, there are no other planned waste discharges from the vessel. Given that any direct impacts from unplanned events to receptors in the offshore environment are likely to be localised and short-term, the residual risk of waste release is assessed to be Dark Blue as per Table 9-43.

9.11.3 Risk Assessment Summary

Table 9-43: Waste Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Physical Environment	N/A	N/A	N/A
Biological Environment	Slight	C	Dark Blue
Socio-Economic Environment	N/A	N/A	N/A

9.11.4 ALARP Assessment and Environmental Performance Standards

Table 9-44: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	N/A	N/A	Waste generation cannot be eliminated from the offshore facilities.	N/A	N/A	N/A
Substitution	N/A	N/A	The use of alternative materials which will produce less wastes is part of the Product Stewardship Standards of Shell. If materials that generate less wastes are identified in the future, these will undergo appropriate assessment.	N/A	N/A	N/A
Administrative and Procedural Controls	Vessels will maintain a Garbage Management Plan (or equivalent) as relevant to vessel class, type and size.	Yes	Vessels are required to have its own Garbage Management Plan/Procedure (or equivalent) to manage wastes generated and stored onboard. All wastes that are not permitted for discharge are sent ashore for reuse, treatment, recycling and/or disposal as appropriate. This control measure is in accordance with Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and AMSA Marine Order 95.	10.2	Vessels (to which MARPOL Annex V / Marine Order 95 applies) have a current Garbage Management Plan (or equivalent) [13].	Garbage Management Plan (or equivalent) is sighted onboard vessels and are maintained up to date.
				10.3	Vessels to comply with AMSA marine order 94 & 95 (marine pollution prevention – packaged harmful substances/garbage), specifically: • No planned disposal of domestic waste, solid	Garbage record book maintained for vessels as per Marine Order 95 demonstrates that there were no unpermitted discharges of solid waste as part of the petroleum activities[14].

[13] Advice from the Registered Organisation will be followed where there is any variation to the this EPS for the Prelude FLNG.

[14] Advice from the Registered Organisation will be followed where there is any variation to the this measurement criteria for the Prelude FLNG.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					wastes or maintenance wastes overboard from vessels (other than planned discharges permitted by this EP).	

9.11.5 Acceptability of Impacts

Table 9-45: Acceptability of Impacts – Waste Management

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	N/A	N/A	N/A	N/A
Biological Environment	Threatened and Migratory Species	No significant impacts to listed Threatened (Endangered and Vulnerable) or Migratory MNES fauna populations	Yes	Shell implements MARPOL standards and internal controls in relation to managing wastes, which reduces the likelihood of wastes being accidentally released to the marine environment. Given the remote location and distance from important habitats of the Operational Area, any accidental release of wastes to the environment would not be expected to interact with a large number of threatened or migratory MNES species.
Socio-economic and Cultural Environment	N/A	N/A	N/A	N/A

The assessment of risks from waste determined the residual risk rating of Dark Blue (Table 9-43). As outlined above, the acceptability of the risks from waste associated with the petroleum activities has been considered in the following context.

Principles of ESD

The risks from waste are consistent with the principles of ESD based on the following points:

- The environmental values/sensitivities within the Operational Area are not expected to be significantly impacted, and
- The precautionary principle has been applied to the risk assessment.

Relevant Requirements

Management of the risks from waste are consistent with relevant legislative requirements, including:

- MARPOL Annex V as ratified by the *Protection of the Sea (Prevention of Pollution from Ships) Act 1983*
- *Navigation Act 2012 (Cth)* and *Protection of the Sea (Prevention of Pollution) Act 1983 (Cth)*:
  - Marine Order 94 – Marine pollution prevention – packaged harmful substances
  - AMSA Marine Order 95 (marine pollution prevention – garbage).
- Management of impacts and risks are consistent with policies, strategies, guidelines, conservation advice, and recovery plans for threatened species (Table 9-46).

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of waste risks indicates significant risks to threatened and migratory species will not credibly result from the waste aspect of the petroleum activities given the limited number of animals that could potentially be impacted in the unlikely event of an unplanned release.

Alignment of the petroleum activities with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-46.

Commonwealth Marine Environment

The impacts and risks from the waste aspect of the petroleum activity on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-46: Summary of Alignment of the Risks from the Waste Aspect of the Petroleum Activities with Relevant Requirements for EPBC Threatened Fauna

Matters of National Environmental Significance	MNES Acceptability Considerations (Significant Impact Criteria, EPBC Management Plans/Recovery Plans/Conservation Advices)	Threats Relevant to the Project	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species	Conservation advice on sei whale (Balaenoptera borealis) (DoE 2015c)	Pollution (persistent toxic pollutants)	Waste generated during the petroleum activities described in this EP will be managed in accordance with standard maritime requirements, international conventions (MARPOL), relevant Marine Orders and Shell's internal management system requirements. This management reduces the likelihood of the accidental release of hazardous and non-hazardous wastes into the marine environment. The frequency, quantities and nature of wastes that may be accidentally released into the environment are unlikely (C) to result in significant impacts to threatened/migratory species or the Commonwealth Marine Environment (Table 8-1).
	Conservation advice on fin whale (Balaenoptera physalus) (DoE 2015d)	Pollution (persistent toxic pollutants)	
	Conservation management plan for the blue whale: A recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 2015–2025 (Commonwealth of Australia 2015a)	Habitat modification including presence of oil and gas platforms/rigs, marine debris infrastructure and acute/chronic chemical discharge	
	Conservation advice on humpback whale (Megaptera novaeangliae) (DoE 2015b)	Entanglement – marine debris	
	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	Marine debris	
	Recovery Plan for Marine Turtles in Australia 2017–2027 (Commonwealth of Australia 2017)	Marine debris	
	Conservation advice on leatherback turtle	Marine debris	

Matters of National Environmental Significance	MNES Acceptability Considerations (Significant Impact Criteria, EPBC Management Plans/Recovery Plans/Conservation Advices)	Threats Relevant to the Project	Demonstration of Alignment as Relevant to the Project
	(Dermochelys coriacea) (DEWHA 2008)		
	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	Marine debris	
	Conservation advice on whale shark (Rhincodon typus) (DoE 2015e)	Marine debris	
	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	Marine debris	
Commonwealth Marine Area	Significant Impact Guidelines for the Commonwealth marine environment (Table 8-1)	Marine debris	
	Threat abatement plan for the impacts of marine debris on vertebrate marine life (DEWHA 2009c)	Marine debris	
Wetlands of International Importance	N/A	N/A	N/A

External Context

There have been no objections or claims raised by Relevant Persons to date around the waste aspect. Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking future assessment of risks.

Internal Context

Shell has also considered the internal context, including Shell's Waste Strategy and Guidelines, environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

The assessment of and risks from waste determined the residual risk rating to be Dark Blue (Table 9-6). As outlined above, the acceptability of the impacts and risks from waste have been considered in the context of:

- The established acceptability criteria for the waste aspect
- ESD
- Relevant requirements

- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Shell considers residual risks of Dark Blue or lower to be inherently acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the waste aspect.

Based on the points discussed above, Shell considered the risks from waste associated with the petroleum activities described in this EP to be acceptable.

9.11.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No injury or mortality of listed Threatened or Migratory MNES species as a result of unplanned waste discharge to sea.	Fauna observations and incident reports demonstrate no mortality of listed Threatened or Migratory species as a result of unplanned waste discharged from the petroleum activities within the Operational Area.

9.12 Emergency Events

9.12.1 Scenario Context

One unplanned event (i.e. incidents or emergencies) resulting in the potential for large-scale releases of hydrocarbons were identified for the petroleum activities, which is:

- LOC of diesel following a collision between any marine vessels operating in the field

A worst-case scenario resulting from this events has been considered in this environmental risk assessment. The smaller spills have not been discussed specifically as their consequences will be lesser in both magnitude and impact.

LOC of Diesel

A diesel spill to the Operational Area could occur as outcome from a collision between any marine vessels operating in the Operational Area.

The risk of a spill from vessel to vessel collision depends on the severity of impact, i.e. the speed and orientation of the vessels during the event. The worst-case scenario is where one of the vessels is ‘hit’ from the broadside by another vessel moving at near full speed resulting in a puncture of the diesel tanks below the waterline.

A typical vessel which may be used in this petroleum activity is expected to have diesel single storage tank capacities of around 120 m^3. The likelihood of collision between supply and support vessels and any other vessels in the field is considered remote given the low frequency of vessel collisions in ports resulting in fuel loss of containment (Det Norske Veritas, 2011) further reduced by the fact that the Operational Area is far less busy than any other Australian or international port.

The Prelude Oil Pollution Emergency Plan (Rev 5, 2020) is being adopted for this petroleum activity given the relatively small nature and scale of the spill risk (around 120 m3). Specifically Prelude OPEP sections table A, 1, 2, 3, 4, 5, 7, 8, 11, 12, 13,15, 16, 17 and 18 are considered directly applicable for this petroleum activity and spill risk.

The largest diesel volume spill scenario is considered to be from a vessel collision with the with another vessel of magnitude such that a breach of the hull and damage to its biggest diesel storage tank would occur. The largest tank is expected to have a capacity of up to 750 m^3. It has been conservatively assumed for the purposes of spill modelling given the modelling location was only done at the Prelude FLNG location, and not the Crux location also. However, given the actual worst credible spill scenario is about 120 m^3, this is considered conservative and therefore appropriate approach to apply to this petroleum activity. The likelihood of this event happening is estimated as remote given no such events have occurred in Shell or are known of in the industry.

9.12.2 Overview of Unplanned Spill Modelling

Numerical modelling studies were commissioned for the worst-case credible spill scenarios outlined above.

Table 9-47 Summary of Modelled Hydrocarbon and Hazardous Liquids Scenarios

Scenario	Location Name	Latitude	Longitude	Depth (m)	Hazardous Liquid	Duration	Total Volume (m^3)
Loss of containment of diesel	Prelude FLNG	13°47.2´S	123°19.0´ E.	surface	Diesel	1 hour	750

The following models were used to predict impacts from these scenarios:

- The diesel spill scenario was modelled using the OILMAP-Deep model for nearfield modelling and the SIMAP model for the far field effects. 200 replicates over four seasons were run.

SIMAP and CHEMMAP represent 3D stochastic models, with physical fates component for oils and chemicals, biological effects and exposure component, GIS component, and environmental features, oil/ chemical and biological databases. OILMAP-Deep is a 2D/3D deterministic model, simulating the fate of oil in the environment (surface, water column and air distribution), interactions with the ecological component of the environment and has a stochastic component which determines the probability and time contours of oiling of the various environmental components and the most likely spill paths on a monthly, seasonal, or annual basis. The metocean conditions used as input to each model were derived from a 39-year data set of current speed and direction at half-hourly intervals.

A stochastic modelling scheme was followed for each modelled scenario, whereby the respective model was applied to repeatedly simulate the defined spill scenario using different samples of current and wind data. Starting dates for each simulation were distributed between the seasons (e.g. summer and winter) to capture the influence of the temporal and spatial variations in the current patterns that would affect the trajectory of any hydrocarbon or chemical spills that commenced in these periods. The results of the replicate simulations were then statistically analysed and mapped to define contours of risk around the release point.

For hydrocarbons, the timeseries contour compilations include floating, entrained, dissolved and accumulated hydrocarbons.

Hydrocarbon Impact Thresholds

Spilled hydrocarbons can exist as floating, entrained, dissolved and accumulated (i.e. stranded onshore) hydrocarbons. Each of these fractions/ phases can interact with the environment in diverse ways due to different pathways to receptors and cause/effect mechanisms. Guideline impact thresholds (NOPSEMA 2019b) for floating, entrained, dissolved and accumulated hydrocarbons were applied to the hydrocarbon spill modelling studies and used to inform the assessment of potential impacts and risks. Three thresholds were applied to each phase i.e. low exposure, moderate exposure and high exposure. These are described in Table 9-48 and are used to delineate the extent (outer edge) of the low, moderate or high exposure zones for each hydrocarbon type. The low, moderate and high exposure zones represent bands/ ranges of hydrocarbon concentrations, grouped on the basis of scientific knowledge of potential impacts of the various hydrocarbon phases on environmental receptors.

Table 9-48: Hydrocarbon Exposure Zones and Thresholds

Exposure Zone	Threshold	Justification
Floating Oil		
Exposure Zone Low (1 g/m^2 – 10 g/m^2)	1 g/m^2	The 1 g/m^2 threshold represents the practical limit of observing hydrocarbon sheens in the marine environment and therefore has been used to define the outer boundary of the low exposure zone. This threshold is considered below levels which would cause environmental harm and is more indicative of the areas perceived to be affected due to its visibility on the sea-surface. This exposure zone represents the area contacted by the spill and defines the conservative outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone Moderate (10 g/m^2 – 25 g/m^2)	10 g/m^2	Ecological impact has been estimated to occur at 10 g/m^2 as this level of oiling has been observed to mortally impact birds and other wildlife associated with the water surface (French et al. 1996; French 2000). Contact within this exposure zone may result in impacts to the marine environment.
Adverse exposure zone High (> 25 g/m^2)	25 g/m^2	The 25 g/m^2 threshold is above the minimum threshold observed to cause ecological impact. Studies have indicated that a concentration of surface oil 25 g/m^2 or greater would be harmful for the majority of birds that contact the hydrocarbon at this concentration (Koops et al. 2004; Scholten et al. 1996). Exposure above this threshold is used to define the high exposure zone.
Accumulated (Shoreline) Oil		
Exposure zone Low (10 g/m^2 – 100 g/m^2)	10 g/m^2	A threshold of 10 g/m^2 has been defined as the zone of potential 'low' exposure. This exposure zone represents the area visibly contacted by the spill and defines the outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone Moderate (100 g/m^2 – 1,000 g/m^2)	100 g/m^2	French et al. (1996) and French-McCay (2009) have defined an oil exposure threshold of 100 g/m^2 for shorebirds and wildlife (furbearing aquatic mammals and marine reptiles) on or along the shore, which is based on studies for sub-lethal and lethal impacts. The 100 g/m^2 threshold has been used in previous

Exposure Zone	Threshold	Justification
Adverse exposure zone High (> 1,000 g/m^2)	1,000 g/m^2	environmental risk assessment studies (French et al. 2011; French-McCay 2004; French-McCay 2003; French McCay et al. 2012; National Oceanic and Atmospheric Administration 2013). This threshold is also recommended in AMSA's foreshore assessment guide as the acceptable minimum thickness that does not inhibit the potential for recovery and below which is best remediated by natural coastal processes alone (AMSA 2015). Thresholds of 100 g/m^2 and 1,000 g/m^2 will define the zones of potential 'moderate' and 'high' exposure on shorelines, respectively. Contact within these exposure zones may result in impacts to the marine environment and coastal areas.
Entrained Hydrocarbons		
Exposure zone Low exposure (10 parts per billion (ppb)–100 ppb)	10 ppb	The 10 ppb threshold represents the lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC & ARMCANZ (2000) water quality guidelines. Due to the requirement for relatively long exposure times (> 24 hours) for these concentrations to have an observable impact, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained oil plumes, or when entrained hydrocarbons adhere to organisms or entrained oil is trapped against a shoreline for periods of several days or more. This exposure zone is not considered to be of significant biological impact. This exposure zone represents the area contacted by the spill and conservatively defines the outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone Moderate (100 ppb–500 ppb)	100 ppb	The 100 ppb threshold is considered conservative in terms of potential for toxic effects leading to mortality for sensitive mature individuals and early life stages of species. This threshold has been defined to indicate a potential zone of acute exposure, which is more meaningful over shorter exposure durations. The 100 ppb threshold has been selected to define the moderate exposure zone. Contact within this exposure zone may result in impacts to the marine environment.
Adverse exposure zone High (> 500 ppb)	500 ppb	The 500 ppb threshold is considered a conservative high exposure level in terms of potential for toxic effects leading to mortality for more tolerant species or habitats. This threshold has been defined to indicate a potential zone of acute exposure, which is more meaningful over shorter exposure durations. The 500 ppb threshold has been selected to define the high exposure zone.
Dissolved Aromatic Hydrocarbons		
Exposure zone Low (6 ppb–50 ppb)	6 ppb	The threshold value for species toxicity in the water column is based on global data from French et al. (1999) and French-McCay (2003, 2002), which show that species sensitivity (fish and invertebrates) to dissolved aromatics exposure > 4 days (96-hour LC50) under different environmental conditions varied from 6 ppb–400 ppb, with an average of 50 ppb. This range covered 95% of aquatic organisms tested, which included species during sensitive life stages (eggs and larvae). Based on scientific literature, a minimum threshold of 6 ppb is used to define the low exposure zones (Clark 1984; Engelhardt 1983;

Exposure Zone	Threshold	Justification
		Geraci and St Aubin 1988; Jenssen 1994; Tsvetnenko 1998). This exposure zone is not considered to be of significant biological impact and conservatively defines the outer boundary of the EMBA from a hydrocarbon spill.
Adverse exposure zone Moderate (50 ppb–400 ppb)	50 ppb	A conservative threshold of 50 ppb was chosen as it is more likely to be indicative of potentially harmful exposure to fixed habitats over short exposure durations (French-McCay 2002). French-McCay (2002) indicates that an average 96-hour LC50 of 50 ppb could serve as an acute lethal threshold to 5% of biota. The 50 ppb threshold has been selected to define the moderate exposure zone. Contact within this exposure zone may result in impacts to the marine environment.
Adverse exposure zone High (> 400 ppb)	400 ppb	A conservative threshold of 400 ppb was chosen as it is more likely to be indicative of potentially harmful exposure to fixed habitats over short exposure durations (French-McCay 2002). French-McCay (2002) indicates that an average 96-hour LC50 of 400 ppb could serve as an acute lethal threshold to 50% of biota. The 400 ppb threshold has been selected to define the high exposure zone.

9.12.3 Summary of Loss of Containment Modelling Results

Diesel Spill

The worst-case diesel spill modelling scenario included 1 hr surface 750m^3 release of Marine Diesel Oil (MDO), nearfield modelling with OILMAP-Deep and SIMAP model which included 200 replicates per four seasons (APASA, 2014c). The key modelling results include:

- The potential **floating oil** exposure zones were shown up to 500 km in the south-southwest direction and 60 km and 10 km from the release location at the low, moderate and high thresholds respectively. The probability of floating oil film contact with Browse Island is 2%, Echuca Shoals 2.5%, Heywood Shoal 1% and less than 0.5% at all other sensitive receptor locations.
- The **maximum accumulated volume** in the worst case replicate simulation is 61.1 m^3, 6.7 m^3, 9.1 m^3 and 0.07 m^3 at Browse Island, Ashmore Reef, Cartier Island and Buccaneer Archipelago respectively. The maximum local accumulation averaged among replicate spills is 25 g/m^2 at Browse Island, 7.2g/m^2 at Cartier Island and 5.5 g/m^2 at Scott Reef, with less than 1 g/m^2 at all other emergent features.
- The 100 ppb **entrained oil** annualised probability at the closest sensitive receptors is 3% for Browse Island, 4% for Heywood Shoal and 2% for Echuca Shoals with 1% or less for all other receptors. The probability of contact with entrained oil at the high exposure level of 500 ppb is less than 0.5% at all sensitivities.
- The annualised probability of exposure to **dissolved aromatic hydrocarbons** at the low exposure threshold of 6 ppb is 2% at Browse Island and 1% at Heywood and Echuca shoals. For all other sensitive locations, this exposure probability is less than 0.5%. Annualised probabilities for the moderate and high exposure thresholds of 50 ppb and 400 ppb are less than 0.5% at all sensitivities.

9.12.4 Description and Evaluation of Impacts and Risks

Table 9-49: Summary of Combined Hydrocarbon Spill Modelling Results for Sensitive Receptors with Contact above Moderate Exposure Thresholds and Chemical Spill Modelling Results

Geographical Receptor Location	Distance from Operational Area [km]	EP Section Ref.	HC Concentration Above Moderate Exposure Thresholds				
			Floating	Accumulated (Shoreline)	Entrained/ Dissolved		
Key Benthic Communities							
Browse Island	39	Section 7.2.1	Yes	Yes	Yes		
Echuca Shoal	53		Yes	-	Yes		
Heywood Shoal	21		Yes	-	Yes		
Cartier Islet	80		Yes	No	Yes		
Seringapatam Reef	136		Yes	-	Yes		
Goeree Shoal	13		Yes	-	Yes		
Vulcan Shoal	22		Yes	-	Yes		
Scott Reef	159		Yes	No	Yes		
Ashmore Reef	127		Yes	No	Yes		
Hibernia Reef	160		Yes	-	Yes		
KEFs							
Continental Slope Demersal Fish Communities	0	Section 7.2.3	Yes	-	Yes		
Ancient coastline at 125 m depth contour	12		Yes	-	Yes		
Seringapatam Reef and Clth waters in the Scott Reef Complex	131		Yes	-	Yes		
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	80		Yes	No	Yes		
Carbonate bank and terrace system of the Sahul Shelf	60		Yes	-	Yes		
Canyons linking the Argo Abyssal Plain with the Scott Plateau	384		No	-	Yes		
Pinnacles of the Bonaparte Basin	457		No	-	Yes		
Mermaid Reef and Clth waters surrounding Rowley Shoals	523		No	-	Yes		
Glomar Shoals	941		No	-	Yes		
Exmouth Plateau	1,127		No	-	Yes		
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	1,256		No	-	Yes		
Commonwealth waters adjacent to Ningaloo Reef	1,304		No	-	Yes		

Demersal slope and associated fish communities of the Central Western Province	1,747		No	-	No		
Western rock lobster	1,862		No	-	No		
RAMSAR Wetlands							
Ashmore reef national nature reserve	127	Section 7.2.5	Yes	No	Yes		
Roebuck bay	474		No	No	Yes		
Eighty-mile beach	610		No	No	Yes		
Commonwealth Marine Area							
Commonwealth Marine Environment - Kimberley multiple use zone - Ashmore Reef recreational use zone & Sanctuary zone - Cartier Island Sanctuary zone - Oceanic shoals multiple use zone	0	Section 7.2.6	Yes	-	Yes		
WA Mainland Coastline							
WA mainland coastline - Camden Sound	<200km	Section 7.2.7	Yes	Yes	Yes		
BIAs and Habitat Critical for the Survival of a Species							
Blue and pygmy blue whales	Migration - 78	Section 7.2.8.2	Yes	-	Yes		
	Foraging - 132		Yes	-	Yes		
Humpback whale	Migration - 145		Yes	-	Yes		
	Calving - 145		Yes	-	Yes		
	Resting - 145		Yes	-	Yes		
	Nursing - 145		Yes	-	Yes		
	Migration (north and south) - 327		No	-	Yes		
Dugong	Foraging (high density seagrass beds) - 168		Yes	-	Yes		
	Foraging - 176		Yes	-	Yes		
	Calving - 176		Yes	-	Yes		
	Breeding - 176		Yes	-	Yes		
	Nursing - 176		Yes	-	Yes		
Australian snubfin dolphin	Foraging - 187		No	-	Yes		
	Breeding - 190		No	-	Yes		

	Foraging (high density prey) - 190		No	-	Yes		
	Calving - 190		No	-	Yes		
	Resting - 190		No	-	Yes		
Indo-Pacific humpback dolphin	Foraging - 190		No	-	Yes		
	Calving - 190		No	-	Yes		
	Breeding - 190		No	-	Yes		
	Foraging (high density prey) - 190		No	-	Yes		
	Significant habitat - unknown behaviour - 247		No	-	Yes		
Indo-Pacific/spotted bottlenose dolphin	Calving - 190		No	-	Yes		
	Foraging - 190		No	-	Yes		
	Breeding - 239		No	-	Yes		
Flatback turtle	Inter-nesting buffer - 268		No	-	Yes		
	Foraging - 344		Yes	-	Yes		
	Nesting - 302		No	No	Yes		
	Inter-nesting - 356		No	-	Yes		
	Mating – 1,005		No	-	Yes		
	Migration corridor – 1,005		No	-	Yes		
	Aggregation – 1,114		No	-	Yes		
Green turtle	Nesting - 23		Yes	No	Yes		
	Foraging - 43		Yes	-	Yes		
	Inter-nesting buffer - 121		Yes	-	Yes		
	Inter-nesting - 169		Yes	-	Yes		
	Mating - 174		Yes	-	Yes		
	Migration corridor - 1,005		No	-	Yes		

	Aggregation – 1,114		No	-	Yes		
	Basking – 1,130		No	-	Yes		
Hawksbill turtle	Foraging - 141		Yes	-	Yes		
	Inter-nesting buffer - 150		Yes	-	Yes		
	Nesting - 169		Yes	No	Yes		
	Nesting - 971		Yes	No	Yes		
	Mating – 1,005		No	-	Yes		
	Migration corridor – 1,005		No	-	Yes		
	Inter-nesting – 1,005		No	-	Yes		
Loggerhead turtle	Foraging - 344		Yes	-	Yes		
	Inter-nesting buffer - 986		Yes	-	Yes		
	Nesting – 1,008		Yes	No	Yes		
	Nesting – 1,285		Yes	No	Yes		
	Inter-nesting – 1,688		Yes	-	Yes		
Olive ridley turtle	Nesting – critical habitat - 177		No	No	No		
	Foraging - 344		Yes	-	Yes		
Whale shark	Foraging - 33		Yes	-	Yes		
	Foraging (high prey density) – 1,329		No	-	Yes		
Dwarf sawfish	Foraging - 203		No	-	Yes		
	Nursing - 416		No	-	Yes		
Freshwater sawfish	Pupping - 416		No	-	Yes		
	Foraging - 416		No	-	Yes		
	Nursing - 433		No	-	Yes		
Green sawfish	Foraging - 203		No	-	Yes		
	Pupping - 454		No	-	Yes		
	Nursing - 769		No	-	Yes		
Red-footed booby	Breeding - 59		Yes	No	Yes		

Greater frigatebird	Breeding - 59		Yes	No	Yes		
Lesser frigatebird	Breeding - 60		Yes	No	Yes		
Wedge-tailed shearwater	Breeding - 61		Yes	No	Yes		
	Foraging (in high numbers) – 1,741		No	-	No		
White-tailed tropicbird	Breeding - 68		Yes	No	Yes		
Brown booby	Breeding - 118		Yes	No	Yes		
Lesser crested tern	Breeding - 141		Yes	No	Yes		
Little tern	Resting - 142		Yes	No	Yes		
	Breeding - 245		No	No	Yes		
Roseate tern	Breeding - 142		Yes	No	Yes		
	Resting - 571		No	No	No		
Fairy tern	Breeding - 991		No	No	Yes		
Bridled tern	Foraging (in high numbers) – 1,747		No	-	No		
Sooty tern	Foraging – 1,772		No	-	No		
Little shearwater	Foraging (in high numbers) – 1,826		No	-	No		
White-faced storm petrel	Foraging (in high numbers) – 1,837		No	-	No		
World Heritage Properties							
Ningaloo Coast	1,283	Section 7.3.1.1	No	No	Yes		
Shark Bay	1,651		No	No	No		
Commonwealth Heritage Places							
Scott Reef and surrounds	155	Section 7.3.1.2	Yes	No	Yes		
Ashmore Reef National Nature Reserve	127		Yes	No	Yes		
Mermaid Reef – Rowley Shoals	535		No	-	Yes		
Ningaloo Marine Area - Commonwealth Waters	1,304		No	-	Yes		
HMAS Sydney II and HSK Kormoran Shipwreck Sites	1,877		No	-	No		
National Heritage Places							
The West Kimberley	1,283	Section 7.3.1.3	Yes	No	Yes		
Barrow Island and the Montebello-Barrow Islands Marine Conservation Reserves	1,651		No	No	Yes		

The Ningaloo Coast	1,877		No	No	Yes		
Shark Bay, Western Australia	1,283		No	No	No		
HMAS Sydney II and HSK Kormoran Shipwreck Sites	1,651		No	-	No		
Underwater Cultural Heritage							
TBA		Section 7.3.1.5	No	-	Yes		
Marine Protected Areas							
Commonwealth							
Kimberley	111	Section 7.3.2	Yes	-	Yes		
Cartier Island	134		Yes	-	Yes		
Ashmore Reef	127		Yes	-	Yes		
Oceanic Shoals	321		Yes	-	Yes		
Argo-Rowley Terrace	323		No	-			
Roebuck	480		No	-			
Mermaid Reef	523		No	-			
Joseph Bonaparte Gulf	604		No	-			
Eighty Mile Beach	788		No	-			
Dampier	950		No	-			
Montebello	1,047		No	-			
Gascoyne	1,277		No	-			
Ningaloo	1,304		No	-			
Shark Bay	1,588		No	-			
Abrolhos	1,781		No	-			
State							
Lalang-garram / Camden Sound	182	Section 7.3.2	No	-			
North Kimberley	188		No	-			
Rowley Shoals	567		No	-			
Eighty Mile Beach Marine Park	612		No	-			
Montebello Islands Marine Park/Barrow Island Marine Park/Barrow Island Marine Management Area	1,097		No	-			
Muiron Islands Marine Management Area and Ningaloo Marine Park	1,283		No	-			
Shark Bay Marine Park	1,691		No	-			
Fisheries							
Commonwealth Fisheries							
North-west slope trawl fishery	0	Section 7.3.3.3	Yes	-	Yes		
Southern bluefin tuna fishery	0		Yes	-	Yes		
Western tuna and billfish fishery	0		Yes	-	Yes		

Skipjack fishery	0		Yes	-	Yes		
Northern prawn fishery	395		Yes	-	Yes		
Western deep-water trawl fishery	1,072		No	-	Yes		
WA State Fisheries							
Mackerel Fishery	0	Section 7.3.4.4	Yes	-	Yes		
West Coast Deep Sea Crustacean	0		Yes	-	Yes		
South West Coast Salmon	0		Yes	-	Yes		
Northern Demersal Scalefish	0		Yes	-	Yes		
Marine Aquarium and Specimen Shell	28		Yes	-	Yes		
Abalone	28		Yes	-	Yes		
Broome Prawn	28		Yes	-	Yes		
Kimberley Prawn	47		Yes	-	Yes		
Kimberley Gillnet and Barramundi	213		No	-	Yes		
Pilbara Trap	477		No	-	Yes		
Pilbara Fish Trawl	560		No	-	Yes		
Nickol Bay Prawn	560		No	-	Yes		
Onslow Prawn	920		No	-	Yes		
Exmouth Gulf Prawn	1,263		No	-	Yes		
West Coast Rock Lobster	1,272		No	-	Yes		
Gascoyne Demersal Scalefish	1,470		No	-	Yes		
Shark Bay Scallop	1,512		No	-	No		
Shark Bay Prawn	1,512		No	-	No		
Shark Bay Crab	1,670		No	-	No		
Shark Bay Beach Seine and Mesh Net	1,685		No	-	No		
West Coast Demersal Scalefish	1,765		No	-	No		
Northern Territory Fisheries							
Offshore Net and Line Fishery	537	Section 7.3.3.5	No	-	Yes		
Spanish Mackerel Fishery	537		No	-	Yes		
Demersal Fishery	540		No	-	Yes		
Timor Reef Fishery	569		No	-	Yes		
Coastal Line Fishery	618		No	-	No		
Indonesian and Timor-Leste Coastlines							
Indonesia and Timor-Leste	>300	Section 7.3.7	Yes	-	Yes		
Oil and Gas Industry							
INPEX Ichthys FPSO	17	Section 7.3.8	Yes	-	Yes		
Crux Platform (Future)	0		Yes	-	Yes		

Montara FPSO	188		Yes	-	Yes		

Physical Environment

Water Quality

For short duration release scenarios (i.e. diesel), these processes will begin to reduce the total amount of hydrocarbons in the water column shortly after the release.

