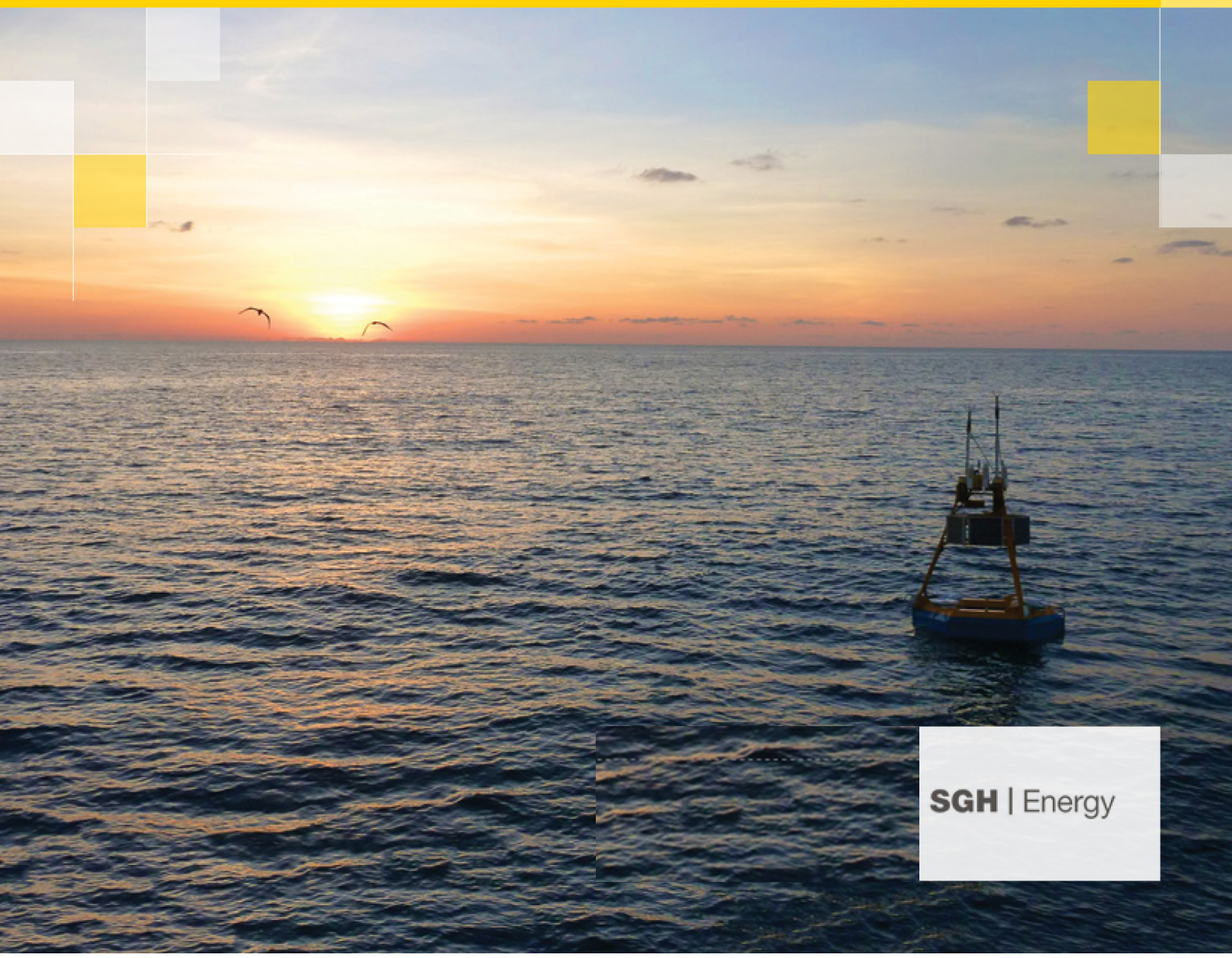
Crux Development Drilling

ENVIRONMENT PLAN
2022



Crux Development Drilling Environment Plan

Department	***HSSE&SP***
Document Number	***2200-010-HX-5880-00001***
Document Status	***Issued for Review***
Revision Number	***02***
Issue Date	***26 July 2022***
Owner	***Crux Project Manager***
Author/s	***Crux Approvals Advisor***
Security Classification	***Unrestricted***
Export Control	***No US Content***

Controlled Document, Copy No: 01

** Copy No 01" is always electronic and held within Shell Document Management systems:

** all printed copies of "Copy No 01" are to be considered uncontrolled

** all electronic copies of "Copy No 01" duplicated outside Shell Document Management systems are to be considered uncontrolled

REVISION HISTORY					
Ver.	**Change Description**	**Date**	**Originator**	**Reviewed by**	**Approved by**
01	Issued for Approval	21/07/2022	Environmental Approvals Advisor	Crux Environment Lead Well Engineering Manager – Australia West Substructure Delivery Manager Crux Senior Engineer – Drilling Template Senior Wells Engineer Drilling Fluids Coordinator Crux HSSE Manager	Crux Project Manager
02	Approved for Use	26/07/2022	Environmental Approvals Advisor	Crux Environment Lead Well Engineering Manager – Australia West Substructure Delivery Manager Crux Senior Engineer – Drilling Template Senior Wells Engineer Drilling Fluids Coordinator Crux HSSE Manager	Crux Project Manager

TABLE OF CONTENTS

List of Tables

List of Figures

1. Environment Plan Summary Statement

This Crux Development Drilling 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):

EP Summary material requirement	Relevant section of EP containing EP Summary material
The location of the activity	6.2
A description of the receiving environment	7
A description of the activity	6
Details of the environmental impacts and risks	9
The control measures for the activity	9
The arrangements for ongoing monitoring of the titleholder's environmental performance	10.4.1
Response arrangements in the oil pollution emergency plan	9.15 and 10.7
Consultation already undertaken and plans for ongoing consultation	5
Details of the titleholders nominated liaison person for the activity	6.4

2. Introduction

The Shell-operated Crux development is located in Commonwealth waters in the northern Browse Basin, 190 kilometres (km) offshore north-west Australia and 620 km north-east of Broome, in approximately 165 metres (m) water depth.

The Crux gas field has been identified as a source of backfill gas to the existing Prelude Floating Liquefied Natural Gas (FLNG) facility as depicted in Figure 2-1.

The project is being progressed by the Crux Joint Venture Participants with Shell Australia as majority operator and encompasses the Production Licence AC/L10.

The first environmental approval for Crux was the Crux Offshore Project Proposal (OPP), which was accepted in August 2020 by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

The Crux development drilling program (inclusive of drilling template and docking pile installation) is the first significant infield activity planned to occur to support the execution of the Crux development.

Environmental management for activities associated with the Crux development drilling activity is undertaken in agreement with this EP, which was prepared in accordance with the requirements of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* (Cth) ("OPGGS(E) Regulations"), and describes the following:

- Shell's Health, Security, Safety and Environment and Social Performance (HSSE & SP) Commitment and Policy and the environmental performance objectives that derive from the Policy
- The consultation process undertaken with the Relevant Persons and the associated resolution of and/or responses to any objections or claims
- The area of operations, the proposed activities and its expected time frame
- The environmental management framework for the activity including legislation and other requirements
- The existing physical, natural, social and economic environments of the region, including issues or sensitivities particular to the activity
- The impacts and risks to the environment from both planned (normal) and unplanned (abnormal) operations
- The Environmental Performance Outcomes (EPOs), Environmental Performance Standards (EPSs) and Measurement Criteria (MC) against which environmental performance is measured
- The Implementation Strategy, including key roles and responsibilities that are employed to achieve the program's environmental performance goals[1]

[1] *The Shell Browse Oil Pollution Emergency Plan (OPEP) (HSE_PRE_013075), APPEA OSMP Framework and the Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_016370) are presented as standalone documents, submitted together with this EP.*

- A system for documenting, monitoring, reporting and reviewing the success of the Implementation Strategy to facilitate improvement of environmental performance and external reporting as required.

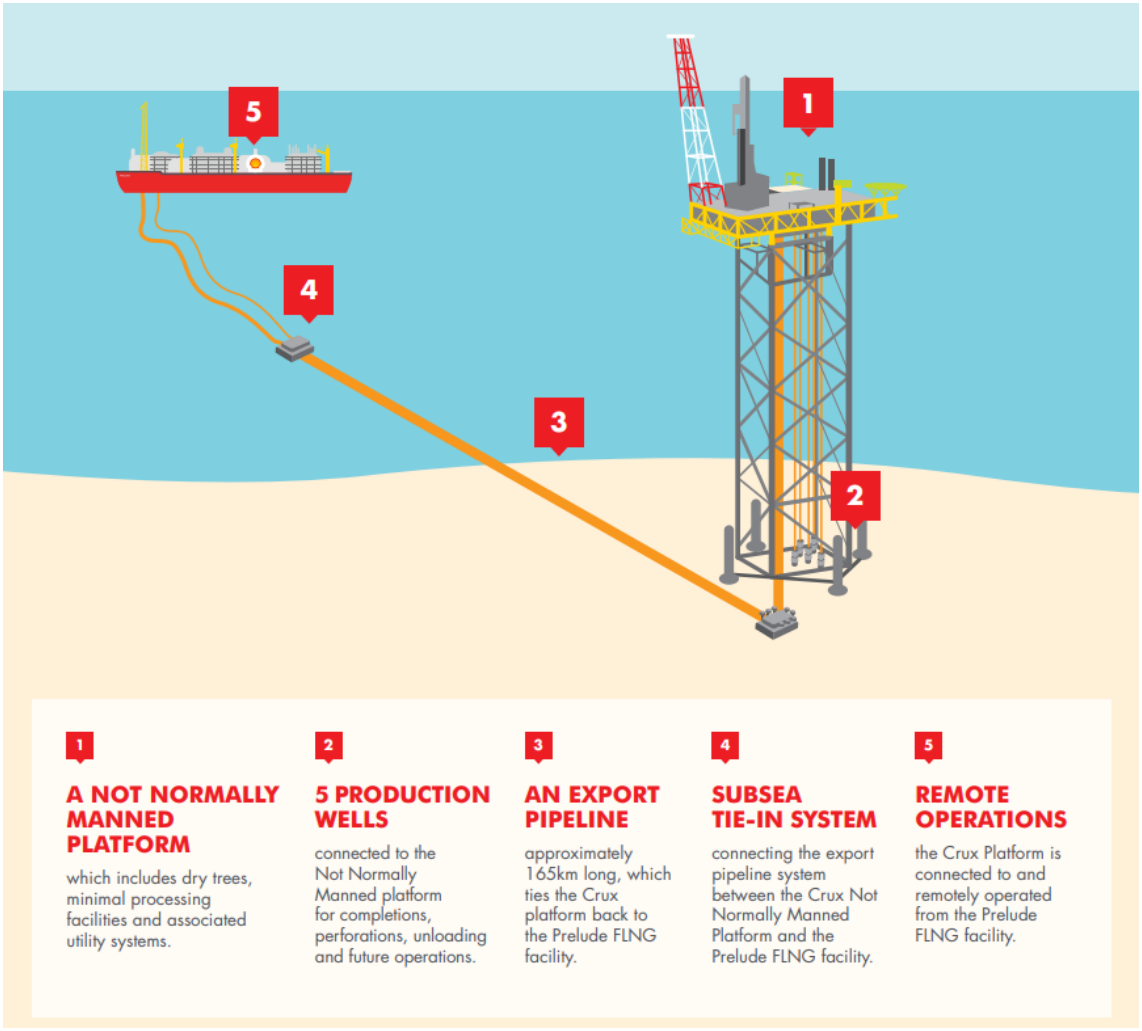


Figure 2-1: Crux development concept overview, noting that this EP is only related to the development drilling and installation of drilling template and docking piles

.

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 2020) 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 *Environmental Protection and Biodiversity Conservation Act 1999* (Cth)(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 adjacent states including Western Australia and the Northern Territory. State 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 (the Act) provides the regulatory framework for petroleum exploration, production and greenhouse gas activities in Commonwealth waters. The 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;

- the *Offshore Petroleu*m and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 (Cth) which require that a Well Operations Management Plan (WOMP) is assessed and accepted by NOPSEMA for existing or proposed offshore facilities; and
- the OPGGS(E) Regulations.

The Act manages all offshore petroleum activities, including decommissioning, under Section 572 and 270. While there are no immediate plans for decommissioning (the scope of this EP is for drilling production wells for future operations) all equipment being installed above the mudline has been designed to allow removal. Subsection 572(2) provides that while structures, equipment and other property remain in the title area, they must be maintained in good condition and repair. Inspection, maintenance and repair of the infrastructure installed for future production, under this Environment Plan, will be managed as described in Section 6.6.

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 as low as reasonably practicable (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 8 and Sections 9.1 and 9.2, with aspect-specific demonstrations provided in each of the impact and risk assessment in Sections 9.3 to 9.15.

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 1 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 10 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 9.15 provides the environmental impact and risk assessments based on the context provided by Section 6 and Section 7 (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	Section 9.1 to Section 9.2 details the method by which Shell demonstrates

OPGGS (E) Regulation	Requirement	Relevant Section of EP
	of the activity will be reduced to ALARP	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 9.15.
10A (c)	The EP demonstrates that the environmental impacts and risks of the activity will be of an acceptable level	Section 8 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 9.15.
10A (d)	The EP provides or appropriate EPOs, EPSs and MC.	EPOs, EPSs and MCs are detailed in Section 9.3 to Section 9.15.
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.
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 details 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 9.15.
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.

3.1.2.1 Offshore Project Proposal (OPP) Acceptance

The Crux project constitutes an offshore project that requires approval under the OPGGS Act and OPGGS (E) Regulations. Subsequently, Shell developed the Crux Offshore Project Proposal (Crux OPP) to meet this requirement.

The impact assessment included in the Crux OPP was aligned to meet the requirements of an OPP regulated under the OPGGS (E) Regulations and administered by NOPSEMA.

The Crux OPP was accepted by NOPSEMA in August 2020.

The purpose of the OPP was to describe:

- the project area, the proposed activities and its expected timeframe;
- the environmental management framework for the proposal, including legislation and other requirements;
- the existing natural, social and economic environments of the local and regional setting, including issues or sensitivities particular to the proposal;
- the possible impacts and risks to the environment from both planned (normal) and unplanned (emergency) operations;
- Shell's HSSE & SP Commitment and Policy and the environmental performance objectives that derive from the Policy; and
- a framework for the forward environmental management and performance, including definition of key management controls and Environmental Performance Outcomes (EPOs), from which environmental performance will be measured and monitored throughout the life of the project.

Acceptance of the Crux OPP confirmed that Shell and its Joint Venture Participants have demonstrated an acceptable level of environmental impact for all Crux project phases during the concept and early engineering stage. To allow Shell to start any activities within the Crux offshore petroleum title area, additional activity specific Environment Plans are required to be accepted by NOPSEMA.

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. As part of the streamlining arrangements, matters protected under Part 3 of the EPBC Act must be considered by NOPSEMA when assessing an EP.

Related EPBC Act Guidance

In addition to the relevant specific management/recovery plans and conservation advices specific to MNES, DoEE also has a suite of Policy Statements and related guidance under the EPBC Act.

Of specific relevance to this proposal, particular consideration is given to the following:

- Matters of National Environmental Significance - Significant Impact Guidelines 1.1 published by the DoEE (DoE 2013a). These have been used to inform the definition of acceptability of impacts, and are described in further detail in Section 8, and carried into the subsequent evaluation of impacts and risks in Section 9.
- EPBC Act Policy Statement 'Indirect consequences' of an action: Section 527E of the EPBC Act (Department of Sustainability, Environment, Water, Population and Communities ((DSEWPaC) 2013a). This has been consideration in the specific context of indirect consequences of a proposal with regard to GHG emissions, and is addressed by the inclusion of Section 9.12 of this 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 7.3.6 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 8 to Section 9 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 7.3.5.

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 7.4.2 for details).
Australian Maritime Safety Authority Act 1990	Provides that a function of the Australian Maritime Safety Authority (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 Western Australian (WA) conservation management agencies to take a lead role in oiled wildlife response in Western Australia. The Department of Biodiversity Conservation and Attractions (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 Department of Transport (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 used during the drilling campaign may potentially breach this convention if unpermitted via this EP and deliberately discharged to the sea.

Legislation	Summary	Relevance to the Project
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 environment are protected from the harmful effects of the waste.	The project will comply with the export, import and transport requirements for hazardous 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 National Environment Protection Measures (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.

Legislation	Summary	Relevance to the Project
Navigation Act 2012 *Navigation Regulations 2013* *Marine Order 21 (Safety and emergency arrangements) 2016* *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*	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 legislation contained in Regulations and Marine Orders.	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.
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*	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 Mobile Offshore Drilling Unit (MODU) 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
Marine Order 96 (Marine pollution prevention — sewage) 2018 *Marine Order 97 (Marine pollution prevention — air pollution) 2013*		
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 7.4.3 for details).

3.2 Standards and Guidelines

3.2.1 Industry Good Practice Standards

In Australia, the petroleum exploration and production industry operate 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 2020)
- 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 2015a)
- Advisory Note for Offshore Petroleum Industry Consultation with Respect of Oil Spill Contingency Plans (AMSA 2017), 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 (International Petroleum Industry Environmental Conservation Association (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 7.3.5.
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 7.3.5.
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 7.3.5.
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 7.3.5.

Agreement / Convention	Summary	Relevance to the Project
Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment 1986 (CAMBA)	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 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.	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 7.3.5.
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 7.3.5.
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 7.3.4.
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 Memorandum of Understanding (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 Crux project is situated adjacent to the MoU box. Refer to Section 7.4.4.

Agreement / Convention	Summary	Relevance to the Project
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 and MODUs may potentially breach this convention if unpermitted via this EP and deliberately discharged to the sea.
Minamata Convention on Mercury 2017	This convention is an agreement to protect human and environmental health from the effects of releases of mercury and mercury-containing compounds to the environment. The convention is not yet ratified by Australia, and hence is not currently implemented in Commonwealth law. Australia has signed the convention and is currently undertaking an assessment process prior to ratification.	Drilling activities may result in mercury compounds being produced from wells as a by-product. Mercury may pose a risk to the environment if not managed appropriately.
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 Watch keeping 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.

Agreement / Convention	Summary	Relevance to the Project
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 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 2°C 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.	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 Crux project.

Agreement / Convention	Summary	Relevance to the Project
	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 HSSE and SP 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; and
- 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 development drilling program.

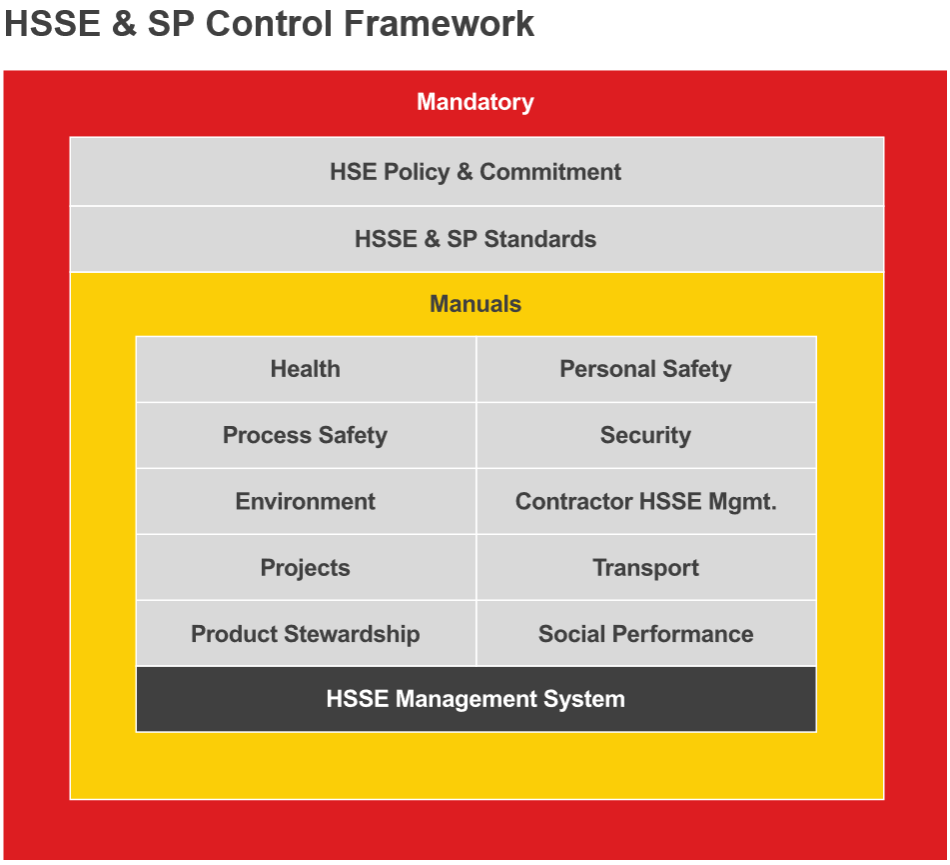


Figure 4-2: Shell HSSE & SP Control Framework

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
- 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 project specific HSSE systems/procedures as set out in this EP.

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 3.2), 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.

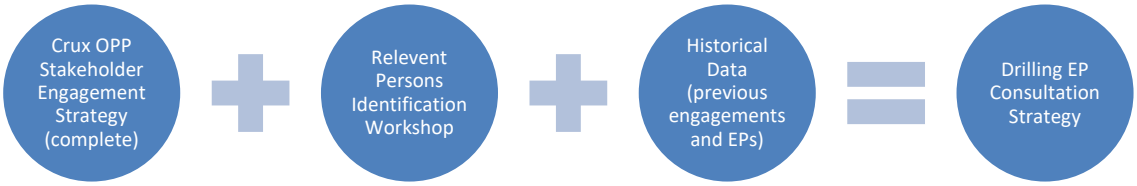


Figure-5-1: Development of Consultation Strategy

Relevant Persons

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

1. Identify stakeholders against specific business objectives.
2. Prioritise stakeholders based on stakeholder views/concerns.
3. Analyse value drivers and views on our activities.
4. Define desired shared outcomes; and
5. Early engagements with stakeholders to understand views of impacts, risks and opportunities.

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.

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

The workshop was held on 12 January 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; and
- 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)
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

Organisation	Guidance
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 determined that a minimum of 30 days is 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. Table 5-2 outlines Shell's approach.

Table 5-2: Reasonable Period for Ongoing Consultation

Type of Consultation	Timing
New, formal consultation The 30-day period acts as a minimum period in the consultation planning process for new information distributed to Relevant Persons.	30 days
Ongoing consultation The 14-day period acts as a minimum period to respond to claims or objections received once in the ongoing consultation phase. This will be managed on a case-by-case basis so that timeframes will take into account other factors (such as how much correspondence there has been with the Relevant Person, the merits of the claim or objection and/or the complexity of the claim or objection).	14 days

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. This process is shown in Figure-5-2 below.

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."

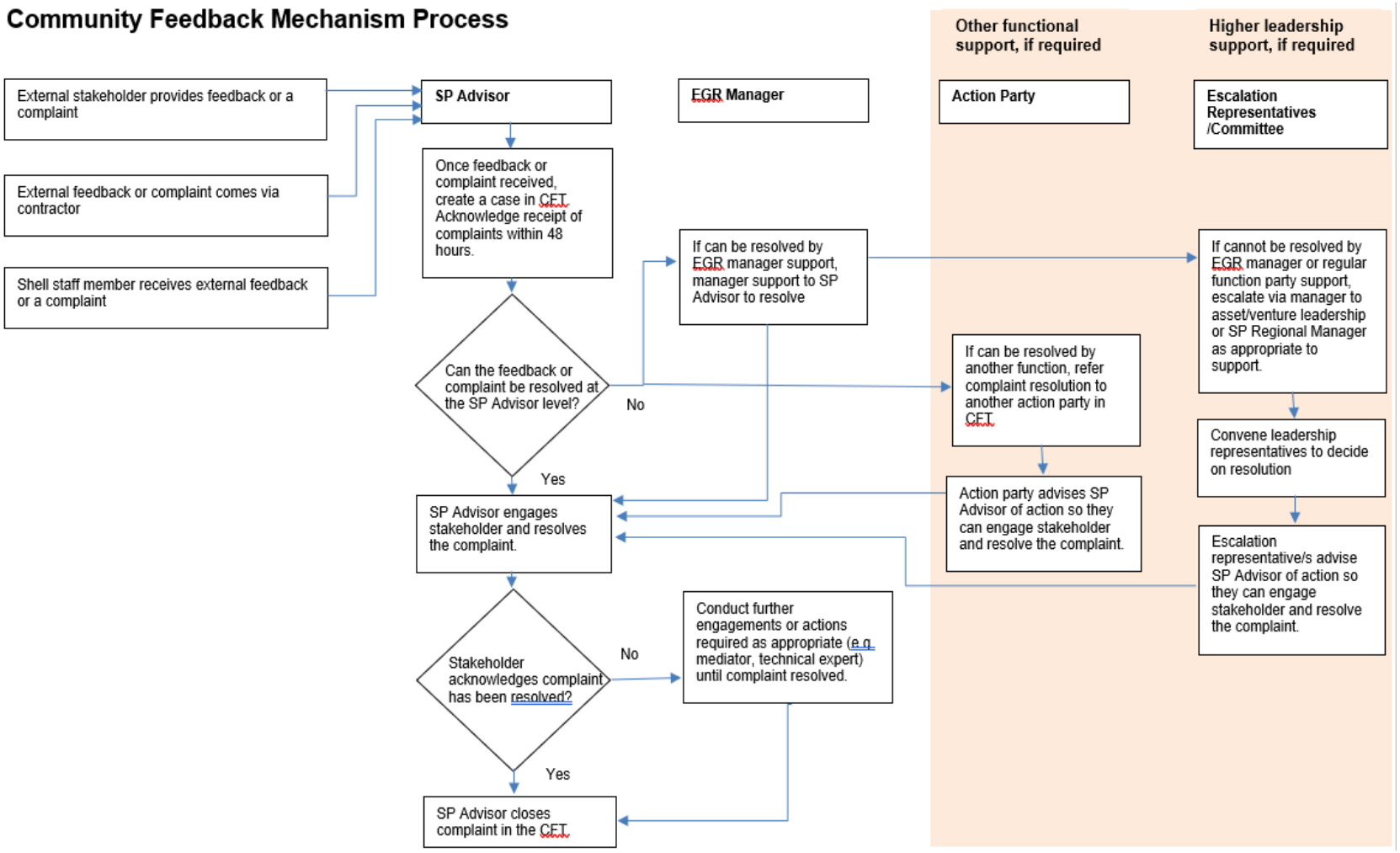


Figure-5-2: Community Feedback Mechanism Process

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 and Table 5-4. An assessment of merit was undertaken and is presented in Table 5-5.

Table 5-3: 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	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	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	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 organistation 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	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	No	Tourism outlet - assisting with Broome accommodation, Broome tours, Kimberley tours, details on The Gibb River Road, Cape Leveque and the Dampier Peninsula, car hire, Cable Beach accommodation, what's on in Broome, hotels in Broome and more.	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	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP05	Community	**Dambimangari Wanjina-Wunggurr (Native Title) Aboriginal Corporation (Registered Native Title bodies Corporate)**	No	No	No	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	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	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 organistation 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	No	The Department of Fire and Emergency Services (DFES) was established on 1 November 2012 and performs a critical role coordinating emergency services for a range of natural disasters and emergency incidents threatening life and property.	d) An organistation 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.
RP09	Community	**Goolarabooloo Aboriginal Corporation**	No	Yes	No	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	No	The Port of Broome is the largest deep-water access port servicing the Kimberley region	d) An organistation 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	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
							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.	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.
RP11	Community	**Kimberly Land Council**	No	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, interests or activities of the Relevant Person.
RP12	Community	**Mayala Inninalang Aboriginal Corporation**	No	No	No	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	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	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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP15	Community	**Nyamba Buru Yawuru and Yawuru Native Title Holders Aboriginal Corporation (Registered Native Title bodies Corporate)**	No	Yes	No	No	Traditional Owner organization in Broome. Interest in Traditional activities on Land and water around Broome. Social Investment partner for Prelude. Interest in traditional activities on land and water. Native Title rights in and around Broome area where transit proposed to take place for Crux.	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.
RP16	Community	**Port of Darwin**	No	No	No	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	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	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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP19	Environmental NGOs	**Australian Conservation Foundation**	No	Yes	No	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	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	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.
RP22	Environmental NGOs	**Environmental Defenders Office WA**	No	Yes	No	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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP23	Environmental NGOs	**Environs Kimberley**	No	No	No	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	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	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 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.	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.
RP26	Environmental NGOs	**WA Marine Science Institute**	No	No	No	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	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	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
							unprecedented pressure from an increasing number of uses such as oil and gas extraction, tourism, aquaculture and large coastal developments.		
RP27	Environmental NGOs	**Wilderness Society**	No	Yes	No	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	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 complex relationships that exist between these elements.	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.
RP29	Commonwealth Fisheries	**Australian Bluefin Tuna Industry Association**	Yes	Yes	No	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 organistation 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	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 organistation 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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP31	Commonwealth Fisheries	**Commonwealth Fishing Association**	No	Yes	No	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	No	Activities exist in or in close proximity to Crux. Bottom trawl.	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.
RP33	Commonwealth Fisheries	**Northern Prawn Fishery via the Association**	No	No	No	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	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	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	• 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	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
								affected by the activity.	
RP36	WA State Fisheries	**Northern Demersal Scalefish Fishery**	Yes	Yes	No	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	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	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.
RP39	Industry	**Finder No 13 Pty Ltd – check this apparently their permis has expired.**	Yes	No	No	No	Following consultation for this EP, Shell deems that Finder No 13 is no longer a Relevant Person as their permit has expired.	No longer 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	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP40	Industry	**INPEX**	Yes	No	No	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.
RP41	Marine Organisations	**Australian Marine Oil Spill Centre (AMOSC)**	No	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.
RP42	State and Commonwealth Government	**Dept of Home Affairs including Maritime Border Command and Australian Border Force (ABF)**	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 (ADF). Along with management of maritime security threats, MBC manages Petroleum Safety Zones.	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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP43	State and Commonwealth Government	**Australian Hydrographic Service including the Department of Defense – Operations Branch**	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 Defense 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.
RP44	State and Commonwealth Government	**Australian Marine Safety Authority (AMSA) including AMSA RCC.**	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.
RP45	State and Commonwealth Government	**Clean Energy Regulator (CER)**	Yes	Yes	No	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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP46	State and Commonwealth Government	***Former* Department of Agriculture, Water and the Environment (DAWE)**	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.
RP47	State and Commonwealth Government	**WA Department of Transport (DOT)**	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 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. • Consultation if there is a risk of a spill impacting State waters.
RP48	State and Commonwealth Government	**Department of Foreign Affairs and Trade (DFAT)**	Yes	No	No	No	International relations with governments and other organisations. Specifically, DFAT will have functions relating to oil spills in international waters or foreign countries jurisdictions. Following consultation for this EP, Shell deems that DFAT are an interested party for the purposes of consultation, rather than a Relevant Person as this does not fall within the remit of DFAT's policy responsibilities.	No longer 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. • Consultation if there is a significant risk of a spill.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP49	State and Commonwealth Government	**Department of Industry, Science, Energy and Resources**	No	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.
RP50	State and Commonwealth Government	**Department of Jobs, Tourism, Science and Innovation (JTSI)**	No	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 development of major resource, industrial and infrastructure projects and works to attract strategic investment.	(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.
RP51	State and Commonwealth Government	**Department of Water & Environmental Regulation (DWER)**	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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP52	State and Commonwealth Government	**Director of National Parks / Parks Australia**	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.
RP53	State and Commonwealth Government	**Federal Member for Kimberley - Melissa Price**	No	Yes	No	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.
RP54	State and Commonwealth Government	**WA Department of Primary Industries and Regional Development - Fisheries Division (DPIRD)**	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.