Sediment Quality (Subsurface)

Sediment quality is not expected to be significantly affected by any of the worst-case scenarios that release hydrocarbons at the sea surface. Hydrocarbon contaminants (e.g. PAHs) from such surface releases are unlikely to reach the seabed due to the water depth and low natural sedimentation rates in the region. Hydrocarbon contaminants from the worst case subsea releases (loss of well control) may contaminate sediments by advective transport of the plume that will be formed during the release (Romero et al. 2015). This is considered likely to occur for the loss of well containment scenario due to the relatively long duration of the release. Any resulting contamination will be concentrated around, and down-current from the wellhead. Due to the low density and volatile nature of the hydrocarbon, weathered condensate is unlikely to be deposited to the seabed. The diesel releases from a loss of fuel from a vessel scenario have relatively low portions of volatiles, which are expected to evaporate quickly following the release. The remaining diesel fractions may sink to the seabed if exposed to considerable sedimentary particles, however this is considered very unlikely to occur in the open sea due to the low density of the residual hydrocarbons relative to seawater and the naturally low suspended solids and associated sedimentation rates. Residual diesel and heavy fuel oils near shorelines may be exposed to higher sediment loads and be more likely to sink. Stranding of residual/persistent oils on shorelines may lead to long-term contamination of sediments with high-molecular weight hydrocarbons. These compounds are typically much less toxic than low-molecular weight hydrocarbons.

Air Quality

The gas plume from the worst-case loss of well containment scenario will result in a gas cloud upon reaching the water surface. This potentially large gas cloud is expected to disperse rapidly in the open, offshore environment. The formation of gas clouds can pose a significant safety risk from the formation of explosive mixtures and asphyxiation. Given the localised extent and open environment, this risk is considered to be very low for the receiving environment.

The table below presents the risk assessment for the worst case in terms of impacts emergency event for the physical environment, based on the worst case outcome for any environmental receptor (i.e. water quality).

Environmental Receptor	Consequence	Likelihood	Residual Risk
Physical Environment (Water, Sediment and Air Quality)	Massive	B-Remote	**Yellow**

Biological Environment

Benthic Communities

Bare Sediments

The seabed in the Operational Area and surrounds is characterised by bare sediments which host low density infaunal and epibenthic communities of filter feeding and deposit feeding organisms. These fauna species may be subject to acute and chronic toxic effects from exposure to hydrocarbons, however the extent of the affected habitat is expected to be localised to the vicinity of the release location. This bare sediment habitat is widely represented in the Timor Sea, and the associated fauna assemblages are not considered to be particularly sensitive or of high conservation value. Filter feeding benthic communities may be vulnerable to entrained and dissolved hydrocarbons. Entrained hydrocarbons can be ingested by filter feeders, leading to increased exposure due to accumulation of ingested oil droplets (Payne & Driskell 2003). While typically less toxic than dissolved hydrocarbons, entrained oil may still cause toxic effects and may also result in physical impacts such as clogging of filter feeding organs, potentially resulting in reduced feeding efficiency. Filter feeder, and sessile organisms in general, may be exposed to concentrations of dissolved hydrocarbons that result in acute and chronic toxic effects.

The more diverse benthic communities in the EMBA are found in shallower waters (< 50 m depth) or in association with islands, shoals, reefs, banks and the shoreline of the Australian, Indonesian and Timor-Leste mainlands. This diversity is due to ambient conditions supporting a healthy presence of primary producers, such as zooxanthellate corals, macroalgae and seagrasses and mangroves.

Modelling results from diesel a scenarios indicate that several offshore reefs and islands, banks and shoals, may be contacted by hydrocarbons above adverse impact thresholds. Impacts on the primary producer communities in these locations are discussed below.

Corals

Experimental studies and field observations in the aftermath of hydrocarbon spills for corals indicate contact with hydrocarbons may result in impacts from no observable injury through to complete or partial tissue death of the colony, with tissue death occurring on the coral colony's surface where oil has adhered (Johannes et al., 1972, Jackson et al., 1989). Branching corals appear to be more sensitive to contact with hydrocarbons than other species and growth forms (Johannes et al., 1972), however, these are uncommon on intertidal reef flats and generally occur only in significant abundance subtidally.

Subtidal corals avoid direct contact with surface oil slicks but can be exposed to the entrained and dissolved hydrocarbon plumes when at the same depths. These hydrocarbon fractions are most likely to cause sublethal effects, such as polyp retraction, changes in feeding, bleaching (loss of zooxanthellae), increased mucous production resulting in reduction in growth rates and impaired reproduction (Negri and Heyward, 2000). The planktonic stages (spawned gametes and larvae) of coral are more susceptible to adverse effects from exposure to hydrocarbons because of their tendency to float or remain near the water surface thus bringing them into direct contact with surface slicks (Villanueva et al., 2008). In addition, the concentrations of water-soluble fractions that inhibit fertilisation or are lethal to coral gametes are lower than those for lethal or sublethal effects in adult colonies (Heyward et al., 1994; Negri and Heyward, 2000). Coral planktonic stages of mass spawning species are largely confined to a 1 to 3-week period after spawning which generally occurs in March/ April but may occur twice a year for the coral colonies in the Timor sea. A spill outside of these periods is of less concern for coral planktonic stages.

Compared to subtidal coral habitats, reef flat communities generally have the lowest coral cover and lowest diversity of corals due to the harsh conditions for coral growth i.e. regular tidal exposure and extensive wave action (particularly along the west coast of Australia). As hydrocarbon ultimately floats to the sea surface, the most vulnerable coral colonies to direct contact with hydrocarbon spills are intertidal corals found on a reef flat, which are periodically exposed during low tides. As such, whilst the reef flat habitat is the most vulnerable coral habitat to direct contact to spills, it is also regarded as the least sensitive of the shallow coral habitats.

The intertidal and shallow water coral reef species at Browse Island, Heywood and Echuca Shoals and other nearby reefs and shoals could potentially suffer sub-lethal stress and, depending on the exposure time and concentration, potentially high rates of mortality. The exposure time and concentration are a function of the location, including the distribution of entrained and dissolved hydrocarbons throughout the water column, the extent of the spill, the met-ocean conditions at the outset of the spill and in the days and weeks following it. The extent of sub-lethal stress and mortality on coral species is likely to be species and depth dependent with intertidal and shallow subtidal species most likely to be impacted by hydrocarbon exposure, compared to their deeper counterparts. These shallow water communities have shown that they can recover quickly from natural mass mortality events. However, depending on the severity of the spill, recovery may still take years.

Macroalgae and Seagrass

Although seagrass and macroalgae may be subject to lethal or sublethal toxic effects including mortality, reduced growth rates and impacts to seagrass flowering, several studies have indicated rapid recovery rates may occur even in cases of heavy oiling (Burns et al.; Dean et al., cited in WEL, 2011).

Most seagrasses within the area that may be affected by the worst-case hydrocarbon spill scenarios are subtidal, although there may be relatively small areas of intertidal seagrasses along the WA coastline. Seagrass in the subtidal and intertidal zones will have different degrees of exposure to hydrocarbon spills. Subtidal seagrass is unlikely to be exposed to surface spilled hydrocarbons, as most hydrocarbons in subtidal environments will be concentrated at the surface. Intertidal seagrasses are vulnerable to smothering by floating oil slicks, which can lead to mortality if it coats their flowers, leaves and stems (Dean et al. 1998; Taylor and Rasheed 2011). Long-term impacts to seagrass are unlikely unless hydrocarbon is retained within the seagrass meadow for a sustained duration (Wilson and Ralph 2011). Toxicity effects can also occur due to absorption of soluble fractions of hydrocarbons into tissues (Runcie et al. 2010). The potential for toxic effects of entrained hydrocarbons may be reduced by weathering processes that should serve to lower the content of soluble aromatic components before contact occurs.

Like seagrasses, the potential impacts to macroalgae depend on the exposure pathway; most macroalgae in the region are subtidal, although intertidal macroalgae may be present. Studies of subtidal macroalgal assemblages exposed to fuel oil spills have shown that impacts from exposure are slight (Edgar et al. 2002; Lobón et al. 2008). Effects of exposure to oil on intertidal macroalgae are more variable; some studies reported little evidence of impacts (Díez et al. 2009), while others show significant impacts (De Vogelaere and Foster 1994). Recovery of intertidal macroalgae has been shown to occur faster in areas where oil has been left to degrade naturally compared to areas subject to intensive clean-up operations (De Vogelaere and Foster 1994). The same applies to the amine spills from the facility which were predicted to

reach the closest sensitive receptors in only 2% of the cases above the defined impact threshold.

Mangroves

Intertidal mangrove habitats occur throughout much of Kimberley, offshore islands, Indonesia and Timor Leste and are highly susceptible to oil pollution (NOAA 2014). Given the distance between potential release locations and the nearest mangroves, any spilled hydrocarbons reaching mangroves will be highly weathered. Mangroves are vulnerable to contact with floating hydrocarbons, which may coat prop roots and pneumatophores (aerial roots that support oxygen uptake) (Duke and Archibald 2016). Exposure can result in direct effects such as yellowed leaves, defoliation and mortality, and indirect effects such as reduced recruitment and increased sensitivity to other stressors (NOAA 2014). Like seagrasses, mangroves can also be impacted by entrained and dissolved aromatic hydrocarbons either in the water or sediment.

The table below presents the risk assessment for the worst-case in terms of impacts emergency events (i.e. diesel) for benthic communities, based on the worst-case outcome for any of the environmental receptors in this group.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Benthic Communities (Bare Sediments, Corals, Macroalgae and Seagrass and Mangroves)	Major	B-Remote	**Yellow**

Pelagic Communities (Plankton, Pelagic Fish and Invertebrates)

Plankton

Potential impacts to phytoplankton and zooplankton from the worst-case hydrocarbon or chemical spills are expected to consist of short-term acute toxic effects. Planktonic communities are characterised by relatively rapid turnover rates of short-lived biota. The high turnover rate will lead to rapid recovery as the spilled hydrocarbons decay in the environment. Within plankton communities, there is evidence from laboratory studies that some taxonomic groups, particularly zooplankton (e.g. copepods) may be more sensitive to hydrocarbon pollution (Almeda et al. 2013; Jiang et al. 2010). Few reliable studies have shown any impacts of hydrocarbon spills on planktonic communities, with most studies concluding that impacts from hydrocarbon pollution cannot be distinguished from natural variability (Abbriano et al. 2011; Davenport et al. 1982; Varela et al. 2006). Many marine species have planktonic larval phases (e.g. corals, many species of fish). Organisms with planktonic larval phases typically produce very high numbers of larvae. A worst-case credible spill may result in increased mortality of planktonic larvae (which are subject to high natural mortality); however, this is not expected to result in population, habitat or species scale impacts.

Pelagic Fish

Fish respire through gills, which may make them more vulnerable to dissolved hydrocarbons than fauna with less permeable skins, such as cetaceans, marine reptiles and birds. Despite this apparent vulnerability, fish mortalities are rarely observed to occur due to hydrocarbon spills (Fodrie and Heck 2011; International

Tanker Owners Pollution Federation 2011), although recorded instances of fish mortality from spills in confined areas (e.g. bays) exist. These observations are consistent with fish moving away from hydrocarbons in the water (Hjermann et al. 2007). Stochastic modelling results for all surface spills indicated that hydrocarbons are likely to be concentrated in surface layers. As a result, demersal fish are unlikely to be directly affected unless near a subsea release, as they are typically concentrated around seabed features e.g. shoals, banks and subsea KEFs. Pelagic fish are more likely to encounter dissolved and entrained hydrocarbons above adverse exposure thresholds but may move away from affected areas following detection.

Exposure of fish to hydrocarbons may results in acute and chronic effects and may vary depending on a range of factors such as exposure duration and concentration, life history stage, inter-species differences and other environmental stressors (Westera and Babcock 2016). Early life history stages of fish (planktonic eggs and larvae) may be more vulnerable to hydrocarbon pollution than juvenile and adults, as these early life history phases cannot actively avoid water with high concentrations of hydrocarbons. Fish embryos and larvae may exhibit genetic and developmental abnormalities from long-term exposure to low concentrations of hydrocarbons (Fodrie and Heck 2011), although such long exposures may not be representative of real-world conditions. Exposures to PAHs have also been linked to increased mortality and stunted growth rates of early life history (pre-settlement) of reef fishes, as well as behavioural impacts that may increase predation of post-settlement larvae (Johansen et al. 2017). Given the temporal and spatial scale of the worst-case credible spill scenarios (as shown by a single deterministic run), and the typically high supply of eggs and larvae, it is unlikely that any of the worst-case credible spill scenarios will result in significantly reduced recruitment of fish due to impacts during early life history phases.

Environmental monitoring of pelagic and demersal fishes immediately following the Montara oil spill indicated that despite the exposure to hydrocarbons, no adverse effects were detected in fish (Gagnon and Rawson 2012, 2011). Further sampling and testing over time indicated that fish captured in close proximity to the Montara wellhead were comparable to those collected from reference sites (Gagnon and Rawson 2012, 2011). This conclusion is supported by studies of fish stocks following large-scale hydrocarbon spills, which have shown relatively little evidence of reduced recruitment at the scale of fish stocks/populations (Fodrie and Heck 2011).

The table below presents the risk assessment for the worst-case in terms of impacts emergency events for pelagic communities, based on the worst-case outcome for any of the environmental receptors in this group.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Pelagic Communities (Plankton, Pelagic Fish and Invertebrates)	Moderate	B - Remote	Dark Blue

Key Ecological Features (KEFs)

Modelling study results indicated no KEFs will be exposed to adverse impact thresholds for floating hydrocarbons, but several KEFs may be exposed to entrained and dissolved hydrocarbons above adverse impact thresholds. KEFs with the closest

proximity to the credible spill sources that may experience contact above moderate impact thresholds include (see Table 9-49):

- continental slope demersal fish communities
- ancient coastline at 125 m depth contour
- Seringapatam Reef and Commonwealth Waters in the Scott Reef Complex
- Ashmore Reef and Cartier Islands and surrounding Commonwealth waters.

The continental slope demersal fish communities and the ancient coastline at 125 m depth contour are entirely sub-tidal. The relatively diverse benthic communities associated with these habitats, such as filter feeding communities and demersal fish assemblages may be impacted by dissolved and entrained hydrocarbon above moderate exposure thresholds, which may result in acute or chronic toxic effects. KEFs are most likely to be contacted by the subsea loss of well control scenario, due to the large, entrained hydrocarbon fraction. Modelling results indicated that no single deterministic run affected the entirety of a sub-tidal KEF; most runs typically affected a minor portion of any given KEF. Given the nature of the KEFs and the scale of potential impacts, recovery of impacted parts of a KEF are expected to be facilitated by movement and recruitment of biota from the unaffected areas.

Several offshore reefs and islands within KEFs were identified by the modelling study results as potentially being contacted by hydrocarbons above adverse exposure thresholds. These include Ashmore Reef and Cartier Island and Seringapatam Reef and Commonwealth waters in the Scott Reef complex. Offshore reefs and islands typically host light-dependent ecosystems characterised by benthic primary producers and biological communities that are distinct from coastal islands and the mainland. Potential impacts will be limited to submerged receptors only as floating oils were predicted to contact any of these KEFs at concentrations well below the lower adverse impact threshold at very low annual probabilities between 0.5% and 3%. Environmental effects will be similar to those described for sub-tidal KEFs.

The table below presents the risk assessment for the worst-case in terms of impacts emergency events for pelagic communities, based on the worst-case outcome for any of the environmental receptors in this group.

Environmental Receptor	Consequence	Likelihood	Residual Risk
KEFs	Major	B-Remote	**Yellow**

Threatened and Migratory Species

Cetaceans and Dugongs

Marine mammals potentially present, their conservation status and any associated BIAs within the EMBA are detailed in Section 7.2.8.

Cetaceans exposed to surface, entrained or dissolved aromatic hydrocarbons above adverse exposure thresholds may suffer external oiling, ingestion of oil and inhalation of toxic vapours (Deepwater Horizon Natural Resource Damage Assessment Trustees 2016). Cetaceans in coastal waters (e.g. coastal dolphin species and humpback

whales at the northern limit of their migration) are at lower risk of impacts than cetaceans in offshore water due to the oil weathering before reaching coastal waters.

Skin contact with floating hydrocarbons could result in irritation and absorption and potential for impact to eyes and airways. Inhalation of vapours or the ingestion of hydrocarbons can potentially have lethal effects due to damage to the whale's respiratory and nervous systems. Baleen whales, such as blue whales and humpback whales, are the most likely to be susceptible to hydrocarbon ingestion due to their feeding through baleen plates including from near water surface. Toothed whales and dolphins are less susceptible due to their 'gulp' feeding approach, often targeting individual specific prey away from the sea surface (Woodside Energy Limited 2011).

However, cetaceans and dugongs are highly mobile, capable of long migrations, and typically in low numbers/densities in the moderate exposure zone. Experimental and field observations indicate that whales and dolphins may be able to detect and actively avoid hydrocarbon slicks, but this may not always be possible and exposure to floating oil may still occur (Smith et al. 1983, Geraci and St. Aubin 1990).

Vessel-based surveys of the Browse Basin area by the Centre for Whale Research (Western Australia) Inc. between June and November 2008 recorded low numbers of cetaceans in a broad survey area, with average densities of 0.00013 large cetaceans (whales) per square kilometre (1 whale per 7,700 km^2) and 0.026 small cetaceans (dolphins) per square kilometre, or 1 cetacean in 39 km^2 (Jenner, Jenner & Pirzl 2009, cited in INPEX 2010). Given such sparse distributions, it is not anticipated that impacts to a significant portion of the cetacean and other mammal populations would result if a spill was to occur.

Dugongs are known to occur in coastal waters and around offshore islands within the moderate exposure zones identified by the stochastic spill modelling. There is a paucity of studies examining the effects of hydrocarbon spills on dugongs, although the direct impacts of exposure to hydrocarbons may be similar to cetaceans. Like cetaceans, dugongs are expected to be resilient to direct impacts due to their thick skin and blubber. Suitable dugong habitat is associated with seagrass meadows, which are typically restricted to shallow waters around the mainland coast and islands. The distance of dugong habitat from the worst-case credible spill release locations means that oil reaching dugong habitat will be highly weathered.

The table below presents the risk assessment for the worst-case in terms of impacts emergency events for cetaceans and dugongs.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Cetaceans and Dugongs	Moderate	B-Remote	Dark Blue

Reptiles

Stochastic modelling results indicated moderate exposure zones overlap the known distribution of several species of marine turtles and sea snakes. Saltwater crocodiles were also identified as potentially occurring within the adverse exposure zone; given the preferred habitat for saltwater crocodiles are freshwater rivers and estuaries, impacts to this species from the worst-case hydrocarbon spills are not considered

credible. Marine turtles may be exposed to floating hydrocarbons when at the sea surface (e.g. breathing, basking etc.), and are not expected to actively avoid floating hydrocarbon slicks (NOAA 2010). Exposure to floating or entrained hydrocarbons may result in external oiling, which could result in impacts such as inflammation or infection (Gagnon and Rawson 2010, Lutcavage et al. 1995; NOAA 2010). Given the large portion of non-persistent hydrocarbons in the loss of diesel or heavy fuel oil scenarios are considered to pose the greatest risk of external oiling. Dissolved hydrocarbons may result in toxic effects on marine turtles, however their relatively impermeable skin reduces the potential for these impacts.

Stochastic modelling identified island and mainland shoreline habitats (sandy beaches and inter-nesting habitat) that may be exposed to hydrocarbons above moderate exposure thresholds. Some of these are classified as habitat critical for the survival of marine turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia 2017a) and BIAs. Of these, the critical nesting and inter-nesting habitats for green turtles at Browse island have the highest probability to be affected above moderate impact thresholds.

Several shoals and banks occur in the EMBA, which may be used as foraging areas by marine turtles. Impacts to benthic habitats and biota at these shoals and banks may result in a reduction of prey for marine turtles. A spill reaching critical nesting habitats during peak periods to turtle nesting could result in impacts. With respect to floating oil, given the distance of these locations from the Operational Area, worst-case credible spills HFO or diesel reaching these areas will be highly weathered and unlikely to result in impacts from an acute toxicity perspective, except for Browse Island.

Sea snakes have similar exposure pathways to spilled hydrocarbons as marine turtles (although sea snakes will not be exposed to shoreline hydrocarbon accumulation). Potential impacts are expected to be comparable and may include irritation of eyes and mucous membranes. Sea snake mortality has been linked to exposure to hydrocarbon spills, with dead sea snakes recovered from the region of the Montara oil spill showing high levels of petroleum hydrocarbons (including PAHs) in the trachea, lungs and stomach (Gagnon 2009). These results are consistent with exposure through ingestion and respiration of hydrocarbons. Ashmore Reef and Hibernia Reef are noted as being one of the few sites where the critically endangered leaf-scaled sea snake and short-nosed sea snake have been recorded, along with other species of sea snake. Both the leaf-scaled and short-nosed sea snakes have not been detected at Ashmore Reef since 2001, despite increased biological survey effort. Both locations were identified by the stochastic modelling as potentially being exposed to hydrocarbon above moderate adverse exposure limits.

The table below presents the risk assessment for the worst-case in terms of impacts emergency events for reptiles.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Reptiles	Major	B-Remote	**Yellow**

Seabirds and shorebirds

Seabirds and shorebirds are present in the EMBA (see Section 7 for details). Seabirds are particularly vulnerable to hydrocarbon spills owing to high potential for contact with the sea surface where they feed, rest or moult. Feeding by seabirds recorded in the region involves snatching prey items from or below the water surface by paddling or aerial diving, and these birds also rest on the ocean surface. Migrating and residential shorebirds by contrast are less susceptible to severe oiling and associated physical effects as they confine feeding to shorelines (Sholz et al. 1992; cited in Woodside Energy Limited 2011) and they do not land on the water surface. In cases where the hydrocarbon spill comes ashore large number of shorebirds may be impacted.

In the event of a spill, seabirds and shorebirds are likely to make contact with spilled hydrocarbons due to the amount of time they spend on or near the surface of the sea and on affected foreshores. Contact with hydrocarbon may impact a bird's ability to fly due to external and/ or internal exposure potentially leading to death by drowning, starvation or predation. Hydrocarbon contamination affects the feathers insulation, buoyancy and waterproofing properties and ultimately the bird's survival. The overriding behaviour of a bird with oiled feathers is preening to the exclusion of all other normal activities. As an affected bird preens, it ingests and inhales hydrocarbons, which can cause damage to internal organs such as the lungs, intestines and liver. Suppression of the immune system can also occur and other effects include impacts to reproductive success through decreased fertility of eggs and reduction in egg shell thickness.

Specifically, estimates for the minimal thickness of floating oil that might result in harm to seabirds through ingestion from preening of contaminated feathers, has been estimated by different researchers at approximately 10g/m^2 (French 2000) to 25g/m^2 (Koops et al. 2004).

The main area of sensitivity for migratory birds are the Ashmore Reef and Cartier Islands, which are recognised as particularly important for feeding migratory shore birds during non–breeding periods. These islands are an important staging point during the migration between the Northern Hemisphere and Australia. During October to November and March to April large flocks of birds protected under the JAMBA, CAMBA and ROKAMBA are more likely to be present in the area and sensitive to shoreline oil contact. Browse Island, and Seringapatam and Scott Reefs are recognised as important habitat for seabirds. These locations, as indicated by modelling, will not be affected to any adverse impact levels i.e. > 10g/m^2 (French 2000).

The table below presents the risk assessment for the worst-case in terms of impacts emergency events for seabirds and shorebirds.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Seabirds and shorebirds	Massive	B-Remote	**Yellow**

Socio-Economic and Cultural Environment

Commonwealth Heritage Places and Marine Protected Areas

Commonwealth Heritage Places and Marine Protected Areas overlap with the sensitive receptors discussed in the Physical and Biological Environment sections above.

Several offshore islands and reefs listed as Commonwealth Heritage Places were identified by the spill modelling results as potentially being contacted by hydrocarbons above moderate exposure thresholds. These include:

- Ashmore Reef National Nature Reserve Commonwealth Heritage Place
- Scott Reef and Surrounds Commonwealth Heritage Place
- Mermaid Reef – Rowley Shoals Commonwealth Heritage Place

The environmental values of these reefs are primarily their outstanding natural values. These have been discussed in the preceding sub-sections.

Modelling results of the worst-case credible spill scenarios indicated a range of Commonwealth, state and territory marine parks may be contacted above moderate exposure thresholds (Table 9-49). These parks contain a range of environmental values such as marine biota, representative marine habitats and unique sea scapes (e.g. KEFs). Environmental values for these marine parks are described in Section 7 and discussed above in Physical and Biological Environments. Refer to these sections for discussion of potential impacts to these environmental values within marine parks.

The table below presents the risk assessment outcome for this receptor.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Commonwealth Heritage Places and Marine Protected Areas	Massive	B-Remote	**Yellow**

Fishing Industry

A number of commercial fisheries operate within the moderate exposure zone determined from spill modelling results. The worst-case credible hydrocarbon spill scenarios may result in a range of impacts to commercial fishing activities, such as (International Tanker Owners Pollution Federation 2011):

- displacement of fishing effort from areas affected by a spill or spill response activities
- damage to fish stocks due to mortality
- closure of fisheries by management agencies
- inability to sell catch due to perceived or actual fish tainting or contamination
- oiling of fishing gear, particularly by floating oil.

A significant hydrocarbon spill would likely result in the temporary closure of areas of fisheries within the area of moderate exposure. The spatial extent and duration of the closure would depend on the nature and scale of the pollution resulting from the hydrocarbon spill. Given the large spatial extent of managed fisheries relative to the area potentially contacted above moderate exposure thresholds for any single event, a spill is unlikely to result in the complete closure of a fishery. Rather, the closure of areas to fishing is more likely to result in the displacement of fishing effort during the response and recovery phases. Displacement from productive fishing areas may result in impacts to fishers such as increased costs and reduced catch per unit effort and reduced income. Exposure of fish to hydrocarbons may result in tainting, which may

render landings unsuitable for human consumption. Tainting may occur even at low levels of hydrocarbon exposure. Monitoring of fish for taint immediately following capping of the Montara well detected differences between fish likely to have been exposed to hydrocarbons, however these differences were not conclusively linked to oil contamination and fell within the range of “normal” fish odours (Rawson et al. 2011). Samples collected at the same monitoring locations two and four months after were not distinguishable (Rawson et al. 2011). These results are consistent with other studies of fisheries resources exposed to hydrocarbon pollution, which acknowledge the potential for impacts to fisheries resources and have shown little potential risk for consumers if suitable fisheries management actions are undertaken (Law and Hellou 1999; Law and Kelly 2004). Fish caught in areas affected by a significant hydrocarbon spill may be perceived as being of poorer quality, even if no decrease in quality is evident. This may result in lower prices at the time of sale and subsequently lead to reduced income for commercial fishers.

The table below presents the risk assessment outcome for this receptor.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Fishing Industry	Moderate	B-Remote	Dark Blue

Tourism and Recreation

There are currently no known tourism activities in the Operational Area, or immediate surrounding areas, due to the remoteness and water depth of the area. Some tourism activities may occur at the remote offshore islands and reefs within the EMBA. These activities are expected to be exclusively nature-based tourism and impacts to the environmental values associated with these islands and reefs may impact upon tourism activities. Mainland coastline and islands will typically host more nature-based tourist activities than offshore islands. This activity is expected to be seasonal, with increased visitation during the winter dry season months. Impacts to tourism activities are expected to be minor based on the likelihood and nature of contact to environmental values that support tourism activities. Impacts to these values may result in displacement of tourism activity, introduction of temporary exclusion zones or avoidance of areas with visible oil sheens, and a corresponding loss of revenue for tourist operators (e.g. charter fishing cancellations due to fishery closures).

The table below presents the risk assessment outcome for this receptor.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Tourism and Recreation	Minor	B-Remote	Dark Blue

Defence

Defence activities within the offshore North Australian Exercise Area (NAXA) are unlikely to be affected by the worst-case credible hydrocarbon spills. Activities may be temporary displaced from areas where spill response operations are underway. This would be highly localised and temporary in nature.

Shipping

Potential impacts to commercial shipping from the worst-case credible spill scenarios are expected to be slight and consist of temporary displacement of other users from areas where spill response activities are underway. These are expected to be concentrated around the release location.

The table below presents the risk assessment outcome for defence and shipping.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Defence and Shipping	Minor	B-Remote	Dark Blue

Oil and Gas Industry

Petroleum activities in the region include drilling and pre-installation activities for the future Shell-operated Crux facility, the INPEX-operated Ichthys facility and the Montara development. Reduction in water quality as a result of a worst-case credible spill may affect the operation of these facilities if seawater at the facility is no longer suitable for intake (e.g. for use as cooling water or feed water for RO water generation). This may result in impacts to routine operations such as decreased production. A worst-case hydrocarbon spill response may result in competition for vessels and potentially drilling rigs (if well intervention or a relief well is required).

The table below presents the risk assessment outcome for the oil and gas industry.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Oil and Gas Industry	Minor	B-Remote	Dark Blue

Indonesian and Timor Leste Coastlines

The spill modelling results indicate there is the potential for the well loss of containment spill scenario resulting in contact with the Indonesian coastline. The probability of floating film contact with the Indonesian Coastline was estimated at < 0.5% and minimum arrival time of 64 days for those rare contact scenarios, with maximum local accumulation of 3 kg/m^2 for the worst replicate spill. Contact for entrained oil was also predicted at 33% for the moderate exposure threshold. The probability of dissolved hydrocarbon contact was predicted to be approx. 5% for the moderate exposure threshold.

Given the relatively long time to contact, soluble aromatic hydrocarbon fractions are unlikely to be present, leaving relatively low toxicity residual hydrocarbons such as

paraffins. Potential impacts may include smothering of coastal infrastructure (e.g. aquaculture, fishing equipment), which may result in localised economic impacts.

The table below presents the risk assessment for the worst case in terms of impacts emergency events for seabirds and shorebirds.

Environmental Receptor	Consequence	Likelihood	Residual Risk
Indonesian and Timor Leste Coastlines	Major	B-Remote	**Yellow**

9.12.5 Risk Assessment Summary

The risk assessment summary in Table 9-50 is based on the worst case in terms of consequences spill event, i.e. the loss of well control LOC.

Table 9-50: Emergency Events Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Physical Environment	Massive	B-Remote	**Yellow**
Biological Environment	Major	B-Remote	**Yellow**
Socio-economic Environment	Massive	B-Remote	**Yellow**

9.12.6 ALARP Assessment and Environmental Performance Standards

Table 9-51: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	None identified	N/A	N/A	N/A	N/A	N/A
Substitution	Substitute HFO/IFO within MDO or LNG with less hazardous chemicals	No	It is not practical for Shell to mandate vessel specifications or requirements given project schedule drivers to have the survey completed in Q3 2022.	N/A	N/A	N/A
Engineering	Use of radars/ Automatic Identification System (AIS)/ Automatic Radar Plotting Aid (ARPA) and associated alarms on vessels	Yes	Use of radars/ Automatic Identification System (AIS)/ Automatic Radar Plotting Aid (ARPA) and associated alarms on FLNG, infield support vessels and supply vessels. This technology allows early identification and notification of approaching vessels and is crucial in minimising the risk of vessel-to-vessel collision. Standard vessel management activities includes specific collision prevention procedures and measures including: • Ability for three way communication between FLNG, infield support vessels and offtake vessel • ARPA and associated alarms monitored for approaching vessels • Contractual requirement for vessels to be manned by competent crew, and • All contracted vessels employed are subjected to a stringent assurance process	11.4	The vessel is equipped with suitable and operational navigation and collision avoidance equipment, specifically: • ARPA • AIS • Radar, and/or • Equivalent system.	Marine Assurance records

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural Controls	Lifting procedures and maintenance & inspection of lifting equipment.	Yes	Lifting and Hoisting Standard are mandatory for all lifting operations on the vessel. The standard which specifies lifting requirements, performance standards and roles and responsibilities will be implemented to reduce the risk of dropped objects impacting subsea infrastructure potentially resulting in damage or at a worst case, a loss of well control event.	11.5	All lifts are approved in line with the Lifting and Hoisting Standard including the required use of PTW/risk assessment where applicable	Records of PTW, lift plans, training records and lifting equipment register
Administrative and Procedural Controls	Vessel Bunkering Procedures for Hydrocarbons and Chemicals	Yes	The purpose of these procedures is to ensure that good practice and industry standards are applied during bunkering operations. Implementation of these procedures will minimise the risk of a spill incident through e.g. both facilities prepared for bunkering, drains plugged, approved bunker plan for specified volumes, designated receiving tanks and agreed pumping rates, direct communication between all involved and supervision at both ends and availability of spill kits onboard each vessel/facility.	11.6	The vessels will have dry-break couplings, inspected and certified bunkering hoses, and this equipment will be maintained.	Assurance and maintenance records.
				11.7	No spills to water as a result of bunkering activities.	Incident records
Administrative and Procedural Controls	SOPEP for vessels[15]	Yes	SOPEP shall be in place for all marine support vessels as required by class in accordance with as per AMSA Marine Order 91.	11.8	Vessels shall have a current SOPEP onboard to respond to small spills	A valid SOPEP for relevant vessels is in place
Administrative and Procedural Controls	Vessel anchoring and mooring plan	Yes	No vessel anchoring in the Operational Area except in emergency situations or under issuance of a specific permit by Shell.	11.9	No support vessel anchoring in the Operational Area except in emergency situations or under issuance of a specific permit by Shell.	Records verify no breaches of anchoring procedures in the Operational Area.

[15] Advice from the Registered Organisation will be followed and updates made where required, where there is any variation to the this control measure which may be applicable to the Prelude FLNG.

9.12.7 Acceptability of Risks

Table 9-52: Acceptability of Risks – Emergency Events

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	Water quality	Limited environmental impact to water quality and quality is maintained so that biodiversity, ecological integrity, social amenity and human health values are protected.	Yes	Weathering data indicates low residual volumes of floating oil will continue to weather, decay and diminish through partitioning between the water column, air and shore/ sediment accumulation. The dissolved hydrocarbon fraction will have the greatest impact on water quality due to the presence of compounds such as BTEX and PAHs. BTEX compounds are not expected to persist in the marine environment due to their volatility and will continually diminish due to weathering and biodegradation once released into the environment. PAHs are less volatile than BTEX due to their higher molecular weight/ more complex structures and are expected to persist for longer. The concentrations of hydrocarbons in the water column will decrease over time once the release has stopped due to processes such as dispersion, dilution, physical and biological degradation, and evaporation.
	Sediment quality	Limited environmental impact to sediment quality and quality is maintained so that biodiversity, ecological integrity, social amenity and human health values are protected.	Yes	Sediment quality is not expected to be significantly affected by any of the worst-case scenarios that release hydrocarbons at the sea surface. Hydrocarbon contaminants (e.g. PAHs) from such surface releases are unlikely to reach the seabed due to the water depth and low natural sedimentation rates in the region. Residual diesel and heavy fuel oils near shorelines may be exposed to higher sediment loads and be more likely to sink. Stranding of residual/persistent oils on shorelines may lead to long-term contamination of sediments with high-molecular weight hydrocarbons. These compounds are typically much less toxic than low-molecular weight hydrocarbons.
Biological Environment	Benthic communities	Limited environmental impact which directly impacts bare sediment benthic habitats outside of the Operational Area as a result of the petroleum activities which adversely effects biological diversity or ecological integrity.	Yes	Modelling results from the diesel and HFO scenarios indicate that several offshore reefs and islands, banks and shoals, may be contacted by hydrocarbons above adverse impact thresholds. Shallow water corals communities have shown that they can recover quickly from natural mass mortality events. However, depending on the severity of the spill, recovery may still take years. Although seagrass and macroalgae may be subject to lethal or sublethal toxic effects including mortality, reduced growth rates and

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		Limited environmental impacts to high-value sensitive benthic communities (corals, macroalgae, seagrasses and mangroves) associated with named reefs, banks and shoals.		impacts to seagrass flowering, several studies have indicated rapid recovery rates may occur even in cases of heavy oiling Mangrove communities will not be impacted by the worst case modelled spills due to the large separation distances between Operational Area and the intertidal mangrove habitats found along the Kimberley coastline, offshore islands, Indonesia and Timor Leste.
	Pelagic communities (Non-Threatened or Migratory)	Limited environmental impact leading to adverse effect on pelagic communities, populations, habitats or spatial distribution of a species.	Yes	Potential impacts to phytoplankton and zooplankton from the worst-case hydrocarbon or chemical spills are expected to consist of short-term acute toxic effects. Planktonic communities are characterised by relatively rapid turnover rates of short-lived biota. The high turnover rate will lead to rapid recovery as the spilled hydrocarbons decay in the environment. Exposure of pelagic fish to hydrocarbons may results in acute and chronic effects and may vary depending on a range of factors such as exposure duration and concentration, life history stage, inter-species differences and other environmental stressors. Studies of fish stocks following large-scale hydrocarbon spills, which have shown relatively little evidence of reduced recruitment at the scale of fish stocks/populations.
	KEFs	Limited impact to environmental values of KEFs	Yes	The continental slope demersal fish communities and the ancient coastline at 125 m depth contour are entirely sub-tidal. The relatively diverse benthic communities associated with these habitats, such as filter feeding communities and demersal fish assemblages may be impacted by dissolved and entrained hydrocarbon above moderate exposure thresholds, which may result in acute or chronic toxic effects. Modelling results indicated that no single deterministic run affected the entirety of a sub-tidal KEF; most runs typically affected a minor portion of any given KEF. Given the nature of the KEFs and the scale of potential impacts, recovery of impacted parts of a KEF are expected to be facilitated by movement and recruitment of biota from the unaffected areas.
	Threatened and Migratory Species	No significant impacts to listed Threatened (Endangered and Vulnerable) or	Yes	Shell has identified the potential for hydrocarbon pollution, and potential consequential habitats degradation for to listed threatened or migratory MNES fauna populations from a large scale hydrocarbon

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		Migratory MNES fauna populations. Management of aspects of the project must be aligned to conservation advice, recovery plans and threat abatement plans, including for bird and marine turtle species.		release as a major environmental risk. Shell has applied a range of controls that are intended to reduce the likelihood of such a release occurring, and mitigative controls to understand and reduce the severity of impacts should such as release occur. Large-scale hydrocarbon releases pose a significant safety risk for Shell personnel, and considerable effort will be applied to reduce the inherent likelihood of large-scale hydrocarbon releases occurring.
	Ramsar Wetlands	Limited environmental impacts to ecological values of Ramsar wetlands	Yes	Shell considers large-scale releases of hydrocarbons from activities to be unacceptable. Such spills have a potential to result in significant environmental impacts. Consequently, Shell will apply its considerable experience and knowledge in the offshore petroleum industry to ensure such a release never occurs. Shell has applied a conservative approach to the identification and modelling of the credible worst case hydrocarbon spills. This information was used to inform the evaluation of the environmental impacts and risks, and is consistent with the precautionary principle. Shell will implement industry standard controls to manage the risk of unplanned hydrocarbon spills through this EP and associated Oil Pollution Emergency Plan (OPEP) commensurate to the nature and scale of the hydrocarbon pollution risks petroleum activities.
	Commonwealth Marine Area	Limited environmental impacts to the Commonwealth Marine Area (refer to Table 8-1)	Yes	
	WA mainland coastline	Limited environmental impacts to mainland coastline.	Yes	
Socio-economic Environment	Commonwealth Heritage Properties	Limited environmental impacts to defined heritage values	Yes	
	Marine Protected Areas	Limited environmental impacts to ecological values of Marine Protected Areas	Yes	
	Fisheries	No interference with fishing to a greater extent than is necessary for the exercise of right conferred by the titles granted to carry out petroleum activities.	Yes	
	Tourism & recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income.	Yes	

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
	Defence & shipping	No interference with defence activities as directed by the Department of Defence. No interference with navigation to a greater extent than is necessary for the exercise of right conferred by the titles granted to carry out petroleum activities.	Yes	
	Oil and Gas industry	No interference with other titleholders to a greater extent than is necessary for the exercise of right conferred by the titles granted to carry out the petroleum activities	Yes	
	Indonesian & Timor Leste Coastlines	No impacts to Indonesian or Timor-Leste coastlines or nearshore environments are acceptable.	Yes	

A comprehensive assessment of the risks from the worst-case credible spill scenarios arising from the petroleum activities has been undertaken. Globally, Shell is experienced in the design, installation and decommissioning of similar developments and understands the impacts and risks that may arise from these worst case credible spill scenarios. Shell has undertaken environmental studies, numerical modelling and consultation to identify the environmental receptors that may be affected and understands the nature and implications of potential hydrocarbon pollution. These studies, along with Shell's organisational experience, allows a high degree of confidence to be placed in the outcomes of the assessment of the risks.

Principles of ESD

The risks and impacts from the worst-case credible spill scenarios are inherently inconsistent with some of the principles of ESD based on the following:

- environmental resources and sensitivities may be significantly impacted in the event a worst-case credible spill, and
- a worst-case credible spill may prevent others exercising their right to access environmental resources.

Shell will apply a range of controls to ensure that a worst-case credible spill from the petroleum activity never occurs. These include a range of industry best practices that have been developed through extensive industry experience, including the lessons

learned from significant unplanned releases such as the Macondo and Montara well blowouts. Following successful application of these controls, Shell considers the residual risk to be consistent with the principles of ESD. This consistency is achieved by:

- developing natural resources in an environmental responsible manner, resulting in income for government, generation of Australian jobs, and developing an increased understanding of the Timor Sea environment.
- application of the precautionary principle in the assessment of hydrocarbon spill scenarios by:
  - using worst-case credible spill scenarios. Industry statistics indicate the vast majority of unplanned spills are significantly smaller than the worst-case credible spills.
  - using a stochastic modelling approach for numerical modelling of the worst-case credible spill scenarios that includes a large number (hundreds) of deterministic runs covering a range of metocean conditions.
  - using environmentally conservative adverse exposure zone thresholds.

Relevant Requirements

Management of the impacts and risks from unplanned hydrocarbon spills are consistent with legislative requirements, including:

- compliance with international maritime conventions, including:
  - STCW Convention
  - SOLAS Convention
  - COLREGS
  - MARPOL: Annex I: prevention of pollution by oil and oily water.
- compliance with Australian legislation and requirements, including:
  - Navigation Act 2012 and Protection of the Sea (Prevention of Pollution from Ships) Act 1983:
    - Marine Order 21 (Safety of Navigation and Emergency Procedures
    - Marine Order 27 (Radio Equipment)
    - Marine Order 30 (Prevention of Collisions)
    - Marine Order 71 (Masters and Deck Officers)
    - Marine Order 91 (Marine pollution prevention – oil).
  - OPGGS Act 2006 and OPGGS (E) Regulations:
    - accepted WOMPs for all well activities, including drilling, operation, suspension and abandonment
    - accepted EP and OPEP for all petroleum activities associated with the Crux project.
  - Implementation of recognised industry best practices, such as:
    - design, construction and operation of Crux infrastructure in accordance with recognised industry standards
    - mutual aid agreement in place with other petroleum operators to assist with drilling rig availability for relief well drilling

- agreements in place with oil spill response service providers
- development of SIMOPS plans for activities that may interact with the Prelude FLNG facility.

Matters of National Environmental Significance

Commonwealth Marine Environment

Table 9-53 provides a summary of the alignment between managing of the emergency events aspect from the petroleum activities associated with the relevant MNES acceptability considerations listed in EPBC Management Plans/Recovery Plans/Conservation Advices.

Table 9-53: Summary of Alignment of the Impacts from the Emergency Events associated with the Petroleum Activities to Relevant Requirements for MNES

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Threatened and Migratory Species – Marine Mammals	Emergency events due to loss of containment are not considered to be acceptable to Shell. In the event of such an incident, the relevant EPBC Management Plans, Recovery Plans and Conservation Advice documentation will be consulted based on the nature/scale of the spill and the determination of the potentially impacted environmental sensitivities to ensure mitigation and recovery efforts are in alignment. Refer to Table 7-7 for full list of potential plans at the time of writing this EP. The relevant databases will be checked at the time to ensure currency and any relevant inclusions will be made.	Shell has identified the potential for hydrocarbon pollution, and potential consequential habitats degradation, from large-scale hydrocarbon releases as a significant environmental risk. Shell has applied a range of controls that are intended to reduce the likelihood of such a release occurring, and mitigative controls to understand and reduce the severity of impacts should such a release occur.
Threatened and Migratory species - marine reptiles		
Threatened and Migratory species - sharks and rays		
Threatened and Migratory species - birds		
Commonwealth Marine Environment		

External Context

There have been no objections or claims raised by Relevant Persons to date around the emergency events aspect. Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking further assessment of impacts.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs, controls and EPSs which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements. Shell has, and will continue to maintain, an appropriate spill response framework, which includes regular testing of the response arrangements as per Section 10.7.

Acceptability Summary

The assessment of impacts and risks from the worst-case credible unplanned hydrocarbon spills determined the residual impact and risk rating is Yellow (Table 9-50). Given the significant consequence of the risks associated with these worst-case hydrocarbon spills, Shell has undertaken an extensive, conservative risk assessment and will apply a range of controls consistent with relevant requirements and industry best practice.

As outlined above, the acceptability of the impacts and risks from unplanned spills associated with the petroleum activity has been considered in the context of:

- The established acceptability criteria for the emergency events aspect
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

Based on the points discussed above, Shell considered the impacts and risks from worst case emergency events to be acceptable following the application of the controls outlined in the ALARP Demonstration above.

9.12.8 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No unplanned release of hydrocarbons or chemicals to the marine environment as a result of loss of containment from: • refuelling, • vessel collision or • bulk transfer or lifting.	Incident reports associated with spills which initiated the ERT and/or IMT.

9.13 Oil Spill Response Strategies

9.13.1 Spill Impact Mitigation Assessment

As described in the SIMA presented in the OPEP, not all response strategies are applicable for every spill scenario. It is considered that a combination of response strategies may be required to implement an effective response.

The scope of this SIMA covers Shell's activities for the Prelude FLNG in addition to the Crux seabed survey. Therefore, there are strategies considered, which are not applicable to the scope of this EP.

The Prelude Oil Pollution Emergency Plan (Rev 5, 2020) is being adopted for this petroleum activity given the relatively small nature and scale of the spill risk (around 120 m3). Specifically Prelude OPEP sections table A, 1, 2, 3, 4, 5, 7, 8, 11, 12, 13,15, 16, 17 and 18 are considered directly applicable for this petroleum activity and spill risk.

In all spill scenarios (Section 9.12.1) source control and monitor and evaluation spill response strategies will be implemented. For diesel releases the success of various response strategies is considered to be limited based on the expected spreading, dispersion and evaporation rates in the marine environment making certain strategies such as contain and recover and surface dispersant application ineffective. Whereas for HFO spills they may be implemented as primary or secondary response strategies.

The applicability of all spill response strategies are assessed in the strategic SIMA presented in the OPEP. An ALARP assessment of the oil spill response strategies described in the OPEP are presented in Table 9-54.

Capability, readiness and implementation requirements for the specific spill response strategies are addressed in the OPEP (HSE_PRE_013075), which includes control measures and EPSs around the required level of performance of each response strategy, and hence are not repeated in this EP.

Table 9-54: ALARP assessment of oil spill response capability

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
Source Control				
Site survey	Documents: Browse Basin Source Control Contingency Plan Source Control Equipment Mobilisation Plan Equipment: Vessel equipped with ROV and tooling Personnel: Subsea Intervention Group/Source Control Branch	A site survey involves the use of a vessel equipped with an ROV to conduct visual observations of the well and surrounding subsea infrastructure, following the loss of containment event. The information gathered is used to enable further source control planning and establish those source control activities that could be implemented. A single vessel with a single ROV is required to conduct the site survey. Multiple vessels and/or ROV's would not result in a better environmental outcome. If the failure can be immediately isolated remotely then this is the quickest response to reduce the environmental impact.	Additional vessels equipped with ROV's would not result in increased benefit for planning source control activities.	A vessel equipped to undertake the site survey is expected to take approximately 7-10 days to mobilise. The vessel to undertake the site survey would be sourced from within Australia using Shell's established vessel contracting procedures. The cost of maintaining a vessel with full ROV spread and ROV crew at all times to undertake a site survey is considered to be grossly disproportionate given that several vessels with ROVs could be made available on short notice within the region. The following well and subsea tree valves are fail-safe closed valves (SCSSSV, PMV, PWV and PSDV). With the subsea tree still connected, if there is a leak then the initial response would be to attempt to isolate the failure by remotely functioning one or more valves from the facility. There is also some ROV intervention capability.
Deployment of SFRT/SIRT and subsea dispersant injection (SSDI)	Documents: Browse Basin Source Control Contingency Plan Source Control Equipment Mobilisation Plan Equipment: AMOSC Subsea First Response Toolkit (SFRT) including 500 m^3 of Dasic Slick gone NS, mobilised to Broome in 6 days.	Access to the SFRT/SIRT to enable intervention in the event of a loss of well control scenario will also enable SSDI capability. SSDI will increase the entrainment of hydrocarbons in the water column thereby reducing the presence of hydrocarbons at the sea surface that can present environmental impacts. The application of subsea dispersant also has benefits over surface application in that it can	Consideration was given to moving the AMOSC SFRT to Broome to from Perth to enable for faster deployment however, it is owned by industry (others may also need the equipment in other areas) and as it is not on critical path there	Based on its location in WA, the AMOSC SFRT (located in Perth) would be mobilised as the primary control with the SIRT located in Norway/Brazil as a redundancy. As described in the row above, a vessel equipped to undertake the site survey is expected to take approximately 7-10 days to mobilise therefore the timeframe for mobilisation of the SFRT is not a limiting factor and improving this timeframe would not result in an environmental benefit.

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	OSRL Subsea Incident Response Toolkit (SIRT) mobilised to Broome. Personnel: Subsea Intervention Group/Source Control Branch, Shell's Well Control Virtual Emergency Response Team (WC VERT) available in 24 hours. AMOSC (SFRT) and Oceaneering (SIRT) personnel available in 24 hours.	reduce volatile organic compounds at the sea surface making it safer for responders to access the area for further source control activities. Where surface application of dispersant can only be applied in daylight hours, SSDI can occur 24 hours a day. The volume of dispersant associated with the SFRT can be replenished from various stockpiles located within Australia and Internationally.	is little value to be gained by such.	
Relief well drilling As described in Section 9.12.1, due to the presence of the Subsea Xmas Tree, the primary method of source control is the drilling of a relief well.	Documents: Prelude Well Operations Management Plan (WOMP) Prelude Safety case Browse Basin Source Control Contingency Plan Browse Basin Exploration and Appraisal Well Control Contingency Plan including relief well locations Relief Well Manual Well Kill Modelling & Analysis APPEA MoU Equipment: MODU to drill relief well and kill the well in 80 days, kill fluid & pumping equipment, tubulars, ranging equipment. Personnel: Shell Relief Well Task Force 24-72 hours.	Improving the timeframes to drill a relief will reduce the volume of hydrocarbons released to the marine environment.	The relief well injection spool (RWIS) is a spool piece with side outlets installed below the BOP of the relief well to enable the connection of more surface pumping resources. These additional resources can deliver greater kill fluid rates to the relief well. As all Prelude wells can be killed with the pumping capacity of standard MODU, use of the RWIS would not result in a faster well kill and	Compliance with Shell's global standards for well design integrity to assure mechanical and functional integrity for all anticipated loads throughout the life of the well. These standards meet or exceed current International and Australian standards. The APPEA MoU allows the signatories to share rigs, equipment, personnel and services to assist other operators in the event of a well blowout. This would potentially enable Shell to source a suitable relief well MODU in a quicker timeframe, and would also provide access to additional equipment, personnel and services. Access to source control specialists is not considered a limiting factor.

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	Specialist personnel from Wild Well Control and Boots and Coots Various locations internationally +72 hours.		subsequent environmental benefit.	
Monitor and Evaluate				
Modelling (oil spill trajectory, fate & weathering, met ocean data, satellite imagery)	Processes: AMOSC call-off procedure Equipment: ADIOS2 on IMT PCs In-house deterministic modelling Personnel: Shell Geomatics team	Oil spill trajectory modelling can be commenced using AMOSC call off contract with RPS group within 2 hours of IMT being notified of the spill. The data would be used to inform IAPs and confirm the selection of other response strategies in the following days. Therefore, there is no environmental gain in improving the activation timeframe.	N/A	No alternative or additional controls have been identified that could improve this response.
Surveillance - vessel	Processes: N/A Equipment: FLNG support vessels Personnel: Trained ISV crew	Several support vessels will be present in WA-44-L. Shell has a contract with marine vessel contractors to provide additional vessels for oil spill response activities if required. There is no environmental gain from providing additional vessels.	N/A	Increasing vessel surveillance capability is not considered to be warranted based on the limitations associated with visual observations made from a vessel platform. Aerial surveillance in conjunction with deployment of tracking buoys is a more effective method of obtaining situational awareness. Vessel surveillance can be undertaken through the use of existing FLNG support vessels.
Surveillance - aerial	Processes: Third party call-off contract Aerial surveillance observation log Equipment: N/A Personnel: Trained aerial observers (AMOSC/AMSA/OSRL)	Shell has third-party call off contracts for helicopters and fixed wing aircraft. These aircraft can be ready for mobilisation in 4-8 hours. Trained aerial observers are available within 24 hours.	Personnel trained in aerial observation could be on standby in order to provide higher quality data to the IMT. However, in the 1st 24 hours the spill it is likely to cover a relatively small	Untrained aerial observation opportunities exist via Shell crew change helicopters. This in conjunction with tracking buoys and other monitor and evaluate data is expected to provide sufficient information for the IMT in the 1st 24 hours, until such time as trained aerial observers are available.