Relevant Persons ID	Relevant Person Category	Relevant Person	Relevant for Prelude EP	Consulted for Crux OPP	Consulted for NOPTA License	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
RP55	State and Commonwealth Government	**NT Department of Environment, Parks and Water Security**	Yes	No	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 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. • The Dept should be made aware of oil/gas pollution incidences likely to enter the waters of the NT as soon as possible and within 24 hours.
RP56	State and Commonwealth Government	**NT Department of Infrastructure, Planning and Logistics – Marine Safety Branch**	Yes	No	No	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.
RP57	State and Commonwealth Government	**NT Department of Primary Industry and Resources**	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.
RP58	State and Commonwealth Government	**WA Department of Mines, Industry Regulation & Safety (DMIRS)**	Yes	Yes	Yes	No	Required to be consulted under the Regulations.	(b) Department or agency of a State or the Northern Territory to which the activities to be	• 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	Previous claims or objections	Relevance *(Functions, Interests or Activities)*	Link to OPGGS(E)R 2009 Regulations Regulation 11A	Frequency of ongoing consultation
								carried out under the environment plan.	• Pre-start notification confirming start date and cessation notification. • Reporting of environmental incidents that could impact on land/water in the State jurisdiction.
RP59	State and Commonwealth Government	**State Member for Kimberley - Divina Grace D'Anna**	No	Yes	No	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.
RP60	State and Commonwealth Government	**WA Department of Biodiversity, Conservation & Attractions (DBCA)**	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 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. • In the event of a hydrocarbon release, notification will be provided to the DBCAs Kimberley Regional office as soon as practicable.
RP61	General Public	**Professor, UWA (personal name redacted)**	No	Yes	No	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 5-4: Stakeholder Consultation Activities During Development of EP

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
Community				
RP01	**Bardi and Jawi Niimidiman Aboriginal Corporation RNTBC**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP02	**Broome International Airport**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP03	**Broome Shire**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
		07 July 2022	Phone call	Advised contact not available.
RP04	**Broome Visitors Centre**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP05	**Dambimangari Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP06	**Darwin city council**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP07	**Djarindjin Aboriginal Corporation (DAC)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
		29 March 2022	Email	Automatic reply received.
RP08	**Department of Fire and Emergency Services (FESA)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP09	**Goolarabooloo Aboriginal Corporation**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP10	**Kimberley Ports Authority**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP11	**Kimberly Land Council**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Email received requesting all PBC's be individually addressed.
		29 March 2022	Email	Follow-up on original email.
		08 June 2022	Phone call	Advised contact was not available.
		22 June 2022	In person	Advised contact was not available – left a message.
		07 July 2022	Phone call	Advised contact was not available.
RP12	**Mayala Inninalang Aboriginal Corporation**	15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		30 March 2022	Email	Follow-up on original email.
RP13	**Nimanburr Aboriginal Corporation**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		30 March 2022	Email	Follow-up on original email.
RP14	**Northern Land Council**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
		29 March 2022	Email	Follow-up on original email.
RP15	Nyamba Buru Yawuru and Yawuru Native Title Holders Aboriginal Corporation RNTBC	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
		21 June 2022	Face to face	Crux project noted by PBC, no feedback apart from that the project was not on their country.
RP16	**Port of Darwin**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP17	**Wanjina-Wunggurr (Native Title) Aboriginal Corporation RNTBC**	15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		30 March 2022	Email	Follow-up on original email.
RP18	**Gogolanyngor Aboriginal Corporation**	15 Feburary 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		30 March 2022	Email	Follow-up on original email.
Environmental NGOs				
RP19	**Australian Conservation Foundation**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP20	**Australian Marine Conservation Society**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP21	**Conservation Council of WA**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP22	**Environmental Defenders Office WA**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		14 February 2022	Email	Automatic response confirming receipt of email.
		29 March 2022	Email	Follow up on original email.
RP23	**Environs Kimberley**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP24	**Greenpeace**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
		29 March 2022	Email	Automatic response that email was received.
RP25	**Save the Kimberley**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP26	**WA Marine Science Institute**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP27	**Wilderness Society**	15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Automated response confirming receipt of email.
		29 March 2022	Email	Follow up on original email.
		29 March 2022	Email	Automated response confirming receipt of email.
RP28	**World Wildlife Fund (WWF)**	15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Automated response confirming receipt of email.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
		29 March 2022	Email	Follow up on original email.
Commonwealth Fisheries				
RP29	**Australian Bluefin Tuna Industry Association**	28 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP30	**Australian Fishery Management Authority (AFMA)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Confirming receipt of information. Recommended how to contact licensed fishers.
RP31	**Commonwealth Fishing Association**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP32	**North West Slope Trawl Fishery**	28 March 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		12 April 2022	Email	Follow up on original email.
RP33	**Northern Prawn Fishery Association (transit route)**	28 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP34	**Western Tuna and Billfish Fishery**	28 March 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		28 March 2022	Post	Info provided on proposed activity with a letter and a tailored fisheries information sheet.to one permit holder without email.
		04 April 2022	Email	Email received from stakeholder seeking to understand if fishing permits will be purchased.
		04 April 2022	Email	Email response sent confirming fishing permits will not be purchased at this time.
		12 April 2022	Email	Follow up on original email.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
		13 April 2022	Email	Supplied new email addresses.
		21 April 2022	Post	Follow up sent on original letter to one permit holder without email.
WA State Fisheries				
RP35	**Mackerel Managed Fishery License Holders**	3 March 2022	Post	Info provided on proposed activity with a letter and a tailored fisheries information sheet.
		26 March 2022	Post	Info provided on proposed activity with a letter and a tailored fisheries information sheet to updated addresses where required.
		21 April 2022	Post	Follow up letter sent.
RP36	**Northern Demersal Scalefish Fishery**	01 March 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite for first lot of licence holders.
		29 March 2022	Email	Follow up email for first lot of licence holders.
		03 March 2022	Post	Info provided on proposed activity with a letter and a tailored fisheries information sheet for second lot of licence holders without email.
		26 March 2022	Post	Info provided on proposed activity with a letter and a tailored fisheries information sheet to third lot of licence holders.
		21 April 2022	Post	Follow up letter sent to second and third lot of licence holders.
RP37	**Pearl Producers Association**	01 March 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up email sent to original email.
RP38	**Western Australian Fishing Industry Council (WAFIC)**	30 November 2021	Virtual Meeting	Meeting to discuss consultation approach for the drilling EP and best way to engage Commercial Fishers.
		15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
		03 March 2022	Email	Email received from WAFIC requesting further information specifically around an unplanned discharge incident.
		08 March 2022	Email	Response sent to WAFIC to confirm receipt of email.
		16 March 2022	Email	Response sent to WAFIC with information requested.
		23 March 2022	Email	Response closing out request.
Industry				
RP39	**Finder No 13 Pty Ltd**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
RP40	**INPEX**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
Marine Organisations				
RP41	**Australian Marine Oil Spill Centre (AMOSC)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
State and Commonwealth Government				
RP42	**Dept of Home Affairs including Maritime Border Command and Australian Border Force (ABF)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow up on original email.
		28 April 2022	Phone call	Follow up to ensure email had been received.
RP43		14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
	Australian Hydrographic Service including the Department of Defense – Operations Branch	14 February 2022	Email	Email received acknowledging receipt of email and that the data would now be registered, assessed, prioritised and validated.
		29 March 2022	Email	Follow up on original email
		29 March 2022	Email	Email received acknowledging receipt of email and that the data would now be registered, assessed, prioritised and validated.
		29 March 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.
		08 April 2022	Email	Email sent confirming request and updated contact details.
RP44	**Australian Marine Safety Authority (AMSA) including AMSA RCC.**	19 April 2021	Email	Email exchange related to the Production Licence & Pipeline Licences Stakeholder Consultation (referred to by AMSA)
		28 May 2021	Email	Email exchange related to the Production Licence & Pipeline Licences Stakeholder Consultation (referred to by AMSA)
		14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Email received noting that initial advice related to this project continues to apply.
		07 March 2022	Email	Email received requesting AMSA involved in any developments of the plan in navigation safety and to be informed of any pollution response.
		30 March 2022	Email	Email response with confirmation AMSA will be informed of any pollution response.
		08 June 2022	Email	Email received with an update on contact details.
RP45	**Clean Energy Regulator (CER)**	15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Email received from CER that Shell's email has been referred to the appropriate contact for response.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
RP46	**Department of Agriculture, Water and the Environment (DAWE)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		03 March 2022	Email	Request received from DAWE for operating in line with low risk status, and interactions with international persons, conveyances or goods will be advised the department.
		03 March 2022	Email	Confirmation Shell will be operating in line with low risk status, and interactions with international persons, conveyances or goods will be advised the department.
RP47	**WA Department of Transport (DOT)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		25 February 2022	Email	Email received referencing the guidance note and notification requirements in case of a risk of a spill impacting state waters.
		30 March 2022	Email	Email response confirming that DOT would be consulted in the event of any spill. And noting Shell's oil pollution emergency plan with agreed linkages to DOT.
RP48	**Department of Foreign Affairs and Trade (DFAT)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
		29 March 2022	Email	Email received noting inbox monitored intermittently.
RP49	**Department of Industry, Science, Energy and Resources**	17 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
		28 April 2022	Phone call	Advised DISER doesn't normally comment on EPs and leaves the process to NOPSEMA.
RP50	**Department of Jobs, Tourism, Science and Innovation (JTSI)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
RP51	**Department of Water & Environmental Regulation (DWER)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		14 February 2022	Email	Email received noting that addressee had left department and email had been forwarded to the Director General.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
		17 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite
		29 March 2022	Email	Follow-up on original email.
		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.
RP52	**Director of National Parks (DAWE) / Parks Australia (PA)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		18 March 2022	Email	Email received confirming receipt of consultation material for the Crux Drilling Environment Plan and confirmation that Shell does not overlap any Australian Marine Parks.
		30 March 2022	Email	Email response to confirm receipt and noting the Oil Pollution Emergency Plan.
RP53	**Federal Member for Kimberley - Melissa Price**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		14 February 2022	Email	Email auto-response noting email received.
		29 March 2022	Email	Follow-up on original email.
		29 March 2022	Email	Email auto-response noting email received.
RRP54	**WA Department of Primary Industries and Regional Development - Fisheries Division (DPIRD)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		14 February 2022	Email	Notification that contacts had left DPIRD and with alternative contact details.
		16 June 2022	Email	Info provided to new contacts at DPIRD.
		04 July 2022	Phone call	Follow up call. Left a voicemail.
		04 July 2022	Email	Follow up on original email.
		04 July 2022	Email	Email from DPIRD to close out consultation.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
		05 July 2022	Email	Email from DPIRD thanking Shell for the update.
RP55	**NT Department of Environment, Parks and Water Security**	15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		01 March 2022	Email and letter	Email received noting that In the event of contaminants entering the NT, points of contact have been provided along with notification requirements.
		04 July 2022	Email	Response sent to close out consultation.
RP56	**NT Department of Infrastructure, Planning and Logistics – Marine Safety Branch**	15 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		29 March 2022	Email	Follow-up on original email.
		29 March 2022	Email	Automated response with changes to services.
		28 April 2022	Phone call	No comments at this stage - asked to be kept informed as project moves into construction
RP57	**NT Department of Primary Industry and Resources**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		15 February 2022	Email	Email received noting addressee has retired and they will advise of replacement in due course.
		27 June 2022	Email	Email resent to general mailbox as follow up.
RP58	**WA Department of Mines, Industry Regulation & Safety (DMIRS)**	14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		09 March 2022	Email	Acknowledging receipt of factsheet and requesting further information.
		29 March 2022	Email	Email received with new contact details.
		30 March 2022	Email	Email confirmation that Shell will provide pre-start notification to DMIRS before the start date of the proposed activity and a cessation notification on completion, using the email address provided. Shell will also ensure that notifications are in place should an environmental incident occur.
RP59		14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.

Stakeholder ID	Stakeholder	Date	Method	Consultation Activities
	State Member for Kimberley - Divina Grace D'Anna	14 February 2022	Email	Automated email response confirming receipt.
		29 March 2022	Email	Follow-up on original email.
RP60	**WA Department of Biodiversity, Conservation & Attractions (DBCA)**	03 May 2021	Email	Email received relating to the Production Licence & Pipeline Licences Stakeholder Consultation.
		28 May 2021	Email	Email sent relating to the Production Licence & Pipeline Licences Stakeholder Consultation.
		14 February 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.
		14 February 2022	Email	Email received noting inbox is monitored intermittently.
		15 February 2022	Email	Email received noting no further comments to DBCA's original response regarding the Crux project.
		30 March 2022	Email	Email sent to acknowledge DBCA's email response and no further comment.
RP61	**Prof, UWA (personal name redacted)**	27 June 2022	Email	Info provided on proposed activity with an information sheet and a link to Crux microsite.

Table 5-5: 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
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

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
RP11	**Kimberly Land Council**	15 February 2022	On behalf of all PBC's Shell was asked to individually address each one.	This matter was actioned accordingly but is not considered to be an objection or claim.	Resent consultation individually addressed to each PBC.
		21 June 2022	Crux project noted, not considered to be on their land.	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 Aboriginal Corporation RNTBC**	-	No response received	No claim or objection received	No response required
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

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
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
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)**	15 February 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.	Information was used to obtain relevant licensed fishers contact details.
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

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
RP33	**Northern Prawn Fishery (transit route)**	-	No response received	No claim or objection received	No response required
RP34	**Western Tuna and Billfish Fishery**	04 April 2022	Confirming receipt of information. Offer for Shell to purchase fishing permits.	This is not considered to be a relevant matter to the Crux EP.	Shell is not considering the purchase of fishing permits at this time.
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	Not applicable.
RP38	**Western Australian Fishing Industry Council (WAFIC)**	08 March 2022	In the event of an unplanned discharge incident, does Shell have established baseline scientific data on aquatic organisms and the aquatic environment.	This matter is considered to have been adequately addressed in the Crux OPP.	Directed to section 6 of the Crux OPP and section 6.2 (page 134) for a comprehensive list of relevant external scientific papers, industry specific studies and Crux specific scientific studies, considered to be a robust baseline of scientific data on the local and regional environment.
			Does Shell have a Communication strategy and scenario/exercise training that considers the commercial fishing industry in the event of an incident.	This matter is considered to have been adequately addressed with Shell's procedures and the Crux OPEP.	Outlined Shell Australia's established emergency response plans which are tested at least annually or more frequently based on the level of risk. Also outlined the Crux Oil Pollution Emergency Plan (OPEP) which will detail how Shell will respond in the event of a spill and including with interfaces across national, state and local Government entities.

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
			In the event of an unplanned discharge incident, will Shell offer support to the commercial fishing industry with regards to traceability of fish products to manage tainting risks a detailed process for post spill scientific monitoring of aquatic organism and aquatic environment.	This matter is considered to have been adequately addressed with Shell's Operational and Scientific Monitoring Plan and the Joint Industry OSMP.	The Crux Drilling EP is required to have an Operational and Scientific Monitoring Plan in place which is activated should there be an unplanned hydrocarbon spill to the environment. This plan will bridge to the Joint Industry Operational and Scientific Monitoring Plan Framework which is publicly available on the APPEA website: Joint Industry OSMP.
			In the event of an unplanned discharge incident, does Shell have Commitment for financial adjustment to the commercial fishing industry	This is considered to be a relevant matter and is currently being developed prior to the commencement of the drilling campaign.	Shell intends to develop a framework for impacted commercial fishing parties to apply for financial adjustment as a result of project impacts. Shell expects this to be developed by early 2023 prior to the commencement of the drilling campaign.
Industry					
RP39	**Finder No 13 Pty Ltd**	-	No response received	No claim or objection received	No response required
RP40	**INPEX**	-	No response received	No claim or objection received	No response required
Marine Organisations					
RP41	**Australian Marine Oil Spill Centre (AMOSC)**	-	No response received	No claim or objection received	No response required
State and Commonwealth Government					
RP42	**Dept of Home Affairs including Maritime Border Command and Australian Border Force (ABF)**	28 April 2022	No comments at this stage – asked to be informed as project moves into construction.	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
RP43	**Australian Hydrographic Service including the Department of Defense – Operations Branch**	29 March 2022	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	This matter is considered to have been adequately addressed within the Crux Development Drilling EP.	Shell has noted the contact details and will ensure notification three weeks prior to commencement of activities is completed.
RP44	**Australian Marine Safety Authority (AMSA) including AMSA RCC.**	15 February 2022	AMSA noted initial advice provided on the Crux project continues to apply *(received during the FDP and Crux Pipeline and Production license consultation in 2021)* Request to contact the Australian Hydrographic Office no less than 4 weeks prior to operations, with details relevant to the operations. Notify AMSA's Joint rescue Coordination Centre by email for promulgation of radio navigation warnings at least 24-48 hours before operations commence. Commented on vessel compliance requirements - appropriate lights and shapes to reflect the nature of operations.	This matter is considered to have been adequately addressed within the Crux Development Drilling EP and the Browse Regional Oil Pollution Emergency Plan.	Previous correspondence *(during the FDP and Crux Pipeline and Production license consultation in 2021)*: Noted feedback, all appropriate and will be monitored and acted upon prior to commencement of operations. Note that the Australian Hydrographic Office was contacted as a relevant stakeholder as part of this consultation process.
		07 March 2022	Request that AMSA be involved in developments of plans regarding navigation safety and be included in any pollution response.	This matter is considered to have been adequately addressed within the Crux Development Drilling Environment Plan and the Browse Regional Oil Pollution Emergency Plan.	Shell has an approved Oil Pollution Emergency Plan for the Prelude FLNG facility which also documents the agreed linkages with AMSA and this will be built on for future oil spill planning and preparedness for Crux activities.
RP45	**Clean Energy Regulator (CER)**	-	No response received	No claim or objection received	No response required
RP46	**Department of Agriculture, Water and the Environment (DAWE)**	03 March 2022	Confirming we will be operating in line with low risk status, and interactions with international persons,	This matter is considered to have been adequately addressed within the Crux Development Drilling Environment Plan.	Shell Australia will ensure that should we have any interactions with international

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
			conveyances or goods will be advised the department.		persons, conveyances or goods we will advise the department immediately.
RP47	**WA Department of Transport (DOT)**	25 February 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 activities.
RP48	**Department of Foreign Affairs and Trade (DFAT)**	-	No response received	No claim or objection received	No response required
RP49	**Department of Industry, Science, Energy and Resources**	28 April 2022	Advised DISER does not normally comment on EPs and leave the process to NOPSEMA. They do take an interest in them to assist with overall understanding of the project and progress being made so expressed appreciation to Shell for sending the fact sheet and keeping them updated.	No claim or objection received	No response required
RP50	**Department of Jobs, Tourism, Science and Innovation (JTSI)**	-	No response received	No claim or objection received	No response required
RP51	**Department of Water & Environmental Regulation (DWER)**	-	No response received	No claim or objection received	No response required
RP52	**Director of National Parks (DAWE) / Parks Australia (PA)**	18 March 2022	Confirmed receipt of consultation material for the Crux Drilling Environment Plan and confirmation that Shell does not overlap any Australian Marine Parks.	No claim or objection received	No response required
RP53	**Federal Member for Kimberley - Melissa Price**	-	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
RP54	**WA Department of Primary Industries and Regional Development - Fisheries Division (DPIRD)**	04 July 2022	Email received to confirm DPIRD have no comments.	No claim or objection received	No response required
RP55	**NT Department of Environment, Parks and Water Security**	01 March 2022	The NT must be notified about the potential for an incident in NT coastal waters as soon as possible, and in any case, within 24 hours of the operator/title holder becoming aware of an incident that could occur in NT coastal waters. This includes incidents that require a Level 1 response.	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 to State Authorities and will build upon this for future oil spill planning and preparedness for the Crux activities as part of future environment plans.
RP56	**NT Department of Infrastructure, Planning and Logistics – Marine Safety Branch**	28 April 2022	No comments at this stage - asked to be kept informed as project moves into construction.	No claim or objection received	No response required
RP57	**NT Department of Primary Industry and Resources**	-	No response received	No claim or objection received	No response required
RP58	**WA Department of Mines, Industry Regulation & Safety (DMIRS)**	09 March 2022	Acknowledging receipt of factsheet. Requested to provide: 1. Start date of proposed activity and cessation notification 2. Ensure the EP includes information about the reporting of environmental incident that could impact land or water in state jurisdiction.	This matter is considered to have been adequately addressed within the Crux Development Drilling Environment Plan and the Browse Regional Oil Pollution Emergency Plan. Requested activity notifications will be managed internally.	Shell confirmed that pre-start notification to DMIRS will be provided before the start date of the proposed activity and a cessation notification on completion, using the email address provided. Shell will also ensure that notifications are in place should an environmental incident occur.
RP59	**State Member for Kimberley - Divina Grace D'Anna**	-	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
RP60	**WA Department of Biodiversity, Conservation & Attractions (DBCA)**	15 February 2022	No further comments above what they provided on 3 May 2021 regarding DCBA's responsibilities related to its *Conservation and Land Management Act 1984* and *Biodiversity Conservation Act 2016*. Previous correspondence *(during the FDP and Crux Pipeline and Production license consultation in 2021)*: • Ecologically important areas in the vicinity of the proposed operations and importance of baseline studies. • Referred Shell to published monitoring reports. • Recommendation that Shell refer to the Commonwealth Department of Agriculture, Water and the Environment's National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds. • In the event of a hydrocarbon release, requested that Shell notify DBCA's Kimberley regional office as soon as practicable. • Referred Shell to the Department of Transport's web content regarding marine pollution and the Offshore Petroleum Industry Guidance Note of September 2018 titled Marine Oil Pollution: Response and Consultation Arrangements.	This matter is considered to have been adequately addressed within the Crux OPP, Crux Development Drilling Environment Plan and the Browse Regional Oil Pollution Emergency Plan.	Previous correspondence *(during the FDP and Crux Pipeline and Production license consultation in 2021)*: • Referred to Crux OPP as well as partnership with Inpex and the Australian Institute of Marine Science (AIMS) for baseline studies. • Referred to the approved Oil Pollution Emergency Plan for Prelude with agreed linkages to State Authorities and will build upon this for future oil spill planning and preparedness for the Crux activities. • Referred to the APPEA industry operational and scientific monitoring framework. • Shell will continue to consider and apply, as appropriate, all relevant national species and managements plans relevant to our activities for the Crux project, including the current versions of the National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds and Offshore Petroleum Industry Guidance Note. • Shell will continue to consult with relevant persons including DOT and DBCA on matters relating to marine pollution, protected areas and wildlife within WA jurisdiction.
RP61	**Prof, UWA (personal name redacted)**	-	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 5-6: 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 5.2.1 to 5.2.6. 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; and
- 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 EP covers the following activities within the Operational Area (Figure 6-1) located within the petroleum title AC/L10:

- Drilling Template and Docking Pile Installation
- Drilling using a semi-submersible MODU
- The operation of in-field support vessels and helicopters required to support drilling activities
- The operation of Remote Operated Vehicles (ROVs)
- Well suspension and contingent sidetrack and/or plugging and abandonment activities.

Non-petroleum activities such as environmental field monitoring or metocean studies are outside of the scope of this EP.

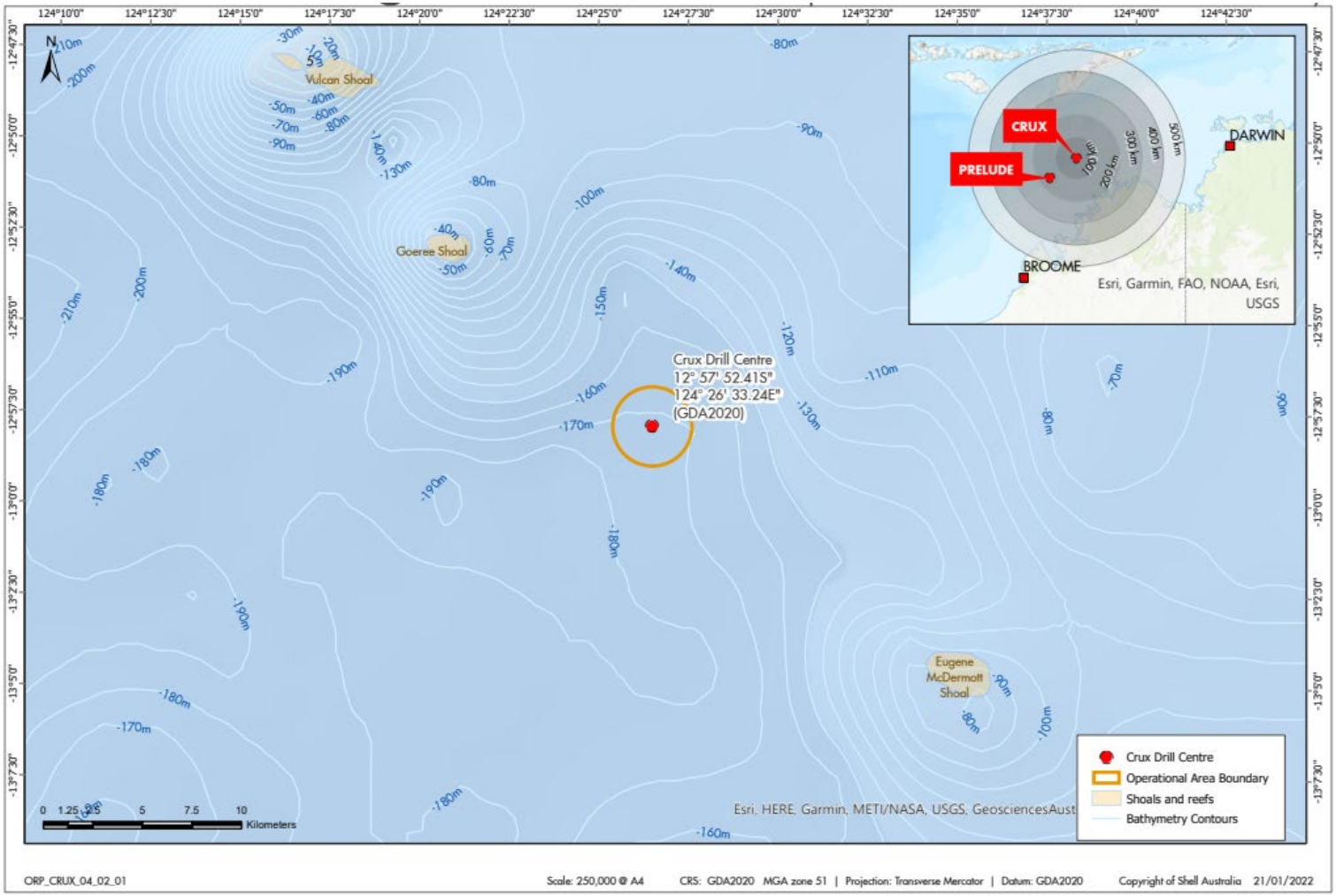


Figure 6-1: Crux Development Drilling Environment Plan Operational Area

Well completion activities are scheduled to occur at a later date from the Crux platform using either a Modular Platform Rig (MPR) or Hydraulic Workover Unit (HWU). The well completion activities are not within the scope of this EP and will be described within the Crux Commissioning, Start-up and Operations Environment Plan (to be developed prior to these activities occurring).

This EP does not cover 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. In addition, helicopter activities outside of a Petroleum Safety Zone (PSZ) are not defined as petroleum activities. Any impacts and risks associated with vessel and helicopter transits are managed in-line with Shells HSSE and SP Control Framework.

6.2 Location

The Crux development drilling activity will be undertaken within petroleum title area AC/L10, located in Commonwealth marine waters, 160 km offshore northwest Australia and 620 km north-north east of Broome (Figure 6-1), in approximately 170 m water depth from Mean Sea Level (MSL). This activity is located within the Crux in-field development area, as defined in the Crux Offshore Project Proposal.

The Operational Area of Crux development drilling activity is defined as a 2 km radius from the seabed centre point of the Crux drill centre, Latitude 12° 57’ 52.414” S, Longitude 124° 26’ 33.238” E (GDA2020). The 2 km radius has been used to set boundaries for the impact assessment as shown in Figure 6-1 . A 500 m petroleum safety zone will also be established around the drilling location.

The Crux Operational Area does not contain any emergent reefs/islands. The nearest island to the Crux drilling location is Cartier Island, which is approximately 105 km to the north-west. The nearest shoal/bank is Goeree Shoal, which is approximately 13 km to the north-west of the Crux drilling location (Figure 6-1). The Crux drilling location will be located within an approximate 1 km radius of the preferred drilling location shown in Figure 6-1.

6.3 Timing

The drilling template installation is the first activity that will be undertaken in relation to this EP. This activity is currently proposed to occur in the second quarter of 2023, approximately three months ahead of the MODU arrival. The drilling template installation campaign is nominally schedule to occur over a one month period. Following the MODU arrival, drilling activities will commence for a planned duration of approximately 10 months, with an additional 10-month contingency drilling period. To allow for MODU availability options, this campaign may use two separate MODU’s to drill different sections of the wells. At the completion of the drilling campaign the wells will be temporarily suspended, and subsequent well completion activities will be undertaken following the topside installation as noted in Section 6.1 (well completion activities will be covered by a separate EP).

The docking pile guides and docking piles will be installed following the suspension of the wells and sail away of the MODU. This installation is planned to be completed during a one week campaign however, weather constraints and subsurface conditions may see this extending over a one month period.

This EP will remain active following the drilling campaign for the duration that the wells are temporarily suspended, which is planned to be approximately 21 months. There are no planned infield well activities during the well suspension period.

To account for potential shifts in schedule, the environmental assessment is not seasonally specific and assumes the activities described in this EP may occur at any time during the life of the EP. To account for extensions of the suspension period and contingency in the timing and duration of the template installation and drilling campaigns, this EP will remain active from the date of acceptance for up to 5 years, or to the point in time where the well completion activities are finalised (whichever comes first). In the latter case, the EP will cease following NOPSEMA acceptance of an end-of- activity notification applied for under Regulation 25A.

6.4 Title Holder 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 in Table 6-1.

Table 6-1: Details of Titleholder and Liaison Person

Titleholder Details:	Liaison Person Details:
Company Name: Shell Australia Pty Ltd	Name: Gawain Langford
562 Wellington St, Perth WA 6000	Position: Crux Project Manager
Phone: (08) 9338 6600	Phone: (08) 9338 6600
ACN: 14 009 663 576	Email: SDA-crux-project@shell.com

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.

6.5 Infrastructure Description

6.5.1 Mobile Offshore Drilling Unit

The five development wells will be drilled with a moored semi-submersible MODU. The generic details of a MODU that are relevant to the nature, scale, impacts and risks associated with the activity are described in Table 6-2 and a representative image of a semi-submersible MODU is provided Figure 6-2.

Table 6-2: Representative MODU Facility Description

MODU Component	Description
Approximate size of MODU	115 m long by 90 m wide by 20 m deep
Mooring system	12-point anchor system. Anchor spread up to 1,500 m from MODU
Accommodation	Maximum capacity 200 persons
Power generation	Diesel Generators
Bulk barite, bentonite and cement capacity	793 m^3 (28,000 ft^3)
Liquid mud capacity	2539 m^3 (16,000 bbl)

MODU Component	Description
Base Oil	836 m^3 (5,260 bbl)
Brine Storage	493 m^3 (3,100 bbl)
Fuel capacity	1,413 m^3 (8,890 bbl)
Drill water capacity	3,439 m^3 (21,630 bbl)
Potable water capacity	1,733 m^3 (10,900 bbl)

Figure 6-2: Representative Image of a Mobile Offshore Drilling Unit (the Valaris MS1)

6.5.2 Drilling template and docking piles

The steel prefabricated drilling template and docking piles will be installed on the seabed to enable correct positioning of the wells and alignment for tie-back to (future) platform infrastructure for well completion. The drilling template includes eight drill slots to support the initial five well development drilling campaign proposed within this EP. The spare slots may be used for well respudding (contingency covered in this EP) or for future development wells subject to acceptance of additional EP/s. The two docking piles will ensure that the Crux substructure and topsides are accurately positioned over the drilling template when installed during the subsequent installation campaigns. The approximate dimensions of the drilling template and docking piles are provided in Table 6-3.

Table 6-3: Environmentally relevant specifications of the drilling template and docking piles

Infrastructure	Specification	Approximate Dimensions
Docking Piles	Height	11 m (above seabed)
	Length	39 m (28 m below seabed)
	Width	5.5 m
Drilling Template	Length	23 m
	Width	14 m
	Height	11 m (with docking pile guides attached)
	Seabed Footprint	322 m^2

6.5.3 Vessels

The drilling template and docking piles will be installed by a Light Construction Vessel (LCV) of suitable class to undertake the activity. The LCV will include suitably sized lifting and piling equipment to enable installation of the drilling template and docking piles. The general specifications of an LCV are included within Table 6-4.

Drilling support vessels, including Anchor Handling Tug Supply (AHTS) and support vessels will be used during the activity. These vessels will be select based on class and operational requirements.

Table 6-4 provides indicative specifications of the class of vessels which may be used to support the activities described in Section 6.6.

Table 6-4: Typical Support Vessel Details

Vessel Type	Detail	Example General Specifications
AHTS	Main Engine Capacity	2 x 8,000 kW
	Engine Configuration	Diesel Electric
	POB	60
	Weight	4,100 ton
	Draft	8 m
	Dynamic Positioning	DP2
	Tank Capacities	
	Base Oil	200 m^3 (1,260 bbl)
	Brine	900 m^3 (5,670 bbl)
	Ballast	2,900 m^3 (18,270 bbl)
	Mud	650 m^3 (4,095 bbl)
	Total Fuel Oil	1,300 m^3 (8,190 bbl)
	Fresh Water	1,100 m^3 (6,930 bbl)

Vessel Type	Detail	Example General Specifications
General Offshore Support Vessel	Main Engine Capacity	2 x 5,500 kW
	Engine Configuration	Diesel Electric
	POB	30
	Weight	4,000 ton
	Draft	7m
	Dynamic Positioning	DP2
	Tank Capacities	
	Base Oil	300 m^3 (1,890 bbl)
	Brine	1,300 m^3 (8,190 bbl)
	Ballast	1,900 m^3 (11,970 bbl)
	Mud	1,300 m^3 (8,190 bbl)
	Total Fuel Oil	900 m^3 (5,670 bbl)
	Fresh Water	700 m^3 (4,410 bbl)
LCV	Main Engine Capacity	2 x 8,000 kW
	Engine Configuration	Diesel Electric
	POB	60
	Weight	4,100 ton
	Draft	8 m
	Dynamic Positioning	DP2
	Tank Capacities	
	Base Oil	200 m^3 (1,260 bbl)
	Brine	900 m^3 (5,670 bbl)
	Ballast	2,900 m^3 (18,270 bbl)
	Total Fuel Oil	1,300 m^3 (8,190 bbl)
	Fresh Water	1,100 m^3 (6,930 bbl)

6.6 Project Operations

6.6.1 Drilling template and docking pile installation

Prior to MODU arrival the drilling template will be installed on the seabed. The template installation includes lifting and lowering of the drilling template onto the seabed by the LCV. The primary purpose of the drilling template is to act as a guide to the drill bit during drilling operations described below. Once installed the drilling template will remain in place for the life of the Crux activity.

The docking pile guides and associated docking piles may be installed through a dedicated vessel based campaign following the completion of the drilling campaign. This scope involves two detachable guides being mounted to the drilling template, the docking

piles lowered into position and driven into the seabed using a hammer pile to a target depth of approximately 28 m. A study to determine the optimal size of the piling hammer is ongoing, however, it is not expected to exceed an MHU-750. Continuous and easy pile driving is predicted with approximate blow-counts of <200 blows/m through upper soil units and <500 blows/m through deeper soil units. Following piling, the detachable mounts will be removed from the drilling template and recovered to the LCV, leaving the docking piles independent from the drilling template to support positioning of the Crux platform substructure during a subsequent installation campaign (covered by a separate EP).

The LCV/s used to support the installation of the template and docking piles will be of suitable size and class to enable safe lifting and piling operations.

A seabed Global Positioning System (GPS) positioning array may be deployed to support the accurate positioning of the drilling template and docking piles. This will be installed on a temporary basis only and will indicatively consist of approximately 5 - 10 subsea beacons attached to clump weights, nominally 100 kg each, positioned over a 50 - 100 m^2 area. The subsea beacons and clump weights will be recovered to surface at the completion of installation campaign.

6.6.2 MODU Mooring

The MODU will be towed to the drilling location and moored up by up to three anchor handling tugs (AHTS). After arriving on location, the MODU will be secured in place with 12 mooring lines and anchors. The MODU will initially be held in place by one AHTS while the remaining AHTS run the “primary” anchors. Once the “primary” anchors have been run, both AHTS may be used to run the remaining anchors.

If the MODU anchors are found to be slipping and the required cross tension cannot be achieved, “piggy back” anchors may be run as a contingency.

To allow for MODU availability options, this campaign may use two separate MODU’s to drill different sections of the wells. For example, an initial MODU may be mobilised to drill the top-hole sections, followed by a second MODU to drill the intermediate and production hole sections.

6.6.3 Drilling Methodology

Once the MODU is on location and moored, drill operations will commence. The Crux development drilling activity comprises of five subsea development wells drilled from the previously installed subsea template. The MODU will drill (but not complete) the wells prior to the installation of the Crux platform. The subsea wells will be cleaned up to completion fluid and suspended until the Crux platform is installed. The suspension of the well will include the installation of a “middle completion”, which consists of the following key elements, i.e. a Polished Bore Receptacle (PBR), packer, tailpipe with suspension plug, and locator seal assembly. The suspension plug will be located within the tailpipe of the middle completion. Other activities associated with well completions, (such as but not limited to tieback operations, tubing installation, perforation and well unloading), will be covered in the Crux Commissioning, Start-up and Operations Environment Plan (to be developed prior to these activities occurring) and are therefore not described here.

The top holes, defined as the hole sections drilled prior to the installation of the high pressure wellhead housing are planned to be batch drilled. Batch drilling reduces the need to change out drilling mud systems for each well section, similar sections are drilled in batches before proceeding to the following section.

The well section diameters are planned to be drilled in the following sequence:

- Top-hole sections, drilled with water-based mud (42", 30"x32", 24" and 17 ½")
- Intermediate and Production hole sections, drilled sequentially with synthetic based mud (12 ¼" and 8 ½").

The top-hole sections will be drilled riserless using water-based mud. When using water-based muds, drilling fluids and cuttings will either be discharged at seabed or returned to the MODU using a Riserless Mud Recovery (RMR) system prior to discharge overboard.

A 42" hole section will be drilled riserless from the template down to a maximum of 70m below seabed with water-based mud. The base plan is to drill to an equivalent depth of 5 conductor joints or circa 62m below mudline. A low pressure wellhead housing and 36" outer conductor are then planned to be run and cemented to seabed. Excess cement will be discharged at seabed.

After drilling out the 36" conductor, a 30"x32" section will be drilled riserless up to a maximum of approximately 350m below seabed with water-based mud. Subsequently a 26" inner conductor will be run and cemented. The intent is to cement both outer and inner conductors to seabed. Excess cement will be discharged at seabed. The 36" and 26" conductors combined form the structural foundation to support the loads from subsequent well operations.

Based on experience from drilling within the Browse Basin, any of the top-hole formations below the 36" shoe will be drilled using a water-based mud system. Drilled cuttings form these sections will be returned to the MODU via the RMR system before being discharged overboard. If the formations cannot sustain a full circulating mud system and significant downhole losses are observed or in the event of RMR failure, then the contingent option exists to drill ahead with seawater and high viscosity gel and/or polymer water-based mud sweeps.

After drilling out the 26" conductor, a 24" hole will be drilled down to below the Grebe formation. An 18-5/8" drilling liner will be run and cemented to isolate off the Grebe formation before continuing to drill down to the 13-3/8" casing point in 17 ½" hole. The setting depth of the 13 ⅜" casing is aimed within the top Fenelon formation at approximately 2,100m Along Hole Depth (AHD). A 13 ⅜" intermediate casing (crossed over to a 22" extension joint) and high pressure wellhead housing will be run to enable drilling the 12 ¼" section with subsea blowout preventer (BOP) and marine riser installed.

The 18-5/8" and 13-3/8" cement jobs are planned to be approximately 150m and 300m along hole length respectively, so cement returns are not expected from either of these cement jobs.

After running the BOP and marine riser, the intermediate and production hole sections are planned to be drilled with a closed mud system, using synthetic-based mud.

The 12 ¼" hole section is planned to be directionally drilled. A 10 ¾" x 9 ⅝" casing string will be run back to the subsea wellhead and cemented in place. Cuttings from the 12-1/4" hole sections shall be processed through the MODU's solids control system before being discharged overboard. The 9-5/8" cement job is planned to be less than 500m along hole length. The 12-1/4" hole section Total Depth (TD) will vary from well to well, but is expected to be in the range of 3400mAHD to 4800mAHD.

The 8 ½" section is planned to be directionally drilled through the reservoir until well total depth is reached. A 7" production liner will be run and cemented to the liner hanger. Well total depths will vary by well, and are expected to be in the range of 3700mAHD and

5200mAHD. Upon completion of the 7” liner cement job the liner will be inflow tested to confirm barrier integrity.

A combination of wireline open and cased hole logs may be run on each well. Wireline logging is the measurement of downhole properties by running instruments down the wellbore. Different tools may be used to record or log information about the formation and well including hydrocarbon and pressure sampling, collection of formation samples (side wall cores) to allow surface measure of the physical formation properties and cased hole measurement for cement quality and casing wear. The wireline logging programme will vary by well.

Prior to MODU departure, the wells will be cleaned up and suspended for future completion and perforation after the Crux platform is installed. The base plan is for wells to be cleaned up by displacing out the drilling mud and leaving clean base oil in the well as the completion fluid. However, a contingent scenario with the well suspended in brine is still considered a possibility. A “middle completion” will be installed as part of the well suspension. This comprises the following key elements, i.e. a PBR, packer, 7” tailpipe, suspension plug, and locator seal assembly. The suspension plug will be located within the tailpipe of the middle completion. The middle completion system shall be pressure tested to verify barrier integrity.

A shallow set “environmental barrier” will be installed just below the 10-3/4” x 9-5/8” crossover allowing the completion fluid to be contained inside the well during suspension. Prior to pulling the blowout preventer and riser, the completion fluid above the tested “environmental barrier” will be displaced to an inhibited aqueous fluid. Following removal of the blowout preventer and riser, a suspension cap will be installed onto the wellhead.

6.6.4 Drilling Fluids, Cuttings and Chemicals

When the riser is connected, the primary function of the drilling fluid is to provide well control. In the process of drilling (riser or no riser), other key functions of the drilling fluid are lubrication and cooling of the drill bit, maintaining well bore stability, and removing drill cuttings (i.e. rock fragments) from the well sections as they are drilled. The two types of drilling fluids which will be used to drill and complete the wells are water-based and synthetic based. The largest well diameters are provided in the table below with information about the types of fluids (and their typical components). In the event of severe losses and potential rapid depletion of whole fluid inventory when drilling with Synthetic Based Mud (SBM) in the drilling campaign, an alternative to synthetic based mud may be used to prevent further losses, i.e. Linear Alpha Olefin (LAO) base oil.

Water based mud and drill cuttings will be discharged to the seabed and will accumulate for a short period of time on the 42” section. The drilling fluid and cuttings on all remaining sections down to the 17 ½” section TD will be returned to the MODU using a riserless mud recovery system. Solids control equipment will be used to process the cuttings when returned at surface. Quantities of drilling fluids and cuttings discharged will be minimised through the use of solids control equipment and recirculation of the mud where possible. Processed cuttings (Water Based Muds (WBM) & SBM) will be discharged just below the water surface and will be dispersed over an extended area, governed by the ocean currents at the time.

Water-based cuttings (excluding 42" section) will be directed across shale shakers to recover any water-based mud for re-use prior to cuttings being discharged to seabed. During synthetic based drilling, drill cuttings will be processed via shale shakers and cuttings drying equipment to reduce discharge of synthetic based mud on cuttings. Well section volumes and material summaries are further detailed by the awarded fluids provider.

During water based and synthetic based drilling, pit storage tanks will be allocated, where feasible and dependent on the MODU contracted, to reduce contamination of synthetic based mud cuttings and water-based mud cuttings. At the end of the SBM drilling phase, the pits, surface equipment and lines will be cleaned using detergent to prepare for the Wellbore Clean Up (WBCU). The pits will be cleaned and circulated with aqueous fluids, noting that the synthetic based mud present in the allocated pits is considered residual, not bulk synthetic based mud. Pit and topside cleaning events will occur throughout the drilling campaign.

As part of the WBCU activity, the base plan is to displace the synthetic based mud initially to an aqueous fluid prior to displacing to base oil. The aqueous fluid used to clean the well, and being displaced out of the well by the base oil, will be captured into a pit and discharged after ensuring the oil content meets specification.

6.6.5 Cementing

Cement is used to create a physical and hydraulic bond between a conductor or casing string and the formation. This is essential for providing structural support and well integrity, to ensure no connection between different geological strata. Cementing fluids consist of cement and additives such as anti-foam, extenders, accelerators, dispersants, silica, retarders, fluid loss agents and gas block agents.

While cementing fluids are not routinely discharged to the environment (unless cleaning residue from dead volume in tanks), cement will be released when the cementing mixture is circulated to seabed during cementing of the 36" and 26" conductors. The two conductor strings form a structural base for supporting the weight of subsequent casing strings and the blowout preventer and are planned to be cemented to seabed. Cement may remain liquid for several hours, during which time there may be some release of chemicals into ambient waters. After the cement has hardened, chemical components of the cement are locked in the inert cement matrix. Cement may be discharged at seabed at a short distance from the template (<150 m) to reduce the risk of cement discharge impacting future flowline installation and platform piling operations.

Depending on the choice of rig, pit storage tanks may be utilised during cementing operations and preparation of water-based spacers (containing solvent/surfactants when cementing in SBM). Cleaning of the pits will occur throughout the drilling campaign and all overboard discharges will be checked and logged by a contracted compliance engineer.

It is anticipated that a high temperature cement blend (or similar) will be used throughout the Crux Development Drilling Campaign. Any remaining cement (wet or dry) at the end of the drilling activity will be mixed with sea water into a slurry and discharged overboard.

6.6.6 Well Suspension

After installing the 7" production liner, the plan is to clean up the well(s) to an aqueous fluid and then displace to a base oil suspension/completion fluid. The well(s) will then be temporarily suspended to allow for well completion activities to be undertaken following the installation of the Crux topside. Well suspension will be addressed in detail in the

WOMP. In addition to well suspension barriers, a shallow set “environmental plug” will be installed just below the 10-3/4” x 9-5/8” crossover to contain the base oil inside the wellbore. Following this, the well will be displaced with an inhibited aqueous fluid prior to the BOP and riser being disconnected.

6.6.7 Contingent Drilling Activities

Geological Sidetrack

Wellhead, and OCTG materials will be purchased to allow for one Crux well to be geological sidetracked. The geological sidetrack contingency is to cover the (unlikely) event where the reservoir interval is found either to be inadequate or absent in one of the five Crux production wells.

If a geological sidetrack is required, the 7” production liner would not be run. Instead, the 8-1/2” production hole would be abandoned with cement plugs and the 9-5/8” x 10-3/4” production casing cut and recovered to below the planned sidetrack depth. A “kick-off” cement plug would then be set in the 12-1/4” hole. The purpose of the “kick-off” plug is to isolate the original wellbore from the new wellbore and is typically a higher density cement plug to encourage deviation from the original wellbore for side tracking. The sidetrack will then be drilled to intersect an alternate geological target. With the exception of the change in target, well activities subsequent to sidetracking will the same as was planned for the original wellbore.

Well Plugging and Abandonment

A significant unplanned downhole event during construction may result in a wellbeing plugged and abandoned if the well condition is such that it is deemed unrecoverable. This may occur at any stage during well construction but is more likely to occur during top hole drilling, before the high-pressure wellhead has been installed.

Any plugging and abandonment activities will be undertaken as per the Shell Well Abandonment Manual and Guide (WS 38.80.31.35-Gen) and associated WOMP. Well abandonment includes installation of cement plugs to form permanent barriers to the hydrocarbon bearing and/or geologically pressured formations and cutting the wellhead/casing strings below the level of the sea floor and recovering the wellhead to surface.

Respudding

Respudding may be required if well problems result in it being impractical to continue to drill in the current well. This may be due to down hole failure or the well being constructed in a manner which is outside of tolerance, e.g. excessive 36” conductor inclination.

In this situation the MODU would be moved to a spare well slot in the template and well construction operations repeated. Well problems requiring a respud typically occur during riserless operations, where remediation options are more limited. Respudding will result in an increased volume of cuttings and cement discharge from the 36” and 26” conductor cementation.

6.6.8 Vessel Operations

A combination of AHTS, support vessels and LCVs will be used throughout the life of this EP.

The operations of the MODU will be supported by both AHTS and suitable classed support vessels, primarily fulfilling the role of offshore resupply, towing and anchor

handling. Up to three vessels will tow the MODU into position and assist with the anchor laying activities. Typically, three vessels will continue to support ongoing MODU activities during top hole operations, reducing down to two vessels for subsequent hole sections.

The AHTS and support vessels may also perform the following roles and functions:

- Infield emergency response support e.g. oil spill response, helicopter operations standby support
- Firefighting with capability commensurate with notation Fi-Fi 1, with remote operated main water monitors and foam drenching system
- 24/7 security surveillance for other vessels that might pose a threat to the MODU using existing systems (e.g. radar, floodlighting and other means of surveillance)
- Monitoring and maintaining traffic activities within the petroleum safety zone
- General supply and bunkering (fuel, other liquids and goods) activities.

Supply and bunkering activities include the transfer of goods from vessels to the MODU via MODU cranes and bunkering lines (for bulk transfer). Typically, goods transferred to the MODU include crew consumables (i.e. food, water, medical supplies and sanitation materials) and drilling support materials (i.e. equipment, machinery, chemicals and fuel). Bulk transfers via bulk transfer lines to support MODU operation include both liquids such as drilling fluids, fuel (diesel) and brine and also fluidised solids such as bentonite, barite and cement.

Backloading of materials will also occur to allow materials (including waste) to be returned to shore for disposal, recycling or reuse.

6.6.9 Other Supporting Operations

Remotely Operated Vehicle(s)

Remotely operated vehicles (ROVs) may be deployed from the MODU and/or support vessels to undertake support tasks during both the template and docking pile installation and during drilling operations. Support tasks may include visual surveys of the seabed before drilling, installing the blowout preventer, monitoring drilling, retrieving the blowout preventer and visual surveys of the seabed after drilling. Remotely operated vehicles may also be used to assist if an incident occurs. Hydraulic control fluids are used to operate ROVs and negligible amounts may be released to sea during some operating functions such as opening and closing valves.

Aviation Support Location

Helicopters are part of the activity when they enter the 500 m petroleum exclusion zone that will be associated with the MODU. Historically, aviation support and crew changes to the MODU have been conducted through Broome International airport (via Djarajin if required for refuelling purposes), and then to location. However, pending future contract awards, an alternative option may be selected. Airfields at Truscott, Derby and Curtin could also be used for alternate landing sites under certain weather conditions, however these activities are outside of the scope of this EP.

Due to the long distances between the Operational Area and the aviation support base(s), helicopter refuelling on the MODU will also be required.

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 Sections 9.

In accordance with Regulation 31(1) of the Environment Regulations, reference to the Master Existing Environment (Section 6), of the accepted Crux Offshore Project Proposal (OPP) (hereafter referred to as the Master Existing Environment) has been made throughout this EP. The accepted OPP (NOPSEMA ID: A742335 is available on the NOPSEMA website.

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 majority of the impacts and risks from the activities covered by this EP occur in close proximity to the Crux Operational Area, however some impacts and risks may extend further. 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 the drilling activities have a remote likelihood of occurring, and Shell implements a range of controls to ensure such incidents are prevented, and risks mitigated to ALARP and Acceptable Levels. The EMBA for the combined worst-case credible hydrocarbon spills from the Crux Operational Area is shown in Figure 7-1 and represents the low exposure thresholds described further in Section 9.14**.** Refer to Section 9.14 or 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;
- Biologically Important Area and Habitat Critical to the survival of species;
- listed threatened species, migratory species and threatened ecological communities; and
- 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 B**.

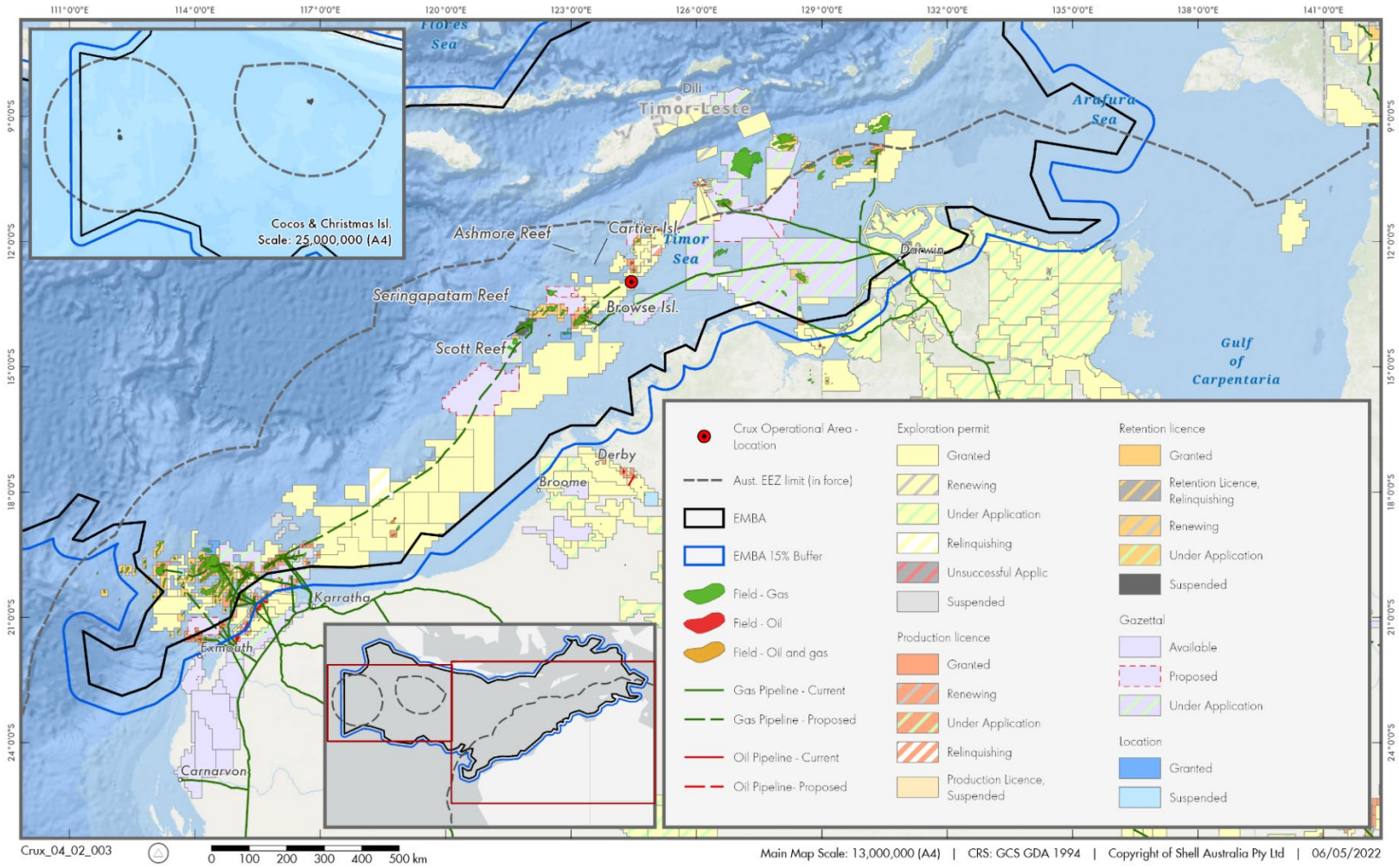


Figure 7-1: EMBA for the Crux - associated Petroleum Activities

Shell commissioned a number of baseline studies to describe the existing environment relevant to the Crux project. The full list of studies are described in full detail in Table 6.1 of the Master Existing Environment, however those relevant to this EP are listed in Table 7-1.

Table 7-1: Summary of Crux Baseline Studies relevant to the Crux Drilling EP.

Study Type	Study Description/Objective
Metocean study	Collection of metocean data (e.g. current, conductivity, wave and wind data) on the surface and through the water column for a full 12 month period from late April 2016 to early May 2017.
Water quality study	Two surveys for the collection of baseline data on physical and chemical components of water quality. The surveys were completed over two survey events in April/May 2016 and October/November 2016.
Sediment, water quality and infauna study	Collection of baseline data on sediment quality, water quality and infauna communities. The study was completed in October/November 2016.
Benthic habitat study	Collection of baseline data to characterise topographic features, benthic habitats and macrofaunal communities, through the use of underwater transects (towed, video camera) and geophysical methods (multibeam, side-scan sonar, seismic reflection and sub-bottom profiling). This study was completed in April/May 2017.
Geotechnical study	An assessment of the geotechnical conditions of the seabed in the Crux field and along the proposed pipeline. This study was completed in 2016, with a further study completed in April 2018.

7.1 Regional Context

The Crux Operational Area is situated in the North-West Marine Region (NWMR), a marine bioregion encompassing Commonwealth Waters extending from the Western Australian – Northern Territory border to Kalbarri, Western Australia (Department of the Environment, Water, Heritage and the Arts (DEWHA), 2008a). The region is characterised by shallow-water tropical marine ecosystems and home to globally significant populations of internationally threatened species (DEWHA, 2008a). The NWMR is further divided into provincial bioregions, of which, the Operational Area is situated within the Timor Province (Integrated Marine and Coastal Regionalisation of Australia (IMCRA) v4.0). The EMBA overlaps additional provincial bioregions of the NWMR and the North Marine Region, including the Central Western Transition, Northwest Province, Northwest Shelf Province, Northwest Transition, Northwest Shelf Transition, Timor Transition, Northern Shelf Province, Christmas Island Province, and Cocos (Keeling) Island Province. Further description of the marine regions and bioregions is found in Section 6.4 of the Master Existing Environment.

7.2 Physical Environment

Key features of the physical environment are summarised in Table 7-2 and described in further detail in Section 6.3 of the Master Existing Environment.

Table 7-2: Summary of the characteristics of the physical environment relevant to the Operational Area and EMBA.

Physical characteristic	Relevance to the Operational Area and EMBA
Bathymetry and geomorphology	The Operational Area is located in depths of 90 – 180 m. Seabed is generally flat with a gentle gradient falling from north east to south west. Seabed morphology is typically smooth and bare of hard substrates, with the exception of a large outcropping reef area to the north-east of the Operational Area. In the wider EMBA there are a number of banks and shoals that support high biodiversity relative to the surrounding environment.
Climate	Monsoonal climatic patterns with a distinct cyclone season between December and March. Climatic conditions between December and March are typical of Western Australia's north, associated with the inflow of moist west to north-westerly winds, producing convection cloud and heavy rainfall. During the cooler months (June - September), brings stable and persistent easterly winds over the region. Long-term maximum and minimum temperatures and mean rainfall in the Operational Area is shown in Figure 7-2.
Oceanography	The NWMR experiences semi-diurnal tides. Tidal ranges are large - 0.8 m neaps and 5 m springs and strongly influence currents in the region. 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. 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.
Water quality	Temperature, salinity, pH and dissolved oxygen were investigated across the Operational Area and determined to be relatively consistent and comparable to previous studies in the region. Minor seasonal variation exists.
Sediment quality	Baseline sediment surveys were conducted across the Operational Area. Concentrations of metals, hydrocarbons and radio nucleotides were generally consistent across sites, indicating no obvious existing anthropogenic impacts on sediment quality in the area.
Air quality	No specific information concerning air quality in the project area is available. However, the Operational Area is approximately 190 km from the Kimberley coastline, which itself is a remote and unindustrialised area. Therefore, the air quality is unlikely to be subject to significant anthropogenic effects. Commercial shipping is likely to represent the main source of localised and temporary reductions in air quality.

Physical characteristic	Relevance to the Operational Area and EMBA
Noise	Previous underwater monitoring programs in the northern Browse Basin and in the Ichthys field (164 km south-west of Operational area), recorded fish chorus, whale calls (pygmy blue, humpback, minke), persistent vessel and some seismic survey signals as part of the underwater soundscape. Underwater noise in the Operational Area is likely to reflect the previous studies.

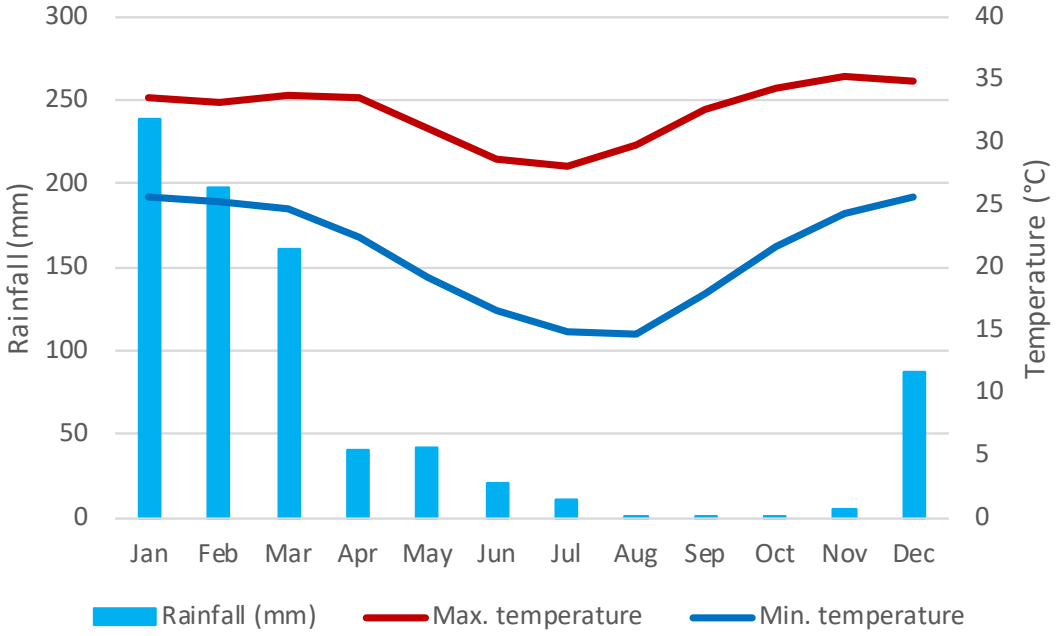


Figure 7-2: Long-term maximum and minimum temperatures and mean rainfall from Cygnet Bay (closest Bureau of Meteorology climate station to the Operational Area). Data sourced from Bureau of Meteorology (n.d.)

7.3 Biological Environment

7.3.1 Habitats and Communities

Surveys undertaken in 2017 by Fugro (2017a) and AECOM (2017) indicated the benthic habitat of the Operational Area to have a very low abundance of macrobenthic fauna. Habitat types observed generally consisted of unconsolidated substrates (sand, gravel, mud etc.) interspersed with patches of hard substrate which provide attachment points for sponges and molluscs. The demersal and pelagic fish communities of the Operational Area and EMBA are expected to include small pelagic fishes, such as sardines and anchovies, which form an important trophic link between microscopic planktonic communities (e.g. zooplankton feeding on phytoplankton) and larger consumers (e.g. tunas). Also present may be migratory larger pelagic fishes such as tunas, bonito, blue sharks etc. 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 demersal fish communities of the Operational Area are

likely to be reflective of the wide Timor Province, of which a high level of endemnicity exists (DEWHA, 2008a).

The environment of the Operational Area is reflective of the wider region and do not support highly diverse benthic communities, such as those found on banks and shoals in the region. Key habitats and communities are summarised in Table 7-3, and described in further detail in Section 6.4.2.2 of the Master Existing Environment.

Table 7-3: Significant Habitats and Communities found in the Operational Area and wider EMBA.

Habitat/Community	Key locations within the Operational Area and EMBA
Benthic communities	
Bare/unconsolidated sediments	Most common habitat type of the Operational Area and EMBA. Inhabitants consist largely of polychaete worms, molluscs and sponges and consistent with the wider region.
Epifauna and Infauna	Macrobenthic infauna of the Operational Area consist of polychaete worms, nermerteans, molluscs and arthropods. Epifauna consist of sponges, branching soft coral, sea whips, hydroids, sea anemones, echinoderms, Crinoids. In the wider EMBA, deep water communities feature soft corals, sea whips, hydroids, etc. Shallower communities include molluscs, hard corals, branching soft corals, echinoderms and crustaceans. The EMBA is dominated by widespread soft sediment habitat that is unlikely to support significant epifauna. Low density epifauna communities are associated with sparser hard substrate in deeper waters.
Corals	Soft branching coral (Alcyonacea) is associated with consolidated rock and unconsolidated gravel within the Operational Area (Fugro, 2017a). Widespread throughout EMBA, associated with banks and shoals, characteristic of the region as well as regionally significant Ashmore Reef and Cartier Island.
Macroalgae & seagrass	Important feature of seabed communities at several offshore banks and shoals in the EMBA, particularly calcareous green algae in the genus *Halimeda.* Seagrass is less common, displaying temporal and spatial variability.
Banks & Shoals	Significant habitat within the EMBA. Nearest shoals include • Goeree Shoal ~14 km north west of Operational Area • Eugene McDermott Shoal ~ 20 km north west of Operational Area • Vulcan Shoal ~ 24 km north west of Operational Area Other shoals in the region include Barracouta Shoals, Heywood Shoals and Echuca Shoals.
Offshore reefs and islands	No known offshore reefs and islands within close proximity to Operational Area. Within the EMBA are key reefs and islands: • Ashmore Reef ~ 160 km north west of Operational Area

Habitat/Community	Key locations within the Operational Area and EMBA
	• Cartier Island ~ 106 km north west of Operational Area • Hibernia Reef ~ 155 km north west of Operational Area • Browse Island ~ 157 km south west of Operational Area • Serigapatam Reef ~ 262 km south west of Operational Area • Scott Reef ~ 320 km south west of Operational Area • Adele Island ~ 312 km south west of Operational Area • Tiwi Islands ~ 621 km east of the Operational Area • Christmas Island ~ 3,567 km west-north-west of the Operational Area • Cocos (Keeling) Islands ~ 4,754 km west of the Operational Area.
WA and NT mainland coastline communities	The WA and NT mainland coastlines occurs within the wider EMBA. The nearshore and costal environments of the Kimberley on the WA coastline are approximately 190 km from the Operational Area. Communities include coral reefs, seagrass and macro algae beds, mangroves, sandy beaches, rocky shores, estuaries, wetlands, creeks and rivers. The NT coastline is approximately 539 km from the Operational Area. Communities include coral reefs, seagrass meadows, mangroves and sand or mudflats.
Other habitats and communities	
Plankton	Surface waters within the Operational Area are typical of clear open water environments with little seasonal variation. In the wider EMBA, phytoplankton is diverse but low in abundance, typical of low nutrient open ocean environments. Distribution of plankton are linked to localised and seasonal productivity i.e. areas of upwelling and fluctuations in abundance and distribution of plankton occurs in response to tidal cycles, seasonal variation and cyclonic events.
Pelagic and demersal fish communities	Free swimming pelagic fish within the Operational Area and EMBA are expected to include small pelagic fishes, such as sardines and anchovies, broadly distributed throughout the tropical pelagic environment. Larger pelagic fish include migratory species (e.g. tunas, bonito, blue sharks etc.) as well as commercially important species, such as marlin, swordfish and mackerel. High level of endemicity associated with separate demersal fish communities of the upper and mid continental slope, particularly in areas of complex geomorphology. Species include trout, snapper and sharks.

7.3.2 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; 14 KEFs have been identified within the EMBA in Table 7-4 and described in Section 6.4.7 of the Master Existing Environment. Figure 7-3 shows the spatial overlap of KEFs within the EMBA.

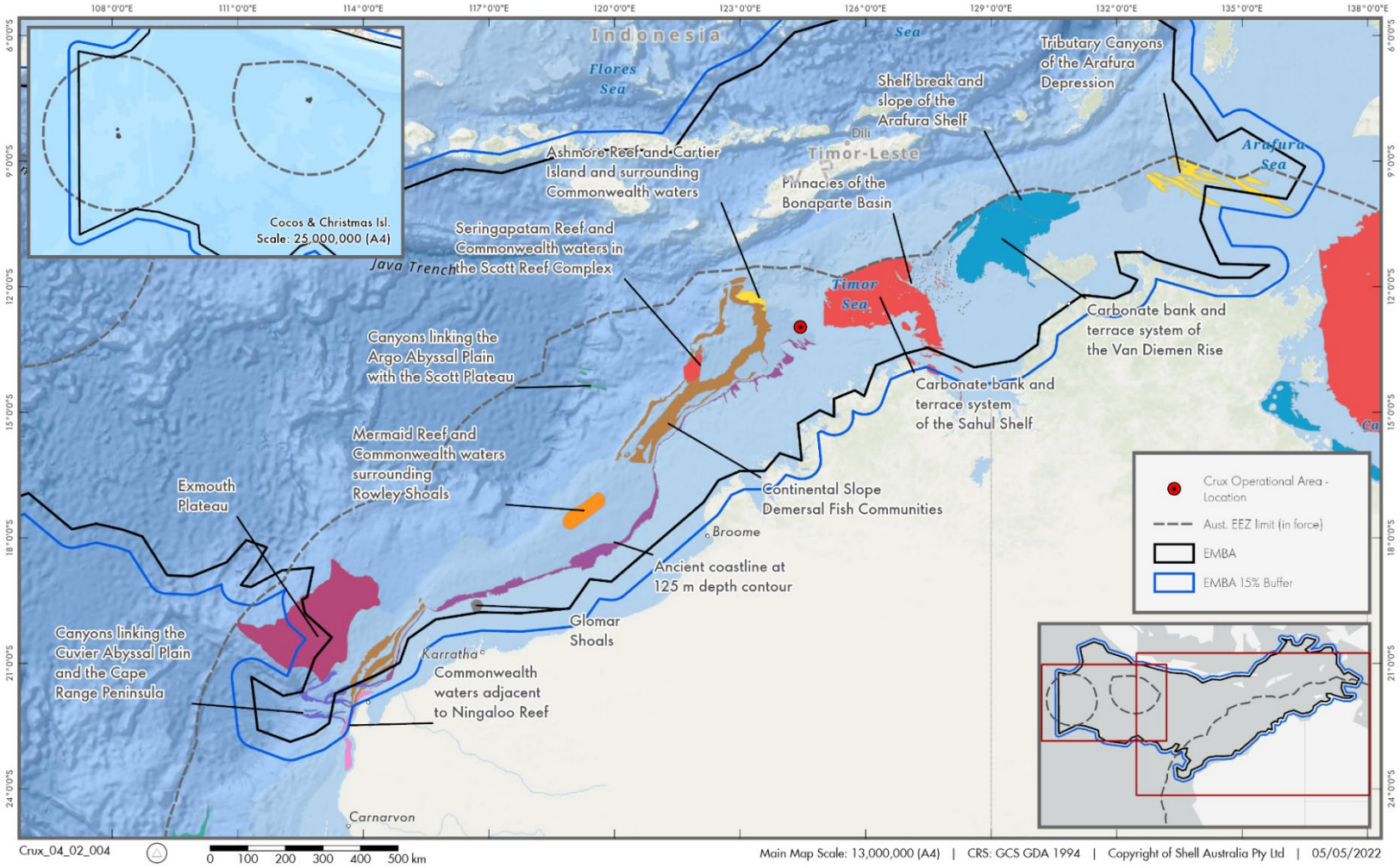


Figure 7-3: Locations of KEFs within the EMBA

Table 7-4: KEFs within the EMBA, including distance from Operational Area

KEF	Distance from Operational Area (km)
Continental Slope Demersal Fish Communities	72 km west
Ancient coastline at 125 m depth contour	28 km south
Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	264 km south west
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	98 km north west
Carbonate bank and terrace system of the Sahul Shelf	60 km east
Canyons linking the Argo Abyssal Plain with the Scott Plateau	526 km south west
Pinnacles of the Bonaparte Basin	306 km north east
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	672 km south west
Glomar Shoals	1,090 km south west
Exmouth Plateau	1,275 km south west
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	1,402 km south west
Carbonate bank and terrace system of the Van Dieman Rise	428 km north east
Shelf break and slope of the Arafura Shelf	605 km north east
Tributary Canyons of the Arafura Shelf	984 km north east

7.3.3 Threatened Ecological Communities

Threatened Ecological Communities (TECs) are protected under Part 3 of the EPBC Act and are Matters of National Environmental Significance (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 402 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.