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
			geographical location close to the release point. Therefore, initial untrained observations are considered to be adequate given the other data available to the IMT such as spill modelling, tracker buoy data etc.	
Tracking buoys	Processes: N/A Equipment: Tracking buoys Personnel: Trained ISV/FLNG crew for tracking buoy deployment	Tracker buoys are available for immediate deployment from a variety of locations including the Prelude FLNG. No environmental benefits can be gained by increasing the number of buoys available or time to deploy.	Access to additional buoys is available from the shared stockpile located in Broome.	No alternative or additional controls have been identified that could improve this response.
Surface Chemical Dispersant				
Vessel based dispersant application	Processes: Shell Surface Dispersant Application Guide Equipment: 5 m^3 Dasic Slickgone and AFEDO spray set on each ISV (3 vessels in field or en-route) Personnel: ISV personnel trained in vessel application techniques	Based on the existing capability, Shell could commence vessel based dispersant application immediately subject to AMSA approval (where relevant). Additional supplies of dispersant can be obtained from stockpiles on the Australian mainland.	N/A	In the event of a spill that was amenable, surface application of dispersant from vessels can be implemented immediately upon approval. In the event that additional stockpiles of dispersant are required they can be accessed from stockpiles in various locations across Australia.
Fixed Wing Aerial Dispersant (FWAD) application	Processes: Shell Surface Dispersant Application Guide. AMOSC/OSRL call-off procedure.	Pre-positioning of aircraft and personnel (air attack supervisor) in particular could enable a faster response time resulting in quicker	Additional costs associated with pre-positioning aircraft and personnel are	Shell has access to AMSA fixed wing aircraft wheels up in 4 hours and first implementation within 36 hours with supporting monitoring aircraft.

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	Equipment: N/A Personnel: Air attack supervisors and pilots.	application of dispersant with more oil treated and hence an overall environmental benefit.	estimated to be in the order of 10s of thousands of dollars per day and are considered to be grossly disproportionate given the access to vessel-based dispersant application.	Surface application of dispersant using vessels can be implemented much faster and therefore the costs associated with increasing FWAD capability are considered to be grossly disproportionate given the risk.
Contain and recover				
Containment and recovery equipment (offshore boom and skimmer system)	Processes: Shell Offshore Contain and Recover Guide. Equipment: FLNG support vessels AMOSC stockpile (Broome) 400 m of offshore boom and skimmer system. Waste storage capability Personnel: AMOSC/AMSA/OSRL trained and experienced personnel.	Increasing a contain and recover response will results in the removal of more oil from the sea surface and therefore less will accumulate on shorelines resulting in less environmental impacts to shoreline receptors and less waste generation.	Additional dedicated vessels with offshore boom and skimmer systems would cost in the order of 10s of thousands of dollars per day and is not considered warranted given the availability of such equipment is not a limiting factor in the effectiveness of this strategy.	Shell has access to the AMOSC stockpile located at Broome (and other stockpiles elsewhere in Australia). The effectiveness of this response strategy is affected by sea state conditions and the thickness of oil at the sea surface; therefore it may only be applicable to the HFO spill scenario. Maintaining booms and skimmers offshore is not practicable due to space limitations. The availability of contain and recover equipment is not a limiting factor and other response strategies could be implemented in faster timeframes (vessel-based dispersant) that would be more effective on HFO spills.
Shoreline Protection and Deflection				
Shoreline and nearshore booming equipment	Processes: Browse Island Incident Management Guide Equipment: AMOSC/OSRL specialised equipment	Undertaking an improved shoreline protection and deflection response may reduce shoreline accumulation of oil resulting in less environmental impacts to shoreline	Access to additional booming equipment would cost in the order of thousands of dollars per day	Given the logistical and safety limitations with shoreline response in the Browse Basin, implementation of the response will take approximately 1 week to occur from decision being made to commence (noting that this decision may be made by WA DoT as the Control

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	Personnel: AMOSC/OSRL trained and experienced personnel.	receptors and less waste generation. However, shorelines in the Browse Basin are difficult to access due to their remoteness and safety risks and may not result in an overall environmental gain.	and is not considered warranted given the availability of such equipment is not a limiting factor in the effectiveness of this strategy.	Agency). Pre-positioning of booms may result in potential damage to sensitive locations and is not considered ALARP. Improving on this response is not considered to provide an environmental gain.
Shoreline Clean-up				
Shoreline Clean-up Assessment	Processes: Shoreline Clean-Up Assessment OMP, Browse Island Incident Management Guide Helicopter call-off contract Equipment: Staging and accommodation facility Personnel: AMOSC/OSRL trained and experienced personnel.	Shoreline assessment specialised personnel can be deployed to remote shorelines from staging/accommodation facilities within 5-6 days. Undertaking quicker shoreline assessment would be beneficial to obtain pre-impact results, however, shorelines in the Browse Basin are difficult to access due to their remoteness and safety risks. Earlier deployment may not result in an overall environmental gain.	N/A	Shoreline surveys must be conducted systematically to be a crucial component of effective decision-making. Repeated surveys are needed to monitor the effectiveness and effects of ongoing treatment methods (i.e. changes in shoreline oiling conditions, as well as natural recovery). Improving the time for specialised personnel to access remote shorelines to make assessments is not warranted and will not result in an environmental gain. Noting that the decision to commence this strategy may be made by WA DoT as the Control Agency.
Manual and mechanical removal (washing, flooding & flushing, sediment reworking & surf washing)	Processes: Shoreline Clean-Up Assessment OMP, Browse Island Incident Management Guide Equipment: AMOSC/OSRL specialised equipment Personnel: AMOSC/OSRL trained and experienced personnel.	Predictive oil spill modelling indicates the largest volumes accumulating on shorelines is 1,393 m^3 of condensate at the Indonesian Boundary and 475 m^3 of HFO at the Buccaneer Archipelago. Depending on the sensitivity of the shoreline removal of accumulated oil using heavy machinery and/or large numbers of personnel may result in additional environmental damage.	Costs for additional clean-up equipment are considered to be negligible and are not considered a limiting factor in the effectiveness of this strategy. Constraints primarily lie in mobilising equipment and	Shell has access to shoreline response kits. Given the logistical and safety limitations with shoreline response in the Browse Basin, implementation of the response will take approximately 1 week to occur from decision being made to commence (noting that this decision may be made by WA DoT as the Control Agency). Large scale operations involving large numbers of personnel and/or heavy equipment may cause adverse environmental impacts at many of these sensitive shoreline locations and would not result in an environmental gain. Manual clean-up equipment, using smaller teams for longer periods would be more effective

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
		Access by heavy machinery would also be restricted at offshore islands.	personnel safely rather than sourcing additional equipment.	in most of the shoreline locations predicted to be contacted.
Oiled Wildlife Response				
Oiled wildlife response implementation	Processes: WA Oiled Wildlife Response Plan (WAOWRP) Equipment: AMOSC OWR containers (2) and box kits. NatPlan OWR containers (4), OSRL OWR equipment. Personnel: AMOSC/OSRL trained and experienced national and international OWR personnel.	Given access to local OWR equipment and personnel (AMOSC) through existing arrangements the response capability cannot be improved to result in an environmental gain unless an OWR kit is maintained offshore.	Any OWR will be undertaken in consultation with the relevant agencies e.g. WA DBCA and WA DoT. Such consultation is more likely to be a time limiting factor than accessing additional OWR resources.	Shell is a participating member of AMOSC with access to Mutual aid arrangements. AMSA MoU and OSRL contracts, enabling access to national and international oiled wildlife expertise. The closest OWR container is located in Fremantle and can be mobilised to Broome within 30 hours by vessel. Additional containers and box kits are available from other locations within Australia (including Broome for the closest box kit). Maintaining a dedicated OWR kit offshore is not considered to be reasonable given the low likelihood of needing to implement an OWR and the requirement for trained OWR personnel.
Waste Management				
Waste management	Processes: Oil Spill Waste Management Plan Template. Equipment: Assorted waste receptacles and trucks from waste contractor with additional stocks from sub-contractors located in Darwin, Broome and/or Dampier. 635 m^3 capacity of offshore storage in Darwin. Personnel: Waste contractor personnel (Rusca Brothers).	There are no limitations to obtaining the required waste storage capacity for this EP and no environmental benefit obtained by accessing additional waste storage capacity.	Costs for additional waste management resources are considered to be negligible.	Predictive oil spill modelling indicates the largest volumes accumulating on Australian shorelines is 475 m^3 of HFO at the Buccaneer Archipelago. Using a bulking factor of 10, potentially 4,750 m^3 of waste could be generated during a shoreline clean-up response. Decanting from contain and recover operations will also generate waste for disposal. Typically, this oily liquid waste would be held in the inboard storage tanks of the support vessels and disposed of at an onshore facility. Based on Shell's waste contractor capability the available resources are considered to be suitable for the worst-case spill scenario.

9.13.2 Aspect Context

This section describes any new or unique environmental impacts or risks presented by implementation of the emergency events response strategies included in the OPEP (HSE_PRE_013075) which may be enacted to respond to hydrocarbon and chemical spills as described in Section 9.12. Where impacts and risks are already adequately addressed in the preceding sections of this EP, as indicated in Table 9-55, they are not discussed further in this section.

Typically environmental aspects, impacts and risks that arise from conducting the emergency response activities are similar to those already described in Section 9.3 to 9.11. for the planned and unplanned activities, particularly for vessel-based operations. Where additional impacts or risks exist for the identified aspects, these are described in the following subsection. Table 9-55 summarises the aspects generated by implementing the spill response activities and identifies any that are new or unique aspects for further assessment.

Table 9-55: Spill response strategies and associated environmental aspects identified for each including those that are considered new or unique

		Aspects Generated											
		Physical Presence	Lighting[2]	Noise Generated	Disturbance to Seabed	Disturbance to Ground[1]	Introduced Marine Pests	Discharge of Liquid Wastes	Planned Chemical Discharge[1]	Atmospheric Emissions	Greenhouse Gas Emissions	Waste Management	Emergency Events
Response Activities	Source Control (including SSDI)[3]	✓	✓	✓	✓		✓	✓	×	✓	✓	✓	✓
	Monitor and Evaluate	✓		✓			✓	✓		✓	✓	✓	✓
	Natural Recovery												
	Chemical Dispersant (Surface)	✓		✓			✓	✓	×	✓	✓	✓	✓
	Contain and Recover	✓		✓	✓		✓	×		✓	✓	✓	✓
	Protect and Deflect	✓		✓		×	✓	✓		✓	✓	✓	✓
	Shoreline Clean-up		☒			×		✓		✓	✓	✓	
	Oiled Wildlife Response	✓		✓			✓	✓		✓	✓	✓	✓
	Scientific/ Oil Spill Monitoring	✓		✓			✓	✓		✓	✓	✓	✓

Notes:

✓ - The aspects and associated impacts and risks are already adequately addressed in the EP Sections 9.3-9.11.

× - There is an aspect of the response activity that may produce a new or unique impact/risk not already addressed in the EP.

1. New or different aspect not previously described in the EP
2. Due to daylight operations only for typical vessel-based activities (excluding source control), lighting impacts for stationary, non-operating vessels at sea during night will not present a credible impact to sensitive receptors.
3. As described further in the OPEP, source control activities to respond to a LoWC emergency event may include drilling a relief well. All source control activities will be managed in accordance with the accepted OPEP, Safety Case and WOMP.

9.13.2.1 Subsea (Source Control) and Surface Dispersant Application

Dispersants are applied to hydrocarbon spills to enhance the breakdown of hydrocarbon droplets and enhance dispersion into the water column to:

- Break up floating oil and reduce floating oil concentrations, thereby reducing the exposure of seabirds and surfacing marine fauna to hydrocarbons
- Reduces the size of the entrapped oil droplets further aiding dispersion and enhancing biodegradation.

Additionally, source control is the primary response strategy for the well loss of containment scenario and is aimed at stopping the flow of well fluids to the environment. Subsea Dispersant Injection (SSDI) may be required as part of the overall source control strategy to ensure conditions are safe for responders (i.e. minimise gas cloud concentration and extent) to enable relief well drilling.

9.14.2.2 Contain and Recover - Decanting Operations

Application of the Contain and Recover strategy is significantly limited by weather, logistics, and requires substantial temporary waste storage for recovered hydrocarbons. Recovered hydrocarbons will inevitably contain a large proportion of water in addition to recovered oil that may need to be decanted back to the sea to optimise the recovered oil fraction. Refer to the OPEP for further details.

9.14.2.3 Shoreline Clean-up and Protect and Deflect – Disturbance to Ground

Conducting shoreline protection and clean-up involves moving personnel and equipment, which includes the environmental aspect of ground disturbance. The objective of shoreline clean-up is to apply clean-up techniques that are appropriate to the shoreline type to remove as much oil as possible where there is a net environmental benefit in doing so. Various techniques may be used alone or in combination to clean up oiled shorelines, including Shoreline Clean-up Assessment Technique (SCAT), natural recovery, absorbents, sediment reworking, manual and mechanical removal and washing, flooding, and flushing. Considerations for selecting and implementing shoreline clean-up techniques are included in the OPEP.

The deployment of booms to protect sensitive shoreline receptors, typically pre-emptively, introduces the potential for ground disturbance or damage to nearshore habitats such as intertidal reefs, mangroves, seagrasses and macroalgal communities that are present at Browse Island and other offshore islands/shorelines.

9.13.3 Description and Evaluation of Impacts

Subsea and Surface Dispersant Application – Planned Chemical Discharges

Physical Environment

Water Quality

Environmental effects associated with dispersant application include a temporary reduction in water quality and exposure of marine biota to dispersant chemical's

inherent ecotoxicity, biodegradability and bioaccumulation properties. The level of toxicity varies amongst the different dispersant types and can result in increased in-water concentrations of the toxic components of hydrocarbons. Dispersant combined with dispersed oil can be acutely toxic in the water column at specific concentration thresholds, and is noted for its toxicity to habitats such as corals, seagrass, and macroalgae.

Biological Environment

Benthic Communities

Environmental effects associated with dispersant application include an increase in the mass of entrained hydrocarbons with smaller droplet sizes affecting larger areas and being bioavailable for ingestion by some oceanic and benthic organisms (e.g. fish, plankton, benthic invertebrates). The effects of entrained hydrocarbons on sensitive environmental receptors are discussed in Section 9.12.4.

The extent of these impacts will also depend on the chemical dispersant type and dose rates, and external conditions (time of the year, weather and sea conditions, proximity of sensitive receptors and their life stage, etc.). These impacts will provide another consideration into the decision process on strategy selection (SIMA) and timing on a case-by-case basis at the time of the incident as described in the OPEP.

Sensitive reef communities are located within the Browse Basin, with the closest being around Browse Island, Echuca and Heywood Shoals and Ashmore and Cartier Islands, while seagrass meadows are located in some of these areas also. If applied appropriately, dispersants can provide a net environmental benefit by limiting exposure of an oil spill to high environmental value sensitive receptors. Elevated concentrations of dispersant are generally localised and of short duration, with dilution and dissipation being relatively rapid after application. Therefore, residual impacts from the use of dispersants are expected to be low in nature and scale when assessed in isolation compared to the impact of the spill without dispersant application, and ranked as minor impact consequence (Magnitude -2, Sensitivity M).

Decanting Operations/Contain and Recover – Discharge of Liquid Wastes

Physical Environment

Water Quality

In order to optimise recovery of floating hydrocarbon removed from the sea surface during Contain and Recover operations, it may be required to decant some of the oily water from temporary storage back into the ocean which may result in dissolved and entrained hydrocarbons being released back into the marine environment. This is not expected to lead to additional environmental impacts compared to the pre-application state of this strategy as the decanted water will be released at the spill site within already affected boomed areas and not elsewhere. Thus, no additional adverse environmental impacts are expected for water quality and marine biota and the residual impact consequence is assessed as nil (Magnitude 0, Sensitivity – L).

Shoreline Clean-up and Protect and Deflect– Disturbance to Ground and Lighting

Biological Environment

Disturbance to Intertidal Habitats and Marine Fauna

Conducting shoreline clean-up activities, including moving personnel and equipment, has the potential to cause damage to terrestrial and intertidal habitats, with subsequent impacts to dune/beach structure, flora such as mangroves and fauna such as turtles

and birds (including nests). Invasive or frequent clean-up can also involve physical removal of substrates that could adversely impact habitats, fauna and alter coastal geomorphology and hydrodynamics. The impacts associated with undertaking shoreline clean-up may be more than if the product was left in place and remediated through natural processes (Natural Recovery). Leaving the product in place is a very common response option if continual human and vessel/vehicle traffic has the potential to generate greater impacts than the product itself. The optimal suite of response strategies will be determined through the SIMA process described in the OPEP.

The deployment of booms to protect shorelines and intertidal environments could potentially cause physical damage to coral reefs/intertidal ecosystems through the movement of the booms and/or anchors. A review of shoreline and shallow water habitats, and bathymetry, and the establishment of demarcated areas for access and anchoring will reduce impacts to nearshore environments.

Shoreline clean-up and protect/deflect activities will be managed to minimise impacts on turtles (including hatchlings) and birds through minimising disturbance to nesting, and feeding sites. Responder transfer to shore would be on small boats or helicopters. Responders would be accommodated on nearby medium sized vessels or facilities such as Prelude (if available). An assessment of appropriate equipment and personnel numbers required to reduce habitat damage, along with the establishment of access routes/demarcation zones, and operational restrictions on equipment and personnel movements will limit sensitive habitat damage and damage to important fauna areas. The establishment of temporary camp areas will be done in consultation with DoT, DBCA and a Heritage Advisor if access is sought to culturally significant areas.

Given the controls in place and the short-term and localised incidental environmental effects from shoreline clean-up activities, there would only be minor residual impact consequences presented by personnel and equipment undertaking shoreline clean-up activities (Magnitude -2, Sensitivity – M).

Lighting

Shoreline response activities may require use of lighting which can cause disorientation, disruption to nesting and breeding behaviours in seabirds, shorebirds and turtles.

Shoreline clean-up and protect/deflect activities will be managed to minimise impacts on turtles (including hatchlings) and birds through minimising disturbance to nesting, and feeding sites. An assessment of the need to conduct night-time operations in sensitive areas will be made and operational restrictions established. Due to the remote location of potentially impacted shorelines, conduct of response operations with smaller teams to reduce ecological impacts (Refer to Section 12.3 of OPEP) and the safety implications associated with dangerous marine fauna (e.g. saltwater crocodiles), it is unlikely that operations will be conducted at night.

Given the controls in place and the short-term and localised incidental environmental effects from shoreline clean-up activities, there would only be minor residual impact consequences presented by personnel and equipment undertaking shoreline clean-up activities (Magnitude -2, Sensitivity – M).

9.13.4 Impact Assessment Summary

Table 9-56 lists the highest residual impact consequence rankings of the relevant environmental receptor groups.

Table 9-56: Spill Response Strategies Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Physical Environment – water quality	-2	M	Minor
Biological Environment – benthic communities, intertidal habitats and marine fauna	-2	M	Minor
Socio-economic and Cultural Environment[1]	N/A	N/A	N/A

1- Potential impacts to socio-economic and cultural environment receptors are not predicted to exceed those presented in Section 9.13 and are therefore not repeated in this section.

9.13.5 ALARP Assessment and Environmental Performance Standards

An ALARP assessment of oil spill response capability is presented in Table 9-54. A description of controls, environmental performance standards and measurement criteria for each oil spill response strategy are presented in the OPEP.

9.13.6 Acceptability of Impacts

Table 9-57 Acceptability of Impacts – Oil Spill Response Strategies

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	Water quality	Limited environmental impact to water quality and quality is maintained so that biodiversity, ecological integrity, social amenity and human health values are protected.	Yes	Spills from decanting and the application of dispersant may result in a temporary reduction in water quality. The level of toxicity varies amongst the different dispersant types and can result in increased in-water concentrations of the toxic components of hydrocarbons. Dispersant combined with dispersed oil can be acutely toxic in the water column. Dispersant application has a limited window of opportunity, as the ability for the dispersants to break up the hydrocarbons typically decreases as the product weathers therefore surface application would only be considered as a secondary response option for an HFO spill in conjunction with the operational SIMA, Shell Surface Dispersant Application Guide and the necessary regulatory approvals. Residual impacts from the use of dispersants are expected to be low in nature and scale when assessed in isolation compared to the impact of the spill without dispersant application.

Biological Environment	Benthic communities	Limited environmental impact which directly impacts bare sediment benthic habitats outside of the Operational Area as a result of the petroleum activities which adversely effects biological diversity or ecological integrity.	Yes	Increased in-water concentrations of toxic components of hydrocarbons due to dispersant application may potentially contact submerged receptors such as corals, seagrass and macroalgae. Damage from protect and deflection equipment such as booms and anchors has a potential to damage intertidal habitats. The optimal suite of response strategies will be determined through the operational SIMA.
	Threatened and Migratory Species	No significant impacts to listed Threatened (Endangered and Vulnerable) or Migratory MNES fauna populations. Management of aspects of the project must be aligned to conservation advice, recovery plans and threat abatement plans, including for bird and marine turtle species.	Yes	Moving personnel and equipment associated with shoreline clean-up activities has the potential to cause ground disturbance or lighting impacts which may affect listed Threatened or Migratory MNES fauna populations fauna such as nesting turtles and birds (including nests). The impacts associated with undertaking shoreline clean-up may be more than if the product was left in place and remediated through natural processes (Natural Recovery). Leaving the product in place is a very common response option if continual human and vessel/vehicle traffic has the potential to generate greater impacts than the product itself. The optimal suite of response strategies will be determined through the operational SIMA and in consultation with relevant agencies such as WA DBCA and WA DoT.
	WA mainland coastline	Limited environmental impacts to mainland coastline.	Yes	Damage from protect and deflection equipment such as booms and anchors has a potential to damage nearshore habitats along the WA coastline. The optimal suite of response strategies will be determined through the operational SIMA and in consultation with the relevant agencies such as WA DoT.
Socio-economic Environment	Fisheries	No interference with fishing to a greater extent than is necessary for the exercise of right conferred by the titles granted to carry out petroleum activities.	Yes	Shell will implement industry standard controls to manage impacts from the implementation of oil spill response strategies required due to unplanned hydrocarbon spills. An operational SIMA will be developed by the IMT using real-time monitoring and evaluation data to select the optimal suite of response strategies.
	Tourism & recreation	No negative impacts to nature-based tourism resources	Yes	

		resulting in demonstrated loss of income.		

New and/or unique environmental impacts associated with implementation of the possible spill response strategies are considered to be acceptable where they present a net environmental benefit compared to the 'do nothing' option as determined and documented through the SIMA process as described in the OPEP.

Assessment of these impacts from the spill response strategies discussed above determined the residual ranking of minor or lower (Table 9-56). The acceptability of these impacts has been considered in the context of:

Principles of ESD

The response option impacts described above are consistent with the principles of ESD based on the following points:

- The health, diversity and productivity of the marine environment will be optimised for future generations through minimising the impact of any large scale spills through implementation of the accepted OPEP and associated response strategies;
- The precautionary principle has been applied, and studies undertaken where knowledge gaps were identified. This knowledge has been applied during the evaluation of environmental impacts
- With the prevention and mitigation controls in place, the conservation of biological diversity and ecological integrity shall be optimised following a large scale spill.

Relevant Requirements

Management of the impacts associated with spill response strategy implementation are consistent with relevant legislative requirements, including:

- The NOPSEMA accepted OPEP (HSE_PRE_013075).

Matters of National Environmental Significance

Threatened and Migratory Species

Alignment with the relevant management plans, recovery plans and conservation advice for threatened and migratory fauna will be addressed on a case-by-case basis through the SIMA process when selecting appropriate spill response strategies (Reference is made to Table 7-7 for the list of potentially applicable plans and advisory documents). These plans and advisory documents will assist with determining protection priorities once the nature, scale and trajectory of the spill is understood post event.

Commonwealth Marine Environment

The new and/or unique environmental impacts presented by dispersant application, decanting and/or shoreline clean-up on the Commonwealth marine environment when assessed in isolation from the spill event itself will not credibly exceed any of the significant impact criteria provided in Table 8-1.

External Context

There have been no objections or claims raised by Relevant Persons to date around the dispersant application, decanting or shoreline clean-up aspect. Shell's ongoing

consultation program will consider statements and claims made by stakeholders when undertaking further assessment of the risks.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the petroleum activity and Shell's internal requirements.

Acceptability Summary

As outlined above, the acceptability of the associated impacts have been considered in the context of:

- The established acceptability criteria
- ESD
- Relevant requirements
- MNES
- External context (i.e. stakeholder claims)
- Internal context (i.e. Shell requirements).

The residual impacts have been assessed as minor which Shell considers to be acceptable if they meet legislative and Shell requirements. The discussion above demonstrates that these requirements have been met in relation to the new and/or unique impacts associated with implementation of the identified spill response strategies. Based on the points discussed above, Shell considers the residual impacts to be ALARP and acceptable.

9.13.7 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
Spill response strategies shall be selected and implemented to minimise the overall environmental impacts from a spill and the associated implementation of the response strategies themselves.	OPEP implementation records and SIMA records

10 Environmental Plan Implementation Strategy

The OPGGS (E) Regulations require an Implementation Strategy to be incorporated into the EP that includes:

- Measures, systems and practices to ensure that environmental risks continue to be identified and reduced to a level that is ALARP, mitigating measures are effective, and environmental performance outcomes and standards are met
- Chain of Command
- Measures to ensure workers are aware of their responsibilities
- Monitoring and management
- Records and reporting
- Oil Pollution Emergency Plan (OPEP) provided as a separate document together with this EP submission
- Consultation.

10.1 Management Systems

The Shell HSSE & SP-MS provides a structured and documented framework for the effective management of HSSE & SP risks and demonstrates how the requirements of the Shell Group HSSE & SP Control Framework are implemented throughout Shell. The Shell HSSE & SP-MS Manual consists of the following sections:

- Leadership & Commitment
- Policy & Objectives
- Organisation, Responsibility & Resources, Standard & Documents
- Risk Management
- Planning & Procedures
- Implementation, Monitoring & Reporting
- Assurance
- Management Review.

The HSSE & SP-MS is subject to a continuous improvement ‘plan, do, check, review’ loop, with eight components as outlined in Table 10-1. There are numerous, specific ongoing (typically annual) assurance activities against each of the eight components in this HSSE & SP-MS Manual as detailed below. The audit and review function of the HSSE-MS seeks to ensure that the system is being implemented, is effective and to identify areas for improvement. Examples of elements that demonstrate continuous improvement are highlighted under each section.

Table 10-1: HSSE & SP-MS Elements Implementation and Improvement

Management System Element	Implementation and Improvement
Leadership and Commitment *Creating and sustaining a culture that drives Shell's commitment of no harm to people or the environment*	Seek ongoing feedback on how others perceive HSSE & SP leadership (performance reviews, HSE Culture Survey (Shell People Survey), 360 feedback)
Policy and Objectives *Supporting the implementation of Shell HSSE & SP Commitment and policy*	Set annual HSSE & SP targets to drive continuous performance Annually Review and approve HSSE & SP objectives
Organization, Responsibilities and Resources *Establishing and maintaining an organization that enables the compliance with the HSSE & SP Control Framework*	When there are changes in the Business or organization, identify the positions that require Competence assurance. HSSE & SP Critical Position Register, Shell People Competency Profiles
Risk Management *Identifying the HSSE & SP hazards and establishing the controls to reduce the risks to As Low as Reasonably Practicable (ALARP)*	Ongoing review of Hazards and Risks. Regular review of Risk Registers
Planning and Procedures *To integrate the requirements of the HSSE & SP Control Framework into business plan and procedures: Emergency & Crisis Response, Spill Preparedness and Response, MOC, PTW*	Establish and maintain a programme of testing of Emergency Response plans and procedures at least once a year or more frequently based on the level of risk. Shell Australia ERP, Records of ER drills, exercises and AARs.
Implementation, Monitoring and Reporting *Implement the HSSE & SP requirements embedded in plans and procedures and take corrective action when necessary*	Report all Incidents, including Near Misses, to the Supervisor of the work activity. Learn from Significant Incidents and High Potential Incidents through communication and implementation of required actions.
Assurance *Providing assurance that the HSSE &SP Control Framework requirements are implemented and effective*	Establish, maintain and execute HSSE & SP Self-Assessments in support of the Business HSSE & SP Assurance Plan, self-assessment, CF Gap Analysis, HSSE & SP Management Review. • Management Review (documents demonstrating how Shell Australia reviews the effectiveness, adequacy and fitness for purpose of the HSSE & SP Management System and take action to improve) • Review the HSSE & SP Management System and its individual elements at least once a year and document the results.
Management Review *Reviewing the effectiveness, adequacy and fitness for purpose of the HSSE & SP MS and taking actions for improvement*	Assess the Effectiveness and Adequacy of the management system in delivering the policy and Objectives and in driving continual improvement.

Shell's HSSE & SP-MS covers all operations within its business, including that of the Crux Project.

Shell implements specific pre- and post-contract award processes and activities aimed at ensuring that contracts consistently and effectively cover the management of HSSE & SP risks and deliver effective management of HSSE & SP risks for contracted activities.

Contractor HSSE & SP Management is governed by the Shell HSSE & SP Control Framework. As a minimum, all relevant field active contractors' HSSE & SP-MS will be assessed to ensure they meet materially equivalent outcomes to Shell's HSSE & SP-MS.

For the activities that occur offshore but not under Shell's management system, Vessel Contractor predominantly use their own vessel/facility HSSE-MSs to manage work scope onboard their vessel.