7.3.4 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 in Table 7-5; the environmental values for these Ramsar wetlands are summarised in Section 6.6.7 of the Master Existing Environment and shown in Figure 7-4.

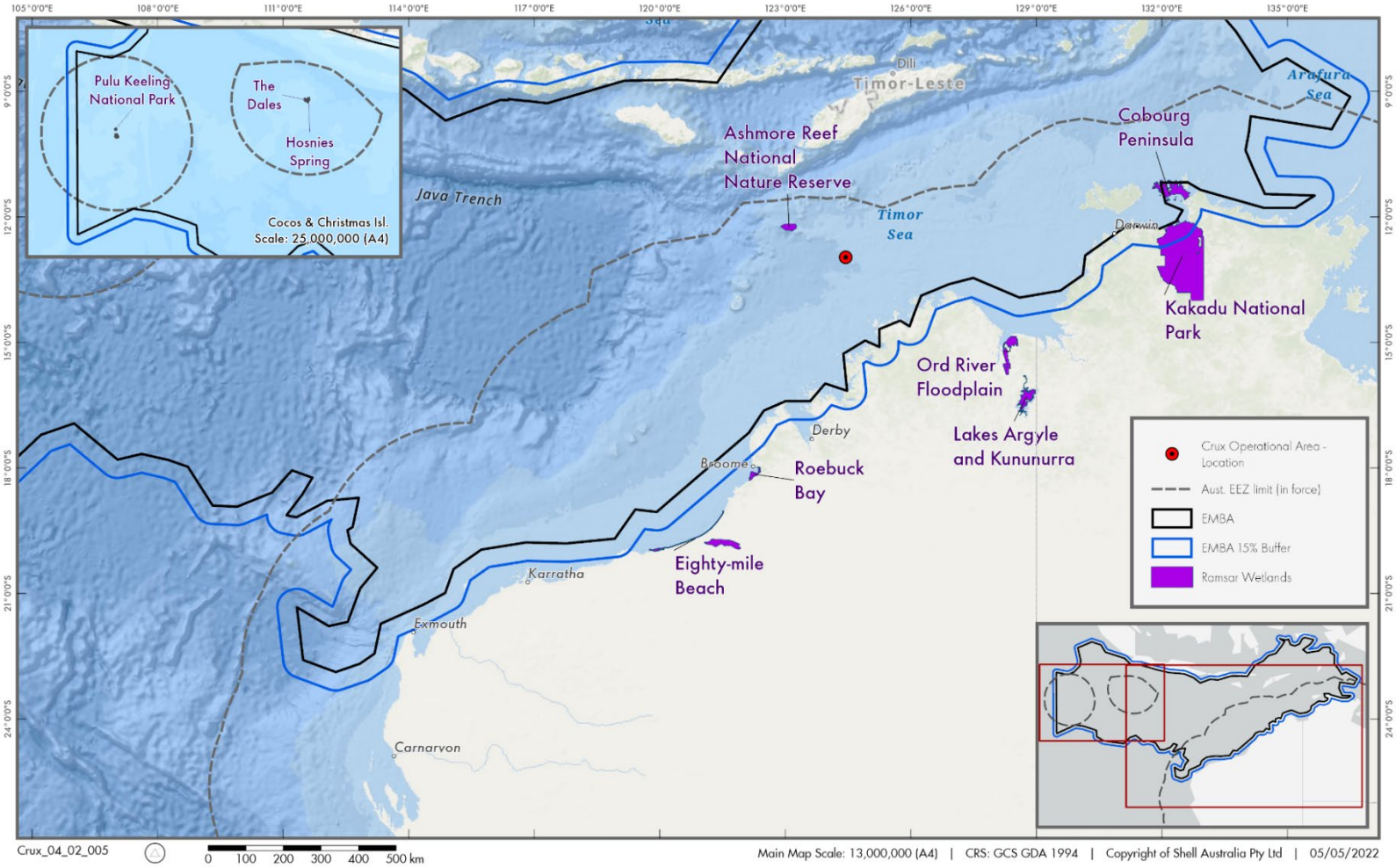


Figure 7-4: Ramsar Wetlands within the EMBA

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

Ramsar Wetland	Distance from Operational Area (km)
Ashmore Reef National Nature Reserve (now part of Ashmore Reef Marine Park)	160 km north west
Roebuck bay	597 km south west
"The Dales" Christmas Island	2,074 km west
Cobourg Peninsula	837 km east north east
Kakadu National Park	864 km east north east
Hosnies Spring Christmas Island	2,060 km west
Pulu Keeling National Park	3,002 km west

7.3.5 Threatened and Migratory Species

A total of 104 EPBC Act listed species considered to be MNES (39 and 91 listed as threatened or migratory respectively) were identified as potentially occurring within the EMBA, of which a subset of 40 (20 threatened and 35 migratory) species were identified as potentially occurring within the Operational Area. Within the Operational Area two Conservation Dependent species were identified, the scalloped hammerhead and southern Bluefin tuna. The full list of marine species identified from the protected matters search is provided in **Appendix B**. A number of Biologically Important Areas (BIAs) and Habitat Critical to the Survival of Species were identified as well. Figure 7-6 to Figure 7-14 summarise the EPBC Act listed species, BIAs and Habitat Critical relevant to the Operational Area and EMBA. Further descriptions of identified species can be found in Section 6.5 of the Master Existing Environment.

Note that a number of MNES that will not credibly be impacted by the petroleum activities were identified by the PMST Report for the EMBA (e.g. terrestrial species). These PMST report results are an artefact of the method used to generate the area upon which the report is based; this method occasionally overlaps small areas of the terrestrial environment that will not credibly be impacted by the petroleum activity. These have been excluded from further consideration and are not listed in Table 7-6 to Table 7-14.

7.3.5.1 Marine Mammals

Table 7-6 provides a list of EPBC Act listed threatened and migratory marine mammals that may occur within the Operational Area and/or EMBA.

Table 7-6: EPBC Act listed threatened and migratory marine mammals that may occur within the Operational Area and/or EMBA

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Balaenoptera borealis	Sei whale	Vulnerable	Migratory	Species or species habitat likely occur within area	✓
Balaenoptera musculus	Blue whale	Endangered	Migratory	Species or species habitat likely occur within area	✓
Balaenoptera physalus	Fin whale	Vulnerable	Migratory	Species or species habitat likely occur within area	✓
Megaptera novaeangliae	Humpback whale	N/A	Migratory	Species or species habitat likely occur within area	✓
Balaenoptera edeni	Bryde's whale	N/A	Migratory	Species or species habitat likely occur within area	✓
Orcinus orca	Killer whale, orca	N/A	Migratory	Species or species habitat may occur within area	✓
Physeter macrocephalus	Sperm whale	N/A	Migratory	Species or species habitat may occur within area	✓
Tursiops aduncus (Arafura/Timor Sea populations)	Spotted bottlenose dolphin (Arafura/Timor Sea populations)	N/A	Migratory	Species or species habitat may occur within area	✓
Eubalaena australis	Southern Right Whale	Endangered	Migratory	x	✓
Dugong dugong	Dugong	N/A	Migratory	x	✓
Orcaella heinsohni	Australian snubfin dolphin	N/A	Migratory	x	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Sousa chinensis (sahulensis)	Indo-Pacific (Australian) humpback dolphin	N/A	Migratory	x	✓
Balaenoptera bonaerensis	Antarctic Minke Whale, Dark-shoulder Minke Whale	N/A	Migratory	x	✓

Table 7-7 provides a list of marine mammal BIA's that may occur within the Operational Area and/or EMBA.

Table 7-7: BIA's of marine mammals that overlap the Operational Area or EMBA

Common Name	BIA Behaviour	Distance from Operational Area (km)
Blue and pygmy blue whales	Migration (Indonesia – Banda sea)	156 km north
	Migration (Augusta to Derby)	120 km west
	Foraging (Scott Reef)	266 km south west
	Foraging (Ningaloo)	1,488 km south west
Humpback whale	Migration (Kimberley/Coastal North Lacepede Island)	183 km south
	Calving (Kimberley/Coastal North Lacepede Island)	183 km south
	Resting (Kimberley/Coastal North Lacepede Island)	183 km south
	Nursing (Kimberley/Coastal North Lacepede Island)	183 km south
	Migration (north and south) (Kimberley to Shark Bay)	469 km south west
	Resting (Exmouth Gulf)	1,448 km south west
Dugong	Foraging (high density seagrass beds) (Ashmore Reef – South)	159 km north west
	Foraging (Ashmore Reef – Far West)	179 km north west
	Calving (Ashmore Reef – Far West)	179 km north west
	Breeding (Ashmore Reef – Far West)	179 km north west

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Nursing (Ashmore Reef – Far West)	179 km north west
	Foraging (Kimberley coast, Dampier Peninsula)	393 km south south west
	Foraging (Pilbara and Kimberley coast near Dampier Peninsula)	465 km south south west
	Foraging (Middle Island, Kimberley coast)	495 km south west
	Calving (Exmouth Gulf)	1,428 km south west
	Nursing (Exmouth Gulf)	1,428 km south west
	Breeding (Exmouth Gulf)	1,428 km south west
	Foraging (high density seagrass beds)	1,428 km south west
	Foraging (Pilbara and Kimberley coast near James Price Point	522 km south south west
Australian snubfin dolphin	Foraging (Maret & Biggee Island)	163 km south east
	Resting (Admiralty Gulf & Parry Harbour)	163 km south east
	Calving (Admiralty Gulf & Parry Harbour)	163 km south east
	Breeding (Admiralty Gulf & Parry Harbour)	163 km south east
	Foraging (high density prey) (Admiralty Gulf & Parry Harbour)	163 km south east
	Resting (Bougainville Peninsula)	193 km south east
	Breeding (Bougainville Peninsula)	193 km south east
	Calving (Bougainville Peninsula)	193 km south east
	Foraging (high density prey) (Bougainville Peninsula)	193 km south east
	Resting (Vansittart Bay)	217 km south east
	Breeding (Vansittart Bay)	217 km south east
	Calving (Vansittart Bay)	217 km south east

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Foraging (high density prey) (Vansittart Bay)	217 km south east
	Resting (Port Nelson)	205 km south south east
	Breeding (Port Nelson)	205 km south south east
	Calving (Port Nelson)	205 km south south east
	Foraging (high density prey) (Port Nelson)	205 km south south east
	Resting (Camden Sound Area)	239 km south
	Breeding (Camden Sound Area)	239 km south
	Calving (Camden Sound Area)	239 km south
	Foraging (high density prey) (Camden Sound Area)	239 km south
	Foraging (high density prey) (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Breeding (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Calving (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Foraging (high density prey) (King Sound Southern Sector)	392 km south south west
	Breeding (King Sound Southern Sector)	392 km south south west
	Calving (King Sound Southern Sector)	392 km south south west
	Breeding (Darwin Harbour)	656 km east
	Breeding (Van Diemen Gulf, south Alligator River)	852 km east
	Breeding (Port Essington, Cobourg Peninsula)	824 km east north east
	Foraging likely (Carnot & Beagle Bay)	470 km south south west

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Foraging likely (Pender Bay)	441 km south south west
	Foraging (high density prey) (Prince Regent River)	247 km south
	Breeding (Prince Regent River)	247 km south
	Calving (Prince Regent River)	247 km south
	Resting (Napier Broome Bay/Deep Bay)	261 km south east
	Breeding (Napier Broome Bay/Deep Bay)	261 km south east
	Calving (Napier Broome Bay/Deep Bay)	261 km south east
	Foraging (high density prey) (Napier Broome Bay/Deep Bay)	261 km south east
	Resting (Cape Londonderry & King George River)	259 km south east
	Breeding (Van Diemen Gulf – East Alligator River)	883 km east
Indo-Pacific humpback dolphin	Foraging (Admiralty Gulf & Parry Harbour)	163 km south east
	Significant habitat - unknown behaviour (Admiralty Gulf & Parry Harbour)	163 km south east
	Calving (Maret & Biggee Island)	163 km south east
	Foraging (Maret & Biggee Island)	163 km south east
	Significant habitat – unknown behaviour (Bougainville Peninsula)	193 km south east
	Foraging (Bougainville Peninsula)	193 km south east
	Significant habitat (Vansittart Bay)	217 km south east
	Foraging (Vansittart Bay)	217 km south east
	Foraging (high density prey) (Vansittart Bay)	217 km south east
	Breeding (Port Nelson)	205 km south south east
	Calving (Port Nelson)	205 km south south east

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Foraging (high density prey) (Port Nelson)	205 km south south east
	Breeding (Camden Sound Area)	239 km south
	Calving (Camden Sound Area)	239 km south
	Foraging (high density prey) (Camden Sound Area)	239 km south
	Breeding (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Calving (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Foraging (high density prey) (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Foraging (high density prey) (King Sound Southern Sector)	392 km south south west
	Breeding (Darwin Harbour)	656 km east
	Breeding (Port Essington, Cobourg Peninsula)	824 km east north east
	Breeding (Van Diemen Gulf, south Alligator River)	852 km east
	Foraging (Carnot & Beagle Bay)	470 km south south west
	Foraging (Pender Bay)	441 km south south west
	Breeding (Prince Regent River)	247 km south
	Calving (Prince Regent River)	247 km south
	Foraging (high density prey) (Prince Regent River)	247 km south
	Significant habitat (unknown behaviour) (Napier Broome Bay/Deep Bay)	261 km south east
	Breeding likely (Van Diemen Gulf – East Alligator River)	883 km east
Indo-Pacific/spotted bottlenose dolphin	Calving (Camden Sound Area)	239 km south

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Foraging (Camden Sound Area)	239 km south
	Breeding (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Calving (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Foraging (King Sound North and Yampi Sound and Talbot Bay Fjord area near horizontal falls)	345 km south south west
	Calving (King Sound Southern Section)	392 km south south west
	Breeding (King Sound Southern Section)	392 km south south west
	Foraging (King Sound Southern Section)	392 km south south west
	Breeding (Darwin Harbour)	656 km east
	Breeding (Port Essington, Cobourg Peninsula)	824 km east north east
	Migration likely (Pender bay)	436 km south south west
	Foraging likely (Pender bay)	436 km south south west

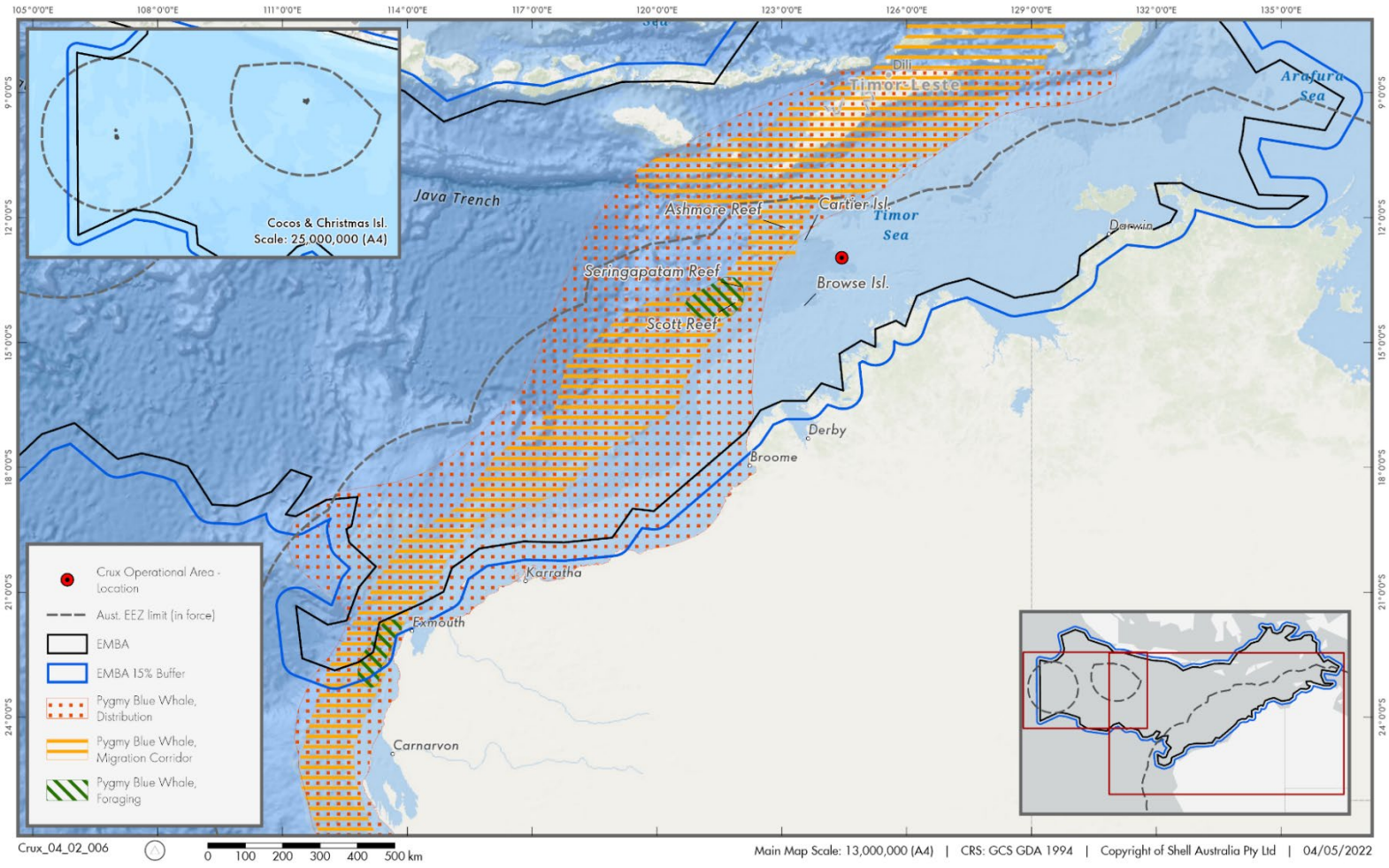


Figure 7-5: BIA's for blue and pygmy blue whales within the EMBA

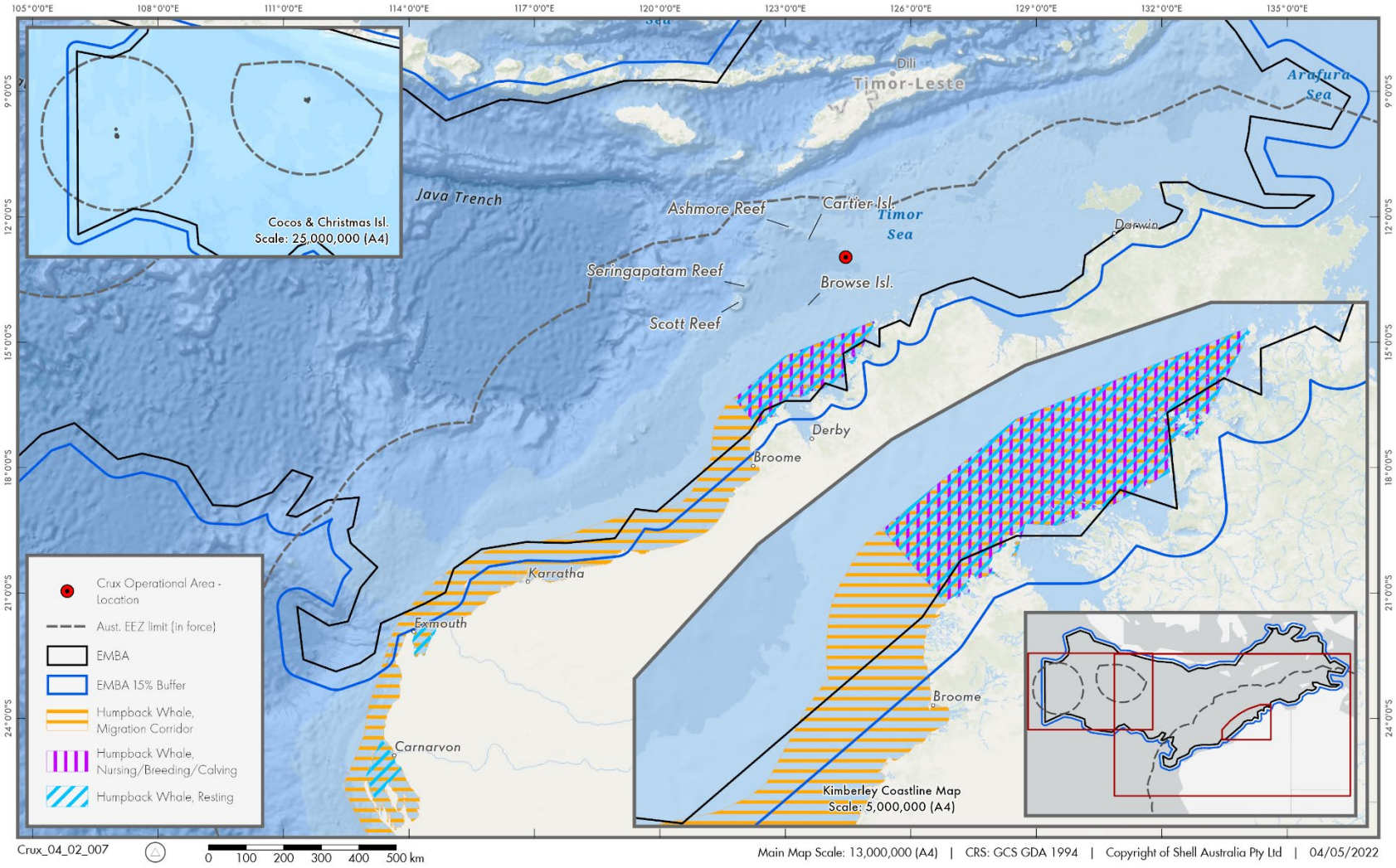


Figure 7-6: BIA's for humpback whales within the EMBA

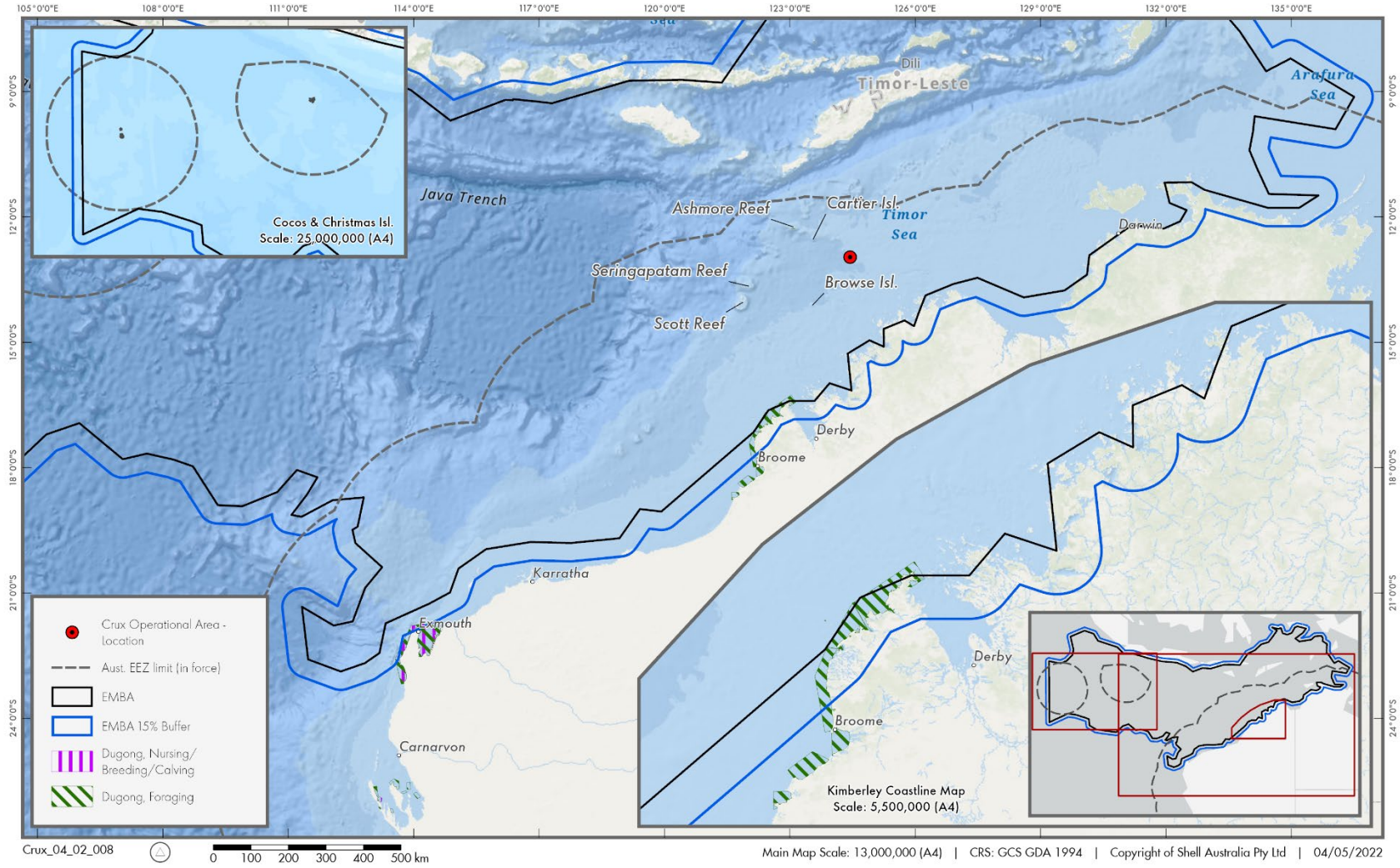


Figure 7-7: BIA's for dugongs within the EMBA

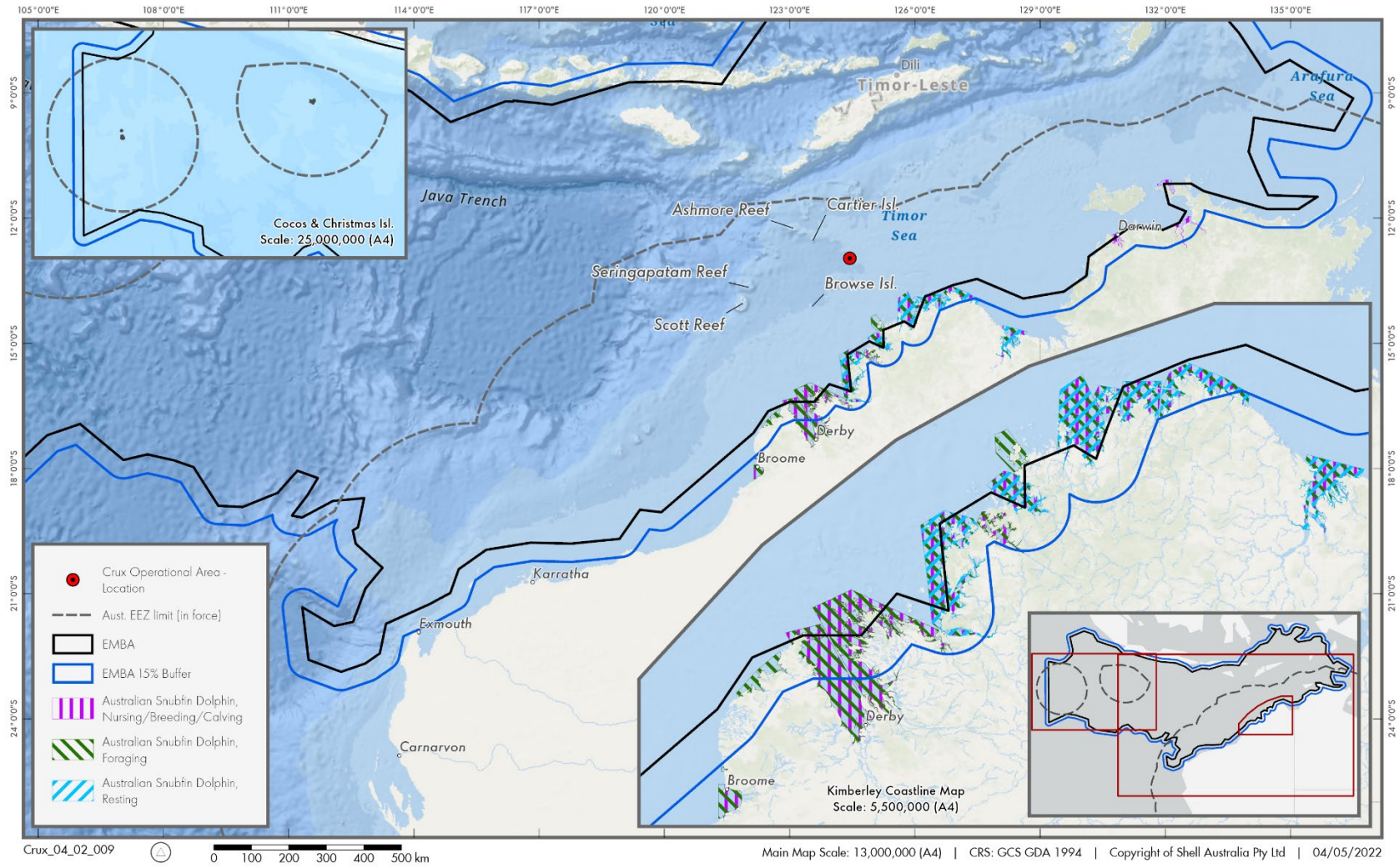


Figure 7-8: BIA's for snubfin dolphins within the EMBA

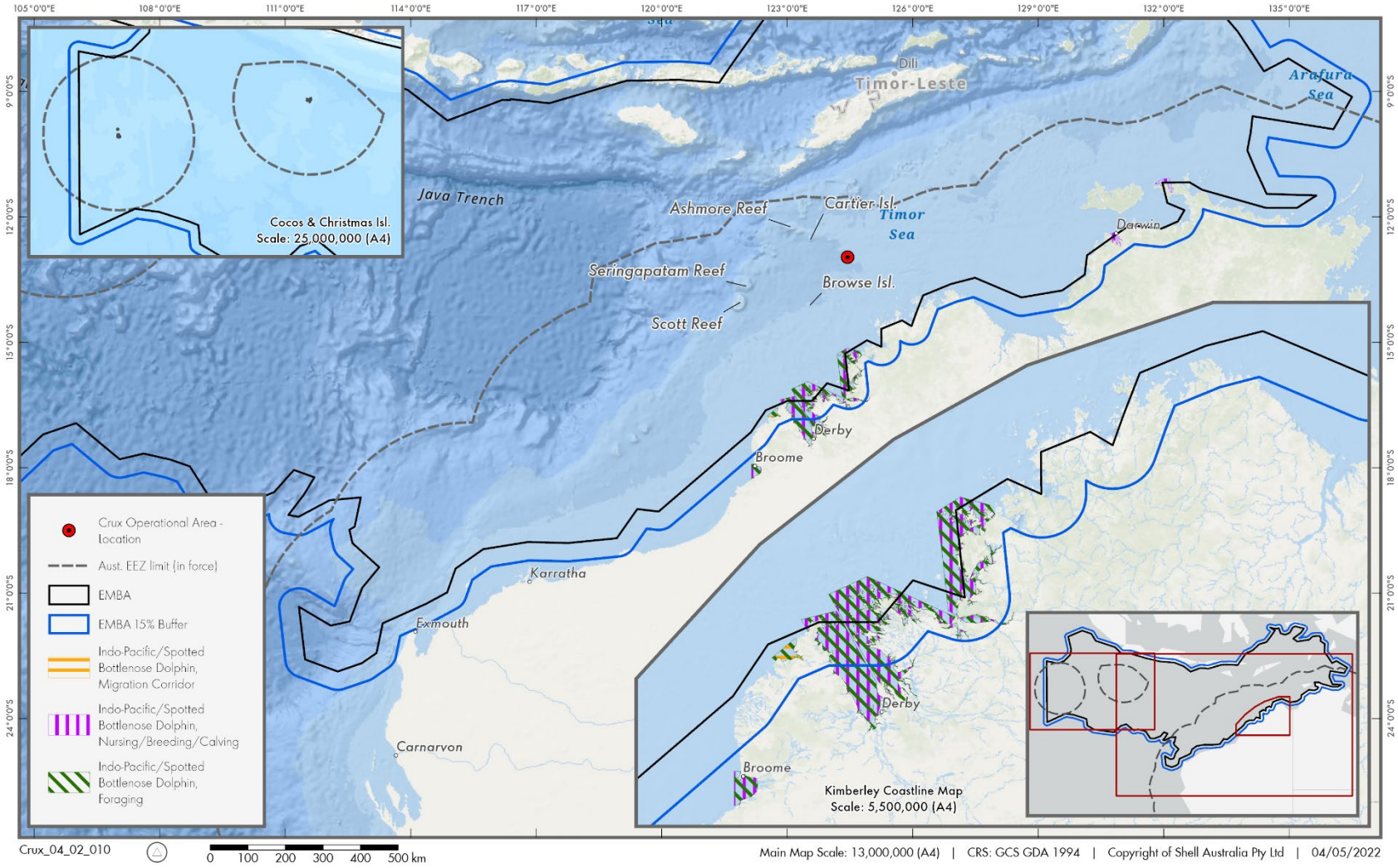


Figure 7-9: BIA's for indo-pacific spotted bottlenose dolphins within the EMBA

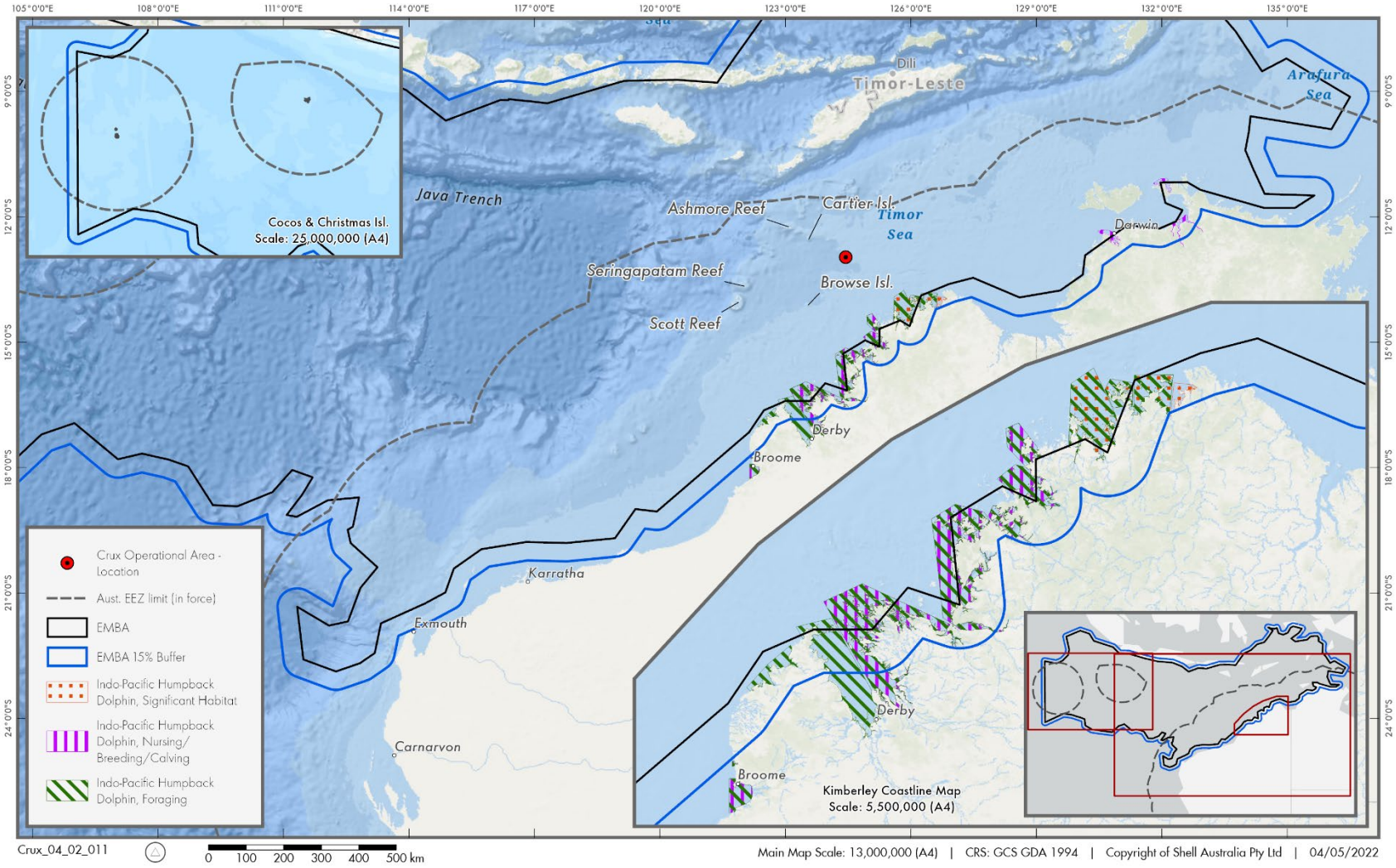


Figure 7-10: BIA's for indo-pacific humpback dolphins within the EMBA

7.3.5.2 Reptiles

Table 7-8 provides a list of EPBC Act listed threatened and migratory reptiles that may occur within the Operational Area and/or EMBA.

Table 7-8: EPBC Act listed threatened and migratory marine reptiles that may occur within the Operational Area and/or EMBA

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Caretta caretta	Loggerhead turtle	Endangered	Migratory	Foraging, feeding or related behaviour likely to occur within area	✓
Chelonia mydas	Green turtle	Vulnerable	Migratory	Foraging, feeding or related behaviour known to occur within area	✓
Dermochelys coriacea	Leatherback turtle	Endangered	Migratory	Foraging, feeding or related behaviour likely to occur within area	✓
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Migratory	Foraging, feeding or related behaviour likely to occur within area	✓
Lepidochelys olivacea	Olive ridley turtle	Endangered	Migratory	Foraging, feeding or related behaviour likely to occur within area	✓
Natator depressus	Flatback turtle	Vulnerable	Migratory	Species or species habitat known to occur within area	✓
Aipysurus foliosquama	Leaf-scaled seasnake	Critically endangered	N/A	Species or species habitat may occur within area	✓
Aipysurus apraefrontalis	Short-nosed seasnake	Critically endangered	N/A	x	✓
Crocodylus porosus	Salt-water crocodile	N/A	Migratory	x	✓

Table 7-9 provides a list of reptile BIA's that may occur within the Operational Area and/or EMBA.

Table 7-9: BIA's of marine turtles that overlap the Operational Area or EMBA

Common Name	BIA Behaviour	Distance from Operational Area (km)
Reptiles		
Flatback turtle	Foraging (Western Joseph Bonaparte Depressions)	196 km north east
	Foraging (Holothuria Zone)	227 km north east
	Internesting buffer (Lacepede Island)	402 km south west
	Internesting (Lacepe Island)	490 km south west
	Nesting (Laceped Island)	490 km south west
	Foraging (James Price Point)	562 km south west
	Internesting buffer (North Turtle Island)	891 km south west
	Foraging (De Grey River area to Bedout Island)	942 km south west
	Internesting buffer (Port Headland, Paradise Beach)	948 km south west
	Internesting buffer (Port Headland, Cemetery Beach)	950 km south west
	Internesting buffer (Port Headland, Pretty Pool)	952 km south west
	Internesting buffer (Cape Thouin)	984 km south west
	Internesting buffer (Lengendre Island, Huay Island)	1,081 km south west
	Internesting buffer (Dampier Archipelago (islands to the west of the Burrup Peninsula)	1,087 km south west
	Internesting buffer (Delambre Island)	1,071 km south west
	Internesting buffer (Montebello Island, Hermite Island, Trimouille Island)	1, 189 km south west)
	Internesting buffer (Thevernard Island - South coast)	1,279 km south west

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Internesting (Melville Island, Cobourg Peninsula)	559 km east
	Internesting (Wessel Islands, Gove Peninsula, Groote Eylandt, Sir Edward Peller Island Group)	1,143 km east
	Internesting buffer (Cape Domett)	381 km south east
	Internesting buffer (80 mile beach)	640 km south south west
	Nesting (North Turtle Island)	958 km south west
	Internesting buffer (West of Cape Lambert)	1,071 km south west
	Internesting buffer (Dixon Island)	1,077 km south west
	Internesting buffer (Intercourse Island)	1,116 km south west
	Nesting (Montebello Island – Hermitte Island, NW Island, Trimouille Island)	1,249 km south west
	Mating (Montebello Island – Hermitte Island, NW Island, Trimouille Island)	1,249 km south west
	Foraging (Montebello Island – Hermitte Island, NW Island, Trimouille Island)	1,249 km south west
	Aggregation (Coral reef habitat west of the montebello group)	1,264 km south west
	Mating (Coral reef habitat west of the montebello group)	1,264 km south west
	Internesting (Coral reef habitat west of the montebello group)	1,264 km south west
	Foraging (Coral reef habitat west of the montebello group)	1,264 km south west
	Mating (Barrow Island)	1, 279 km south west
	Foraging (Barrow Island)	1, 279 km south west
	Nesting (Barrow Island)	1, 279 km south west
	Nesting (Thevernard Island – South coast)	1,345 km south west
Green turtle	Internesting buffer (Cartier Island)	85 km north west
	Nesting (Cartier Island)	104 km north west

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Internesting buffer (Ashmore Reef)	144 km north west
	Foraging (Ashmore Reef)	159 km north west
	Nesting (Ashmore Reef)	163 km north west
	Mating (Asmore Reef)	173 km north west
	Foraging (Seringapatam Reef)	275 km south west
	Internesting buffer (Scott Reef)	293 km south west
	Nesting (Scott Reef)	310 km south west
	Foraging (Browse Island)	158 km south west
	Internesting buffer (Browse Island)	158 km south west
	Internesting buffer (Cassini Island)	143 km south east
	Nesting (Cassini Island)	162 km south east
	Foraging (Joseph Bonaparte Gulf)	327 km east south east
	Internesting (North-west of Melville Island)	656 km north east
	Foraging (Montgomery Reef)	319 km south
	Internesting buffer (Lacepede Island)	470 km south west
	Internesting (Lacepe Island)	489 km south west
	Nesting (Lacepede Island)	489 km south west
	Foraging (James Price Point)	564 km south west
	Foraging (De Grey River area to Bedout Island)	942 km south west
	Internesting buffer (Montebello Islands)	1, 226 km south west
	Foraging (Kakadu)	858 km east

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Internesting (Islands north-east of Cobourg Peninsula)	913 km north east
	Internesting buffer (North West Cape)	1,443 km south west
	Internesting buffer (North and South Murion Island)	1,413 km south west
	Nesting (North West Cape)	1,460 km south west
	Nesting (North and South Murion Island)	1,434 km south west
	Internesting buffer (Middle Island West Coast, Barrow Island West Coast and North Coast)	1,261 km south west
	Internesting (Barrow Island)	1,278 km south west
	Foraging (inshore tidal and shallow subtidal areas around Barrow Island)	1,278 km south west
	Basking (Middle Island West Coast, Barrow Island West Coast and North Coast)	1,278 km south west
	Mating (Middle Island West Coast, Barrow Island West Coast and North Coast)	1,278 km south west
	Nesting (Middle Island West Coast, Barrow Island West Coast and North Coast)	1,278 km south west
	Internesting buffer (Montebello Islands)	1,225 km south west
	Internesting buffer (Montebello Islands– Hermite Isalnd, NW Island, Trimouille Island)	1,233 km south west
	Internesting (Montebello Islands)	1,243 km south west
	Nesting (Montebello Islands)	1,243 km south west
	Mating (Montebello Islands)	1,243 km south west
	Foraging (Montebello Islands)	1,243 km south west
	Aggregation (Coral reef habitat west of the montebello group)	1,264 km south west
	Mating (Coral reef habitat west of the montebello group)	1,264 km south west
	Internesting (Coral reef habitat west of the montebello group)	1,264 km south west

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Foraging (Coral reef habitat west of the montebello group)	1,264 km south west
	Nesting (Montebello Island – Hermitte Island, NW Island, Trimouille Island)	1,249 km south west
	Mating (Montebello Island – Hermitte Island, NW Island, Trimouille Island)	1,249 km south west
	Foraging (Montebello Island – Hermitte Island, NW Island, Trimouille Island)	1,249 km south west
	Internesting (Dampier Archipelago (islands to the west of the Burrup Peninsula)	1,140 km south west
	Internesting buffer (Legendre Island, Huay Island)	1,131 km south west
	Foraging (North Turtle Island)	958 km south west
	Internesting (Drysdale Island, Cunningham Islands, Buckingham Bay, Pera Channel)	1,250 km east
Hawksbill turtle	Foraging (Cartier Island)	104 km north west
	Inter-nesting buffer (Asmore Reef)	144 km north west
	Nesting (Ashmore Reef)	163 km north west
	Foraging (Ashmore Reef)	170 km north west
	Internesting buffer (Scott Reef)	292 km south west
	Nesting (Scott Reef)	312 km south west
	Foraging (De Grey River to Bedout Island)	942 km south west
	Internesting (Greenhill Island)	828 km east
	Internesting (Islands north-east of Cobourg Peninsula)	918 km north east
	Internesting Buffer (Ningaloo coast and Jurabi coast)	1,447 km south west
	Nesting (Ningaloo coast and Jurabi coast)	1,462 km south west
	Internesting buffer (Thevenard Island)	1,352 km south west
	Nesting (Thevenard Island)	1,372 km south west

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Internesting buffer (Barrow Island)	1,257 km south west
	Nesting (Barrow Island)	1,276 km south west
	Foraging (shallow water coral reef and artificial reef (pipeline) habitat, Barrow Island)	1,276 km south west
	Mating (Barrow Island)	1,276 km south west
	Internesting buffer (Lowendal Island Group)	1,247 km south west
	Internesting buffer (Varanus Island)	1,250 km south west
	Internesting buffer (Montebello Island, Trimoulle and NW Islands)	1,242 km south west
	Internesting buffer (Montebello Island – Hermite Island, NW Island, Trimoulle Island	1,235 km south west
	Mating (Lowendal Island Group)	1,267 km south west
	Internesting (Lowendal Island Group)	1,267 km south west
	Nesting (Lowendal Island Group)	1,267 km south west
	Foraging (Lowendal Island Group)	1,267 km south west
	Internesting buffer (Ah chong and South East Island)	1,233 km south west
	Nesting (Montebello Island – Hermite Island, NW Island, Trimouille Island)	1,248 km south west
	Mating (Montebello Island – Hermite Island, NW Island, Trimouille Island)	1,248 km south west
	Foraging (Montebello Isalnd – Hermite Island, NW Island, Trimouille Island)	1,248 km south west
	Nesting (Ah chong and South East Island)	1,250 km south west
	Nesting (Montebello Island, Trimoulle and NW Islands)	1,260 km south west
	Internesting buffer (Delambre Island (and other Dampier Archipelago Islands)	1,136 km south west

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Internesting buffer (Dampier Archipelago (islands to the west of the Burrup Peninsula	1,136 km south west
	Internesting (Elcho Island, Drysdale Island, Cunningham Islands, Wessel Islands (South))	1,249 km east
Loggerhead turtle	Foraging (Western Joseph Bonaparte Depression)	196 km north east
	Foraging (James Price Point)	565 km south west
	Foraging (De Grey River area to Bedout Island)	943 km south west
	Internesting buffer (Ningaloo coast and Jurabi coast)	1,449 km south west
	Nesting (Ningaloo coast and Jurabi coast)	1,462 km south west
	Internesting buffer (Murion Island)	1,414 km south west
	Nesting (Murion Island)	1,431 km south west
	Internesting buffer (Lowenthal Island)	1,250 km south west
	Internesting buffer (Montebello Islands)	1,238 km south west
	Nesting (Lowenthal Island)	1,267 km south west
	Nesting (Montebello Islands)	1,256 km south west
	Internesting buffer (Cohen Island)	1,133 km south west
Olive ridley turtle	Foraging (Western Joseph Bonaparte Depression)	196 km north east
	Foraging (Joseph Bonaparte Gulf)	325 km east
	Foraging (Joseph Bonaparte Gulf-banks_	338 km east
	Foraging (Northern Joseph Bonaparte Gulf)	402 km north east
	Internesting (Fog Bay to Cox Peninsula)	620 km east
	Foraging (Fog Bay)	627 km east

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Internesting (Bathurst Island/Melville Island – North-west	633 km north east
	Internesting (Melville Island – North)	715 km north east
	Internesting (Greenhill Island)	829 km north east
	Internesting (Islands north-east of Cobourg Peninsula)	916 km north east
	Internesting (Elcho Island, Drysdale Island, Cunningham Islands, Wessel Islands (South))	1,202 km east
Leatherback turtle	Internesting (Danger Point, Cobourg Peninsula)	864 km north east

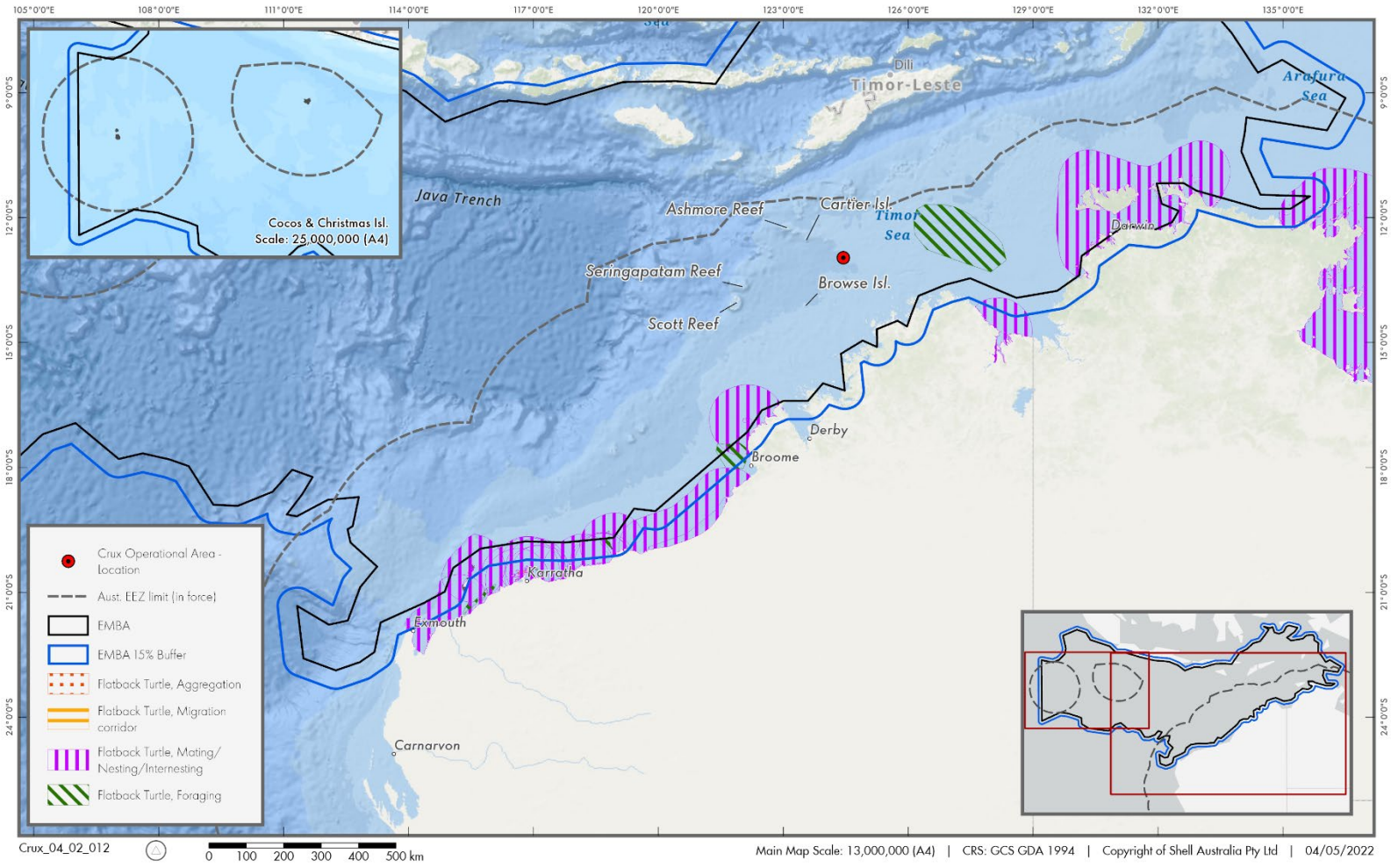


Figure 7-11: BIA's for flatback turtles within the EMBA

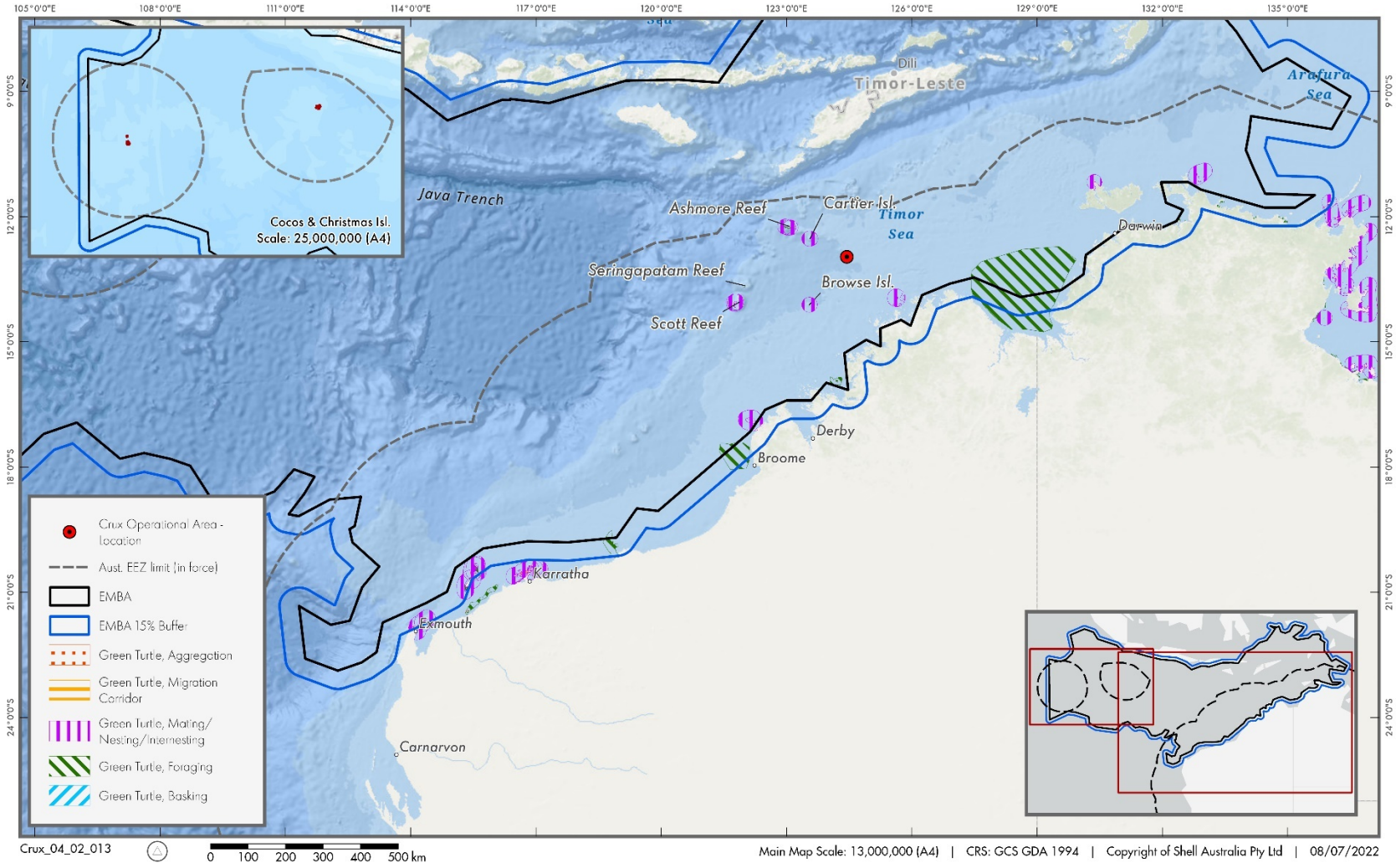


Figure 7-12: BIA's for green turtles within the EMBA

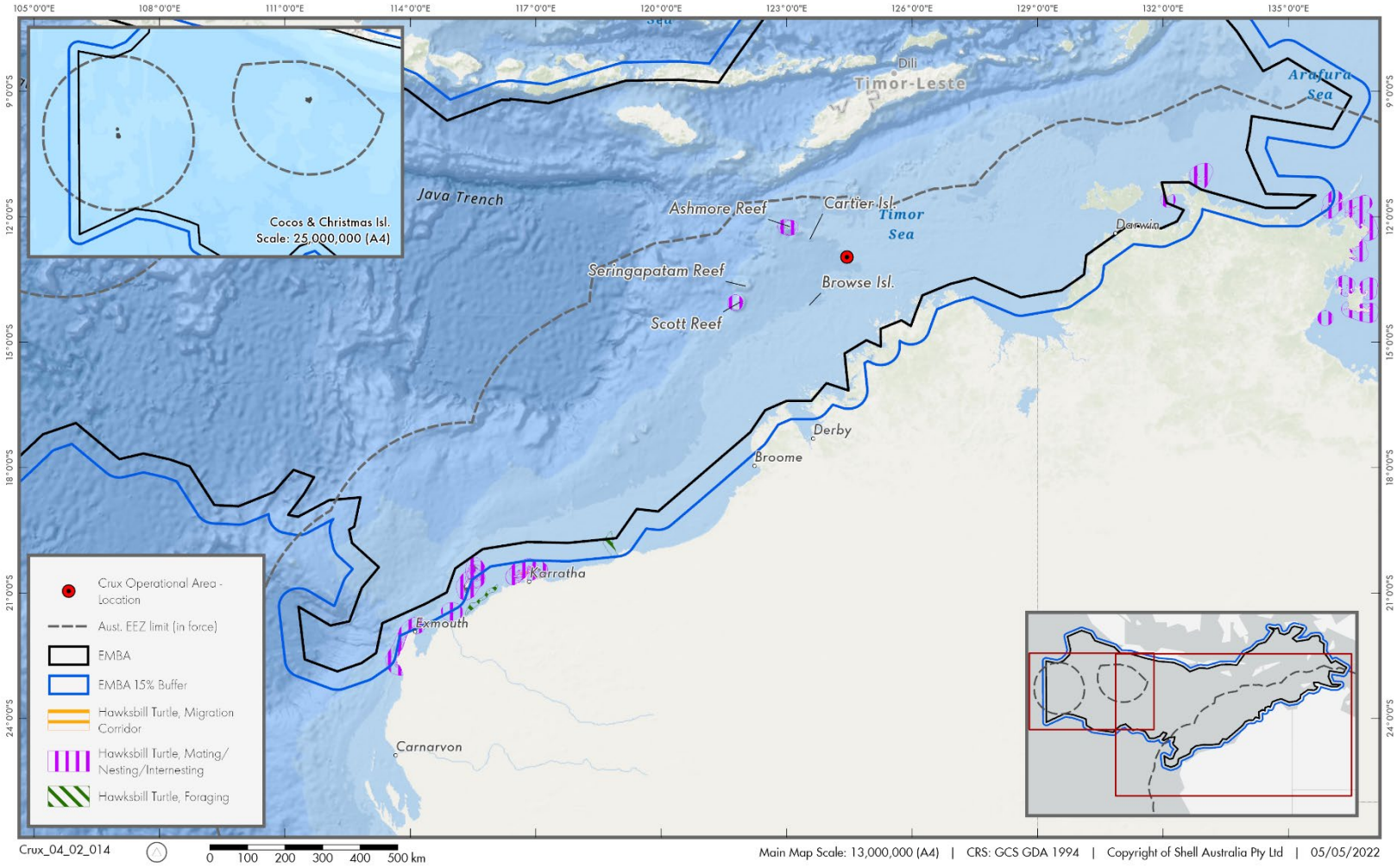


Figure 7-13: BIA's for hawksbill turtles within the EMBA

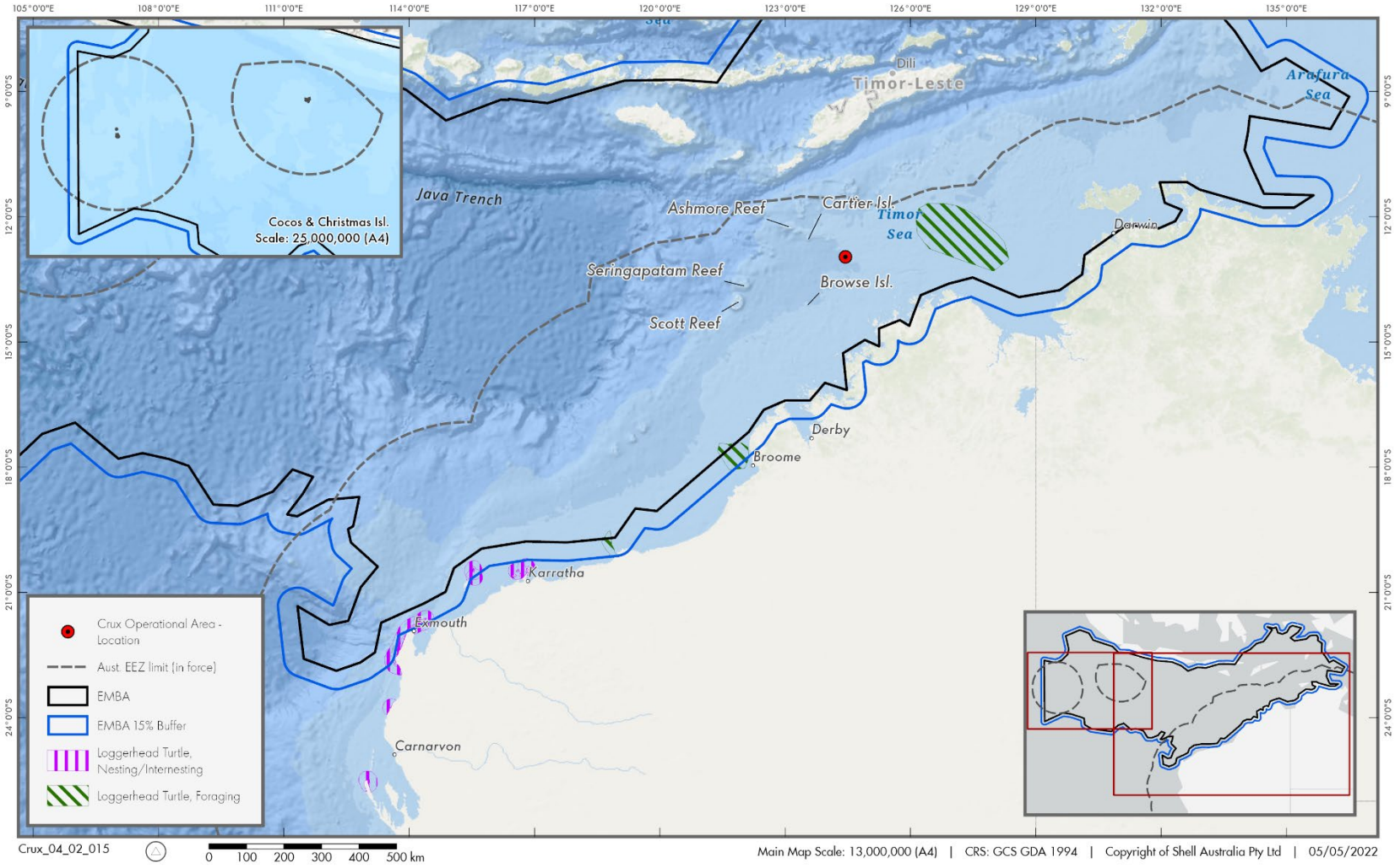


Figure 7-14: BIA's for loggerhead turtles within the EMBA

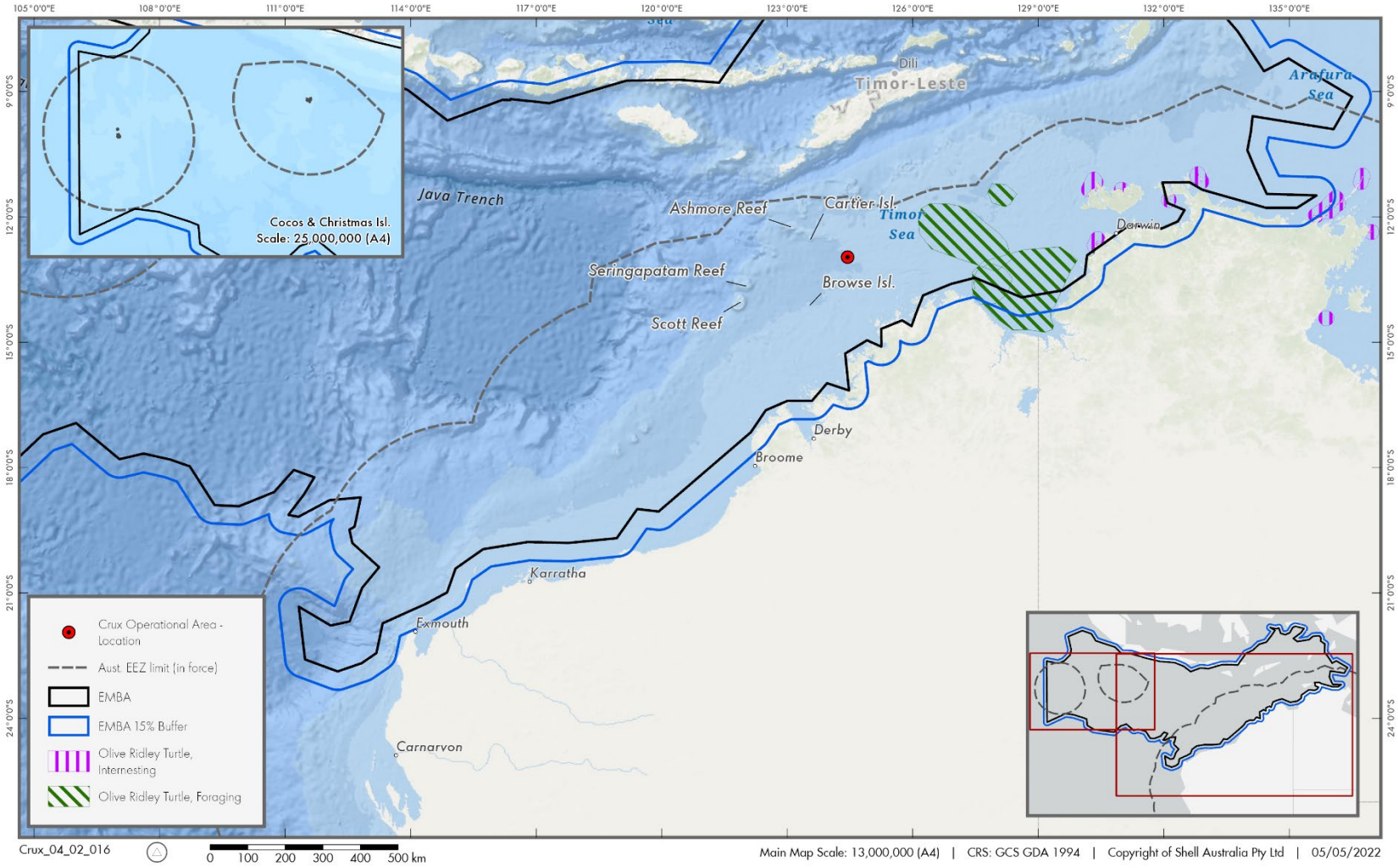


Figure 7-15: BIA's for olive ridley turtles within the EMBA

Table 7-10: Habitat Critical to the Survival of marine turtle species within the Operational Area and EMBA