10.1.1 Contractor Management

Contractors and their sub-contractors carry out a number of activities on behalf of Shell. Effective management of environment, integrity, health and safety risks in contracts involves setting clear expectations and managing these risks throughout the contract lifecycle.

Shell implements specific processes and activities aimed at ensuring that contracts consistently and effectively cover the management of HSSE & SP risks for the contracted activities. These processes are detailed in the HSSE & SP Contractor Management Strategy Manual. The contractor management processes implemented for Crux Project are consistent with the requirements of the Shell HSSE & SP Control Framework Contractor HSSE Management Manual.

Key aspects of the Contractor HSSE Management are:

Pre-contract Award Activities

- Appointing a competent contract owner and contract holder for each contract.
- Determine the Contract HSSE & SP risk, by assessing the risk associated with the contracted activities.
- Determine the contract mode.
- For a high contract HSSE Risk, the contractor is to develop and provide a Contract HSSE Plan.
- Assess whether the Contractor has the capability and resources to manage the risks associated with the contracted activities.
- Before contract award, confirming that the Contractor meets requirements. Focus on closing gaps in draft contract HSSE & SP Plan submitted by Contractor.
- Define the level of Company monitoring based on the capability of the Contractor, the contract HSSE & SP risk and the contract mode.

Post-contract Award Activities

- Require the Contractor to demonstrate that Contractor personnel responsible for managing the HSSE Risks of the contracted activity have knowledge of the HSSE requirements of the contract and any associated Contract HSSE Plan related to their role.
- Require the Contractor to demonstrate that all Contractor personnel will be given an induction on the HSSE risks of the contracted activities including the controls to manage those Risks specified in the contract and any associated Contract HSSE Plan.
- Verify that the HSSE requirements of the contract and any associated Contract HSSE Plan are being implemented and are effective at managing the HSSE Risk of the contract. Where necessary implement actions for improvement.

- Regularly assess the HSSE performance of the Contractor, including its management of Subcontractors.

10.1.2 Contractor Competency Requirements and Assurance

The contractor is responsible for ensuring that all their personnel have the appropriate level of competence required to carry out the work safely and effectively. The contractor is also responsible for the development and implementation of a competence assurance plan. The contract holder is responsible for ensuring that the contractor's competence assurance system is reviewed, robust and meets the Shell requirements.

In addition to trade competencies and qualification requirements, the minimum competence requirements for key contractors working on Crux are based on the required contractor work scope and are developed in consultation between Shell and the contractor. The minimum requirements for a contractor going offshore on the Crux Project include the following:

- Facility Induction (such as Life Saving Rules, Emergency Response and Muster procedures, Incident Reporting, Waste Management, Oil Spill Awareness)
- Role-specific training such as Permit to Work, operating procedures of specific process units

10.1.3 Permit to Work (PTW)

The Permit to Work (PTW) process is used to control and approve work on the Prelude FLNG facility and within the Prelude Safety Zones. It ensures that adequate controls and measures are in place to safeguard people, asset and environment from work activity hazards. Details of the PTW process is described in the Permit to Work Manual (HSE_PRE_004404) and an electronic PTW system is used. There is a high level redundancy built into the electronic PTW tool.

A permit is required for activities that have the potential to adversely affect personnel's safety/health, cause damage to asset, the environment and reputation. Most activities on Prelude FLNG require a permit; examples include hot work, breaking containment and confined space entry. However, there are standard operational and marine operations activities that do not require permits and are managed through approved procedures; execution of these activities is allowed only after safety and environmental precautions have been put in place.

All permitted activities on Prelude are categorised based on their risk level: into low-low, low, medium or high risk. The level of risk assessment, review and approval are proportionate to the risk of the activity.

10.1.4 Management of Change (MOC)

The Management of Change process for Crux is described in the Crux Management of Change Procedure. The MoC process is designed to "provide assurance that, when changes are introduced, new risks are not knowingly incurred, or the prevailing risk profile is not adversely changed without appropriate mitigation".

The scope covered by this procedure includes:

- Engineering changes
- Process Changes (Hardware, Process Control, Process Conditions)

- Procedural Changes that affect HSSE Critical Content
- Organisational Changes (Shell and Contractor) impacting HSSE Critical Roles.

The application of this scope includes:

- Permanent Change
- Temporary Change
- Emergency Change.

The MoC Manual is supported by specific procedures, templates and checklists. The progress of change requests is monitored through an electronic MoC system.

The MoC process is built around 7 simple steps forming an overarching governance framework (Figure 10-1).

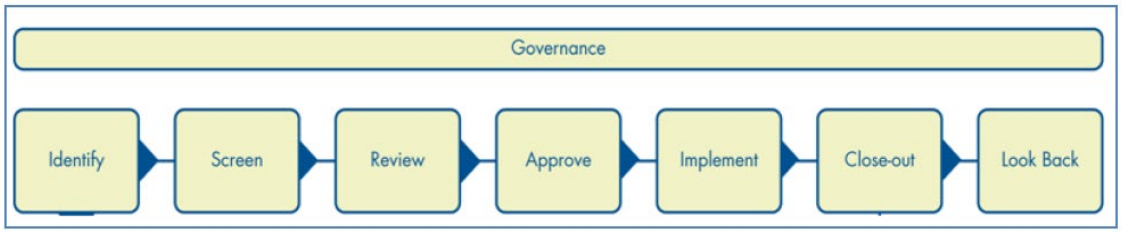


Figure 10-1: Management of Change Process Steps

The screening process for all new changes (hardware or software) require assessment of HSSE&SP aspects as per Crux Management of Change Procedure. this may result in a change being flagged as possibly needing a change to the EP which require compliance with Regulation 17 of the Environment Regulations. If a change is considered significant as per Regulation 17 (5) or (6) and as determined by the MOC process, then a revised or new EP will be submitted to NOPSEMA for acceptance.

The following will also trigger the review of the management of a particular environmental impact or risk to ensure that ongoing management of impacts and risks are at ALARP and Acceptable levels:

- Changes in regulatory requirements/standards
- Information which may suggest an increase in environmental risks or impacts to those outlined in the EP
- Prominent new scientific studies which may ‘negatively’ change the understanding of environmental risks and impacts
- Objections or claims raised which require changes in EP content following the process outlined in Section 5.

10.1.5 Chemical Selection Process

Shell has adopted a chemical selection and approval process in accordance with Shell’s chemical selection and approval guidelines as indicated in Shell Chemical Management Process (HSE_GEN_007879) and Shell Global Product Stewardship guidelines to assess chemicals than may pose environmental impact via planned discharges.

All chemical applications are required to be screened in accordance with Shell Global Product Stewardship guidelines (Figure 10-2).

Where chemicals may be discharged to the marine environment preference shall be given to chemicals that are deemed environmentally acceptable (PLONOR, Gold, Silver, D and E) with no substitution warning under the Offshore Chemical Notification Scheme (OCNS) adopted in the United Kingdom and the Netherlands. Chemicals that fall within this banding require no further assessment and are deemed ALARP and accepted.

Chemicals that do not have an OCNS ranking or fall outside of the preferential banding (PLONOR, Gold, Silver, D and E with no substitution warning) are required to be assessed further incorporating seeking a suitable alternative chemical of lower environmental impact. If no alternative is technically suitable, the chemical is required to be assessed via Shell Global Product Stewardship guidelines and ALARP demonstration with risk reduction control measures (Figure 10-3). Approval will be provided by the Shell Production Chemist / Product Steward Focal Point. Chemicals that are not deemed ALARP will be not approved and an alternative product shall be requested.

To ensure that chemicals which may pose impact to the marine environment are managed appropriately on an ongoing basis, annual compliance checks will be made by Shell and chemical vendors of Shell's Chemical Programme Treatment Guide (TEC_PRE_006805) and Chemical Risk Assessment Register operational chemical registers. To accompany routine compliance checks, the impact of chemicals in key discharge streams will be assessed on an ongoing basis as indicated in Adaptive Management Framework outlined in Section 10.4.1.

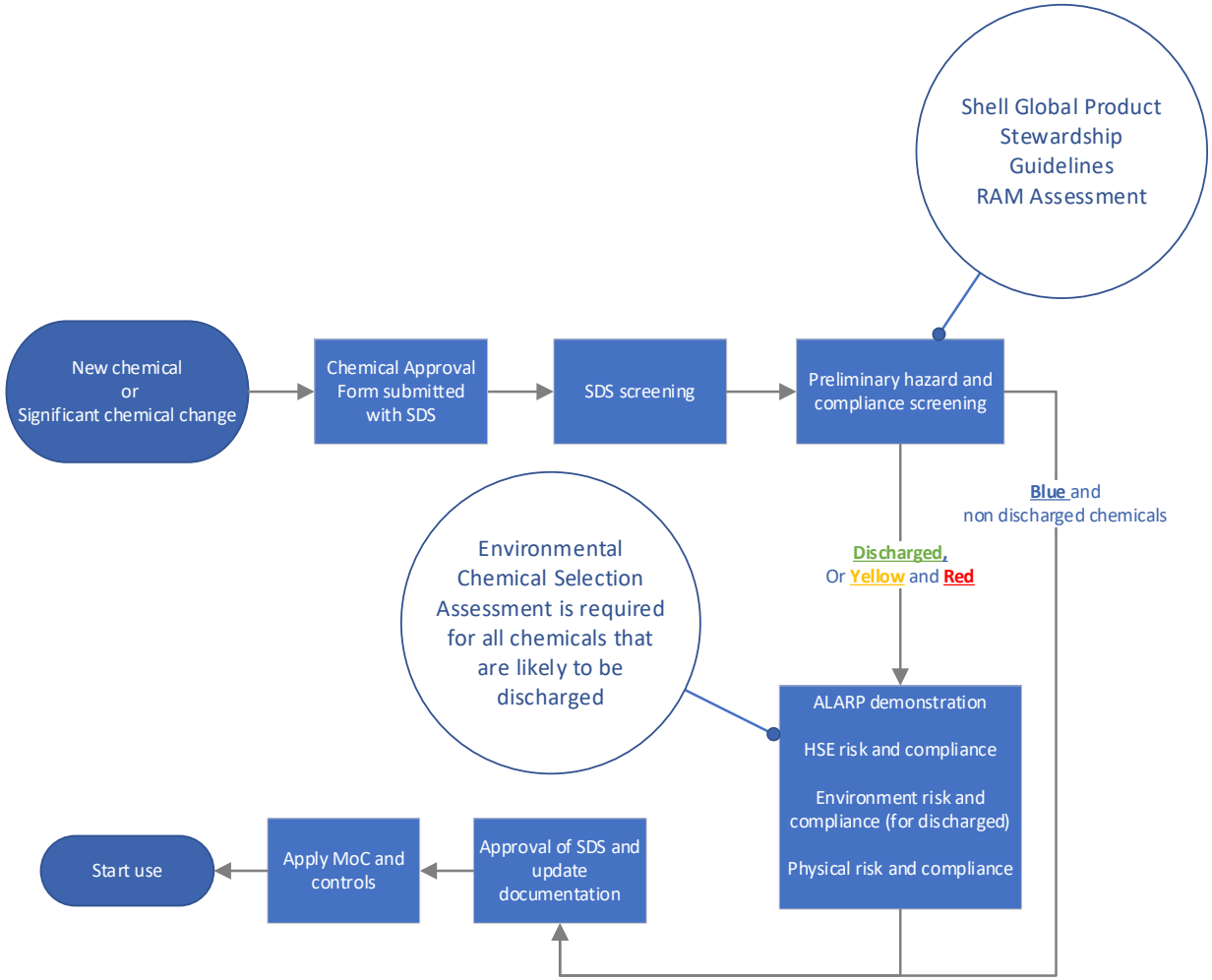


Figure 10-2: Chemical Approval Process

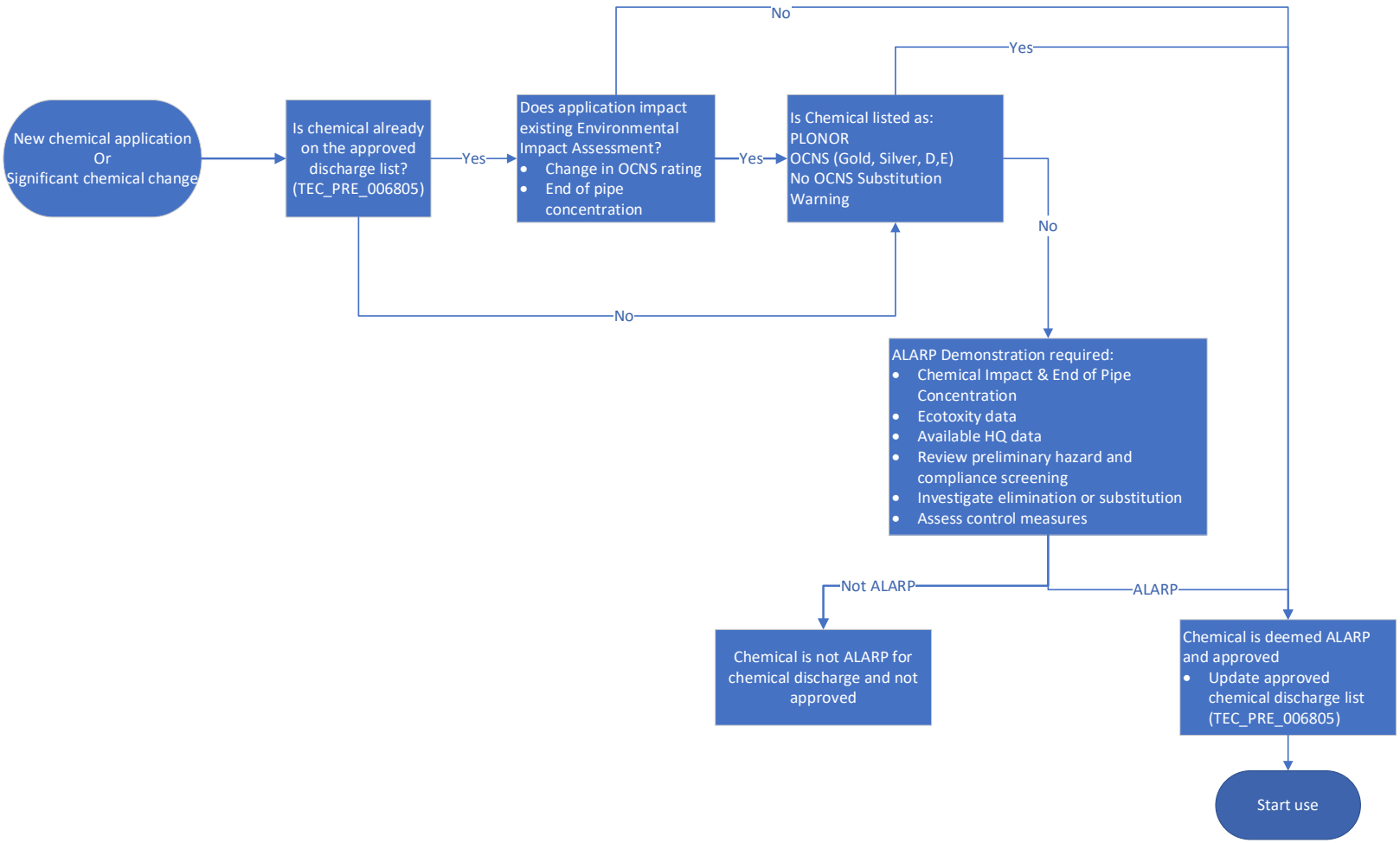


Figure 10-3: Environmental Chemical Impact Assessment

10.2 Organisation, Roles and Responsibilities

The core organisation of Crux Project consists of the Crux Project Manager. The Project Manager is accountable for the safe and environmentally responsible execution of the Crux Project.

As required by Regulation 14(4) this section of the Implementation Strategy establishes a clear chain of command that sets out the roles and responsibilities of personnel in relation to the implementation, management and review of the EP, ranging from senior management to operational personnel that support Crux activities. Roles and responsibilities associated with emergency management arrangements are detailed in Table 10-5.

The roles, responsibilities and accountabilities for processes undertaken are detailed in the Business Management System and individual's job descriptions. General responsibilities associated with this EP for key personnel are summarised in Table 10-2.

Table 10-2: Key Responsibilities

Position	Responsibilities
Crux Project Manager (EP Owner)	**Systems, Practices and Procedures** • Accountable for the overall execution of the Crux Project. • Accountable for ensuring all necessary regulatory approvals are in place to operate. • Accountable for the implementation and compliance of the EP. • Accountable for safe, efficient and environmentally sound execution of activities in accordance with the EP, legislative requirements and Shell's policies and standards. • Custodian of communication with all regulatory agencies required to execute the Crux project. • Accountable and responsible for agreeing and meeting KPIs and environment initiatives from annual Plans and reviewing environmental performance to drive continuous improvement. • Accountable for the implementation of stakeholder consultation as per the description in this EP and in compliance with regulations.
Shell Site Representative	**Systems, Practices and Procedures** • In charge of the vessel activities in field. • Accountable for the implementation of the EP onsite. • Accountable for ensuring all teams operate in a safe and reliable manner to meet targets. • Accountable for the Permit to Work governance, process and permit requirements. • Implements environment initiatives from the Integrated Activity Plan including review of environmental performance to drive continuous improvement. • Ensures effective communication with workforce on environmental performance.

Position	Responsibilities
	• Accountable for effective and appropriate handovers between shifts. **Resourcing, Training and Competencies** • Provides appropriate offshore resource allocation to meet the EP requirements including performance outcomes, standards and measurement criteria. • Accountable for the performance and development of production, services and maintenance teams and ensuring capability and competency across all shifts. **Monitoring, Auditing, Non-conformance and Emergency Response** • Accountable for monitoring performance against the EP. • Implements environmental assurance activities and audits and implementing and monitoring close out of recommended actions. • Ensures incidents are reported and investigated in line with Shell Australia standards and EP requirements, with appropriate actions initiated and closed out. • Responsible for acting as the Incident Controller during emergencies. • Responsible for ensuring exercises and drills are carried out such that the facility's ability to respond effectively to an emergency is assured.
Shell Australia Environment Manager	**Systems, Practices and Procedures** • Overall coordination of environmental management across Shell Australia to ensure the performance outcomes, standards and measurement criteria of the EP are met. • Ensuring the organisation understands and adheres to regulatory requirements and environmental management system. • Guiding and driving the direction of environmental management across the organisation, maintaining alignment with Shell Group's environment direction. • Providing support on environmental standards and EP compliance through the Shell Australia assurance programs. • Monitoring and communicating to the organisation any relevant changes to legislation, policies and regulator organisation that may impact the EP or the business. • Functional support on developing and maintaining appropriate environmental processes for Crux. **Resourcing, Training and Competencies** • Supporting the Divisional environmental performance through implementation of effective environmental training programs. **Monitoring, Auditing, Non-conformance and Emergency Response** • Monitor and review progress against environmental improvement plans, targets and KPIs with divisional management to drive continuous improvement.

Position	Responsibilities
Crux HSSE manager	**Systems, Practices and Procedures** • Monitor and review progress against EP, targets and KPIs with Prelude management to ensure compliance with the EP and drive continuous improvement. • Escalate to Crux Project Leadership Team any potential environmental issues and non-compliances to ensure ownership by the line.
Crux Environment Lead	**Systems, Practices and Procedures** • Ensuring appropriate personnel have access to the EP and understand the outcomes, standards and measurement criteria and their environmental responsibilities for the activity. • Liaising with applicable regulatory authorities and stakeholders as required. • Develops risk reduction strategies and defines Performance Standards. • Facilitates ALARP & Acceptability reviews. • Update of the EP as required. • Facilitate and provide coaching for environmental improvement plans. **Resourcing, Training and Competencies** • Developing and maintaining environmental training, and coaching materials for deployment to Crux organisation. **Monitoring, Auditing, Non-conformance and Emergency Response** • Responsible for environmental monitoring and reporting requirements from the EP including environmental performance and compliance reporting. • Monitoring progress against environmental improvement plans. • Participating in environmental audits/inspections to ensure regular checking of compliance to this EP. Communicating findings to management and assisting with close out of actions. • Assisting with review, investigation and reporting of environmental incidents.
External Relations Advisor	• Responsible for preparing and implementing Prelude Stakeholder Engagement Plan.
Vessel Master	• Responsible for taking action immediately to rectify any environmental incident on the vessel. • Implementation of the EP on board the vessel. • Ensure effective operation of the vessel, taking into account relevant environmental aspects. • Communication of vessel environmental management activities on board. • Maintain administration of vessel's environmental management system requirements • Ensure all crew members comply with the EP.

Position	Responsibilities
	• Manage any spills per SOPEP. • Responsible for ensuring cetacean sighting recording is undertaken. • Maintain good housekeeping and cleanliness around the vessel; • Compliance with DAFF and other marine regulations
Contract Holders	• Ensuring implementation of this EP for the contractor's scope of work. • Ensuring contractors have adequate environmental capability in order to execute their scope of work. • Reviewing and provide assurance over contractor environmental performance.
All personnel	• Complying with standards and procedures that apply to their area of work. • Immediate reporting of any environmental hazards or incident to the supervisor. • Understanding the environmental risks and controls applicable to work. • Following instructions from the supervisor with respect to environmental protection and measurement criteria outlined in this EP. • Undergo environmental training as required by role and activity. • Carry out assigned activities in accordance with approved procedures and the EP. • Stop any operation or activity that is deemed to present an unacceptable risk to the environment.

10.3 Competence and Inductions

10.3.1 EP Training

OPGGS(E) Regulation 14(5) requires that the implementation strategy must include measures to ensure that each employee and contractor working on, or in connection with, the activity is aware of their roles and responsibilities in relation to the EP.

All employees and contractors working on or in connection with Crux project with defined responsibilities to fulfil as part of the EP are required to attend EP Training.

On arrival at the facility or vessel, personnel (including short-term visitors) attend an onsite orientation designed to familiarise them with the general operations and location of key areas. The orientation explains the site-specific safety, environmental and emergency response aspects.

10.4 Monitoring, Assurance and Incident Investigation

This section of the EP outlines the measures undertaken by Shell to regularly monitor the management of environmental risks and impacts of the petroleum activities against the performance outcomes, standards and measurement criteria, with a view to

continuous improvement of environmental performance. The effectiveness of the Management System is also reviewed periodically as part of the monitoring and assurance process.

10.4.1 Environmental Performance Monitoring

Monitoring and review of environmental performance of the petroleum activities are done in a number of ways including monitoring of emissions and discharges, and through the use of various tools and systems. These monitoring systems meet the requirements of the following:

- Shell Australia Environmental Reporting Procedure (HSE_GEN_003179)
- Shell Australia Offshore Environmental Regulatory Approvals & Compliance Procedure (HSE_GEN_003180).

In accordance with OPGGS(E) Regulation 14 (7), the implementation strategy must provide for sufficient monitoring of, and maintain quantitative records of, emissions and discharges (whether occurring during normal operations or otherwise), such that the record can be used to assess whether the environmental performance outcomes and standards in the environment plan are being met.

Parameters that are monitored and recorded during the petroleum activity are detailed in relevant parts of Section 5 and in the performance outcomes, standards and measurement criteria table in Section 6, and are summarised in Table 10-3.

Table 10-3: Emissions and Discharges Monitoring for Petroleum Activity

Source	Parameter to be Monitored	Monitoring Frequency	Monitoring Equipment/ Methodology*	Records	EP Reference
Diesel fuel used on vessels	Sulphur content	As required (every delivery)	Delivery certificates	Delivery certificates	Section 9.10
	Volume used	Monthly	Delivery certificates and storage tank volumes	Delivery certificates	
Waste generation	Hazardous Waste Non-Hazardous Waste	Monthly	Waste records/manifests	Monthly waste reports	Section 9.11
Accidental releases of hydrocarbons or chemicals	Volume of accidental release Characteristic of release	As required	If unmetered, volumes will be estimated based on technical data and evaluations (e.g. known well flow rates, production flowrates, pressure, duration of release and known inventory volumes)	Incident reports in Sphera	Section 9.12.

10.4.2 Marine Vessel Assurance

All marine vessels which are planned to be used within the Operational Area are required to achieve “Positive Vetting” in accordance with the requirements specified in the HSSE & SP Control Framework – Transport Manual - Maritime Safety. Numerous assurers are required in order to assure a positive vetting, including Marine SME, Aviation SME and country security manager, Global Maritime Marine Warranty Surveyor and the project workstreams responsible for the particular activity to be conducted. The Marine Vessel Assurance process ensures that the physical controls are robust, including:

- Navigation Equipment and Aids
- Communication Equipment
- Dynamic Positioning System
- Lifting Equipment
- Emergency shut-down, alarm and lighting systems.

OCIMF OVID is the basis for all support vessel vetting. Additionally, vessels are screened for class and port state control infractions.

The following compliance are required for “Positive Vetting” for vessel operating in the Operational Area, excluding equipment and material transportation vessels.

10.4.4.1 Marine Warranty Survey

All vessels and activities are assessed by the Marine Warranty Surveyor (MWS) on behalf of Shell’s underwriter. Where required by the Marine Warranty Surveyor (MWS) and in accordance with Construction All Risk (CAR) insurance rules, a marine vessel inspection/suitability survey is performed and a Vessel Suitability Report issued by the MWS with all significant actions and findings closed.

10.4.4.2 Pre-Mobilisation Inspection Report

The Pre-Mobilisation Inspection is conducted to ensure compliance with HSSE, marine and technical requirements and readiness prior to commencing work. Vessels (inclusive of their equipment, processes and procedures) are thoroughly inspected and the inspection report items are closed prior to completion of mobilization.

10.4.4.4 Group Maritime Assurance System (GMAS) Clearance

A GMAS clearance from the Shell Marine SME must be obtained prior to the commencement of marine operations on the Project and prior to the contracted marine vessel entering the Operational Area. This ensures that the above marine vessel assurance has been completed satisfactorily.

10.4.4.5 Biofouling Risk Assessment for Domestic Movements

In accordance with the Biosecurity Management Plan (2000-010-G000-GE00-G00000-HX-5798-00003) and to ensure the ongoing ‘Low Risk Status’ of the FLNG, the assessment of biofouling risk will be done for all vessels which will operate within the Operational Area using the Marine Vessel Biofouling Risk Assessment template.

The risk assessment will be done by the Vessel Owner/Operator with advice from the Crux Environment Lead.

10.4.3 Environmental Assurance

Shell and its contractor's HSSE Plans make provisions for monitoring, audits and review. Annual HSSE Plans identify environmental audits and reviews that are to be conducted for the year. These audits and reviews include internal and external environmental audits, contractor HSSE audit, waste management audit/review and gap analyses against HSSE Control Framework Manuals.

Shell Group audits are undertaken across all Shell businesses on an intermittent basis. This auditing process assures the HSSE & SP management system as a whole.

The outputs of the audits and reviews are the corrective actions that feed the improvement process. Close-out of these corrective actions is monitored and reviewed.

Regular onsite HSSE assurance is conducted which includes checking that environmental controls are implemented. Any specific environmental issues, like any HSSE issues, identified during these assurance checks are raised in the HSSE Leadership and Assurance meeting and resolved as part of continually reducing the risks to ALARP and Acceptable levels.

Given the short duration and nature of the activities being carried out, no specific environmental audit is planned for this petroleum activity.

10.4.4 Management of Incidents and Non-Conformances

All Health, Safety, Security and Environmental incidents and non-conformances are managed in accordance with the Shell Australia HSSE Incident Reporting, Investigation and Follow up Procedure (HSE_GEN_000027) that describes the process of reporting, classification, investigation, follow-up and close out. Non-conformances are treated in the same way as incidents and for the purposes of this document are referred to as incidents.

All incidents records are managed in an online electronic system called Sphera. Below is the overview of the incident management process:

- The system allows incidents to be raised by any employee of the company including offshore personnel.
- The incident is then assigned to a Responsible Supervisor (Incident Owner) who then retains the ownership of the incident until closeout.
- The Responsible Supervisor initiates the Incident Investigation the depth of which depends on the actual and potential risk ranking of the incident.
- The recommendations of the investigation team are reviewed by the Incident Owner who then assigns the corrective and preventative actions to the appropriate action party. Actions are tracked to closeout where the Incident Owner accepts that the remedial action is successfully completed based on the evidence recorded and logged in Sphera.
- Sphera provides functionality for automatic reminders for Incident Owner and Action Parties about the actions due. However, in addition reviews of outstanding actions are carried out both at asset/department level, and at the Shell Business Assurance Committee level at regular intervals to ensure timely closeout of actions.

All employees or contracted staff are encouraged to submit incident reports to alert the organisation about the occurrence of an incident or non-conformance.

In addition to the Incident Management Process outlined above, Shell also reports the number of non-compliances (incidents/ non-conformance) to the Shell Group on a quarterly basis, along with other HSE data in accordance with Shell Group Performance Monitoring and Reporting (PMR) standard. This information is reviewed in a dedicated HSE Business Performance Review where Shell Australia performance is reviewed by the Shell Group.