Species	Genetic Stock	Nesting locations	Approximate distance of area from Operational Area	Internesting buffer	Nesting period	Hatching period
Green turtle	Ashmore Reef	Ashmore Reef and Cartier Reef	83 km north west	20 km	Year round (peak: Dec – Jan)	Sep - May
	Scott Reef – Browse Island	Scott Reef, Browse Island	138 km south west	20 km	Nov – Mar (peak Jan - Feb)	Mar - Apr
	North West Shelf	Mainland east of Mary Island to mainland adjacent to Murrara Island including all offshore islands, Adele Island.	145 km south east	20 km	Nov – Mar (peak Dec-Feb)	Jan - May (peak: Feb – Mar)
		Browse Island	139 km south west			
		Adele Island, Lacepede Islands	294 km south west			
		Exmouth Gulf and Ningaloo coast	1,444 km south west			
		Dampier Archipelago	1,119 km south west			
		Barrow Island, Montebello Islands, Serrier Island and Thevenard Island	1,231km south west			

Species	Genetic Stock	Nesting locations	Approximate distance of area from Operational Area	Internesting buffer	Nesting period	Hatching period
	Cobourg Peninsula	Croker Island and McCluer Island groups plus Black Point to Smith Point.	843 km east	20 km	Oct – April (peak: Dec – Jan)	Dec – May (peak: Feb – Mar)
	Gulf of Carpentaria	Cape Shield to Banyan Island	1,205 km east	20 km	Year round (peak: Jun-Jul)	Aug- Sep
	Cocos Keeling	Cocos Keeling Islands within the Pulu Keeling National Park	2,985 km west	N/A	Oct – Apr (peak: Dec - Jan	Dec – May (peak: Feb – May)
Flatback turtle	South-west Kimberly	Lacepe Islands	439 km south	60km	All year (peak: Dec - Jan)	All year
	Pilbara	Barrow Island, Montebello Islands, coastal islands from Cape Preston to Locker Island.	1,222 km south west	60 km	Oct – Mar (peak: Nov-Jan)	Feb- Mar
		Cemetary Beach, Port Hedland	966 km south west			
		Mundabullangana Beach	999 km south west			
		Dampier Archipelago, including Delambre Island and Huay Island	1,081 km south west			
	Arafura Sea	Waigait Beach to south of Point Blaze, including all offshore islands.	557 km east	60 km	All year (peak: Jun - Sep)	Jul - Sep

Species	Genetic Stock	Nesting locations	Approximate distance of area from Operational Area	Internesting buffer	Nesting period	Hatching period
		Brace Point to One Tree Point including all offshore islands	566 km east			
		Soldier Point to Pirlangimpi including Seagull Island,	593 km east			
		Waters between Melville Island and Vernon Islands,	672 km east			
		Field Island (Cobourg Peninsula),	809 km east			
		Crocodile Island Group,	1,079 km east			
		Cape Shield to Banyan Island (Wessel Islands and Gove Peninsula)	1,138 km east			
	South-west Kimberley	Eco Beach – coastal beach near Broome	591 km south west	60 km	All year (peak: Dec-Jan)	All year
		Eighty mile beach – coastal beach	690 km south west			
	Cape Domett	Cape Domett and Lacrosse Island in the Cambridge Gulf	428 km south east	60 km	All yeas (peak: Aug – Sep)	All year

Species	Genetic Stock	Nesting locations	Approximate distance of area from Operational Area	Internesting buffer	Nesting period	Hatching period
Hawksbill turtle	North-east Arnhem Land	New Year Island	942 km east	20 km	May – Nov (peak Aug)	Year round (peak: Aug – Nov)
		English Company Islands inc. Truant and Bromby Islands, and Wessel Island group	1,205 km east			
	Western Australia	Dampier Archipelago, including Delambre Island ad Rosemary Island	1,119 km south west	20 km	All year (peak: Oct – Jan)	All year (peak: Dec – Feb)
		Cape Preston to mouth of Exmouth Gulf including Montebello islands and Lowendal islands	1,231km south west			
Olive ridley turtle	Unknown genetic stock Kimberley, Western Australia	Vulcan Island	230 km south	20 km	May - Jul	Year round (peak: Jun-Aug)
		Darcy Island	244 km south			
		Cape Leveque	393 km south south east			
		Prior Point and Llanggi	280 km south			
	Northern Territory	Brace Point to One Tree Point, including all offshore islands	600 km east	20km		Year round (peak: Jun-Aug)

Species	Genetic Stock	Nesting locations	Approximate distance of area from Operational Area	Internesting buffer	Nesting period	Hatching period
		Soldier point to Pirlangimpi including Seagull Island	626 km east		Year round (peak: Apr-Jun)	
		Croker Island, Cobourg Peninsula, west of Murganella to the West Alligator River,	798 km east			
		Crocodile Island Group.	1,121 km east			
		English Company Islands inc. Truant and Bromby Islands, and Wessel Islands group	1,205 km east			
Leatherback turtle	Australia	All sandy beaches from Coburg Peninsula to Cape Arnhem including Danger Point Wessel Islands and Elcho Island	795 km east	20 km	Dec - Jan	Jan - Feb
Loggerhead turtle	Western Australia	Exmouth Gulf and Ningaloo coast	1,444 km south west	20km	Nov-Mar (peak Jan)	Jan - May

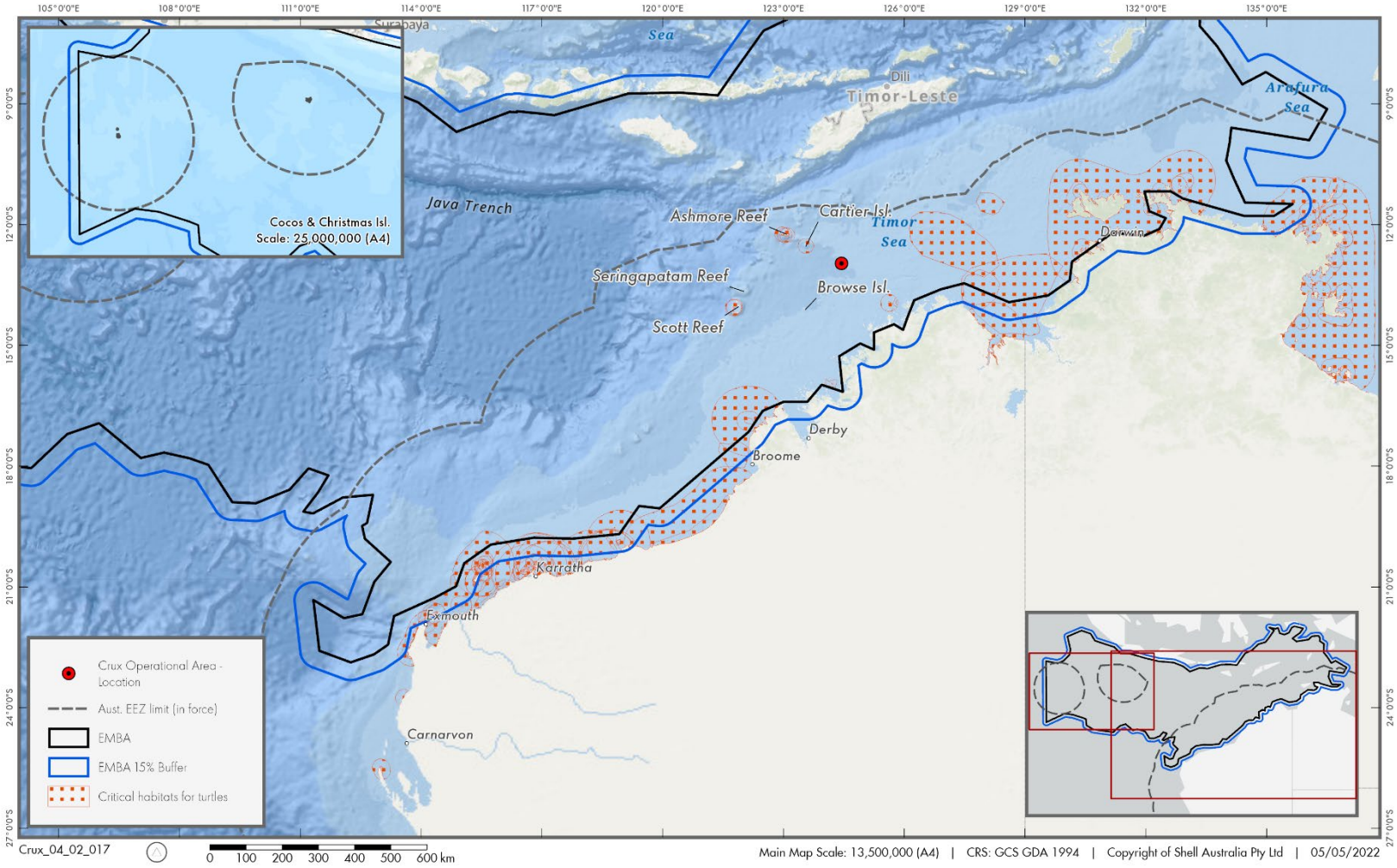


Figure 7-16: Habitat critical for the survival of marine turtles within the EMBA

7.3.5.3 Fish, Sharks and Rays

Table 7-11provides a list of EPBC Act listed threatened and migratory fish, sharks and rays that may occur within the Operational Area and/or EMBA.

Table 7-11: EPBC Act listed threatened and migratory Fish, Sharks and Rays that may occur within the Operational Area and/or EMBA

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Anoxypristis cuspidata	Narrow sawfish	N/A	Migratory	Species or species habitat may occur within area	✓
Carcharodon carcharias	White shark	Vulnerable	Migratory	Species or species habitat may occur within area	✓
Glyphis garricki	Northern river shark	Endangered	N/A	Species or species habitat may occur within area	✓
Isurus oxyrinchus	Shortfin mako	N/A	Migratory	Species or species habitat likely to occur within area	✓
Isurus paucus	Longfin mako	N/A	Migratory	Species or species habitat likely to occur within area	✓
Pristis pristis	Freshwater sawfish	Vulnerable	Migratory	Species or species habitat known to occur within area	✓
Pristis zijsron	Green sawfish	Vulnerable	Migratory	Species or species habitat known to occur within area	✓
Rhincodon typus	Whale shark	Vulnerable	Migratory	Foraging, feeding or related behaviour known to occur within area	✓
Carcharhinus longimanus	Oceanic whitetip shark	N/A	Migratory	Species or species habitat may occur within area	✓
Manta alfredi	Reef manta ray	N/A	Migratory	Species or species habitat likely to occur within area	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Manta birostris	Giant manta ray	N/A	Migratory	Species or species habitat likely to occur within area	✓
Sphyrna lewini	Scalloped hammerhead	Conservation dependent	N/A	Species or species habitat likely to occur within area	✓
Thunnus maccoyii	Southern bluefin tuna	Conservation Dependent	Migratory	Breeding known to occur within area	✓
Carcharias taurus (west coast population)	Grey nurse shark (west coast population)	Vulnerable	N/A	x	✓
Lamna nasus	Porbeagle	N/A	Migratory	x	✓
Pristis clavata	Dwarf sawfish	Vulnerable	Migratory	x	✓
Gylphis glyphis	Speartooth shark	Critically Endangered	Migratory	x	✓

Table 7-12 provides a list of reptile BIA's that may occur within the Operational Area and/or EMBA.

Table 7-12: BIA's of Fish, Sharks and Rays that overlap the Operational Area or EMBA

Common Name	BIA Behaviour	Distance from Operational Area (km)
Sharks and Rays		
Whale shark	Foraging (Northward from Ningaloo along 200 m isobath)	Overlap
	Foraging (high density prey (Ningaloo Marin park and adjacent Commonwealth waters)	1,476 km south west
Freshwater sawfish	Foraging (King Sound – tidal tributaries)	410 km south
	Nursing (King Sound – tidal tributaries)	410 km south
	Nursing (King Sound – tidal tributaries)	419 km south
	Foraging (King Sound – tidal tributaries)	419 km south
Dwarf sawfish	Foraging (Camden Sound – eastern shore)	258 km south
	Pupping (Fitzroy River Mouth, May & Robinson River – tidal tributaries)	419 km south
	Juvenile (Fitzroy River Mouth, May & Robinson River – tidal tributaries)	419 km south
	Nursing (Fitzroy River Mouth, May & Robinson River – tidal tributaries)	419 km south
Green sawfish	Foraging (Camden Sound)	258 km south
	Foraging (Cape Leveque)	410 km south south west
	Pupping (Cape Leveque)	410 km south south west

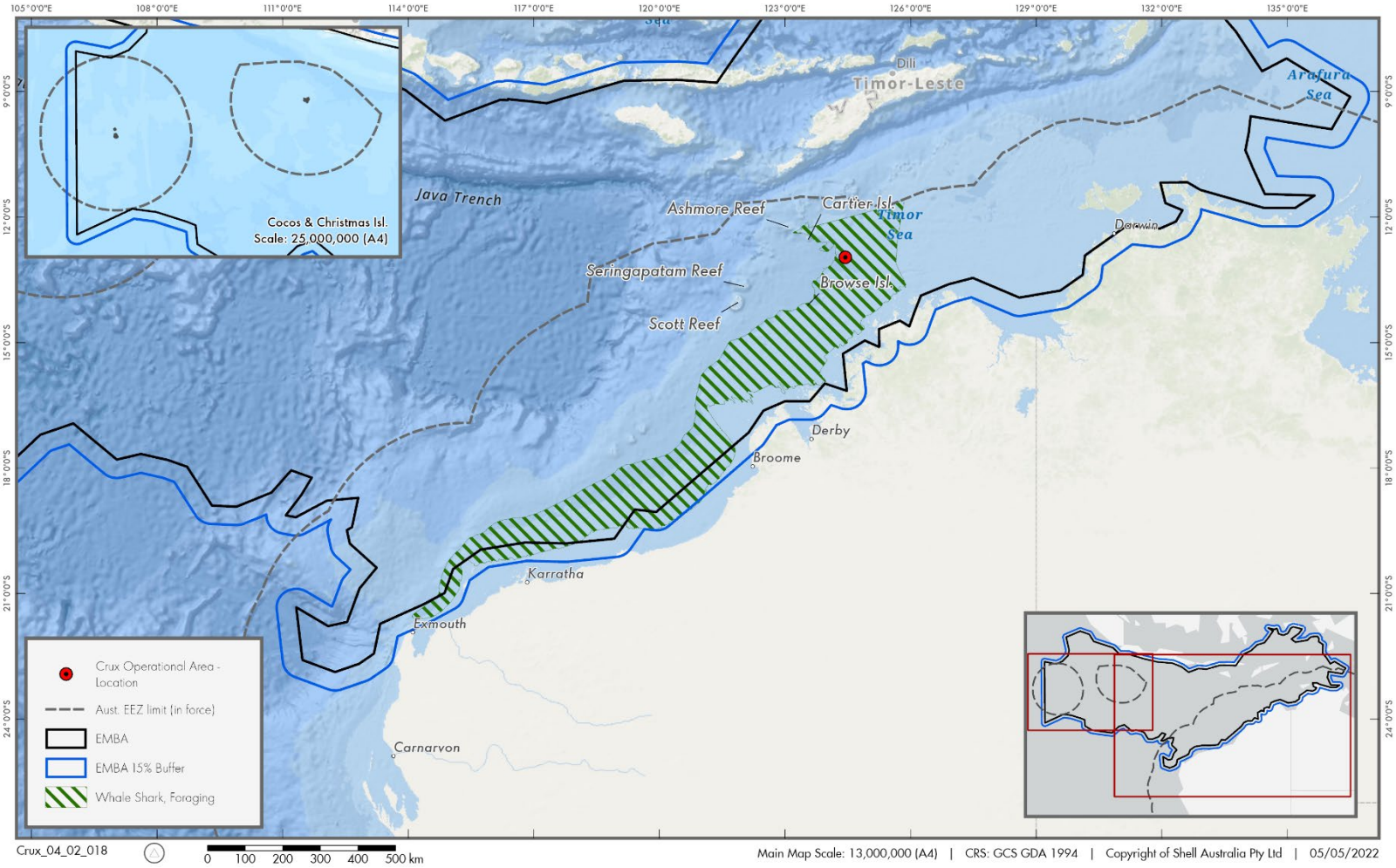


Figure 7-17: BIA's for whale sharks within the EMBA

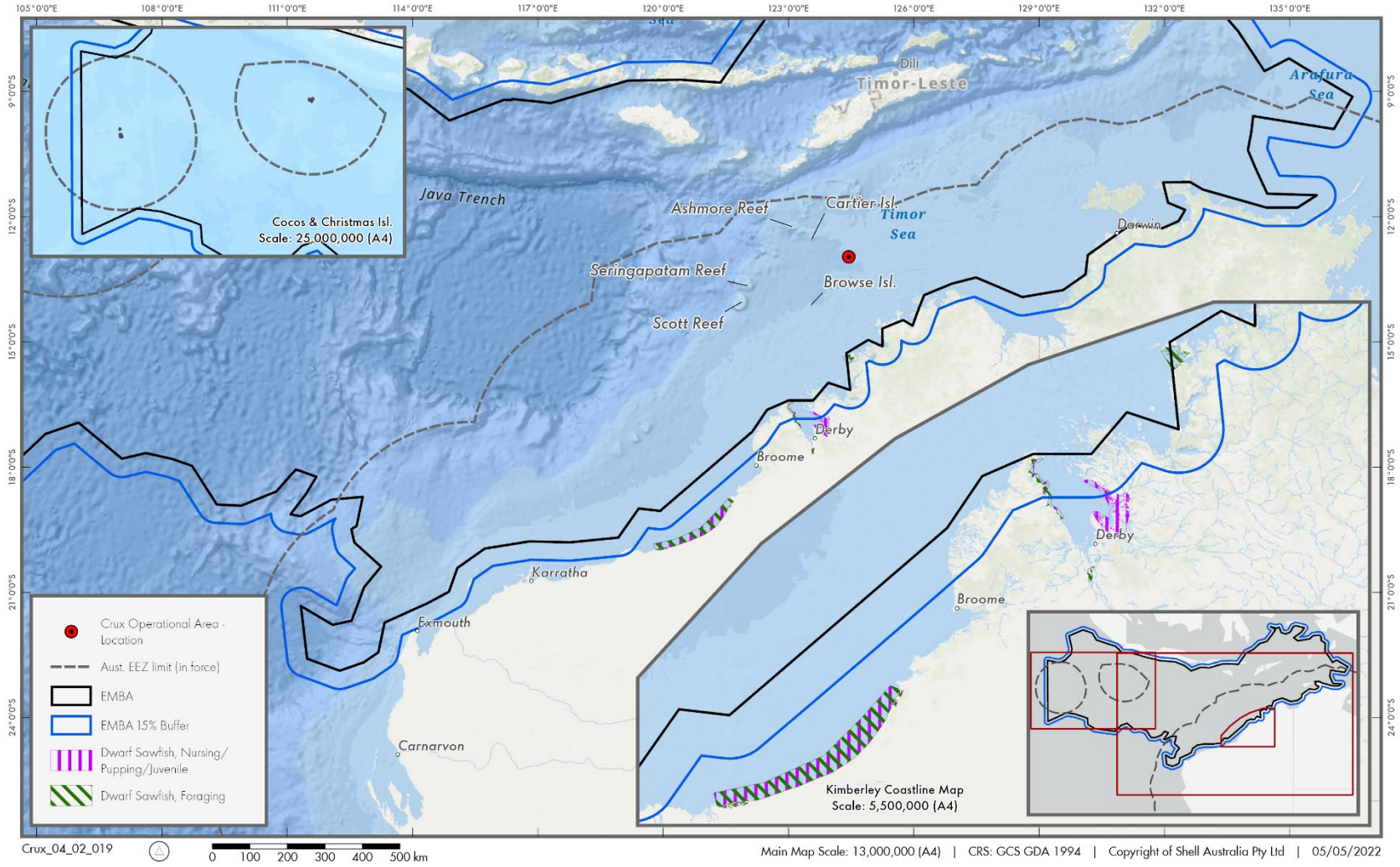


Figure 7-18: BIA's for dwarf sawfish within the EMBA

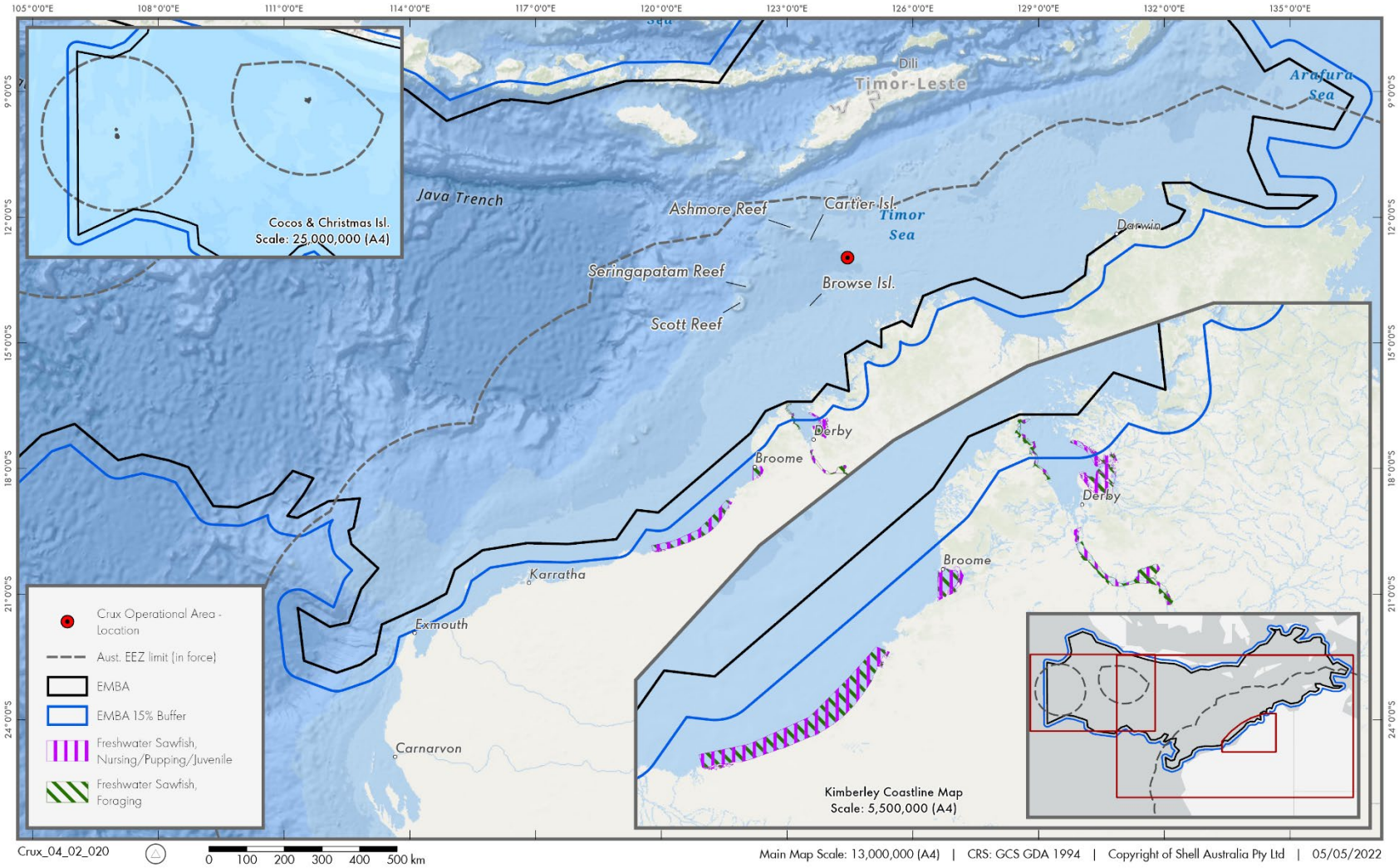


Figure 7-19: BIA's for freshwater sawfish within the EMBA

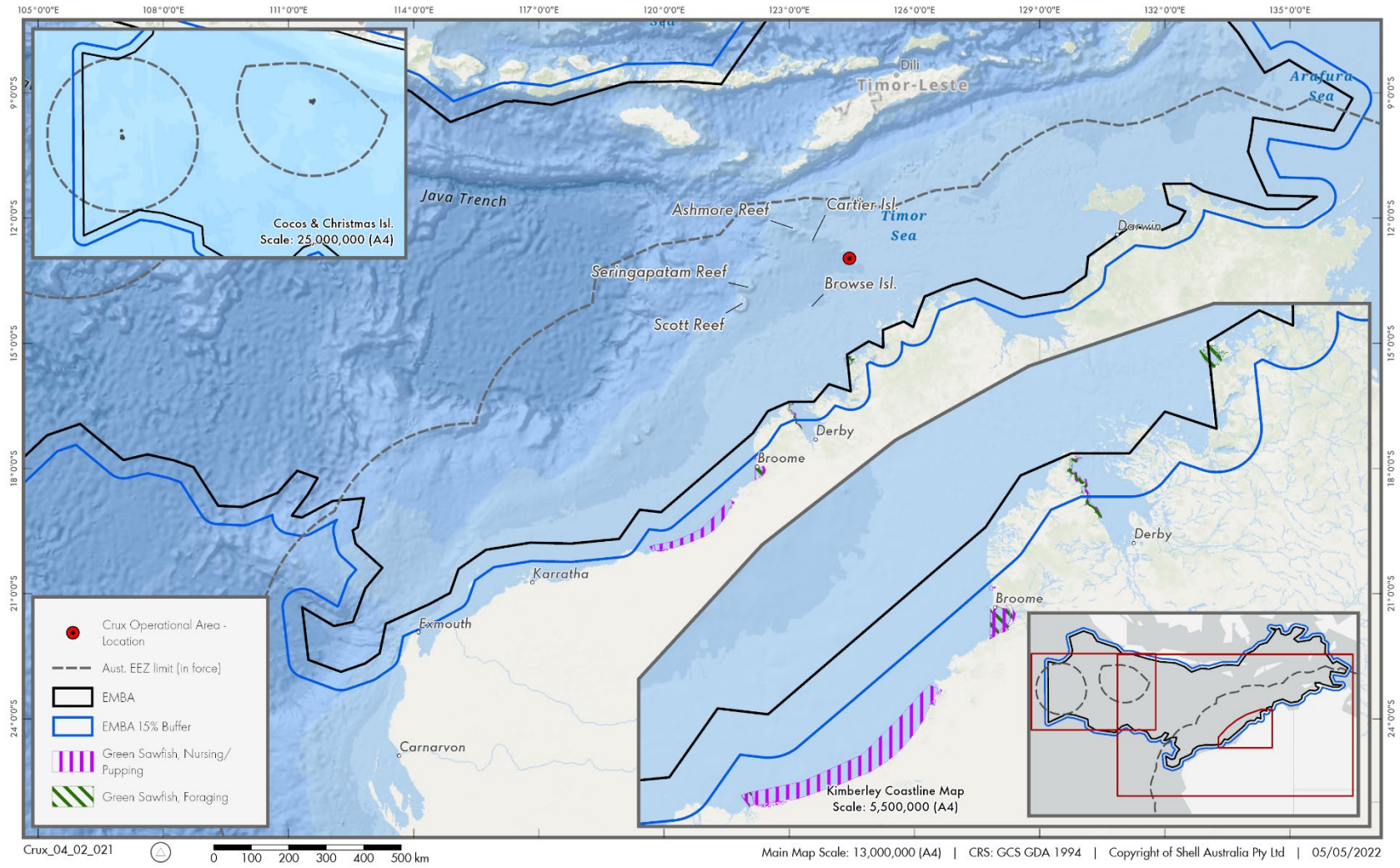


Figure 7-20: BIA's for green sawfish within the EMBA

7.3.5.4 Birds

Table 7-13 provides a list of EPBC Act listed threatened and migratory birds that may occur within the Operational Area and/or EMBA.

Table 7-13 EPBC Act listed threatened and migratory birds that may occur within the Operational Area and/or EMBA

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Actitis hypoleucos	Common sandpiper	N/A	Migratory	Species or species habitat may occur within area	✓
Anous stolidus	Common noddy	N/A	Migratory	Foraging, feeding or related behaviour likely to occur	✓
Anous tenuirostris melanops	Australian lesser noddy	Vulnerable	N/A	Foraging, feeding or related behaviour likely to occur	✓
Calidris acuminata	Sharp-tailed sandpiper	N/A	Migratory	Species or species habitat may occur within area	✓
Calidris canutus	Red knot	Endangered	Migratory	Species or species habitat may occur within area	✓
Calidris ferruginea	Curlew sandpiper	Critically endangered	Migratory	Species or species habitat may occur within area	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Calidris melanotos	Pectoral sandpiper	N/A	Migratory	Species or species habitat may occur within area	✓
Calonectris leucomelas	Streaked shearwater	N/A	Migratory	Species or species habitat may occur within area	✓
Fregata ariel	Lesser frigatebird	N/A	Migratory	Species or species habitat may occur within area	✓
Fregata minor	Great frigatebird	N/A	Migratory	Species or species habitat may occur within area	✓
Numenius madagascariensis	Eastern curlew	Critically endangered	Migratory	Species or species habitat may occur within area	✓
Papasula abbotti	Abbott's booby	Endangered	N/A	Species or species habitat may occur within area	✓
Ardenna carneipes	Flesh-footed shearwater	N/A	Migratory	x	✓
Ardenna pacifica	Wedge-tailed shearwater	N/A	Migratory	x	✓
Arenaria interpres	Ruddy turnstone	N/A	Migratory	x	✓
Calidris alba	Sanderling	N/A	Migratory	x	✓
Calidris ruficollis	Red-necked stint	N/A	Migratory	x	✓
Calidris tenuirostris	Great knot	Critically endangered	Migratory	x	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Charadrius leschenaultii	Greater sand plover	Vulnerable	Migratory	x	✓
Charadrius mongolus	Lesser sand plover	Endangered	Migratory	x	✓
Charadrius veredus	Oriental plover	N/A	Migratory	x	✓
Fregata andrewsi	Christmas Island frigatebird	Endangered	Migratory	x	✓
Glareola maldivarum	Oriental pratincole	N/A	Migratory	x	✓
Hydroprogne caspia	Caspian tern	N/A	Migratory	x	✓
Limicola falcinellus	Broad-billed sandpiper	N/A	Migratory	x	✓
Limnodromus semipalmatus	Asian dowitcher	N/A	Migratory	x	✓
Limosa lapponica	Bar-tailed godwit	N/A	Migratory	x	✓
Limosa lapponica baueri	Bar-tailed godwit (baueri)	Vulnerable	N/A	x	✓
Limosa lapponica menzbieri	Northern Siberian bar-tailed godwit	Critically endangered	N/A	x	✓
Limosa limosa	Black-tailed godwit	N/A	Migratory	x	✓
Macronectes giganteus	Southern giant-petrel	Endangered	Migratory	x	✓
Numenius phaeopus	Whimbrel	N/A	Migratory	x	✓
Onychoprion anaethetus	Bridled tern	N/A	Migratory	x	✓
Pandion haliaetus	Osprey	N/A	Migratory	x	✓
Phaethon lepturus	White-tailed tropicbird	N/A	Migratory	x	✓
Phaethon lepturus fulvus	Christmas Island white-tailed tropicbird	Endangered	N/A	x	✓
Phaethon rubricauda	Red-tailed tropicbird	N/A	Migratory	x	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Pluvialis fulva	Pacific golden plover	N/A	Migratory	x	✓
Pluvialis squatarola	Grey plover	N/A	Migratory	x	✓
Pterodroma mollis	Soft-plumaged petrel	Vulnerable	N/A	x	✓
Pterodroma arminjoniana	Round island petrel	Critically Endangered	N/A	x	✓
Rostratula australis	Australian painted-snipe	Endangered	Migratory	x	✓
Sterna dougallii	Roseate tern	N/A	Migratory	x	✓
Sternula albifrons	Little tern	N/A	Migratory	x	✓
Sternula nereis nereis	Australian fairy tern	Vulnerable	N/A	x	✓
Sula dactylatra	Masked booby	N/A	Migratory	x	✓
Sula leucogaster	Brown booby	N/A	Migratory	x	✓
Sula sula	Red-footed booby	N/A	Migratory	x	✓
Thalassarche carteri	Indian yellow-nosed albatross	Vulnerable	Migratory	x	✓
Thalassarche impavida	Campbell albatross	Vulnerable	Migratory	x	✓
Acrocephalus orientalis	Oriental reed-warbler	N/A	Migratory	x	✓
Calidris ruficollis	Red-necked stint	N/A	Migratory	x	✓
Calidris subminuta	Long-toed stint	N/A	Migratory	x	✓
Charadrius dubius	Little ringed plover	N/A	Migratory	x	✓
Gallinago megala	Swinhoe's snipe	N/A	Migratory	x	✓
Gallinago stenura	Pin-tailed snipe	N/A	Migratory	x	✓
Thalasseus bergii	Pluvialis squatarola	N/A	Migratory	x	✓
Tringa brevipes	Grey-tailed tattler	N/A	Migratory	x	✓

Species Name	Common Name	Threatened Status	Migratory Status	Operational Area	EMBA
Tringa glaereola	Wood sandpiper	N/A	Migratory	x	✓
Tringa incana	Wandering tattler	N/A	Migratory	x	✓
Tringa nebularia	Common greenshank	N/A	Migratory	x	✓
Tringa stagnatilis	Marsh sandpiper	N/A	Migratory	x	✓
Tringa totanus	Common redshank	N/A	Migratory	x	✓
Xenus cinereus	Terek sandpiper	N/A	Migratory	x	✓
Apus pacificus	Fork-tailed swift	N/A	Migratory	x	✓

Table 7-14 provides a list of bird BIA's that may occur within the Operational Area and/or EMBA.