The incident investigation process works to understand the cause of an incident and the reason why a control/ mitigation measure has failed and to rectify the fault to prevent recurrence and the reporting process works to track performance and allows sharing of learnings. This process contributes to reducing the risks to ALARP and Acceptable Levels.

10.5 Reporting

10.5.1 External Incident Reporting

Reportable Incidents

NOPSEMA will be notified of all reportable incidents under Regulation 26 of the OPGGS (E) Regulation within two hours of the incident and in writing within three days. Under the OPGGS (E) Regulations, Reportable Incidents are defined as *'an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage'*. The Shell Risk Assessment Matrix (refer to Section 9.2) uses severity levels 0 to 5 to define environmental consequences (no effect, slight effect, minor effect, moderate effect, major effect and massive effect'). All environmental effects with a severity 3 or greater (i.e. moderate to massive) are considered Reportable Incidents. Based on the risk assessment (Table 9-28 and Table 9-50), five events are considered to be of moderate or higher consequence:

- Any confirmed introduced marine pest species in Australian waters attributable to the petroleum activities
- Diesel spill resulting from a collision with another vessel
- HFO spill due to rupture of storage tank of a vessel fuel tank
- Condensate spill due to rupture of storage tanks on the FLNG as a result of breach of the hull
- An uncontrolled hydrocarbon release from the wellhead similar to a well blow-out.

The reportable incident report contains all material facts and circumstances concerning the reportable incident, actions taken to avoid or mitigate any adverse impacts and corrective action taken. This report will be made to NOPSEMA.

Recordable Incidents

For the purpose of this activity, in accordance with the OPGGS (E) Regulations, a recordable incident, for an activity, means '*a breach of an environmental performance outcome or environmental performance standard, in the environment plan that applies to the activity, that is not a reportable incident*'.

NOPSEMA will be notified of all Recordable Incidents, according to the requirements of Regulation 26B of the *OPGGS (E) Regulations*. A report of Recordable Incidents must be given to NOPSEMA *'as soon as practicable after the end of each calendar month, and in any case not later than 15 days after the end of the calendar month'*.

As per the OPGGS (E) Regulations, the report will comprise:

- *'A record of all Recordable Incidents that occurred during the calendar month*
- *All material facts and circumstances concerning the Recordable Incidents that the operator knows or is able, by reasonable search or enquiry, to find out*
- *Any action taken to avoid or mitigate any adverse environment impacts of the Recordable Incidents*
- *The corrective action that has been taken, or proposed to be taken, to prevent similar Recordable Incidents'*.

Other Externally Notifiable Incidents

Other externally notifiable incidents are captured in Table 10-4.

Table 10-4: Other Externally Notifiable Incidents

Incident	Legislation	Timing of Notification with respect to the occurrence of the incident.	Contact Details
Any breach in the quarantine regulations, including exchange of ballast water within the twelve nautical mile limit.	Biosecurity Act 2018, Australian Ballast Water Management Requirements 2017	As soon as practicable	Department of Agriculture, Water and the Environment (Maritime National Coordination Centre) Phone: 1300 004 605
Any confirmed introduced marine pest species in Western Australian state waters.	Fish Resources Management Regulations 1995 r176(1)	Within 24 hours.	DPIRD FishWatch 1800 815 507 Email: aquatic.biosecurity@dpird.wa.gov.au Aquatic Pest Biosecurity Section: 08 9203 0111
Death or injury of threatened, migratory or cetacean species from collision with a vessel.	EPBC Act 1999, Chapter 5, Part 13, Division 3, subdivision C, 232 (2)	Within 7 days, including the time, place, circumstances, species affected and the consequences of the action.	The Secretary, DAWE

Performance Reporting

NOPSEMA will be provided with an environmental performance report as per regulation 26C and 14 (2). The report will be submitted to NOPSEMA no more the 4 months following the completion of the activity as defined by section 10.5.3.

10.5.2 Internal Reporting

Shell also has internal reporting requirements against environment parameters identified in the Shell Group Performance Monitoring and Reporting (PMR) standard. This data is used as the basis for an annual Shell Group Sustainability Report.

10.5.3 Notifications

In accordance with Regulation 19 of the OPGGS (E) Regulations, this EP remains valid from NOPSEMA acceptance for the period of the activity as outlined in section 6.2, or until NOPSEMA has accepted an end-of- activity notification under Regulation 25A or Shell Australia revise and resubmit this EP.

10.5.4 Details of Titleholder and Liaison Person

In accordance with Regulation 15 of the OPGGS (E) Regulations, details of the titleholder, liaison person and arrangements for notifying of changes are described below.

Titleholder:

Shell Australia Pty. Ltd. (ACN/ABN: 009663576/14009663876)

562 Wellington Street, Perth 6000 WA

Activity Contact:

Gawain Langford

Crux Project Manager

Email address: SDA-preludeflng@shell.com

Contact numbers: 1800 059 152

Should the titleholder, titleholder's nominated liaison person or the contact details for either change, NOPSEMA is to be notified in writing of the change within two weeks or as soon as practicable.

10.6 Record Keeping

Compliance records will be maintained. Record keeping will be in accordance with OPGGS (E) Regulation 14(7) that addresses maintaining quantitative records of emissions and discharges which is accurate and can be monitored and audited against the environmental performance standards and measurement criteria.

10.7 Emergency Preparedness and Response

Under Regulations 14(8) the Implementation Strategy must contain an OPEP and provide for the updating of the OPEP. Regulation 14(8AA) outlines the requirements for the OPEP which must include adequate arrangements for responding to and monitoring of oil pollution.

A summary of Shell Australia's emergency and incident management framework and arrangements are presented in Figure 10-4 and described in the following sections.

10.7.1 Shell HSSE & CP Control Framework

The Shell HSSE & SP Control Framework is a comprehensive corporate management framework that applies to every Shell company, contractor and joint venture under Shell's operational control. The framework contains a simplified set of mandatory requirements that define high level HSSE & SP principles and expectations. Emergency Response Management and Spill Preparedness and Response are two areas covered in the Shell HSSE & SP Control Framework.

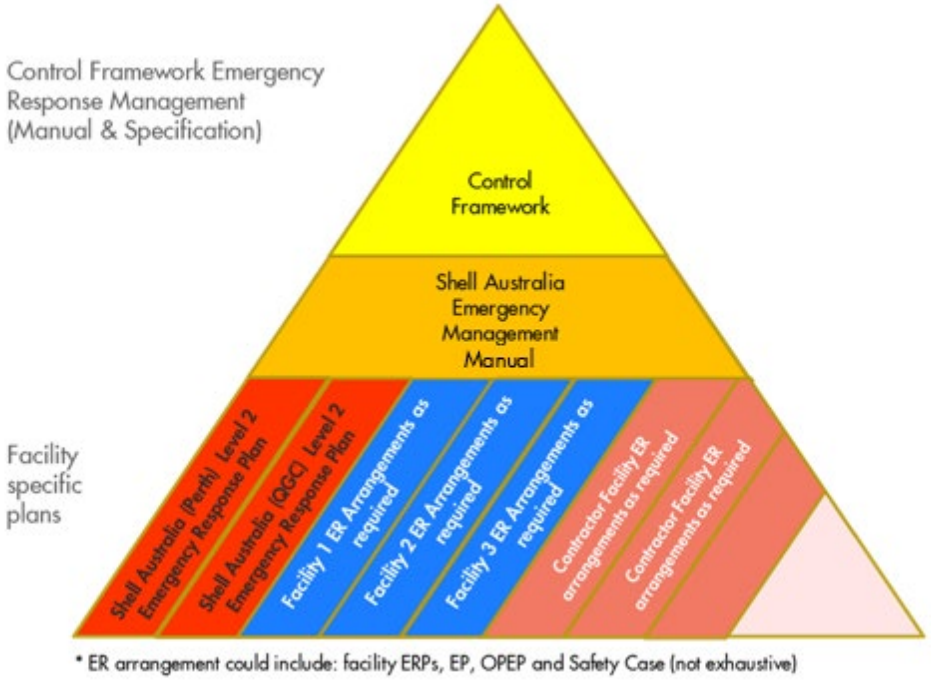


Figure 10-4: Shell Australia Emergency and Incident Management System Overview

10.7.2 Shell Australia Emergency Management Manual

The Shell Australia Emergency Management Manual (HSE_GEN_010996) provides a tiered response framework which classifies incidents based on the level of resourcing and support required. It also outlines communication arrangements associated with each level of emergency, emergency response roster arrangements, emergency response training and competencies, and requirements for emergency management drills and exercises.

10.7.3 Incident Management Team (West) (IMT(W)) Emergency Response Plan

The Incident Management Team (West) (IMT(W)) Emergency Response Plan (HSE_GEN_011209) is a supporting document to the Shell HSSE & SP Control Framework, Shell Australia Emergency Management Manual (HSE_GEN_010996) and is consistent with Australian Commonwealth and State Emergency Management Arrangements. The purpose of the IMT (W) Emergency Response Plan (HSE_GEN_011209) is to provide specific assistance and guidance to Shell Australia IMT (W) in support of Shell owned, operated or contracted facilities. The following topics are detailed in the document:

- Shell Australia emergency management arrangements;
- Shell Australia IMT(W) role checklists and duty cards;
- Incident management, action planning, ICS forms and briefing templates;
- IMT (W) communications;
- Guidance for responding to emergencies;

- Supporting subject matter expert units; and
- De-escalation and recovery.

10.7.4 Oil Pollution Emergency Plan

Shell refers to information previously given under Regulation 31(1), the Prelude Oil Pollution Emergency Plan (OPEP HSE_PRE_013075). The Prelude OPEP (HSE_PRE_013075) outlines emergency management arrangements to respond to credible spill scenarios associated with the Prelude activity. The OPEP provides the information required for an effective response in the unlikely event of an unplanned release of petroleum products. The OPEP details the actions to be taken in response to the incident and provides contact details of emergency specialist response groups, statutory authorities and other external bodies requiring notification.

10.7.5 Operational and Scientific Monitoring Framework

Shell is required to have in place arrangements for monitoring oil pollution as part of its OPEP. Shell is adopting use of the Joint Industry Operational and Scientific Monitoring Plan (OSMP) Framework (APPEA, 2020) and its associated Operational Monitoring Plans (OMP's) and Scientific Monitoring Plans (SMP's) to guide environmental monitoring that may be implemented in the event of a Level/Tier 2-3 spill of hydrocarbons. Further information on how the Joint Industry OSMP Framework interfaces with Shell's activities, spill risks and internal management systems is presented in Shell's Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_16370). Shell refers to information previously given under Regulation 31(1), the Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_16370) – Parts A and B (excluding Appendix D).

10.7.6 Shell Australia's Emergency Management Structure

Shell Australia applies the Incident Command System (ICS) methodology for emergency management. The ICS is a management system designed to enable incident management through integrating facilities, equipment, personnel, procedures and communications operating under one structure. An ICS is commonly structured into functional areas that facilitate incident management activities, including operations, planning, logistics, finance and incident command.

Shell Australia also applies a graduated response framework that increases resource involvement based on the significance and escalation potential of the incident. This graduated framework involves three key emergency management teams, as described below:

- Emergency Response Team (ERT) which is based on the facility and is responsible for the initial response to the incident. The Facility Incident Commander (Offshore Installation Manager (OIM)) will liaise closely with the IMT West Leader (onshore) and will identify when additional support is required to respond to an incident
- Incident Management Team (West) (IMT(W)) is based onshore and supports the ERT, by providing advice, logistical support and managing the operational and technical aspects of the response; and
- Crisis Management Team (CMT) is based onshore and is responsible for the overall management of the incident from a strategic, commercial, legal, reputational and high level liaison perspective.

The ERT and IMT (W) are scalable to the nature and scale of the response i.e. one person can take on multiple roles where circumstances permit. The mobilisation of the

ERT is at the directive of the Facility Incident Commander or delegate. The mobilisation of the IMT (W) will occur by the Facility Incident Commander contacting the on-duty IMT (W) Leader who will then mobilise the IMT (W) as the situation warrants. Duty positions within IMT (W) area are staffed by a roster system where each position has required personnel identified for the role. On-call positions within IMT (W) provide specific functional expertise that helps the business respond to relevant incident scenarios. On-call positions are activated as part of the IMT(W) at the discretion of the IMT Leader based upon known or potential requirements. A number of people are identified and trained for each on-call position, with a rotating on-call list used to contact these personnel.

Figure 10-5 outlines the emergency management escalation process adopted by the IMT (W) and the IMT (W) structure is shown in Figure 10-6.

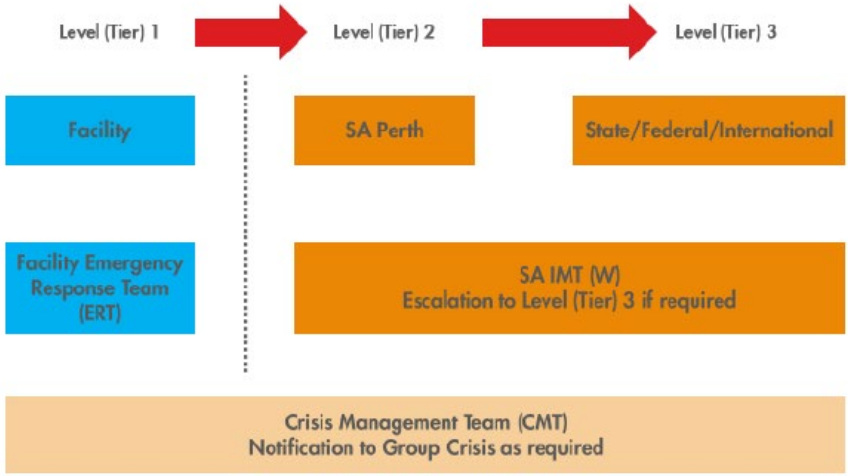


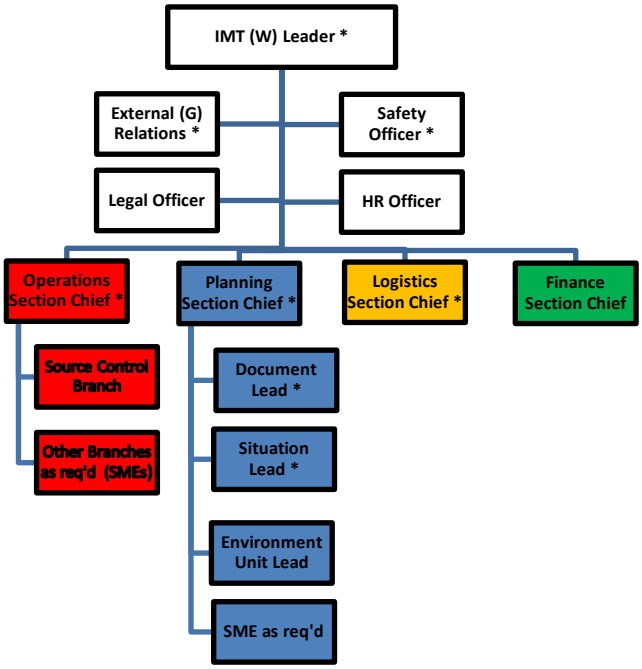
Figure 10-5: Emergency Management Escalation Process Adopted by IMT (W)

Interface between the IMT and Crisis Management Team (CMT) is outlined in the Shell Australia Weekly Contact List (HSE_GEN_011648). The affected facility business executive will have been notified by the IMT (W) Leader and will in turn notify the Shell Australia CMT leader.

In addition to these resources, Shell Australia can activate additional support through the Shell Global Response Support Network (GRSN). The GRSN is a network of emergency response trained Shell Staff employed in a wide range of positions within Shell's global and local businesses who have received specific training related to oil spill response and who may be called upon to support any business or country globally which is responding to a large scale incident.

Shell Australia also has access to the Well Control Virtual Emergency Response Team (WCVERT), which provides virtual or physical mobilisation of a wide range of technical expertise. The major advantage of the GRSN and WCVERT is the ability for a local operations team to leverage the resources and support from the Shell group in the event of an incident.

Shell Australia could also activate external additional resources for Level/Tier 2-3 spills to fill various ERT and IMT roles for the duration of the response if they were required. This includes Oil Spill Response Organisation (OSRO) personnel and trained mutual aid personnel (as per AMOSPlan), as outlined in Section 3.2 of the Prelude OPEP (HSE_PRE_013075).



*indicates duty roles, all other positions are on-call

Figure 10-6: Incident Management Team (West) (IMT (W)) Structure

The Source Control Branch (if required), falls under the Operations Section of the IMT and develops and implements strategies and tactics to regain control of the well, and stop or contain the discharge of hydrocarbons. This strategy includes:

- Development of solutions;
- Coordination of engineering safety and operational activities;
- Development of task-specific plans and procedures;
- Identification of required tools and equipment; and
- Monitoring progress in achieving well control.

The activities of the Source Control Branch in Australia will be organised into additional groups, according to the specific requirements of the incident. These additional groups may include a Capping and Subsea Intervention Group, Well Control Group and Offset Installation Taskforce. All source control personnel complete ICS 100 and 200 training.

10.7.7 Emergency Management Roles and Responsibilities

Shell Australia's Incident Management Team (West) (IMT(W)) Emergency Response Plan (HSE_GEN_011209) and Prelude Facility Emergency Response Plan (HSE_PRE_005612) provide detailed guidance on roles and responsibilities for all emergency management personnel.

A summary of key roles and responsibilities for Shell Australia personnel for incident response are outlined in Table 10-5. Also provided are the roles and responsibilities of Shell Australia personnel required to work within the WA Department of Transport (DoT) organisational structure (Table 10-6), where DoT has responsibilities for spill response as a Control Agency, as per DoT's Offshore Petroleum Industry Guidance Note – Marine Oil pollution: Response and Consultation Arrangements. DoT will

provide two roles to Shell's IMT/CMT in a coordinated response. These roles and responsibilities are provided in Table 10-7.

Table 10-5: Summary of Roles and Responsibilities of Key Emergency Management Personnel

Key Roles	Responsibilities
Facility Incident Commander (OIM) (or vessel master) (Offshore)	Maintain the safety of all Prelude personnel and initiates actions to protect the environment and the Prelude asset Ensure all first strike actions carried out as per OPEP Control source of spill (if practicable) Classify the Level/Tier of spill Notify and maintain regular communications with Incident Management Team Leader (West) of incident Verbally notify NOPSEMA (within 2 hours of spill) if spill is within Commonwealth waters Initiate monitor and evaluate activities, as per OPEP
On-scene Commander (Offshore)	Responsible for emergency scene coordination and safety of all personnel at the emergency scene Move ERT forward when authorised by Incident Commander (OIM) Provide regular situation updates to the Operations Section Chief on incident progress against response plan priorities
IMT (W) Leader (Onshore)	Ensure all first strike actions carried out per OPEP Activate IMT, if required Conduct overall management of incident response operations Assess the situation and confirm or adjust the spill classification Level/Tier in consultation with the OIM and Operations Section Chief Notify CMT Leader of event and initial response level Determine incident priorities and objectives for IMT Confirm Incident Action Plan (IAP) is being developed, approve and authorise implementation of IAPs Confirm all external notifications and reporting have been made, as outlined in OPEP Mobilise external support, if required, as per OPEP
Operations Section Chief (OSC) (Onshore)	Oversees all operational resources and activities supporting an emergency Establish communications with ERT Provide overview of response operations at initial IMT brief Communicate incident updates provided by the ERT to IMT through meetings and team briefs Provide incident details to the Planning Section Chief and Situation Unit Lead for development of Initial IAP and help develop incident objectives and strategies Determine operational areas e.g. staging areas, forward command, incident area, oiled wildlife receiving and demobilisation areas Executes IAPs for each operational period Responsible for safety of all personnel involved in response

Key Roles	Responsibilities
Planning Section Chief (PSC) (Onshore)	Facilitate all IMT meetings Assist the IMT (W) Leader in development of incident objectives Facilitate development of IAP for next operational period Mobilise Environment Unit Monitor situation reports and update status displays with additional information and adjust IAP as necessary
Logistic Section Chief (LSC) (Onshore)	Source all logistical requirements to complete response operations, including personnel, equipment and supplies for ongoing incidents Liaise with Planning Section Chief on specialist resource requirements being considered in response strategies. Verify availability as this may affect strategy selection Where required incident resources are not immediately available through existing contracts, liaise with Contracts & Procurement to develop contractual arrangements as required
Environment Unit Lead (EUL) (Onshore)	Conduct relevant external notifications, as outlined in OPEP Review OMP initiation criteria and activate OSMP contractor where required Confirm protection priorities Validate strategic SIMA and generate the initial operational SIMA Provide guidance to the OSC on environmental management measures to be followed during response operations.
Source Control Branch Director	Develops and implements strategies and tactics to regain control of the well, and stop or contain the discharge of hydrocarbons. This strategy includes: • the development of task-specific plans and procedures • the identification of required tools and equipment • monitoring progress in achieving well control Assign a person or persons to liaise with the SIMOPS unit (if assigned) under the Operations Section, which is overall in charge of simultaneous operations and maintenance of the Common Operating Picture Activate specialist Source Control Groups as required
Situation Unit Lead (Onshore)	Responsible for collecting, processing and organising incident information relating to the growth, mitigation or intelligence activities taking place on the incident Manages all situational awareness and intelligence information relating to the incident, including geospatial/meteorological information Ensure status boards updated, retain clear records of out of date vs current information Prepare and disseminate resource and situation status information as required, including special requests.

Key Roles	Responsibilities
Documentation Unit Lead (Onshore)	Responsible for the maintenance of accurate, up-to-date incident files i.e. IAP, incident reports, communications logs Compiles and collates all unit logs, communications and other records so that a consolidated set of incident documentation is maintained. Liaise with the Situation Unit Lead to collate and store all relevant documentation produced for Situation Updates
External (Government) Relations/ Public Information Officer (PIO) (Onshore)	Conduct relevant external notifications, as outlined in OPEP Manages all external communications until CMT assumes responsibility Evaluate the need for a joint information communication centre Ensure active and ongoing engagement with all relevant stakeholders and external response agencies. Prepare stakeholder management plan for approval by IMT Develop material for use in media releases
Safety Officer (Onshore)	Conduct hazard assessment and advise OIM of recommended safety actions and safe approach routes Assist the OSC and LSC by facilitating risk assessments during event response and recovery plan development as required Review IAPs for safety implications
Finance Section Chief (Onshore)	The Finance (& Admin) Section Chief is responsible for all financial, administrative and cost analysis aspects of an emergency Provide financial and cost analysis information as requested

Table 10-6: Shell Personnel Roles Positioned within the State Maritime Environmental Emergency Coordination Centre (MEECC)/ DOT IMT

Key Roles	Responsibilities
CST Liaison Officer	Provide a direct liaison between the Shell and the State MEECC Facilitate effective communications and coordination between the Shell CMT Leader and the State Maritime Environmental Emergency Coordinator (SMEEC) Offer advice to SMEEC on matters pertaining to Shell crisis management policies and procedures
Deputy Incident Officer	Provide a direct liaison between the DoT IMT and the Shell IMT Facilitate effective communications and coordination between the Shell IMT (W) Leader and the DoT Incident Controller Offer advice to the DoT Incident Controller on matters pertaining to the Shell incident response policies and procedures Offer advice to the Safety Coordinator on matters pertaining to Shell safety policies and procedures particularly as they relate to Shell employees or contractors operating under the control of the DoT IMT
Intelligence Support Officer	As part of the Intelligence Team, assist the Intelligence Officer in the performance of their duties in relation to situation and awareness Facilitate the provision of relevant modelling and predications from the Shell IMT Assist in the interpretation of modelling and predictions originating from the Shell IMT

Key Roles	Responsibilities
	Facilitate the provision of relevant situation and awareness information originating from the DoT IMT to the Shell IMT Facilitate the provision of relevant mapping from the Shell IMT Assist in the interpretation of mapping originating from the Shell IMT Facilitate the provision of relevant mapping originating from the Shell IMT
Deputy Planning Officer	As part of the Planning Team, assist the Planning Officer in the performance of their duties in relation to the interpretation of existing response plans and the development of incident action plans and related sub plans Facilitate the provision of relevant IAP and sub plans from the Shell IMT Assist in the interpretation of the Shell OPEP from Shell Assist in the interpretation of the Shell IAP and sub plans from the Shell IMT Facilitate the provision of relevant IAP and sub plans originating from the DoT IMT to the Shell IMT Assist in the interpretation of Shell's existing resource plans Facilitate the provision of relevant components of the resource sub plan originating from the DoT IMT to the Shell IMT (Note this individual must have intimate knowledge of the relevant Shell OPEP and planning processes)
Environmental Support Officer	As part of the Planning Team, assist the Environmental Officer in the performance of their duties in relation to the provision of environmental support into the planning process Assist in the interpretation of the Shell OPEP and relevant TRP plans Facilitate in requesting, obtaining and interpreting environmental monitoring data originating from the Shell IMT Facilitate the provision of relevant environmental information and advice originating from the DoT IMT to the Shell IMT
Public Information Support & Media Liaison Officer	As part of the Public Information Team, provide a direct liaison between the Shell Media team and DoT IMT Media team Facilitate effective communications and coordination between Shell and DoT media teams Assist in the release of joint media statements and conduct of joint media briefings Assist in the release of joint information and warnings through the DoT Information & Warnings team Offer advice to the DoT Media Coordinator on matters pertaining to Shell media policies and procedures Facilitate effective communications and coordination between Shell and DoT Community Liaison teams Assist in the conduct of joint community briefings and events Offer advice to the DoT Community Liaison Coordinator on matters pertaining to Shell community liaison policies and procedures Facilitate the effective transfer of relevant information obtained from through the Contact Centre to the Shell IMT
Deputy Logistics Officer	As part of the Logistics Team, assist the Logistics Officer in the performance of their duties in relation to the provision of supplies to sustain the response effort Facilitate the acquisition of appropriate supplies through Shell's existing OSRL, AMOSC and private contract arrangements Collects Request Forms from DoT to action via the Shell IMT

Key Roles	Responsibilities
	(Note this individual must have intimate knowledge of the relevant Shell logistics processes and contracts)
Deputy Operations Officer	As part of the Operations Team, assist the Operations Officer in the performance of their duties in relation to the implementation and management of operational activities undertaken to resolve an incident Facilitate effective communications and coordination between the Shell Operations Section and the DoT Operations Section Offer advice to the DoT Operations Officer on matters pertaining to Shell incident response procedures and requirements Identify efficiencies and assist to resolve potential conflicts around resource allocation and simultaneous operations of Shell and DoT response efforts
Deputy Waste Management Coordinator	As part of the Operations Team, assist the Waste Management Coordinator in the performance of their duties in relation to the provision of the management and disposal of waste collected in State waters Facilitate the disposal of waste through Shell's existing private contract arrangements related to waste management and in line with legislative and regulatory requirements Collects Waste Collection Request Forms from DoT to action via the Shell IMT
Deputy Finance Officer	As part of the Finance Team, assist the Finance Officer in the performance of their duties in relation to the setting up and payment of accounts for those services acquired through Shell's existing OSRL, AMOSC and private contract arrangements Facilitate the communication of financial monitoring information to the Shell to allow them to track the overall cost of the response Assist the Finance Officer in the tracking of financial commitments through the response, including the supply contracts commissioned directly by DoT and to be charged back to Shell
Deputy On Scene Commander (FOB)	As part of the Field Operations Team, assist the On Scene Commander in the performance of their duties in relation to the oversight and coordination of field operational activities undertaken in line with the IMT Operations Section's direction Provide a direct liaison between Shell's Forward Operations Base/s (FOB/s) and the DoT FOB Facilitate effective communications and coordination between Shell On Scene Commander and the DoT On Scene Commander Offer advice to the DoT On Scene Commander on matters pertaining to Shell incident response policies and procedures Assist the Safety Coordinator deployed in the FOB in the performance of their duties, particularly as they relate to Shell employees or contractors Offer advice to the Safety Coordinator deployed in the FOB on matters pertaining to Shell safety policies and procedures

Table 10-7: Roles and Responsibilities of DoT Personnel to be Positioned in Shell's IMT/CMT

Key Roles	Responsibilities
DoT Liaison Officer	Facilitate effective communications between DoT's SMEEC and Incident Controller and Shell's appointed CMT Leader and Incident Controller Provide enhanced situational awareness to DoT of the incident and the potential impact on State waters

Key Roles	Responsibilities
	Assist in the provision of support from DoT to Shell Facilitate the provision technical advice from DoT to Shell's Incident Controller as required
Media Liaison Officer	Provide a direct liaison between Shell's Media team and DoT IMT Media team Facilitate effective communications and coordination between Shell and DoT media teams Assist in the release of joint media statements and conduct of joint media briefings Assist in the release of joint information and warnings through the DoT Information and Warnings team Offer advice to the Shell Media Coordinator on matters pertaining to DoT and wider Government media policies and procedures

10.7.8 Emergency Management Exercises, Training and Competencies

Shell Australia follows the approved ICS and IMO emergency management training requirement for ICS command and general staff. Specific competencies for IMT members are defined in the Shell Operational HSSE Competence Framework and are tracked in the Shell Open University. A summary of training requirements and core competencies for Shell key ERT, IMT and CMT personnel are outlined in Table 10-8.

Only persons that have completed all mandatory training requirements can be placed on the IMT roster. Training status of IMT personnel is reviewed monthly (or following significant personnel or policy change by the SA Emergency Response Coordinator) and notifications issued in advance to personnel requiring re-validation by training and/or emergency response exercise participation.

Oil spill responder training requirements are outlined in Table 10-9.

Table 10-8: Exercise and Training Requirements for Key ERT, IMT and CMT Personnel

Key Roles	Exercises	Training
ERT Personnel OIM	Level/Tier 2/3 exercise 6 monthly in accordance with 3 year exercise plan.	Some offshore roles may have AMOSC - IMO training.
IMT Personnel IMT (W) Leader	It is required that 80% of personnel will participate in an IMT exercise annually.	All IMT personnel complete ICS 100, 200 and IMT induction. IMT (W) leader undertakes - IMO3 Oil Spill Command & Control
Operations Section Chief (OSC) Planning Section Chief (PSC) Logistic Section Chief (LSC) Environment Unit Lead (EUL)	It is a target that 80% of personnel will participate in an IMT exercise annually. Participation in exercises is tracked in the Shell Australia Exercises & Training Schedule and is reviewed monthly or following significant personnel or policy change by the Shell Australia Emergency Response Coordinator.	AMOSC – IMO2 Oil Spill Management

Key Roles	Exercises	Training
CMT Personnel	Level/Tier 2/3 exercise on a biennial basis	Shell specific – Group Crisis training

Table 10-9: Oil Spill Responder Training and Resources

Key Roles	Exercises/Training	Available Resources
Shell AMOSC Core Group members	AMOSC Core Group Workshop (refresher training undertaken every 2 years) Operations stream and management stream	As defined in AMOSC contractual core group requirements
AMOSC Core Group Responders	AMOSC Core Group Workshop (refresher training undertaken every 2 years)	As defined in AMOSC contractual core group requirements
OSRL Oil Spill Response Personnel	As per OSRL training and competency matrix	As defined in OSRL Service Level Agreement
AMOSC Oil Spill Response Specialists	As per AMOSC training and competency matrix	As defined in AMOSC Master Services Agreement
Operational and Scientific Monitoring Service Providers	As defined in the Shell Australia Operational and Scientific Monitoring (OSM) Bridging Implementation Plan (HSE_PRE_16370).	As per Standby Capability and Competency Report
Oiled Wildlife Responders (Level 2-4) Shoreline clean-up personnel	As per DBCA OWR requirements (WA OWRRP) As per WA DoT requirements	As per OWR stateboard (AMOSC & DBCA) As defined in AMOSC Master Services and OSRL Service Level Agreements. Team members available through labour hire contracts (training provided prior to deployment)

Shell Australia maintains an Exercise and Training Schedule as detailed in the Shell Australia Emergency Management Manual (HSE_GEN_010996) to ensure its competency in responding to and managing major incidents, including oil spills. The Exercise and Training Schedule is reviewed and revised (if required) annually.

As part of this schedule, Shell conducts a number of different exercise types, which are further described in Table 10-10.

Table 10-10: Exercise Types, Objectives and Frequency

Exercise Type	Objective	Frequency
Notification exercise	To test all communication and notification processes to service providers and regulatory agencies defined within the OPEP	At least annually When OPEP is accepted or introduced When response arrangements have been significantly amended If a new location for the activity is added after the response arrangements have been tested
Equipment deployment exercises	To focus on Shell's deployment capability To inspect and maintain the condition of Shell's oil spill response equipment To maintain training of field response personnel	Level /Tier 1 – Annually Level/Tier 2 – Every 2 years
Tabletop exercise	To encourage interactive discussions of a simulated scenario amongst IMT members and refresh roles and responsibilities	As per Shell Australia's Exercise and Training Schedule
Incident Management Exercise	To activate IMT and establish command, control, and coordination of a simulated Level/Tier 2 or 3 incident and test response arrangements in OPEP	Minimum of one oil spill exercise per year for Shell Australia's activities. Where response arrangements are the same for a number of activity-specific OPEPs, one exercise may be used to test these response arrangements for these OPEPs at the same time
National Plan Exercises or WA DoT exercises	Participate as required to ensure alignment between National/State Response Framework and Shell Australia's Response Framework	As determined by AMSA and/or WA DoT, Shell may not be requested to participate every year
Shell Global Response Support Network (GRSN)	Test the functionality of Shell's Regional Core Group Level/Tier 3 oil spill response capabilities Target of 100% for participation of Shell Australia's Core Group personnel in GRSN regional exercises as required.	Annually Every 2 years
AMOSC Audit	To test deployment readiness and capability of AMOSC as per its Master Services Agreement with Shell	Annually
OSRL Audit	To test deployment readiness and capability of OSRL in Singapore as per OSRLs Service Level Agreement with Shell	Every 2 years

As part of the exercise process, a number of documents are prepared to ensure exercises are well planned, conducted and evaluated. To support this, the following documents are used:

- Exercise scope document – provides background context to the exercise, outlines the exercise need, aim, objectives, details of the scenario, participating groups and agencies, exercise deliverables and management structure. This document can be used to engage a third-party contractor to assist in conducting the exercise
- Exercise plan and instructions – provide instructions and 'play' (including any injects) for conducting the exercise
- Post exercise report – includes an after-action review of the exercise, evaluating how the exercise performed against meeting its aim and objectives.

10.7.9 Mechanism to examine the effectiveness of the response arrangements against the objectives of testing

Shell Australia routinely undertakes post-exercise debriefings following Level/Tier 2-3 OPEP exercises to evaluate effectiveness of response arrangements against the exercise objective/s, identify opportunities for improvement and communicate lessons learned. Shell sets Specific, Measurable, Achievable, Realistic and Timely (SMART) objectives for oil spill exercises so that they can be clearly evaluated as being met or not.

An independent assessor (either internal or external) will examine the effectiveness of the response arrangements during a spill exercise. The assessor will make written findings and recommendations from the test for consideration by Shell to assist in identifying deficiencies with response arrangements and continually improve the overall response readiness of Shell.

Recommendations from the tests will have SMART actions put against them where appropriate and they will be tracked to closure in Shell's Action Tracking System, Sphera. The Sphera system assigns a responsible person and due date against each action to ensure they are tracked to closure..

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Threatened Species Scientific Committee, 2016d. Conservation Advice *Charadrius mongolus* lesser sand plover. Threatened Species Scientific Committee, Canberra.

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List of Acronyms

Acronym	Definition
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AHO	Australian Hydrographic Office
AHTS	Anchor Handling Tug Supply Vessel
AIS	Automatic Identification System
ALARP	As low as reasonably practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment Conservation Council
APPEA	Australian Petroleum Production & Exploration Association Limited
ASV	Accomodation Support Vessel
AusSAR	Australian Search and Rescue
BAT	Best Available Technology
Bbl	Barrels
BIAs	Biologically Important Areas
BOD	Biological oxygen demand
BOP	Blowout Preventer
BTEX	Benzene, toulene, ethylbenzene, xylenes
BTU	British Thermal Unit
CAMBA	China-Australia Bilateral Agreement on the Protection of Migratory Birds
CHARM	Chemical Hazard Management Risk Management
CMT	Crisis Management Team
CO	Carbon monoxide
CO_2	Carbon dioxide
COLREGS	International Regulations for Preventing Collisions at Sea 1972
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTA	Cable Termination Assembly
CW	Cooling Water
DAFF	Department of Agriculture, Fisheries and Forestry (now known as the Department of Agriculture, Water and the Environment)
DAWE	Department of Agriculture, Water and the Environment (represents the former Department of Agriculture and Department of Environment and Energy)
DoEE	Department of Environment and Energy (now known as the Department of Agriculture, Water and the Environment)
dB	Decibels

DBCA	Department of Biodiversity, Conservation and Attractions (WA)
DC	Drill centre
DEWHA	Department of Environment Water Heritage and Arts (formally DEH, Department of Environment and Heritage)
DMIRS	Department of Mines, Industry Regulation and Safety (WA)
DMR	Double mixed refrigerant
DP	Dynamic positioning
DPIRD	Department of Primary Industries and Regional Development (WA)
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DVA	Direct vertical access
EAAF	East Asian-Australasian Flyway
ECE	Environmentally Critical Elements
ECU	Electrochlorination Unit
EDG	Emergency Diesel Generators
EEZ	Exclusive ecnomic zone
EGR	External and Givernment Relations
EIS	Environmental Impact Statement
EMBA	Zone of potential impact/ Environment that May be Affected
ENVID	Environmental Risk Identification
EP	Environment Plan
EPO	Environmental Performance Outcome
EPS	Environmental Performance Standard
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESD	Ecological Sustainable Development
EUL	Environment Unit Lead
FID	Final Investment Decision
FLNG	Floating Liquefied Natural Gas
FO	Fibre optic
FRC	Fast rescue craft
FWAD	Fixed Wing Aerial Dispersant
GHG	Greenhouse gas
HEMP	Hazards and Effects Management Process
HFO	Heavy Fuel Oil
HLIV	Heavy Lift Installation Vessel
HOCNF	Harmonized Offshore Chemical Notification Format
HSE	Health, Safety and Environment

HSSE and SP	Health, Security, Safety, Environment and Social Performance
ICS	Incident Command System
IFC	International Finance Corporation
IFO	Intermediate Fuel Oil
IOPP	International Oil Pollution Prevention
IMO	International Maritime Organisation
IMR	Inspection, Maintenance and Repair
IMS	Invasive Marine Species
IMT (W)	Incident Management Team West
IPEICA	The International Petroleum Industry Environmental Conservation Association
ISPP	International Sewage Pollution Prevention
ISVs	Infield Support Vessels
ITF	Indonesian Throughflow
IUCN	International Union for the Conservation of Nature
JAMBA	Japan-Australia Bilateral Agreement on the Protection of Migratory Birds
KEFs	Key Ecological Features
LNG	Liquefied Natural Gas
LOC	Loss of containment
LOWC	Loss of well containment
LPG	Liquefied Petroleum Gas
LQ	Living quarters
LWI	Light well intervention
MAE	Major Accident Events
MARPOL	The International Convention for the Prevention of Pollution from Ships, adopted by the International Conference on Marine Pollution, convened by IMO, 1973/78.
MBP	Mixed bed polisher
MC	Measurement criteria
MEG	Mono-ethylene Glycol
MFO	Marine fauna observer
MGC	Marine growth covers
MHWS	Mean High Water Spring
MLWS	Mean Low Water Spring
MNES	Matters of National Environmental Significance
MoC	Management of Change
MODU	Mobile Offshore Drilling Unit
MOPO	Manual Of Permitted Operations
MOU	Memorandum of Understanding

MPPE	Macro Porous Polymer Extraction
MPV	Multi-Purpose Vessel
MS	Management System
MSL	Mean Sea Level
MW	Mega watt
NEPM	National Environment Protection Measures
NGO	Non-Government Organisations
Nm	Nautical mile
NMR	North Marine Region
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NORM	Naturally Occuring Radioactive Materials
NO_x	Nitrogen oxides, typically expressed as NO_2
NPI	National Pollutant Inventory
NT	Northern Territory
NT DENR	Northern Territory Department of Environment and Natural Resources
NT DIPL	Northern Territory Department of Infrastructure, Planning and Logistics
NWMR	North West Marine Region
NWS	North West Shelf
OCNS	Offshore Chemicals Notification Scheme
ODS	Ozone depleting substances
OGP	Oil and Gas Producers
OIE	Offset Installation Equipment
OIM	Offshore Installation Manager
OPEP	Oil Pollution Emergency Plan
OPGGS (E) Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPRC 90	International Convention on Oil Pollution Preparedness, Response and Cooperation 1990
OSMP	Operational and Scientific Monitoring Plan
OSPAR	Oslo and Paris Conventions for the protection of the marine environment of the North-East Atlantic
OWR	Oiled Wildlife Response
PAH	Polycyclic Aromatic Hydrocarbon
PFW	Produced Formation Water
PLET	Pipeline End Termination
PLONOR	Poses Little or No Risk
PM	Particulate matter

PMR	Pre-cool mixed refrigerant
PMST	Protected Matters Search Tool (EPBC Act)
PNEC	Predicted no effect concentration
POB	Persons on Board
POP	Persistent Organic Pollutant
PPM	Parts per million
PPT	Parts per trillion
PSV	Platform Supply Vessel
PSZ	Petroleum Safety Zone
PTS	Permanent threshold shift
PTW	Permit to work
PW	Produced Water
RAM	Risk Assessment Matrix
RBM	Riser Base Manifold
RFSU	Ready for Start-Up
RIH	Run in hole
ROV	Remotely Operated Vehicle
ROKAMBA	The Republic of Korea Migratory Birds Agreement
SCAT	Shoreline clean up assessment technique
SCE	Safety Critical Elements
SCM	Subsea control module
SCSSV	Surface Controlled Sub-Surface Safety Valve
Shell	Shell Australia Pty Ltd
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
SFRT	Subsea First Response Toolkit
SG	Specific gravity
SGG	Synthetic greenhouse gases
SID	Subsea Intervention Device
SIRT	Subsea Incident Response Toolkit
SIMA	Spill impact mitigation assessment
SIMOPs	Simultaneous Operations
SOLAS	International Convention for the Safety of Life at Sea 1974
SOPEP	Shipboard Oil Pollution Emergency Plan
SO_2	Sulphur dioxide
SSD	Species Sensitivity Distribution
SSDI	Subsea dispersant injection
SURU	Start-up Ramp-up
TACL	Threshold Activity Concentration Limits
TEC	Threatened Ecological Communities

tpa	Tonnes per annum
tpd	Tonnes per day
TMS	Turret Mooring System
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TTS	Temporary Threshold Shift
UTA	Umbilical termination assemblies
VOC	Volatile Organic Compounds
WA	Western Australia
WA DoT	Western Australia Department of Transport
WB	World Bank
WCVERT	Well Control Virtual Emergency Response Team
WET	Whole Effluent Toxicity
WHA	World Heritage Area
WOMP	Well Operations Management Plan
WRFM	Well, Reservoir and Facility Management (WRFM)
XT	Xmas tree for wellheads

12 Appendix A: EPBC Act Protected Matters Reports

This appendix consists of two reports issed by the Australian Government Department of the Environment and Energy (renamed to Department of Agriculture, Water and the Environment at the time of submission of this EP):

- EPBC Act Protected Matters Report (Export Pipeline Corridor), Report created: 15/07/22 (30 pages)
- EPBC Act Protected Matters Report, Report created: 21/08/18 (31 pages)

Australian Government
Department of Agriculture, Water and the Environment

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 15-Jul-2022

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	31
Listed Migratory Species:	54

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	91
Whales and Other Cetaceans:	28
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	2
Habitat Critical to the Survival of Marine Turtles:	3

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	6
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	21
Key Ecological Features (Marine):	3
Biologically Important Areas:	26
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
EEZ and Territorial Sea	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Russkoye Bar-tailed Godwit [86432]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Rostratula australis](#) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area	In feature area
[Sternula nereis nereis](#) Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area	In feature area
FISH			
[Thunnus maccoyii](#) Southern Bluefin Tuna [69402]	Conservation Dependent	Breeding known to occur within area	In feature area
MAMMAL			
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Migration route known to occur within area	In feature area
[Balaenoptera physalus](#) Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area	In feature area
[Bettongia lesueur Barrow and Boodie Islands subspecies](#) Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Translocated population known to occur within area	In feature area
[Isoodon auratus barrowensis](#) Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Translocated population known to occur within area	In feature area
[Lagorchestes conspicillatus conspicillatus](#) Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Translocated population known to occur within area	In feature area
[Lagorchestes hirsutus Central Australian subspecies](#) Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area	In feature area
[Macroderma gigas](#) Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area	In feature area
REPTILE			

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Aipysurus apraefrontalis](#) Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
[Aipysurus foliosquama](#) Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area	In feature area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
SHARK			
[Carcharias taurus (west coast population)](#) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area	In feature area
[Carcharodon carcharias](#) White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area
[Pristis clavata](#) Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pristis pristis			
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis zijsron			
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus			
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Sphyrna lewini			
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area	In feature area

Listed Migratory Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Anous stolidus			
Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna pacifica			
Wedge-tailed Shearwater [84292]		Breeding known to occur within area	In feature area
Calonectris leucomelas			
Streaked Shearwater [1077]		Species or species habitat likely to occur within area	In feature area
Fregata ariel			
Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area	In feature area
Fregata minor			
Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area	In feature area
Hydroprogne caspia			
Caspian Tern [808]		Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Migratory Marine Species			
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat likely to occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat likely to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Dugong dugon Dugong [28]		Species or species habitat known to occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Breeding known to occur within area	In feature area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area	In feature area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area	In feature area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Sousa sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		Species or species habitat may occur within area	In feature area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Motacilla cinerea](#) Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
[Motacilla flava](#) Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
[Calidris canutus](#) Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
[Charadrius veredus](#) Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area	In feature area
[Glareola maldivarum](#) Oriental Pratincole [840]		Species or species habitat may occur within area	In feature area
[Limosa lapponica](#) Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
[Pandion haliaetus](#) Osprey [952]		Breeding known to occur within area	In feature area
[Thalasseus bergii](#) Greater Crested Tern [83000]		Breeding known to occur within area	In feature area
[Tringa nebularia](#) Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
[Actitis hypoleucos](#) Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
[Anous stolidus](#) Common Noddy [825]		Species or species habitat likely to occur within area	In feature area
[Apus pacificus](#) Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
[Ardenna pacifica as Puffinus pacificus](#) Wedge-tailed Shearwater [84292]		Breeding known to occur within area	In feature area
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
[Calidris canutus](#) Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area	In feature area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area overfly marine area	In feature area
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area	In feature area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area	In feature area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area	In feature area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area overfly marine area	In feature area
Hydroprogne caspia as Sterna caspia Caspian Tern [808]		Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Onychoprion anaethetus as Sterna anaethetus Bridled Tern [82845]		Breeding known to occur within area	In feature area
Onychoprion fuscatus as Sterna fuscata Sooty Tern [90682]		Breeding known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Breeding known to occur within area	In feature area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat may occur within area	In feature area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Species or species habitat may occur within area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Sternula nereis as Sterna nereis Fairy Tern [82949]		Breeding known to occur within area	In feature area
Thalasseus bengalensis as Sterna bengalensis Lesser Crested Tern [66546]		Breeding known to occur within area	In feature area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area	In feature area
Fish			
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area	In feature area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area	In feature area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area	In feature area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area	In feature area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area	In feature area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area	In feature area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area	In feature area
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area	In feature area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area	In feature area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area	In feature area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area	In feature area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area	In feature area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area	In feature area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area	In feature area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area	In feature area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area	In feature area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area	In feature area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area	In feature area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area	In feature area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area	In feature area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area	In feature area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area	In feature area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area	In feature area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area	In feature area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area	In feature area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area	In feature area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area	In feature area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area	In feature area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area	In feature area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area	In feature area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area	In feature area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area	In feature area
Mammal			
Dugong dugon Dugong [28]		Species or species habitat known to occur within area	In feature area
Reptile			
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area	In feature area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area	In feature area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area	In feature area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area	In feature area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Chitulia ornata as Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area	In feature area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area	In feature area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area	In feature area
Leioselasma czeblukovi as Hydrophis czeblukovi Fine-spined Seasnake, Geometrical Seasnake [87374]		Species or species habitat may occur within area	In feature area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area	In feature area

Whales and Other Cetaceans		[Resource Information]	
Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Breeding known to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
[Mesoplodon densirostris](#) Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
[Orcinus orca](#) Killer Whale, Orca [46]		Species or species habitat may occur within area	In feature area
[Peponocephala electra](#) Melon-headed Whale [47]		Species or species habitat may occur within area	In feature area
[Physeter macrocephalus](#) Sperm Whale [59]		Species or species habitat may occur within area	In feature area
[Pseudorca crassidens](#) False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
[Sousa sahulensis as Sousa chinensis](#) Australian Humpback Dolphin [87942]		Species or species habitat may occur within area	In feature area
[Stenella attenuata](#) Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area	In feature area
[Stenella coeruleoalba](#) Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area	In feature area
[Stenella longirostris](#) Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area	In feature area
[Steno bredanensis](#) Rough-toothed Dolphin [30]		Species or species habitat may occur within area	In feature area
[Tursiops aduncus](#) Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Tursiops aduncus (Arafura/Timor Sea populations)			
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str.			
Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris			
Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Australian Marine Parks		[Resource Information]
Park Name	Zone & IUCN Categories	Buffer Status
Gascoyne	Multiple Use Zone (IUCN VI)	In feature area
Montebello	Multiple Use Zone (IUCN VI)	In feature area

Habitat Critical to the Survival of Marine Turtles			
Scientific Name	Behaviour	Presence	Buffer Status
Aug - Sep			
Natator depressus			
Flatback Turtle [59257]	Nesting	Known to occur	In feature area
Dec - Jan			
Chelonia mydas			
Green Turtle [1765]	Nesting	Known to occur	In feature area
Nov - May			
Eretmochelys imbricata			
Hawksbill Turtle [1766]	Nesting	Known to occur	In feature area

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Barrow Island	Marine Management Area	WA	In feature area
Montebello Islands	Conservation Park	WA	In feature area
Montebello Islands	Conservation Park	WA	In feature area
Montebello Islands	Marine Park	WA	In feature area

Protected Area Name	Reserve Type	State	Buffer Status
Unnamed WA40828	5(1)(h) Reserve	WA	In feature area
Unnamed WA41080	5(1)(h) Reserve	WA	In feature area

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Develop Jansz-Io deepwater gas field in Permit Areas WA-18-R, WA-25-R and WA-26-	2005/2184	Controlled Action	Post-Approval	In feature area
Equus Gas Fields Development Project, Carnarvon Basin	2012/6301	Controlled Action	Completed	In feature area
Gorgon Gas Development	2003/1294	Controlled Action	Post-Approval	In feature area
Pluto Gas Project	2005/2258	Controlled Action	Completed	In feature area
Not controlled action				
Bollinger 2D Seismic Survey 200km North of North West Cape WA	2004/1868	Not Controlled Action	Completed	In feature area
Cazadores 2D seismic survey	2004/1720	Not Controlled Action	Completed	In feature area
Echo A Development WA-23-L, WA-24-L	2005/2042	Not Controlled Action	Completed	In feature area
Exploration of appraisal wells	2006/3065	Not Controlled Action	Completed	In feature area
Western Flank Gas Development	2005/2464	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
'Tourmaline' 2D marine seismic survey, permit areas WA-323-P, WA-330-P and WA-32	2005/2282	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
"Leanne" offshore 3D seismic exploration, WA-356-P	2005/1938	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
2D Seismic Survey	2005/2146	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D seismic survey	2006/2715	Not Controlled Action	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		(Particular Manner)		
Draeck 3D Marine Seismic Survey, WA-205-P	2006/3067	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Harmony 3D Marine Seismic Survey	2012/6699	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Honeycombs MC3D Marine Seismic Survey	2012/6368	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Leopard 2D marine seismic survey	2005/2290	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Moosehead 2D seismic survey within permit WA-192-P	2005/2167	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Osprey and Dionysus Marine Seismic Survey	2011/6215	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
West Panaeus 3D seismic survey	2006/3141	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Ancient coastline at 125 m depth contour	North-west	In feature area
Continental Slope Demersal Fish Communities	North-west	In feature area
Exmouth Plateau	North-west	In feature area

Biologically Important Areas			
Scientific Name	Behaviour	Presence	Buffer Status
Marine Turtles			
Caretta caretta Loggerhead Turtle [1763]	Internesting buffer	Known to occur	In feature area
Caretta caretta Loggerhead Turtle [1763]	Nesting	Known to occur	In feature area
Chelonia mydas Green Turtle [1765]	Aggregation	Known to occur	In feature area
Chelonia mydas Green Turtle [1765]	Foraging	Known to occur	In feature area
Chelonia mydas Green Turtle [1765]	Internesting	Known to occur	In feature area
Chelonia mydas Green Turtle [1765]	Internesting buffer	Known to occur	In feature area
Chelonia mydas Green Turtle [1765]	Mating	Known to occur	In feature area
Chelonia mydas Green Turtle [1765]	Nesting	Known to occur	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Foraging	Known to occur	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting buffer	Known to occur	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Mating	Known to occur	In feature area
Eretmochelys imbricata Hawksbill Turtle [1766]	Nesting	Known to occur	In feature area
Natator depressus Flatback Turtle [59257]	Aggregation	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Natator depressus Flatback Turtle [59257]	Foraging	Known to occur	In feature area
Natator depressus Flatback Turtle [59257]	Internesting	Known to occur	In feature area
Natator depressus Flatback Turtle [59257]	Internesting buffer	Known to occur	In feature area
Natator depressus Flatback Turtle [59257]	Mating	Known to occur	In feature area
Natator depressus Flatback Turtle [59257]	Nesting	Known to occur	In feature area
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In feature area
Sterna dougallii Roseate Tern [817]	Breeding	Known to occur	In feature area
Sternula nereis Fairy Tern [82949]	Breeding	Known to occur	In feature area
Thalasseus bengalensis Lesser Crested Tern [66546]	Breeding	Known to occur	In feature area
Sharks			
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Migration	Known to occur	In feature area
Megaptera novaeangliae Humpback Whale [38]	Migration (north and south)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

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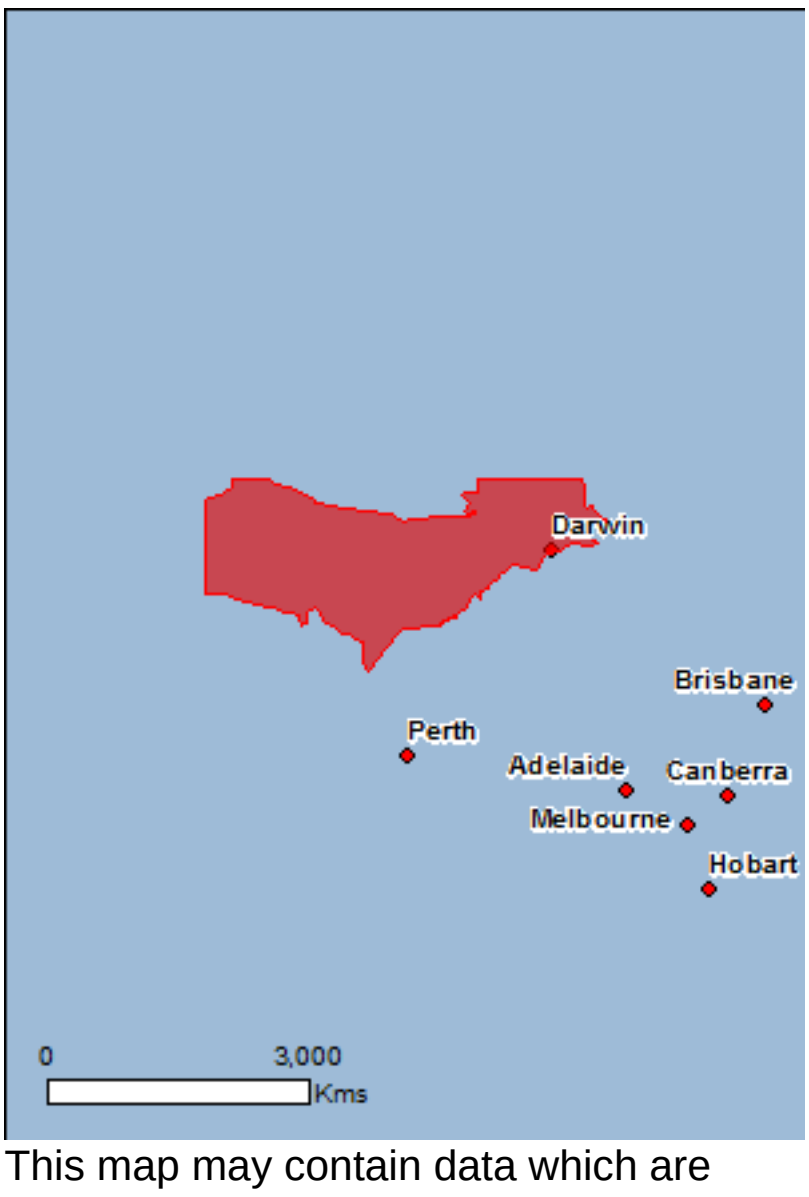

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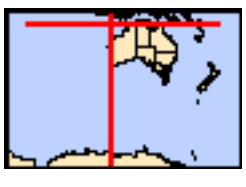

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance:	5
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	96
Listed Migratory Species:	95

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	6
Commonwealth Heritage Places:	35
Listed Marine Species:	169
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	25

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	30
Regional Forest Agreements:	None
Invasive Species:	37
Nationally Important Wetlands:	9
Key Ecological Features (Marine)	15

Details

Matters of National Environmental Significance

National Heritage Properties		[Resource Information]
Name	State	Status
Natural		
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site
Cobourg peninsula	Within Ramsar site
Hosnies spring	Within Ramsar site
Pulu keeling national park	Within Ramsar site
The dales	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside the Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area. Generally the Commonwealth Marine Area stretches from three nautical miles to two hundred nautical miles from the coast.