Table 7-14: Bird BIA's within the Operational Area or EMBA

Common Name	BIA Behaviour	Distance from Operational Area (km)
Red-footed booby	Breeding (North west Kimberley and Ashmore Reef, including Ashmore Reef and Adele Island)	56 km north west
Greater frigatebird	Breeding (Kimberley and Ashmore Reef including Adele Island)	56 km north west
Lesser frigatebird	Breeding (Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef, Adele Island, Lacepede Islands, Bedout Island and Sand Island)	60 km north west
Wedge-tailed shearwater	Breeding (Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef, Barrow Island, Dampier Archipelago)	60 km north west
White-tailed tropicbird	Breeding (Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef, and Cunningham Island)	65 km north west

Common Name	BIA Behaviour	Distance from Operational Area (km)
Brown booby	Breeding (Kimberley and northern Pilbara coasts and islands including Ashmore Reef, Vulcan Islands, Adele Island, Lacepede Islands and Bedout Island)	117 km north west
Lesser crested tern	Breeding (Kimberley, Pilbara and Gascoyne coasts and islands including Ashmore Reef, Bedout Island, Lacepede Islands, Adele Island, Bigge Island, Montalivet Islands, Descartes Island, Thevenard Island, and Lowendal Islands)	139 km north west
Little tern	Resting (Kimberley, Pilbara and Gacoyne coasts and islands including Ashmore Reef, Scott Reef, Adele Island, and Bedwell Island.	153 km north west
	Breeding (Kimberley, Pilbara and Gascoyne coasts and islands including, Kingfisher Islands, Sunday Island, Dampier Peninsula, Corneille Islands, and coastal near Broome)	172 km south east
Roseate tern	Breeding (Kimberley, Pilbara and Gascoyne coasts and islands including, Ashmore Reef, Montalivet Islands, Corneille Island, Sir Graham Moore Island, Sunday Island, Lacepe Islands, Bedout Island, Ningaloo Coast, Airlie Island, Lowendal Islands, Montebello Islands, Dampier Archipelago and Legendre Island)	140 km north west
	Breeding (Low Rocks and Stern Island in Admiralty Gulf)	164 km south east
	Breeding (North-east and North-west Twin Islet near the mouth of King sound)	366 km south west
	Breeding (high numbers) (Grant Island)	919 km east
	Breeding (Haul Round Island (Boucat Bay))	1,049 km east
	Breeding (high numbers) (Small sand, rock and mangrove island between Stevens and Burgungurra Islands)	1,259 km east
Crested Tern	Breeding (high numbers) (Seagull Island, off NW of Cape Van Diemen, Melville Island.	653 km north east
	Breeding (No. 2 Sandy Island (Cobourg))	859 km north east

Common Name	BIA Behaviour	Distance from Operational Area (km)
	Breeding (Haul Round Island (Boucat Bay)	1,050 km east
	Breeding (NW Crocodile, NE of Milingimbi (Large Island))	1,152 km east
Bridled tern	Breeding (No. 2 Sandy Island (Cobourg))	859 km north east
	Breeding (Cowlard Island)	911 km north east
	Breeding (NE Crocodile, NE of Milingimbi)	1,176 km east
	Breeding (Haul Round Island (Boucat Bay))	1,057 km east
	Breeding (Island west of Abbott Island / Elcho Island airstrip)	1,196 km east
	Breeding (Small Island South of Alger Island)	1,243 km east
Australian Fairy Tern	Breeding (Pilbara and Gascoyne coasts and islands, including Ningaloo coast, Thevenard Island, Barrow Island, Hermite Island, Dampier Archipelago)	1,141 km south west

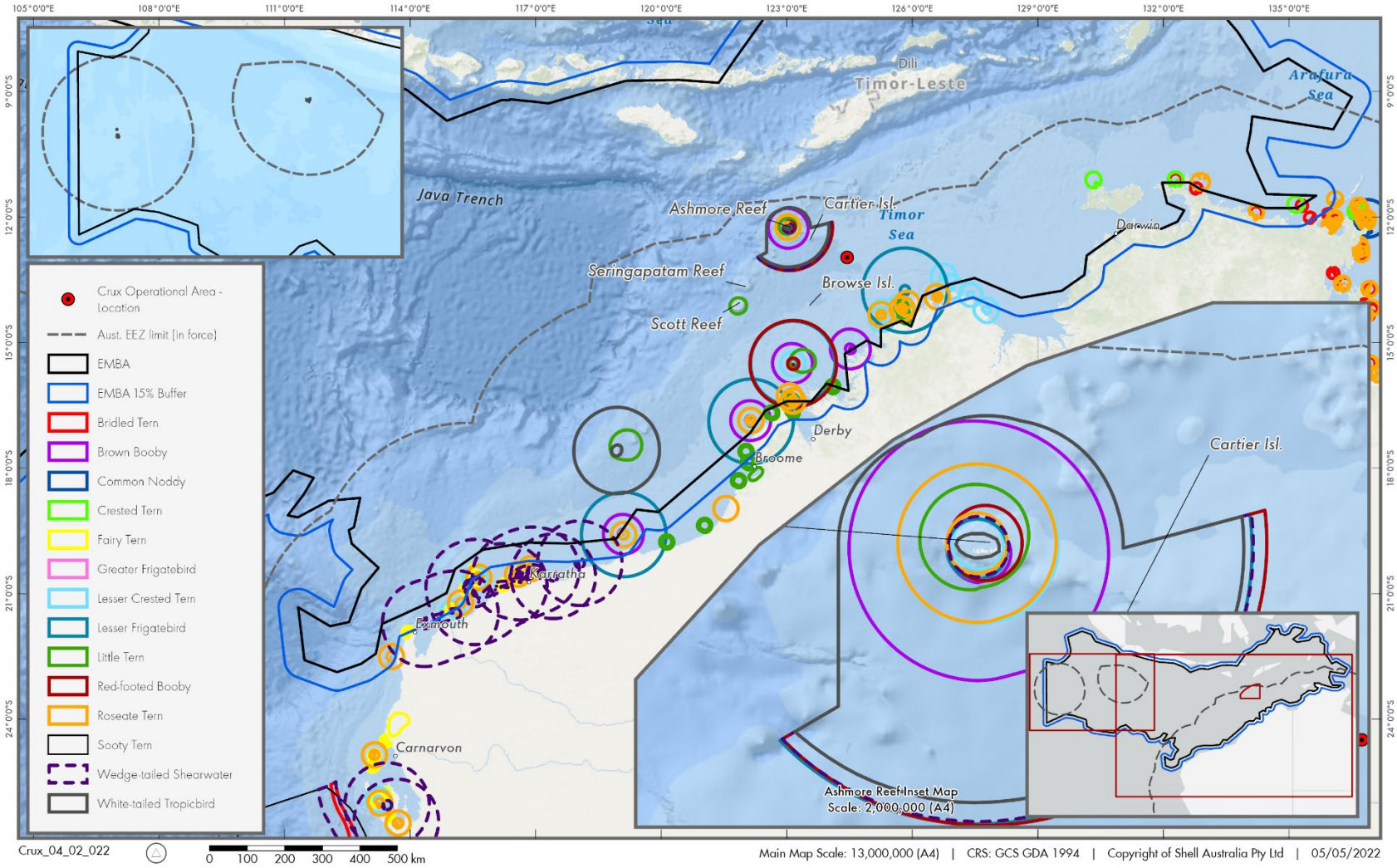


Figure 7-21: BIA's of birds within the EMBA

7.3.5.5 Seasonal Sensitivities of Threatened Species

Periods of the year coinciding with key environmental sensitivities for the Operational Area and EMBA, including EPBC Act listed threatened and/or migratory species potentially occurring within the Operational Area, are presented in Table 7-15. These relate to breeding, foraging or migration of the indicated fauna.

Table 7-15: Key environmental sensitivities and indicative timings for migratory fauna within the Operational Area and EMBA (North-west and North Marine Region)

Species	January	February	March	April	May	June	July	August	September	October	November	December
Mammals												
Blue whale – northern migration (Exmouth, Montebello, Scott Reef)[1]												
Blue whale – southern migration (Exmouth, Montebello, Scott Reef)[2]												
Humpback whale – northern migration (Jurien Bay to Montebello)[3]												
Humpback whale – southern migration (Jurien Bay to Montebello)[4]												
Fish, Sharks and Rays												
Whale shark* – foraging/ aggregation near Ningaloo[5]												
Manta rays – presence/ aggregation/breeding (Ningaloo)[6]												
Reptiles												
Green turtle[7]	N,H	N,H	H	H	H	N	N	H	H	H	H	N,H
Hawksbill turtle[7]	N,H	H						N,H	H	N,H	N,H	N,H
Olive ridley turtle[7]				N	N	N,H	N,H	H				
Flatback turtle[7]	N,H	H	H	H	H	N,H	N,H	N,H	N,H	N,H	N,H	N,H

Species	January	February	March	April	May	June	July	August	September	October	November	December
Leatherback turtle[7]	N,H	H										N
Loggerhead turtle[7]	N,H	H	H	H	H							
Birds												
Migratory shorebirds[6]												

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

1 – DSEWPAC, 2012a; McCauley and Jenner, 2010;
2 – DSEWPaC, 2012a; McCauley and Jenner, 2010
3 – CALM, 2005; Jenner et al, 2001; McCauley and Jenner, 2001, Double et al., 2012
4 – McCauley and Jenner, 2001
5 – TSSC, 2015a; Wilson et al., 2006
6 – CALM, 2005, DSEWPaC, 2012a, Environment Australia, 2002, Sleeman et al., 2010
7 – Commonwealth of Australia, 2017a
8 – Rogers et al., 2011

7.3.5.6 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 7-16) for threatened species identified within the EMBA were considered to identify any aspects that may be applicable to the risk assessment (Section 9.14).

Table 7-16: 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) (TSSC 2015b)	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 Biodiversity Conservation Act 1999 2015-2025 (Commonwealth of Australia 2015a)	Noise interference	Assessing and addressing anthropogenic noise.
		Vessel disturbance	Minimising vessel collisions
Fin whale	Approved conservation advice for *Balaenoptera physalus* (fin whale) (TSSC 2015c)	Noise interference	Assessing and addressing anthropogenic noise
		Vessel disturbance	Minimising vessel collisions
		Vessel disturbance	Addressing vessel collisions

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
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 2012b)	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, 2017a)	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) (DEWHA 2008b)	Vessel disturbance	No explicit relevant management actions; vessel strikes identified as a threat
Short-nosed sea snake	Approved conservation advice for *Aipysurus apraefrontalis* (short-nosed sea snake) (DSEWPaC 2011a)	No additional threats identified (ex. marine debris)	None applicable
Leaf-scaled sea snake	Approved conservation advice for *Aipysurus foliosquama* (leaf-scaled sea snake) (DSEWPaC 2011b)	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
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) (TSSC 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 (DEWHA 2008c)	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 (TSSC 2015a)	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*) (Commonwealth of Australia 2014)	No additional threats identified (ex. marine debris)	None applicable
Dwarf sawfish	Approved conservation advice for *Pristis clavata* (dwarf sawfish) (DEWHA 2009a)	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
Freshwater sawfish	Approved conservation advice for *Pristis pristis* (largetooth sawfish) (TSSC 2014b)	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
Speartooth Shark	Approved conservation advice for Glyphis glyphis (speartooth shark) (TSSC 2014c)	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
Birds			
Migratory shorebird species[2]	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[3]	Draft national recovery plan for threatened albatrosses and giant petrels (DSEWPaC 2021)	Marine pollution	No explicit relevant management actions; pollution identified as a threat
Australian lesser noddy	Approved conservation advice for *Anous tenuirostris*	Habitat degradation / modification	No explicit relevant management actions; habitat

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

[3] Several albatrosses and giant petrels were identified as potentially occurring: southern giant-petrel, soft-plumaged petrel, Indian yellow-nosed albatross, Campbell albatross,

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
	melanops (Australian lesser noddy) (TSSC 2015d)		degradation/ modification identified as a threat
Red knot, knot	Approved conservation advice for *Calidris canutus* (Red knot) (TSSC 2016a)	Pollution / contamination	No explicit relevant management actions; pollution identified as a threat
Australian fairy tern	Approved conservation advice for Sternula nereis nereis (fairy tern) (DSEWPaC 2011c)	Oil spills	Ensure appropriate oil-spill contingency plans are in place for breeding sites which are vulnerable to oil spills.
Curlew sandpiper	Conservation advice *Calidris ferruginea* curlew sandpiper (TSSC 2015e)	Pollution / contamination	No explicit relevant management actions; pollution identified as a threat
Eastern curlew	Conservation advice *Numenius madagascariensis* eastern curlew (TSSC 2015f)	Pollution / contamination	No explicit relevant management actions; pollution identified as a threat
Abbott's booby	Approved Conservation Advice for *Papasula abbotti* (Abbott's booby) (TSSC 2015g)	No threats identified	None applicable
Great knot	Conservation advice *Calidris tenuirostris* great knot (TSSC 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) (TSSC 2016c)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Lesser sand plover	Approved Conservation Advice for *Charadrius mongolus* (Lesser sand plover) (TSSC 2016d)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Soft-plumaged petrel	Conservation advice *Pterodroma mollis*	Habitat degradation / modification	No explicit relevant management actions; habitat

Species / Sensitivity	Recovery plan / conservation advice (date issued)	Key threats identified in the recovery plan/conservation advice	Relevant Conservation Actions
	soft-plumage petrel (TSSC 2015g)		degradation/ modification identified as a threat
Bar-tailed godwit (baueri)	Approved Conservation Advice for *Limosa lapponica baueri* (Bar-tailed godwit (western Alaskan) (TSSC 2016e)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat
Northern siberian bar-tailed godwit	Conservation advice Limosa lapponica menzbieri, Bar-tailed godwit (northern Siberian) (TSSC 2016f)	Habitat degredation	No explicit relevant management actions
		Pollution	
		Direct mortality (e.g. collisions, oil spills)	
Australian painted snipe	Approved Conservation Advice on *Rostratula australis* (Australian Painted Snipe) (TSSC 2013)	Habitat degradation / modification	No explicit relevant management actions; habitat degradation/ modification identified as a threat

7.3.6 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. Each of these MPAs is identified in Table 7-17**,** Figure 7-22, and Figure 7-23 and described in Section 6.6.8 of the Master Existing Environment.

All AMPs and many State and Territory 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 risk assessment in Section 9.14.

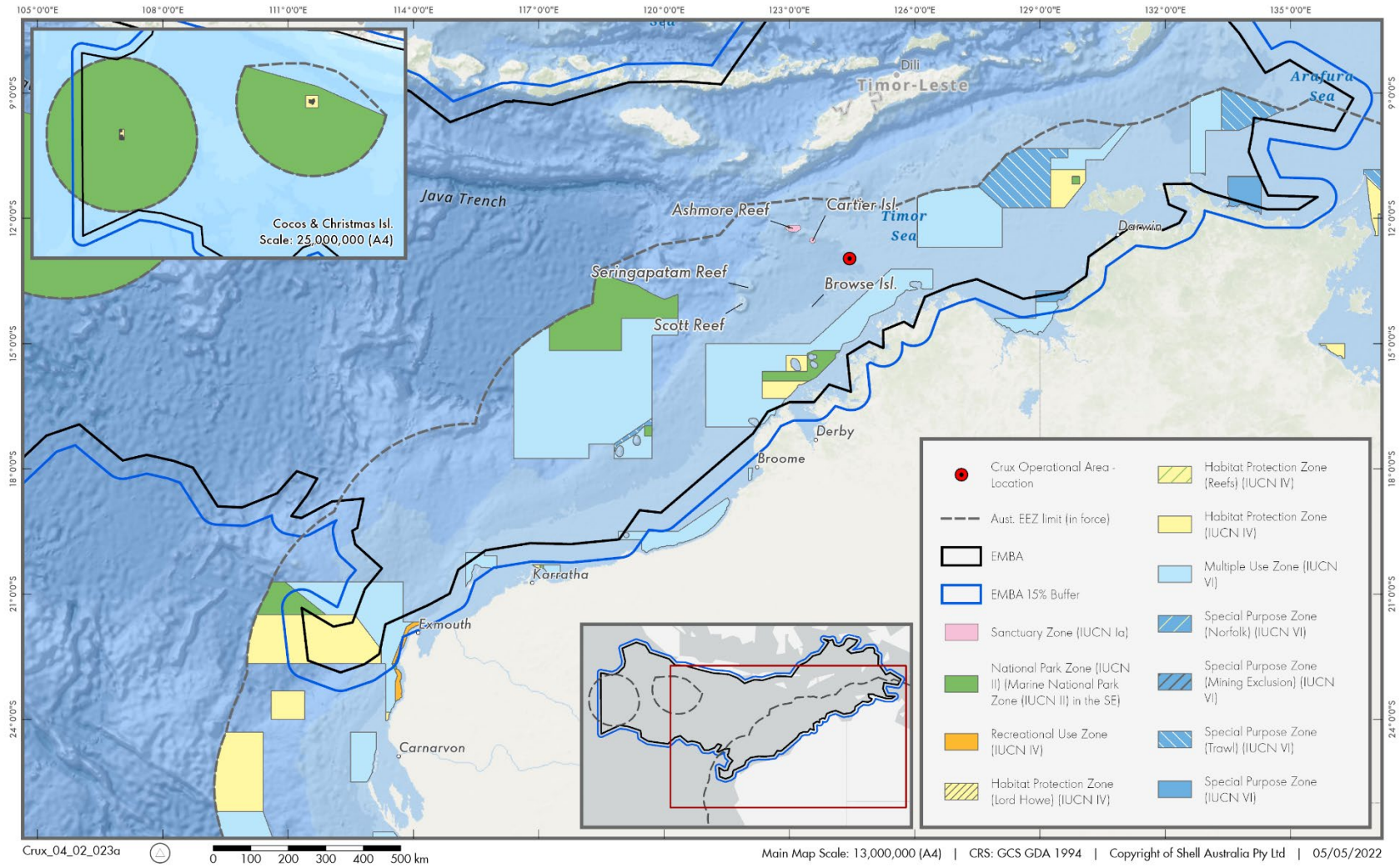


Figure 7-22: Commonwealth and State/Territory Marine Protected Areas within the EMBA

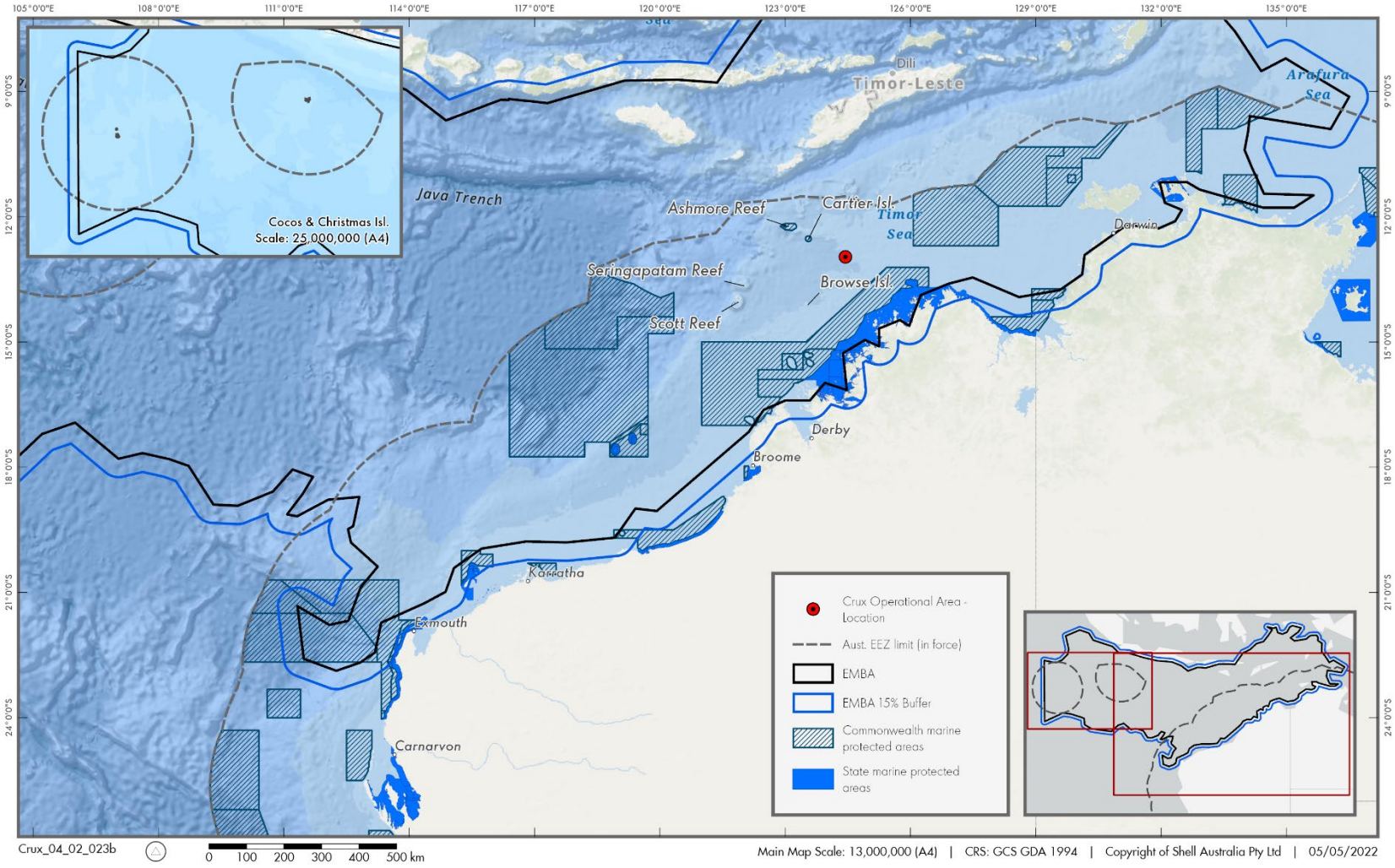


Figure 7-23: Commonwealth and State/Territory protected areas (Collaborative Australia Protected Areas Database (CAPAD))

Table 7-17: Protected Areas within the EMBA

Marine Park	Distance from Operational Area (km)	IUCN Category* or relevant park zone overlapping the Operational Area and/ or EMBA
Commonwealth AMPs		
Kimberley	93	Multiple Use Zone (IUCN VI)
	246	National Park Zone (IUCN II)
	279	Habitat Protection Zone (IUCN IV)
Cartier Island	99	Sanctuary Zone (IUCN Ia)
Ashmore Reef	148	Sanctuary Zone (IUCN Ia)
	172	Recreation Use Zone (IUCN IV)
Oceanic Shoals	177	Multiple Use Zone (IUCN VI)
	385	Special Purpose Zone (Trawl) (IUCN VI)
	540	Habitat Protection Zone (IUCN IV)
	610	National Park Zone (IUCN II)
Argo-Rowley Terrace	455	National Park Zone (IUCN II)
	473	Multiple Use Zoe (IUCN VI)
	660	Special Purpose Zone (Trawl) (IUCN VI)
Mermaid Reef	672	National Park Zone (IUCN II)
Joseph Bonaparte Gulf	494	Multiple Use Zone (IUCN VI)
	489	Special Purpose Zone (IUCN VI)
Eighty Mile Beach	705	Multiple Use Zone (IUCN VI)
Montebello	1,213	Multiple Use Zone (IUCN VI)
Gascoyne	1,423	Multiple Use Zone (IUCN VI)
	1,671	National Park Zone (IUCN II)
	1,577	Habitat Protection Zone (IUCN IV)
Cocos (Keeling) Islands	2,975	National Park Zone (IUCN II)
	2,625	Habitat Protection Zone (IUCN IV)
Christmas Island	1,700	National Park Zone (IUCN II)
	2,029	Habitat Protection Zone (IUCN IV)
Arafura	934	Multiple Use Zone (IUCN VI)
	940	Special Purpose Zone (IUCN VI)
	1,032	Special Purpose Zone (Trawl) (IUCN VI)

Marine Park	Distance from Operational Area (km)	IUCN Category* or relevant park zone overlapping the Operational Area and/ or EMBA
Arnhem	1,001	Special Purpose Zone (IUCN VI)
Carnarvon Canyon	1791	Habitat Protection Zone (IUCN IV)
Ningaloo	1574	National Park Zone (IUCN II)
	1450	Recreational Use Zone (IUCN VI)
Western Australian Marine Parks		
Lalang-garram / Camden Sound	221	N/A
North Kimberley	158	N/A
Lalang-garram / Horizontal Falls	351	N/A
North Lalang-garram	225	N/A
Barrow Island Marine Park and Barrow Island Marine Management Area	1263	N/A
Rowley Shoals	716	N/A
Montebello Islands	1246	N/A
Muiron Islands Marine Management Area	1430	N/A
Ningaloo	1450	N/A
Western Australian Nature Reserve		
Adele Island	313	N/A
Airlie Island	1,351	N/A
Barrow Island	1,281	N/A
Bedout Island	929	N/A
Bessieres Island	1,397	N/A
Boodie, Double Middle Islands	1,283	N/A
Browse Island	157	N/A
Coulomb Point	532	N/A
Lacepede Islands	496	N/A
Lesuer Island	318	N/A
Lowendal Islands	1,723	N/A
Low Rocks	195	N/A

Marine Park	Distance from Operational Area (km)	IUCN Category* or relevant park zone overlapping the Operational Area and/ or EMBA
Muiron Islands	1,434	N/A
North Turtle Island	968	N/A
Round Island	1,415	N/A
Scott Reef	310	N/A
Serrurier Island	1,410	N/A
Swan Isands	402	N/A
Tanner Island	359	N/A
Thevenard Island	1,372	N/A
Western Australian Conservation Parks		
Montebello Islands	1,252	N/A
Western Australian 5(1)(h) Reserves		
Bundegi Coastal Park	1,468	N/A
Jurabi Coastal Park	1,307	N/A
Unnamed WA2896	362	N/A
Unnamed WA37168	497	N/A
Unnamed WA40322	1,351	N/A
Unnamed WA40828	1,253	N/A
Unnamed WA41080	1,254	N/A
Unnamed WA41775	158	N/A
Unnamed WA44665	1,398	N/A
Unnamed WA44669	360	N/A
Unnamed WA44672	929	N/A
Unnamed WA44673	313	N/A
Unnamed WA44677	317	N/A
Western Australian National Park		
Cape Range	1,486	N/A
Lawley River	233	N/A
Mtchell River	218	N/A
Niiwalarra Islands	242	N/A
Prince Regent	245	N/A
Western Australian Indigenous Protected Area		
Balanggarra	319	N/A
Bardi Jawi	394	N/A

Marine Park	Distance from Operational Area (km)	IUCN Category* or relevant park zone overlapping the Operational Area and/ or EMBA
Dambimangari	237	N/A
Uunguu	164	N/A
Wilinggin	262	N/A
Other Conservation Area or Nature Park		
Territory Wildlife Park / Berry Springs	707	N/A
Northern Territory Marine Parks		
Garig Gunack Barlu	865	N/A
Northern Territory Conservation Reserves		
Blackmore River	702	N/A
Northern Territory Indigenous Protected Area		
Djelk	1,026	N/A
Marri-Jabin (Thamurrurr – Stage 1)	576	N/A
Marthakal	1,213	N/A
Northern Territory National Parks		
Charles Darwin	696	N/A
Djukbinj	749	N/A
Garig Gunak Barlu	829	N/A
Mary River	774	N/A
Melacca Swamp	739	N/A
Northern Territory Coastal Reserve		
Casuarina	697	N/A

7.4 Socio-Economic Environment

7.4.1 World, Commonwealth and National Heritage Listed Places

There are no World, Commonwealth or National Heritage Places within the Operational Area. World, Commonwealth, and National Heritage Places within the EMBA are identified in Table 7-18. Section 6.6.4, Section 6.6.5 and Section 6.6.6 of the Master Existing Environment outlines the values and sensitivities of these places respectively.

Table 7-18: World, National and Commonwealth Heritage Listed Places within the EMBA

Listed Place	Approximate Distance from Operational Area (km)
World Heritage Places	
Kakadu National Park	807

Listed Place	Approximate Distance from Operational Area (km)
The Ningaloo Coast	1,432
Commonwealth Heritage Listed Places	
Scott Reef and surrounds	298
Ashmore Reef National Nature Reserve	148
Mermaid Reef – Rowley Shoals	685
North Keeling Island	2,996
Christmas Island Natural Areas	2,055
Ningaloo Marine Area - Commonwealth Waters	1,451
National Heritage Places	
The West Kimberley	158
The Ningaloo Coast	1,447
Kakadu National Park	810

7.4.2 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.

Due to the distance from the mainland it is unlikely that the Operational Area is used for hunting or fishing by Australian Aboriginal people. There are no islands or land within the Operational Area and therefore there are no land based Aboriginal heritage sites. A review of the Aboriginal Heritage Inquiry System (Department of Planning, Land and Heritage (DPLH) 2022) indicates that the nearest registered sites are on the coastal islands of the Bonaparte Archipelago off the Kimberley coast, a minimum 165 km away from the Operational Area.

The EMBA partially overlaps parts of the Kimberley, Pilbara, Gascoyne and Northern Territory coastlines, which host numerous culturally significant sites, including sites that contribute to the national heritage value of the West Kimberley National Heritage Place and Kakadu National Park.

7.4.3 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 (DAWE 2022). The closest shipwreck to the project is the Anne Millicent, which is approximately 108 km from the Operational Area.

A number of other shipwrecks occur within the EMBA; however, these are highly unlikely to be affected given they are located on the seabed and they are distant from the Operational Area. They include a number of unnamed Indonesian Fishing Vessels and the Sinar Bonerate in the vicinity of Ashmore Reef and Cartier Island, and the Browse Island Unident and Selina in the vicinity of Browse Island (DAWE 2022).

7.4.4 Fishing Industry

7.4.4.1 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'.

Whilst the Operational Area is located 40 km outside of the edge of the MoU Box, the export pipeline will lie within this area. Given the shallow water target species, however, traditional Indonesian fishermen are only likely to be found in deep water areas during transit to and from the reef locations; therefore, they are unlikely to be affected by project activities.

Dugong, fish and marine turtles are important components of Aboriginal culture and diet. Aboriginal people continue to actively manage their sea country in coastal waters of the NT in order to protect and manage the marine environment, its resources and cultural values. Traditional Indigenous fishers generally utilise waters within 3 nm of the coastline (Northern Territory Government, 2015) and are not considered to be active within the offshore waters of the Operational Area.

7.4.4.2 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 Operational 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. Annual expenditure by recreational fishers and the guided fishing industry in the NT is estimated at over $100 million (Northern Territory Government, 2019).

7.4.4.3 Commercial Fisheries

A number of Commonwealth and State/Territory fishery management areas are located with the Operational Area and EMBA. Table 7-19 provides an assessment of the potential for interaction with the Operational Area, and Section 6.6.9 of the Master Existing Environment provides further detail on the fisheries that have been identified through desktop-based assessment and consultation.

Table 7-19: Commercial fisheries within the EMBA

Fishery Name	Overlap with EMBA	Overlap with Operational Area	Potential for interaction within Operational Area	
Commonwealth Managed Fisheries				
North West Slope Trawl Fishery	✓	✓	✓	The total catch in the North West Slope Trawl Fishery for the 2019-20 season was 111.5 t, over 306 days with Scampi making up approximately 65% of the total catch from vessels. There were 6 active vessels and 7 fishing permits in the 2019-20 season (Patterson et al., 2021). The total area waters fished during the 2019-20 fishing season did not overlap the Operational Area (Patterson et al., 2021). However, the total area fished during the 2018-19 fishing season overlapped the Operational Area, therefore there is potential for interaction with the fishery within the Operational Area.
Southern Bluefin Tuna Fishery	✓	✓	X	The total catch for the Southern Bluefin Tuna Fishery 2019-20 fishing season was 5,429 t over 1,248 seine hours and 146 shots. There were 7 active purse seine vessels and 23 active longline vessels during the 2019-20 season (Patterson et al., 2021). All though the management area for the Southern Bluefin Tuna Fishery overlaps the Operational Area and EMBA, the fishery has not been active within Operational Area or the EMBA over the last five years (Patterson et al., 2021); all activity in this fishery occurs well south of the EMBA, primarily off South Australia. As such, there is no potential for interaction within the Operational Area.
Western Tuna and Billfish Fishery	✓	✓	X	In recent years, fishing effort in the Western Tuna and Billfish Fishery has concentrated of south-west Western Australia (Patterson et al., 2021). Since 2005, fewer than 5 vessels have been active in the fishery each year (Patterson et al., 2021). During 2020 there was 161 t of catch from 231,085 Pelagic longline hooks. Although the fishery management area operates the Operational Area, the maximum area fished has not overlapped the Operational Area over the last five years (Patterson et al., 2021) Therefore there is no potential for interaction with this fishery within the Operational Area.

Fishery Name	Overlap with EMBA	Overlap with Operational Area	Potential for interaction within Operational Area	
Western Skipjack Fishery	✓	✓	X	There were 14 active permits and no active vessels in the Western Skipjack Tuna Fishery during the 2019-20 fishing season. The Western Skipjack Tuna Fishery is not currently active and no fishing has occurred since 2009 (Patterson et al., 2021). Therefore, no fishing effort occurs within the Operational Area and there is no potential for interaction with this fishery within the Operational Area.
Northern Prawn Fishery	✓	X	X	The fishery management area does not overlap with the Operational Area, therefore there is considered no potential for interaction with this fishery within the Operational Area.
Western Deepwater Trawl Fishery	✓	X	X	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. The fishery management area does not overlap the Operational Area, therefore there is considered no potential for interaction with this fishery within the Operational Area.
Western Australian Managed Fisheries				
Mackerel Fishery	✓	✓	✓	The Operational Area overlaps with the Mackerel Managed Fishery management area. Catch effort in the 2020 season was 288 t (Spanish mackerel) and 11t (Grey mackerel) (Lewis & Watt, 2021). The Operational area occurs in the 125242 10NM CAES block and there has been no fishing effort from the Mackerel Managed Fishery in the 10NM CAES block (ref. 125242) between 2016-2020 inclusive (DPIRD, 2021). There has been less than 3 vessels active in the Mackerel Fishery in the 60NM CAES block (ref.12240) that overlaps with the Operational Area over the last five years therefore, there is considered to be potential for interaction with this fishery within the Operational Area.

Fishery Name	Overlap with EMBA	Overlap with Operational Area	Potential for interaction within Operational Area	
Northern Demersal Scalefish	✓	✓	✓	The Northern Demersal Scalefish Managed Fishery management area overlaps the Operational Area. Catch effort in the 2020 season was 1,419 t. (Newman, et al. 2021). There have been five vessels active within the 10 NM CAES block (ref. 12240) that overlaps the Operational Area from 2011-2020, inclusive (DPIRD, 2021). Therefore there is potential for interaction with this fishery within the Operational Area.
West Coast Deep Sea Crustacean	✓	✓	X	The West Coast Deep Sea Crustacean Managed Fishery can fish in water deeper than the 150 m isobath and therefore overlaps the Operational Area. Total catch in the 2020 season was 153 t (How and Baudains, 2021). However, there is considered to be no potential for interaction with this fishery within the Operational Area given effort is concentrated between Carnarvon and Fremantle.
Pearl Oyster Fishery	✓	✓	X	The Operational Area overlaps 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. Total catch for the 2020 season was 455,980 shells (Hart et al. 2021). There have been no active vessels within the 60 NM CAES block (ref. 12240) overlapping the Operational Are between 2011 and 2020, inclusive. Given the fishery is diver-based (i.e. restricted to safe diving depths) there is no potential for interaction with the fishery within the Operational Area.
Marine Aquarium and Specimen Shell	✓	X	X	Given the nature of the Marine Aquarium and Specimen Shell fisheries, effort is expected to be largely restricted to coastal waters < 30 m water depth. Therefore, no fishing effort occurs within of nearby the Operational Area, and there is no potential for interaction with this fishery within the Operational Area.