Name

EEZ and Territorial Sea

Extended Continental Shelf

Marine Regions [Resource Information]

If you are planning to undertake action in an area in or close to the Commonwealth Marine Area, and a marine bioregional plan has been prepared for the Commonwealth Marine Area in that area, the marine bioregional plan may inform your decision as to whether to refer your proposed action under the EPBC Act.

Name

North

North-west

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Name	Status	Type of Presence
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Accipiter hiogaster natalis		
Christmas Island Goshawk [82408]	Endangered	Species or species habitat known to occur within area
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area

Name	Status	Type of Presence
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Chalcophaps indica natalis Christmas Island Emerald Dove, Emerald Dove (Christmas Island) [67030]	Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Epthianura crocea tunneyi Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat known to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falcunculus frontatus whitei Crested Shrike-tit (northern), Northern Shrike-tit [26013]	Vulnerable	Species or species habitat likely to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Geophaps smithii blaauwi Partridge Pigeon (western) [66501]	Vulnerable	Species or species habitat likely to occur within area
Geophaps smithii smithii Partridge Pigeon (eastern) [64441]	Vulnerable	Species or species habitat known to occur within area
Hypotaenidia philippensis andrewsi Buff-banded Rail (Cocos (Keeling) Islands), Ayam Hutan [88994]	Endangered	Translocated population known to occur within area
Limosa lapponica baueri Bar-tailed Godwit (baueri), Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat likely to occur within area
Limosa lapponica menzbieri Northern Siberian Bar-tailed Godwit, Bar-tailed Godwit (menzbieri) [86432]	Critically Endangered	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Melanodryas cucullata melvillensis Tiwi Islands Hooded Robin, Hooded Robin (Tiwi Islands) [67092]	Critically Endangered	Species or species habitat known to occur within area
Mirafra javanica melvillensis Horsfield's Bushlark (Tiwi Islands) [81011]	Vulnerable	Species or species habitat known to occur within area
Ninox natalis Christmas Island Hawk-Owl, Christmas Boobook [66671]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Breeding likely to occur within area
Polytelis alexandrae Princess Parrot, Alexandra's Parrot [758]	Vulnerable	Species or species habitat known to occur within area
Pterodroma arminjoniana Round Island Petrel, Trinidade Petrel [89284]	Critically Endangered	Breeding likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Turdus poliocephalus erythropleurus Christmas Island Thrush [67122]	Endangered	Species or species habitat likely to occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat known to occur within area
Tyto novaehollandiae melvillensis Tiwi Masked Owl, Tiwi Islands Masked Owl [26049]	Endangered	Species or species habitat known to occur within area
Mammals		
Antechinus bellus Fawn Antechinus [344]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area

Name	Status	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Conilurus penicillatus Brush-tailed Rabbit-rat, Brush-tailed Tree-rat, Pakooma [132]	Vulnerable	Species or species habitat known to occur within area
Crocidura trichura Christmas Island Shrew [86568]	Critically Endangered	Species or species habitat likely to occur within area
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Isoodon auratus auratus Golden Bandicoot (mainland) [66665]	Vulnerable	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesembriomys gouldii gouldii Black-footed Tree-rat (Kimberley and mainland Northern Territory), Djintamoonga, Manbul [87618]	Endangered	Species or species habitat known to occur within area
Mesembriomys gouldii melvillensis Black-footed Tree-rat (Melville Island) [87619]	Vulnerable	Species or species habitat known to occur within area
Mesembriomys macrurus Golden-backed Tree-rat, Koorrawal [119]	Vulnerable	Species or species habitat known to occur within area
Notomys aquilo Northern Hopping-mouse, Woorrentinta [123]	Vulnerable	Species or species habitat may occur within area
Petrogale concinna canescens Nabarlek (Top End) [87606]	Endangered	Species or species habitat may occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Phascogale pirata Northern Brush-tailed Phascogale [82954]	Vulnerable	Species or species habitat known to occur within area
Phascogale tapoatafa kimberleyensis Kimberley brush-tailed phascogale, Brush-tailed Phascogale (Kimberley) [88453]	Vulnerable	Species or species habitat known to occur within area
Pipistrellus murrayi Christmas Island Pipistrelle [64383]	Critically Endangered	Species or species habitat known to occur within area
Pteropus natalis Christmas Island Flying-fox, Christmas Island	Critically Endangered	Roosting known to occur

Name	Status	Type of Presence
Fruit-bat [87611]		within area
Saccolaimus saccolaimus nudicluniatus		
Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat known to occur within area
Sminthopsis butleri		
Butler's Dunnart [302]	Vulnerable	Species or species habitat known to occur within area
Xeromys myoides		
Water Mouse, False Water Rat, Yirrkoo [66]	Vulnerable	Species or species habitat known to occur within area
Plants		
Asplenium listeri		
Christmas Island Spleenwort [65865]	Critically Endangered	Species or species habitat known to occur within area
Burmannia sp. Bathurst Island (R.Fensham 1021)		
[82017]	Endangered	Species or species habitat likely to occur within area
Hoya australis subsp. oramicola		
a vine [55436]	Vulnerable	Species or species habitat known to occur within area
Mitrella tiwiensis		
a vine [82029]	Vulnerable	Species or species habitat likely to occur within area
Pneumatopteris truncata		
fern [68812]	Critically Endangered	Species or species habitat known to occur within area
Stylidium ensatum		
a triggerplant [86366]	Endangered	Species or species habitat likely to occur within area
Tectaria devexa		
[14767]	Endangered	Species or species habitat likely to occur within area
Typhonium jonesii		
a herb [62412]	Endangered	Species or species habitat known to occur within area
Typhonium mirabile		
a herb [79227]	Endangered	Species or species habitat known to occur within area
Xylopia monosperma		
a shrub [82030]	Endangered	Species or species habitat known to occur within area
Reptiles		
Acanthophis hawkei		
Plains Death Adder [83821]	Vulnerable	Species or species habitat known to occur within area
Aipysurus apraefrontalis		
Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus foliosquama		
Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Breeding known to occur

Name	Status	Type of Presence
		within area
Cryptoblepharus egeriae		
Christmas Island Blue-tailed Skink, Blue-tailed Snake-eyed Skink [1526]	Critically Endangered	Species or species habitat likely to occur within area
Cryptoblepharus gurrmul		
Arafura Snake-eyed Skink [83106]	Endangered	Species or species habitat known to occur within area
Cyrtodactylus sadleiri		
Christmas Island Giant Gecko [86865]	Endangered	Species or species habitat known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Emoia nativitatis		
Christmas Island Forest Skink, Christmas Island Whiptail-skink [1400]	Critically Endangered	Species or species habitat known to occur within area
Eretmochelys imbricata		
Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Lepidochelys olivacea		
Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Lepidodactylus listeri		
Christmas Island Gecko, Lister's Gecko [1711]	Critically Endangered	Species or species habitat known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Ramphotyphlops exocoeti		
Christmas Island Blind Snake, Christmas Island Pink Blind Snake [1262]	Vulnerable	Species or species habitat likely to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat known to occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Glyphis garricki		
Northern River Shark, New Guinea River Shark [82454]	Endangered	Breeding known to occur within area
Glyphis glyphis		
Speartooth Shark [82453]	Critically Endangered	Species or species habitat known to occur within area
Pristis clavata		
Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Listed Migratory Species	[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.	
Name	Threatened	Type of Presence

Name	Threatened	Type of Presence
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat may occur within area
Ardenna pacifica Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Onychoprion anaethetus Bridled Tern [82845]		Breeding known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat may occur within area
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to occur within area
Balaena glacialis australis Southern Right Whale [75529]	Endangered*	Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Dugong dugon Dugong [28]		Breeding known to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Isurus paucus Longfin Mako [82947]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area

Name	Threatened	Type of Presence
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat known to occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pristis clavata Dwarf Sawfish, Queensland Sawfish [68447]	Vulnerable	Breeding known to occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat known to occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Breeding known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Migratory Terrestrial Species		
Cecropis daurica Red-rumped Swallow [80610]		Species or species habitat known to occur within area
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		

Name	Threatened	Type of Presence
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris subminuta Long-toed Stint [861]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius dubius Little Ringed Plover [896]		Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Foraging, feeding or related behaviour known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Limicola falcinellus Broad-billed Sandpiper [842]		Foraging, feeding or related behaviour known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Foraging, feeding or related behaviour known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour known to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Thalasseus bergii Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Foraging, feeding or related behaviour known to occur within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa incana Wandering Tattler [831]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area
Tringa totanus Common Redshank, Redshank [835]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -
Commonwealth Land - Australian Government Solicitor
Commonwealth Land - Christmas Island National Park
Commonwealth Land - Pulu Keeling National Park
Defence - QUAIL ISLAND BOMBING RANGE
Defence - YAMPI SOUND TRAINING AREA

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Christmas Island Natural Areas	EXT	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
North Keeling Island	EXT	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place
Yampi Defence Area	WA	Listed place
Historic		
Administration Building Forecourt	EXT	Listed place
Administrators House Precinct	EXT	Listed place
Bungalow 702	EXT	Listed place
Captain Ballards Grave	EXT	Listed place
Direction Island (DI) Houses	EXT	Listed place
Drumsite Industrial Area	EXT	Listed place
Early Settlers Graves	EXT	Listed place
Government House	EXT	Listed place
Home Island Cemetery	EXT	Listed place
Home Island Foreshore	EXT	Listed place
Home Island Industrial Precinct	EXT	Listed place
Industrial and Administrative Group	EXT	Listed place
Malay Kampong Group	EXT	Listed place
Malay Kampong Precinct	EXT	Listed place
Oceania House and Surrounds	EXT	Listed place
Old Co-op Shop (Canteen)	EXT	Listed place
Phosphate Hill Historic Area	EXT	Listed place
Poon Saan Group	EXT	Listed place
Qantas Huts (former)	EXT	Listed place
RAAF Memorial	EXT	Listed place
Settlement Christmas Island	EXT	Listed place
Six Inch Guns	EXT	Listed place
Slipway and Tank	EXT	Listed place
South Point Settlement Remains	EXT	Listed place
Type 2 Residences	EXT	Listed place
Type T Houses Precinct	EXT	Listed place
West Island Elevated Houses	EXT	Listed place
West Island Housing Precinct	EXT	Listed place
West Island Mosque	EXT	Listed place

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Acrocephalus orientalis Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Anous minutus Black Noddy [824]		Breeding known to occur within area
Anous stolidus Common Noddy [825]		Breeding known to occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Breeding known to occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]		Foraging, feeding or related behaviour known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Foraging, feeding or related behaviour known to occur within area
Calidris alba Sanderling [875]		Foraging, feeding or related behaviour known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Foraging, feeding or related behaviour known to occur within area
Calidris subminuta Long-toed Stint [861]		Foraging, feeding or related behaviour known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Foraging, feeding or related behaviour known to occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Foraging, feeding or related behaviour known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Foraging, feeding or related behaviour known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Foraging, feeding or related behaviour known to occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Foraging, feeding or related behaviour known to occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat known to occur within area
Fregata andrewsi Christmas Island Frigatebird, Andrew's Frigatebird [1011]	Endangered	Breeding known to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Breeding known to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Breeding known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Foraging, feeding or related behaviour known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Heteroscelus brevipes Grey-tailed Tattler [59311]		Foraging, feeding or related behaviour known to occur within area
Heteroscelus incanus Wandering Tattler [59547]		Foraging, feeding or related behaviour known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Foraging, feeding or related behaviour known to occur within area
Hirundo daurica Red-rumped Swallow [59480]		Species or species habitat known to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area
Larus novaehollandiae Silver Gull [810]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Foraging, feeding or related behaviour known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Foraging, feeding or related behaviour known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour known to occur within area
Numenius phaeopus Whimbrel [849]		Foraging, feeding or related behaviour known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat known to occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Breeding known to occur within area
Phaethon lepturus fulvus Christmas Island White-tailed Tropicbird, Golden Bosunbird [26021]	Endangered	Breeding likely to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Foraging, feeding or related behaviour known to occur within area
Pluvialis squatarola Grey Plover [865]		Foraging, feeding or related behaviour known to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat may occur within area
Puffinus pacificus Wedge-tailed Shearwater [1027]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Sterna albifrons Little Tern [813]		Breeding known to occur within area
Sterna anaethetus Bridled Tern [814]		Breeding known to occur within area
Sterna bengalensis Lesser Crested Tern [815]		Breeding known to occur within area
Sterna bergii Crested Tern [816]		Breeding known to occur within area
Sterna caspia Caspian Tern [59467]		Breeding known to occur within area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sterna fuscata Sooty Tern [794]		Breeding known to occur within area
Sterna nereis Fairy Tern [796]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Foraging, feeding or related behaviour known to occur within area
Sula dactylatra Masked Booby [1021]		Breeding known to occur within area
Sula leucogaster Brown Booby [1022]		Breeding known to occur within area
Sula sula Red-footed Booby [1023]		Breeding known to occur within area
Thalassarche cauta Tasmanian Shy Albatross [89224]	Vulnerable*	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Foraging, feeding or related behaviour known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Foraging, feeding or related behaviour known to occur within area

Name	Threatened	Type of Presence
Tringa totanus Common Redshank, Redshank [835]		Species or species habitat known to occur within area
Xenus cinereus Terek Sandpiper [59300]		Foraging, feeding or related behaviour known to occur within area
Fish		
Acentronura larsonae Helen's Pygmy Pipehorse [66186]		Species or species habitat may occur within area
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		Species or species habitat may occur within area
Bulbonaricus brauni Braun's Pughead Pipefish, Pug-headed Pipefish [66189]		Species or species habitat may occur within area
Campichthys tricarinatus Three-keel Pipefish [66192]		Species or species habitat may occur within area
Choeroichthys brachysoma Pacific Short-bodied Pipefish, Short-bodied Pipefish [66194]		Species or species habitat may occur within area
Choeroichthys latispinosus Muiron Island Pipefish [66196]		Species or species habitat may occur within area
Choeroichthys sculptus Sculptured Pipefish [66197]		Species or species habitat may occur within area
Choeroichthys suillus Pig-snouted Pipefish [66198]		Species or species habitat may occur within area
Corythoichthys amplexus Fijian Banded Pipefish, Brown-banded Pipefish [66199]		Species or species habitat may occur within area
Corythoichthys flavofasciatus Reticulate Pipefish, Yellow-banded Pipefish, Network Pipefish [66200]		Species or species habitat may occur within area
Corythoichthys haematopterus Reef-top Pipefish [66201]		Species or species habitat may occur within area
Corythoichthys intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area
Corythoichthys schultzi Schultz's Pipefish [66205]		Species or species habitat may occur within area
Cosmocampus banneri Roughridge Pipefish [66206]		Species or species habitat may occur within area
Cosmocampus maxweberi Maxweber's Pipefish [66209]		Species or species habitat may occur within area
Doryrhamphus baldwini Redstripe Pipefish [66718]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Doryrhamphus dactyliophorus Banded Pipefish, Ringed Pipefish [66210]		Species or species habitat may occur within area
Doryrhamphus excisus Bluestripe Pipefish, Indian Blue-stripe Pipefish, Pacific Blue-stripe Pipefish [66211]		Species or species habitat may occur within area
Doryrhamphus janssi Cleaner Pipefish, Janss' Pipefish [66212]		Species or species habitat may occur within area
Doryrhamphus multiannulatus Many-banded Pipefish [66717]		Species or species habitat may occur within area
Doryrhamphus negrosensis Flagtail Pipefish, Masthead Island Pipefish [66213]		Species or species habitat may occur within area
Festucalex cinctus Girdled Pipefish [66214]		Species or species habitat may occur within area
Festucalex scalaris Ladder Pipefish [66216]		Species or species habitat may occur within area
Filicampus tigris Tiger Pipefish [66217]		Species or species habitat may occur within area
Halicampus brocki Brock's Pipefish [66219]		Species or species habitat may occur within area
Halicampus dunckeri Red-hair Pipefish, Duncker's Pipefish [66220]		Species or species habitat may occur within area
Halicampus grayi Mud Pipefish, Gray's Pipefish [66221]		Species or species habitat may occur within area
Halicampus macrorhynchus Whiskered Pipefish, Ornate Pipefish [66222]		Species or species habitat may occur within area
Halicampus mataafae Samoan Pipefish [66223]		Species or species habitat may occur within area
Halicampus nitidus Glittering Pipefish [66224]		Species or species habitat may occur within area
Halicampus spinirostris Spiny-snout Pipefish [66225]		Species or species habitat may occur within area
Haliichthys taeniophorus Ribboned Pipehorse, Ribboned Seadragon [66226]		Species or species habitat may occur within area
Hippichthys cyanospilos Blue-speckled Pipefish, Blue-spotted Pipefish [66228]		Species or species habitat may occur within area
Hippichthys heptagonus Madura Pipefish, Reticulated Freshwater Pipefish [66229]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Hippichthys parvicarinatus Short-keel Pipefish, Short-keeled Pipefish [66230]		Species or species habitat may occur within area
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		Species or species habitat may occur within area
Hippichthys spicifer Belly-barred Pipefish, Banded Freshwater Pipefish [66232]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus histrix Spiny Seahorse, Thorny Seahorse [66236]		Species or species habitat may occur within area
Hippocampus kuda Spotted Seahorse, Yellow Seahorse [66237]		Species or species habitat may occur within area
Hippocampus planifrons Flat-face Seahorse [66238]		Species or species habitat may occur within area
Hippocampus spinosissimus Hedgehog Seahorse [66239]		Species or species habitat may occur within area
Hippocampus trimaculatus Three-spot Seahorse, Low-crowned Seahorse, Flat-faced Seahorse [66720]		Species or species habitat may occur within area
Micrognathus brevirostris thorntail Pipefish, Thorn-tailed Pipefish [66254]		Species or species habitat may occur within area
Micrognathus micronotopterus Tidepool Pipefish [66255]		Species or species habitat may occur within area
Phoxocampus belcheri Black Rock Pipefish [66719]		Species or species habitat may occur within area
Solegnathus hardwickii Pallid Pipehorse, Hardwick's Pipehorse [66272]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Solenostomus cyanopterus Robust Ghostpipefish, Blue-finned Ghost Pipefish, [66183]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area
Trachyrhamphus bicoarctatus Bentstick Pipefish, Bend Stick Pipefish, Short-tailed Pipefish [66280]		Species or species habitat may occur within area
Trachyrhamphus longirostris Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Mammals		

Name	Threatened	Type of Presence
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptiles		
Acalyptophis peronii Horned Seasnake [1114]		Species or species habitat may occur within area
Aipysurus apraefrontalis Short-nosed Seasnake [1115]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus duboisii Dubois' Seasnake [1116]		Species or species habitat may occur within area
Aipysurus eydouxii Spine-tailed Seasnake [1117]		Species or species habitat may occur within area
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Aipysurus fuscus Dusky Seasnake [1119]		Species or species habitat known to occur within area
Aipysurus laevis Olive Seasnake [1120]		Species or species habitat may occur within area
Aipysurus tenuis Brown-lined Seasnake [1121]		Species or species habitat may occur within area
Astrotia stokesii Stokes' Seasnake [1122]		Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area
Crocodylus porosus Salt-water Crocodile, Estuarine Crocodile [1774]		Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Disteira major Olive-headed Seasnake [1124]		Species or species habitat may occur within area
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species

Name	Threatened	Type of Presence
		habitat may occur within area
Ephalophis greyi North-western Mangrove Seasnake [1127]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Breeding known to occur within area
Hydrelaps darwiniensis Black-ringed Seasnake [1100]		Species or species habitat may occur within area
Hydrophis atriceps Black-headed Seasnake [1101]		Species or species habitat may occur within area
Hydrophis coggeri Slender-necked Seasnake [25925]		Species or species habitat may occur within area
Hydrophis czeblukovi Fine-spined Seasnake [59233]		Species or species habitat may occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis inornatus Plain Seasnake [1107]		Species or species habitat may occur within area
Hydrophis mcdowelli null [25926]		Species or species habitat may occur within area
Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [1111]		Species or species habitat may occur within area
Hydrophis pacificus Large-headed Seasnake, Pacific Seasnake [1112]		Species or species habitat may occur within area
Lapemis hardwickii Spine-bellied Seasnake [1113]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Breeding known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Parahydrophis mertoni Northern Mangrove Seasnake [1090]		Species or species habitat may occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke		Species or species

Name	Status	Type of Presence
Whale [67812]		habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Migration route known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat may occur within area
Feresa attenuata Pygmy Killer Whale [61]		Species or species habitat may occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Indopacetus pacificus Longman's Beaked Whale [72]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia simus Dwarf Sperm Whale [58]		Species or species habitat may occur within area
Lagenodelphis hosei Fraser's Dolphin, Sarawak Dolphin [41]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Breeding known to occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon ginkgodens Gingko-toothed Beaked Whale, Gingko-toothed Whale, Gingko Beaked Whale [59564]		Species or species habitat may occur within area
Orcaella brevirostris Irrawaddy Dolphin [45]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Status	Type of Presence
Peponocephala electra Melon-headed Whale [47]		Species or species habitat may occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Sousa chinensis Indo-Pacific Humpback Dolphin [50]		Breeding known to occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Stenella coeruleoalba Striped Dolphin, Euphrosyne Dolphin [52]		Species or species habitat may occur within area
Stenella longirostris Long-snouted Spinner Dolphin [29]		Species or species habitat may occur within area
Steno bredanensis Rough-toothed Dolphin [30]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat known to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks

[Resource Information]

Name	Label
Arafura	Multiple Use Zone (IUCN VI)
Arafura	Special Purpose Zone (IUCN VI)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Arnhem	Special Purpose Zone (IUCN VI)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Habitat Protection Zone (IUCN IV)
Gascoyne	Multiple Use Zone (IUCN VI)
Gascoyne	National Park Zone (IUCN II)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Kimberley	Habitat Protection Zone (IUCN IV)

Name	Label
Kimberley	Multiple Use Zone (IUCN VI)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Montebello	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	National Park Zone (IUCN II)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Adele Island	WA
Balanggarra	WA
Bardi Jawi	WA
Bedout Island	WA
Browse Island	WA
Casuarina	NT
Christmas Island	EXT
Coulomb Point	WA
Dambimangari	WA
Djukbinj	NT
Garig Gunak Barlu	NT
Indian Island	NT
Lacepede Islands	WA
Lawley River	WA
Lesueur Island	WA
Low Rocks	WA
Prince Regent	WA
Pulu Keeling	EXT
Swan Island	WA
Tanner Island	WA
Unnamed WA28968	WA
Unnamed WA37168	WA
Unnamed WA41775	WA
Unnamed WA44669	WA
Unnamed WA44672	WA
Unnamed WA44673	WA
Unnamed WA44674	WA
Unnamed WA44677	WA
Uunguu	WA
Vernon Islands	NT

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Gallus gallus Red Junglefowl, Domestic Fowl [917]		Species or species habitat likely to occur within area
Gallus varius Green Junglefowl [81207]		Species or species habitat likely to occur within area
Lonchura oryzivora Java Sparrow [59586]		Species or species habitat likely to occur within area
Meleagris gallopavo Wild Turkey [64380]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos javanicus Banteng, Bali Cattle [15]		Species or species habitat likely to occur within area
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Bubalus bubalis Water Buffalo, Swamp Buffalo [1]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Rattus exulans Pacific Rat, Polynesian Rat [79]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Plants		
Andropogon gayanus Gamba Grass [66895]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat likely to occur within area
Cabomba caroliniana Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171]		Species or species habitat likely to occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Hymenachne amplexicaulis Hymenachne, Olive Hymenachne, Water Stargrass, West Indian Grass, West Indian Marsh Grass [31754]		Species or species habitat likely to occur within area
Jatropha gossypifolia Cotton-leaved Physic-Nut, Bellyache Bush, Cotton-leaf Physic Nut, Cotton-leaf Jatropha, Black Physic Nut [7507]		Species or species habitat likely to occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Mimosa pigra Mimosa, Giant Mimosa, Giant Sensitive Plant, ThornySensitive Plant, Black Mimosa, Catclaw Mimosa, Bashful Plant [11223]		Species or species habitat likely to occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Pennisetum polystachyon Mission Grass, Perennial Mission Grass, Missiongrass, Feathery Pennisetum, Feather Pennisetum, Thin Napier Grass, West Indian Pennisetum, Blue Buffel Grass [21194]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area
Lepidodactylus lugubris Mourning Gecko [1712]		Species or species habitat likely to occur within area
Lycodon aulicus Wolf Snake, Common Wolf Snake, Asian Wolf Snake [83178]		Species or species habitat likely to occur within area
Lygosoma bowringii Christmas Island Grass-skink [1312]		Species or species habitat likely to occur within area
Ramphotyphlops braminus Flowerpot Blind Snake, Brahminy Blind Snake, Cacing Besi [1258]		Species or species habitat known to occur

Name	Status	Type of Presence within area

Nationally Important Wetlands [Resource Information]

Name	State
"The Dales", Christmas Island	EXT
Adelaide River Floodplain System	NT
Ashmore Reef	EXT
Cobourg Peninsula System	NT
Finniss Floodplain and Fog Bay Systems	NT
Hosine's Spring, Christmas Island	EXT
Mermaid Reef	EXT
Pulu Keeling National Park	EXT
Yampi Sound Training Area	WA

Key Ecological Features (Marine) [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Carbonate bank and terrace system of the Van	North
Pinnacles of the Bonaparte Basin	North
Shelf break and slope of the Arafura Shelf	North
Tributary Canyons of the Arafura Depression	North
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding	North-west
Canyons linking the Argo Abyssal Plain with the	North-west
Canyons linking the Cuvier Abyssal Plain and the	North-west
Carbonate bank and terrace system of the Sahul	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters	North-west
Pinnacles of the Bonaparte Basin	North-west
Seringapatam Reef and Commonwealth waters in	North-west

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-7.825 95.017,-7.258 95.057,-6.889 95.237,-6.546 96.79,-5.888 97.702,-5.082 97.709,-5.082 101.768,-5.414 102.196,-5.93 103.76,-7.147 106.451,-7.373 106.405,-7.371 106.464,-7.442 106.953,-7.744 107.995,-7.905 109.722,-8.356 111.662,-8.658 114.361,-9.316 115.483,-9.106 116.195,-9.15 116.927,-8.821 119.311,-8.755 122.28,-8.452 122.881,-8.181 122.864,-8.618 122.351,-8.542 122.084,-8.149 121.927,-7.45 122.23,-6.573 121.494,-6.268 121.687,-6.441 122.623,-6.416 123.13,-5.113 123.133,-5.113 133.938,-5.756 134.147,-7.713 134.118,-7.969 134.501,-7.815 135.134,-8.241 135.302,-8.909 135.884,-9.195 136.427,-9.473 136.375,-9.844 136.011,-9.831 135.131,-10.246 134.206,-10.601 134.135,-10.823 135.421,-10.709 134.224,-11.029 134.456,-11.348 135.339,-11.563 135.522,-11.768 134.789,-11.405 132.823,-12.258 131.691,-12.208 131.004,-12.913 130.189,-14.271 129.243,-13.816 126.757,-13.977 126.369,-14.59 125.843,-14.391 125.612,-14.655 125.271,-14.96 125.273,-15.436 124.511,-16.112 124.318,-16.25 123.58,-17.181 123.449,-16.508 122.977,-17.191 122.224,-17.832 121.993,-18.363 121.112,-18.861 120.844,-19.26 119.724,-19.711 119.219,-20.146 115.456,-22.107 113.387,-23.866 112.25,-24.037 111.896,-23.478 111.438,-22.327 111.418,-21.302 111.244,-21.164 110.494,-20.578 110.015,-20.556 109.025,-19.69 108.376,-19.261 107.083,-18.477 106.843,-17.955 106.373,-18.429 105.463,-19.468 105.407,-19.652 105.038,-18.834 104.781,-18.465 104.174,-18.39 103.302,-17.903 102.18,-18.024 101.627,-17.698 100.31,-17.302 99.413,-17.054 98.178,-16.713 97.326,-16.574 96.068,-16.593 95.119,-7.825 95.017

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-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
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-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
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-Other groups and individuals

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Please feel free to provide feedback via the Contact Us page.

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