Fishery Name	Overlap with EMBA	Overlap with Operational Area	Potential for interaction within Operational Area	
Abalone Fishery	✓	X	X	No commercial fishing for abalone north of Moore River (zone 8 of the managed fishery) has taken place since 2011/2012 (Strain et al. 2020). The Operational Area does not overlap with the Abalone Fishery management area therefore, there is no potential for interaction with the fishery within the Operational Area.
North Coast Prawn Fishery	✓	X	X	The Operational Area does not overlap with the North Coast Prawn Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Kimberley Gillnet and Barramundi	✓	X	X	The extent of the fishery is located approximately 213 km to the east (near to the shoreline) of the Operational Area. Therefore there is no potential for interaction with the fishery within the Operational Area.
Pilbara Trap	✓	X	X	The extent of the Pilbara Trap Managed Fishery is located approximately 477 km south-west of the Operational Area. Therefore there is no potential for interaction with the fishery within the Operational Area.
Pilbara Trawl	✓	X	X	The extent of the Pilbara Fish Trawl (Interim) Managed Fishery is located approximately 560 km south-west of the Operational Area. Therefore there is no potential for interaction with the fishery and the Operational Area.
Pilbara Line	✓	X	X	The Operational Area does not overlap with the Pilbara Line Fishery management area; therefore there is no potential for interaction with this fishery within the Operational Area.
West Coast Rock Lobster	✓	X	X	The Operational Area does not overlap with the West Coast Rock Lobster Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
WA Sea Cucumber Fishery (formerly	✓	X	X	The Operational Area does not overlap with the Sea Cucumber Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.

Fishery Name	Overlap with EMBA	Overlap with Operational Area	Potential for interaction within Operational Area	
Beche-de-mer Fishery)				
Northern Shark Fishery	✓	X	X	No catch effort has been recorded since the 2008/09 season (DPIRD, 2021), therefore there is considered no potential for interaction with this fishery within the Operational Area.
Northern Territory Managed Fisheries				
Aquarium Fishery	✓	X	X	The Operational Area does not overlap with the Aquarium Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Offshore Net and Line Fishery	✓	X	X	The Operational Area does not overlap with the Offshore Net and Line Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Spanish Mackerel Fishery	✓	X	X	The Operational Area does not overlap with the Spanish Mackerel Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Demersal Fishery	✓	X	X	The Operational Area does not overlap with the Demersal Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Timor Reef Fishery	✓	X	X	The Operational Area does not overlap with the Timor Reef Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Pearl Oyster Fishery	✓	X	X	The Operational Area does not overlap with the Pearl Oyster Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Coastal Line Fishery	✓	X	X	The Operational Area does not overlap with the Coastal Line Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.

Fishery Name	Overlap with EMBA	Overlap with Operational Area	Potential for interaction within Operational Area	
Jigging Fishery	✓	X	X	The Operational Area does not overlap with the Jigging Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Coastal Net Fishery	✓	X	X	The Operational Area does not overlap with the Coastal Net Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Barramundi Fishery	✓	X	X	The Operational Area does not overlap with the Barramundi Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Trepang Fishery	✓	X	X	The Operational Area does not overlap with the Trepang Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Development Fishery (Small Pelagic)	✓	X	X	The Operational Area does not overlap with the Development Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Mud Crab Fishery	✓	X	X	The Operational Area does not overlap with the Mud Crab Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Bait Net Fishery	✓	X	X	The Operational Area does not overlap with the Bait Net Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.
Mollusc Fishery	✓	X	X	The Operational Area does not overlap with the Coastal Line Fishery management area; therefore there is no potential for interaction with this fishery and the Operational Area.

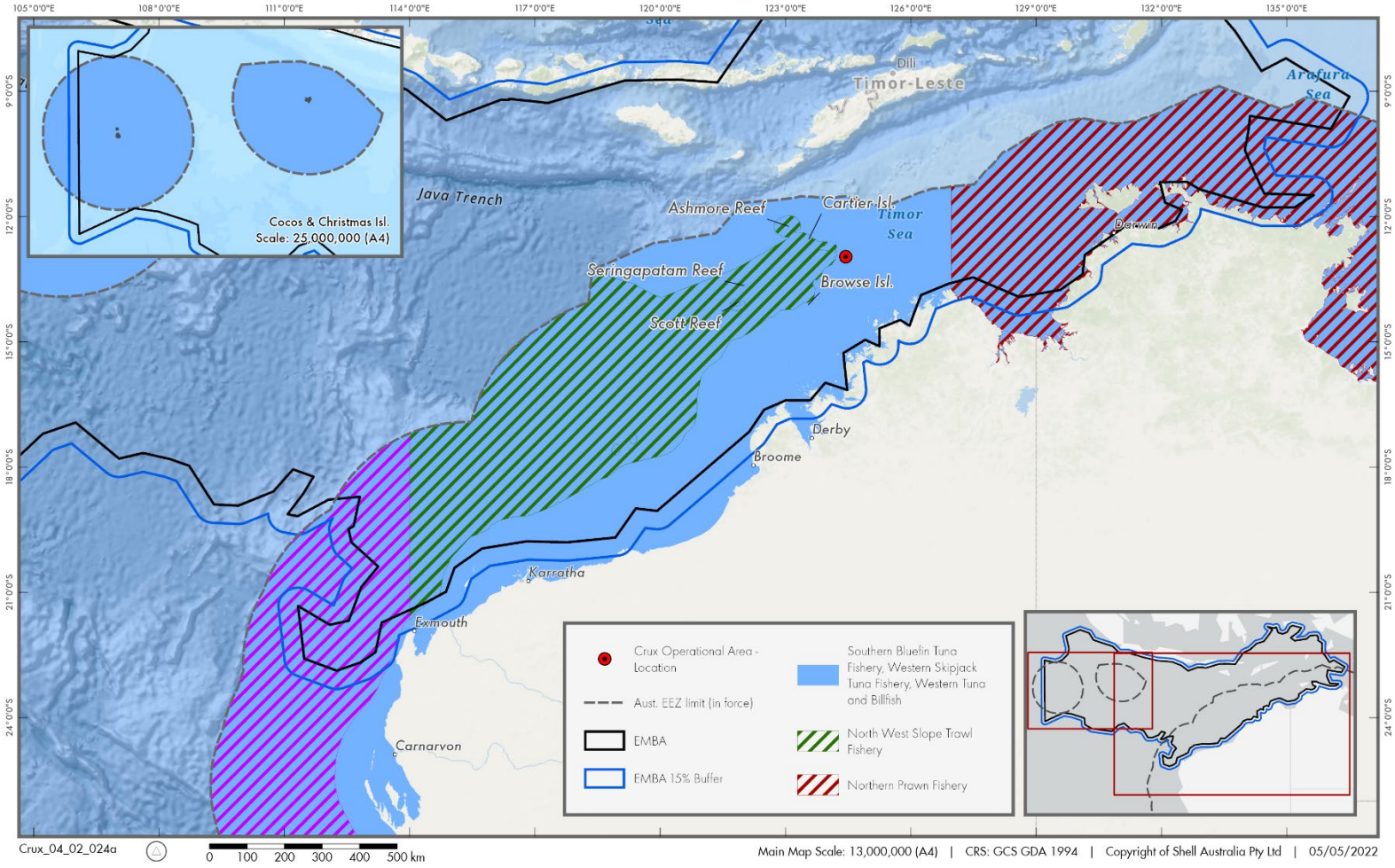


Figure 7-24: Commonwealth managed fisheries management areas within the EMBA

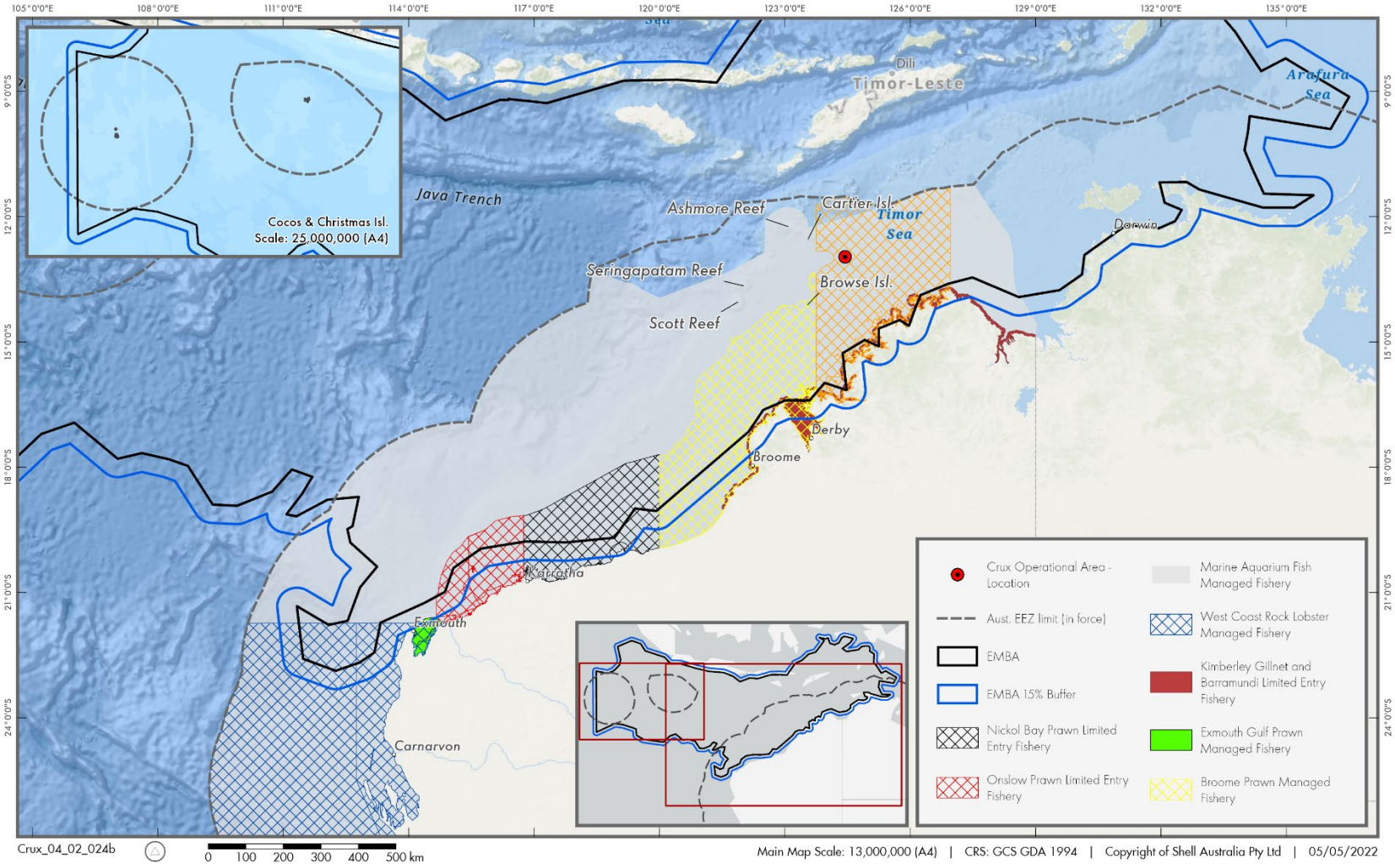


Figure 7-25: Western Australian managed fisheries management areas within the EMBA (1)

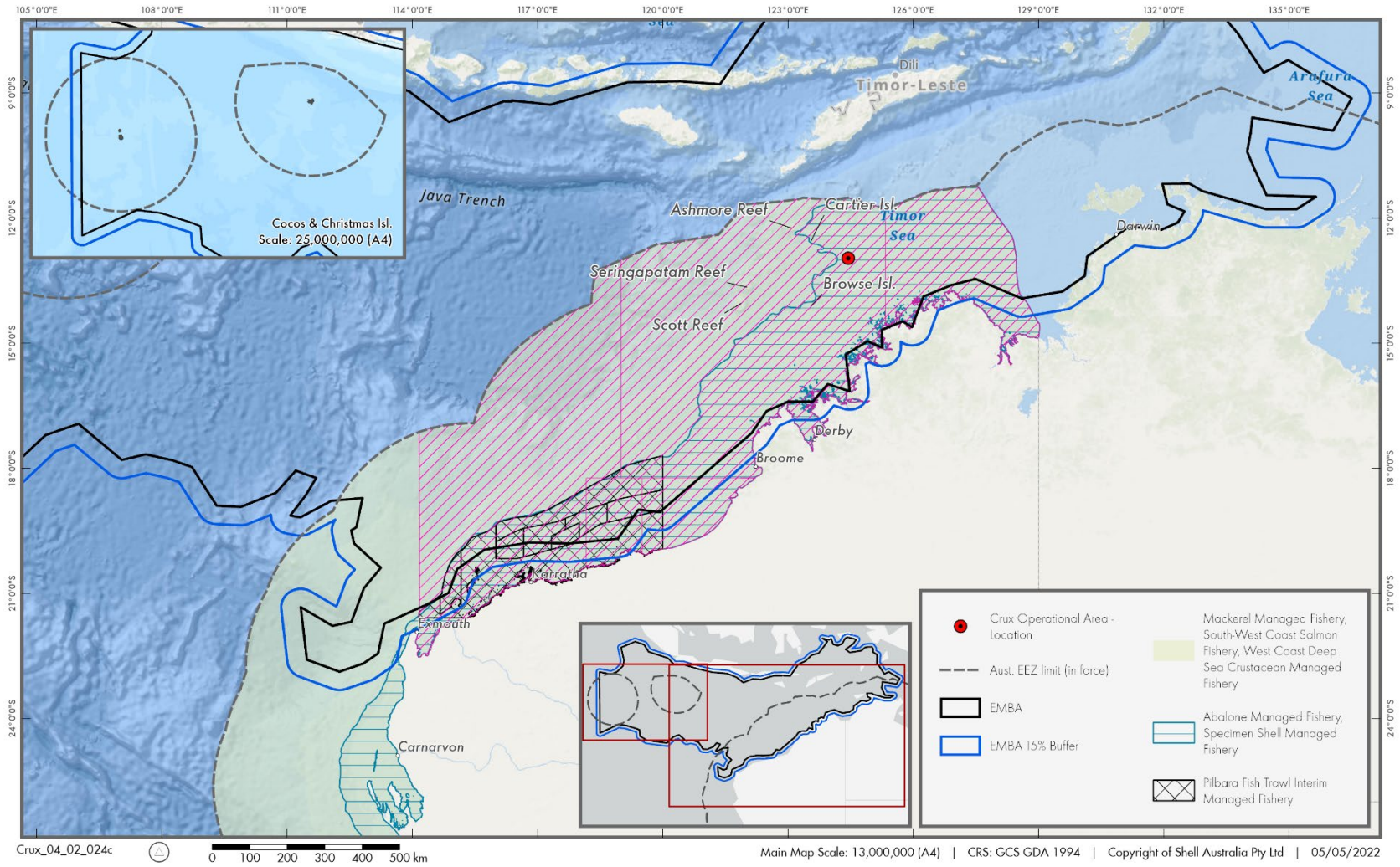


Figure 7-26: Western Australian managed fisheries management areas within the EMBA (2)

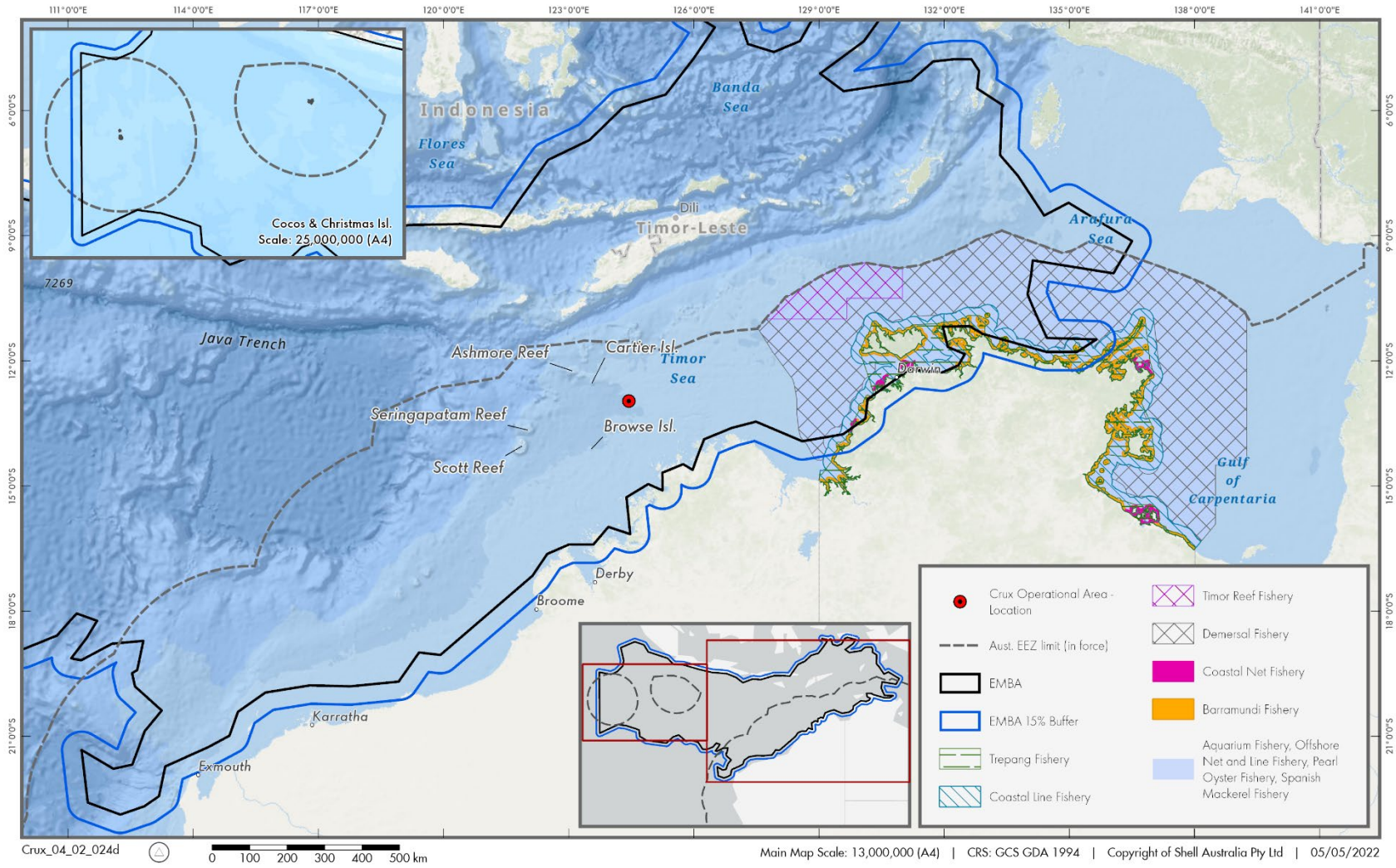


Figure 7-27: Northern Territory managed fisheries management areas within the EMBA

7.4.4.6 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. The Kimberley region is of significance to the WA pearling industry, which is the world's top producer of silver-white South Sea Pearls (Hart et al. 2016). However, WA pearling activities are primarily focussed near Broome and Eighty Mile Beach, and leases typically occur in shallow coastal waters at depths of less than 20 m (Fletcher et al. 2006).

In the NT, pearl farm leases are understood to be limited to the coastal waters around Bynoe Harbour and Beagle Gulf near Darwin, as well as Cobourg Peninsula and Nhulunbuy (Northern Territory Government 2021).

Other aquaculture activities in the Kimberley region of WA and in the NT are also understood to be limited to land-based projects (e.g. the Darwin Aquaculture Centre and Project Sea Dragon prawn hatchery development near Darwin), barramundi farming and other activities in shallow coastal waters (Northern Territory Government 2021).

7.4.5 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 has a much larger presence along the coast from Exmouth to Darwin, largely confined to coastal waters and inshore islands, with Cape Leveque, Beagle Bay, Cockatoo Island and the Buccaneer Archipelago all being popular destinations for coastal cruises. Fishing and diving charters operate out of Broome and Derby and the occasional charter vessel may visit Scott Reef, Ashmore Reef, Browse and Adele Island. A search of recreational fishing charters in the north-west region of WA did not reveal any recreational fishing to the marine waters representing the Operational Area. Birdwatching tours operate occasionally out of Broome, with annual expeditions visiting Ashmore Reef and associated offshore islands such as the Lacepede Islands, Adele Island, Browse Island, and Scott Reef. 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.

Most recreational and tourism activities in the Northern Territory are adjacent to population centres, such as Darwin. Tourism in the region typically peaks during the dry season (May to October), which includes activities such as recreational fishing, diving, snorkelling, wildlife watching and boating (DEWHA 2008d).

7.4.6 Defence

The Australian Border Force undertake civil and maritime surveillance (and enforcement) in and around the Operational Area (Department of Home Affairs (DHA) 2018a, 2018b). The primary purpose of the activity is to monitor the passage of suspect illegal entry vessels and illegal foreign fishing activity within and beyond Australia's Exclusive Economic Zone, which extends to approximately 200 nm from the mainland (DHA 2018a).

There are no designated military/defence exercise areas in the Operational Area However, regionally relevant activities include the North Australian Exercise Area (NAXA) offshore training area and the Browse Basin and Northern Carnarvon Basin offshore air-to-air weapons ranges, which are maritime military zones administered by the Department of Defence. The NAXA extends approximately 300 km north and west from just east of Darwin into the Arafura Sea and is used for offshore naval exercises and onshore weapon-firing training (Department of Defence 2015). The Browse Basin (Curtin) and Northern Carnarvon (Learmonth) situated air-to-air weapons ranges are 513 km and 1,500 km from the Operational Area, respectively. Within the EMBA is also a Royal Australian Air Force base at Learmonth, on North West Cape, about 1,262 km from the Operational Area.

A search of the Department of Defence's Unexploded Ordinance (UXO) map confirmed no UXO's occur within the Operational Area (Defence 2019). The nearest UXO is 256 km southeast of the Operational Area and would not be affected in the event of a spill response in the EMBA.

7.4.7 Shipping

There are no major shipping routes traversing the Operational Area with the nearest major shipping channel approximately 560 km to the west of the Operational Area. Given the distances between the Operational Area and shipping channels, the Crux development drilling activities pose a minimal navigational risk to commercial shipping.

There may potentially be coastal ships traversing the Operational Area supporting other petroleum activities in the vicinity, as well as the major State and Territory ports of Broome, Derby, Wyndham and Darwin. Additionally, Civil and maritime surveillance in and around the Operational Area may occur by the Australian Border Force Maritime Border Command to monitor the passage of illegal entry vessels and illegal foreign fishing activity (DHA 2018b).

A summary of the regional shipping movements and port areas within the EMBA is presented in Figure 7-28.

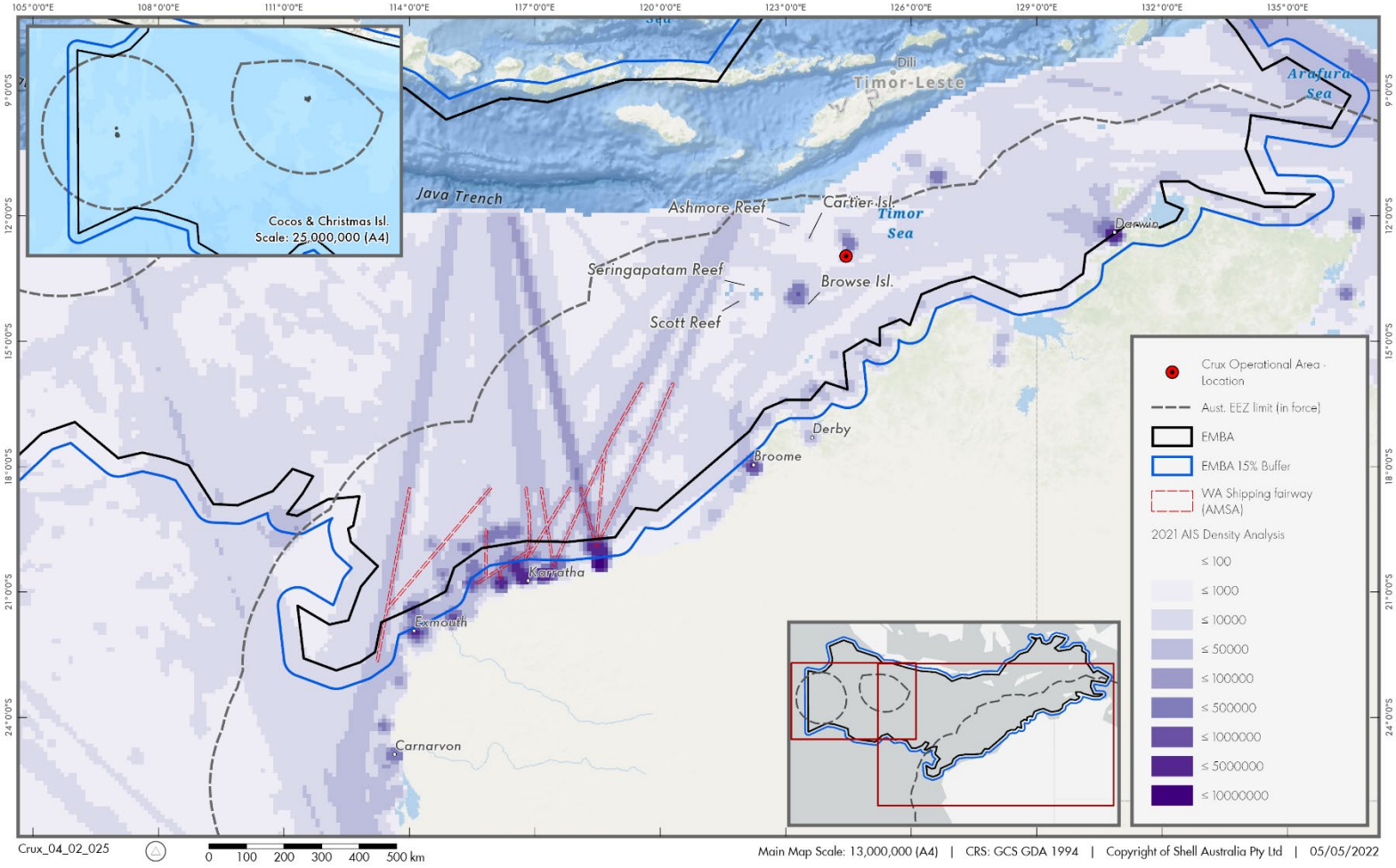


Figure 7-28: Shipping levels within the Operational Area and broader EMBA

7.4.8 Indonesian and Timor-Leste Coastlines

The Indonesian and Timor-Leste Coastlines are located 280 km and 400 km north of the Operational Area and overlap with 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) 2014a). 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 2014a). 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.

The island of Timor is shared with Timor-Leste, which has similar coastal environmental values. Timor-Leste has a coastline of more than 700 km and a marine Exclusive Economic Zone which extends 200 nm offshore (Coral Triangle Center 2018). Notably, Timor-Leste is located in a biodiversity hotspot with a number of endemic species (ADB 2014b). The island has 30 declared protected areas, including Nino Konis Santana National Park which encompasses nearly 350 km^2 of coral reef (ADB 2014b; Coral Triangle Center 2018). The environmental values of Timor-Leste's coastline are under pressure from illegal fishing, over-exploitation of natural resources and lack of waste management (ADB 2014b).

7.4.9 Oil and Gas Industry

The petroleum exploration and production industry is a significant user of offshore waters in northern WA, particularly within and adjacent to the Browse and Northern Bonaparte basins (DMP 2014). The closest facility to the Operational Area is the Montara production Floating Production Storage and Offloading (FPSO) facility, which is located approximately 36 km north. The Ichthys facilities are situated approximately 164 km south-west of the Operational Area and the Prelude FLNG facility is approximately 165 km to the south-west of the Operational Area

8. Acceptable Levels of Impact and Risk for the Petroleum Activities

The OPGGS (E) Regulations require the titleholder to 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.), including significant impacts4 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 ESD in defining acceptable levels of impacts and risks, as defined in Section 3A of the EPBC Act 1999. 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; and

[4] 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.

- improved valuation, pricing and incentive mechanisms should be promoted.

8.1.2 Other 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 8).

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; and
- 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

Category	Significant Impact Criteria
	• 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, or • 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 • Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or • 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, or • 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[5], 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, social amenity or human health may be adversely affected, or • Have a substantial adverse impact on heritage values of the Commonwealth marine area, including damage or destruction of an historic shipwreck.

[5] In the context of the activities covered by this EP, 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."

8.1.3 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:

- 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

8.1.4 External Content

Shell also considered the external context when establishing acceptable levels of impacts and risks. This includes information provided by Relevant Persons during the preparation of the EP and the Crux OPP. Shell routinely implements an ongoing stakeholder engagement program managed by Shell's Corporate Relations team. Reference is made to Section 1 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.

8.1.5 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 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 discharges associated with the Vessel and MODU operations covered by this EP are typically of short duration and will not have the potential for significant impacts over an extended period. Modelling studies indicate the impacts will be localised around the Crux Drilling location (characterised as open offshore waters, typical of the offshore Browse Basin) and will not persist following the cessation of the activity. Liquid discharges during the activity cannot be avoided. However, the area influenced from 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.
	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 the Crux Drilling Centre. Sediment quality in the vicinity of the Crux in-field development area is characteristic of the sediment quality conditions of the offshore region.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
			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 location). 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 activity consist primarily of combustion engine exhaust emissions (e.g. Vessel and MODU engine and generators). 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. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the project area.	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 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

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
			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[6] 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 (refer to **Section 6.4.4.1** of the Master Existing Environment for further discussion). 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.
	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

[6] As defined in the Matters of National Environmental Significance - Significant impact guidelines 1.1 (Commonwealth of Australia 2013).

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
			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** **Marine reptiles** **Birds** **Fish** **Sharks and rays**	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.
Socio-economic and Cultural Environment	**Commonwealth Marine Area**	No significant impacts to the Commonwealth marine area beyond 1 km from the Crux	Discharges during the activity may result in impacts to water and sediment quality, both of which are components of the Commonwealth marine environment, within 1 km of the

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
		platform or drilling locations.	drilling location. 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, duration of the activity 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.
	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

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
			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 area (excluding petroleum safety zones) is acceptable. Permanent exclusion of traditional fishing activities from gazetted petroleum exclusion zones is acceptable.	Impacts to traditionally exploited fish stocks may deprive traditional fishers of the benefits provided by the environment. Shell considers this to be unacceptable. 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

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
			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 drilling centre.
	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.
	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.	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

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Justification
		Permanent exclusion of commercial shipping from gazetted petroleum exclusion zones is acceptable.	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 drilling centre is the Montara production FPSO facility, approximately 36 km away.
	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 for evaluating environmental impacts and risks (including socio-economic and cultural impacts) and the development of mitigation measures for the petroleum activities described within this EP. 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 31000:2018 Risk Management and Handbook 203:2012 Managing Environment-Related Risk. The process is summarised in Figure 9-1. The 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.

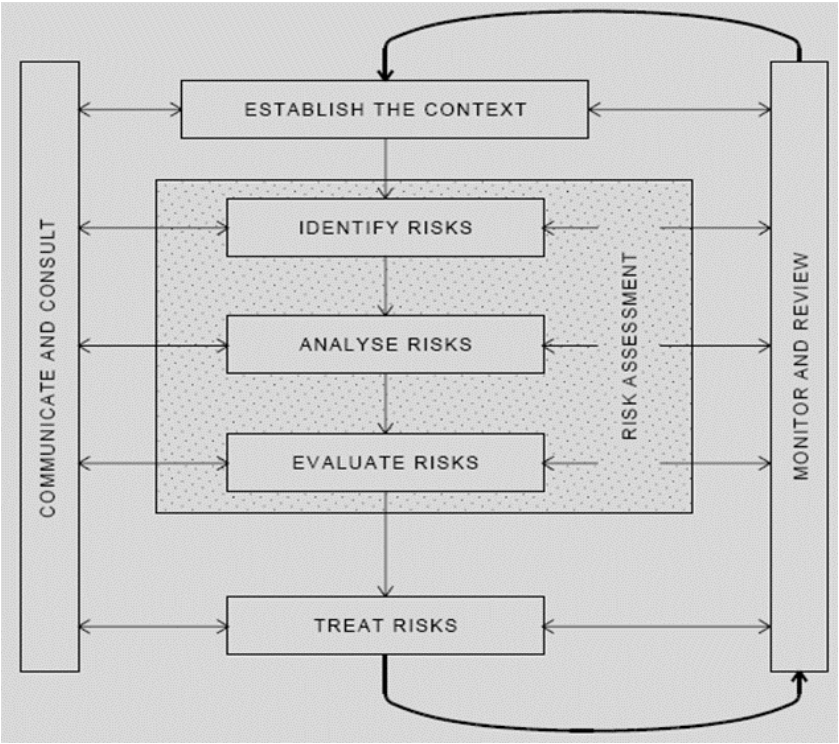


Figure 9-1: Risk Management Framework (AS/NZS 4360:2004 Risk Management)

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 EP 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 operations associated with the Crux development drilling activity 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 ALARP is also presented.

In preparation of this EP, a detailed desktop review of the impact and risks assessments were carried out by environment professionals. Throughout the desktop assessment additional supporting information such as current forecasts from Shell's business planning processes were also used to provide input to the impact assessment.

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 of environmental impacts resulting from unplanned or accidental events is evaluated by taking the likelihood of the event occurring into consideration.

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 Shell Risk Assessment Matrix (RAM) for assessment of significance of potential 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, in accordance with the Shell RAM, for the assessment of unplanned events, the additional likelihood of occurrence of an event taken into account (See Section 9.2.3).

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 regarding 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.
Consequence	The outcome of an event, which can lead to a range of consequences. A consequence can be certain or uncertain and can have positive or negative effects. Consequences can be expressed qualitatively or quantitatively.
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.
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 impact	The level of impact remaining after impact treatment, i.e. application of controls (inclusive of unidentified impact).
Residual risk	The level of risk remaining after risk treatment, i.e. application of controls (inclusive of unidentified risk).

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 consider potential control measures.

The key aspects arising from the Crux development drilling activity have been identified as:

- Physical presence
- Lighting
- Underwater noise
- Disturbance to seabed
- Vessel movements (unplanned)
- Introduction of Invasive Marine Species from vessels (unplanned)
- Discharge of liquid effluent
- Discharge of drill cuttings, muds and other drilling-related discharges
- Atmospheric emissions
- Greenhouse gas emissions
- Waste management
- Emergency events
- Oil spill response strategies.

9.2.2 Evaluation of Impacts

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.

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.

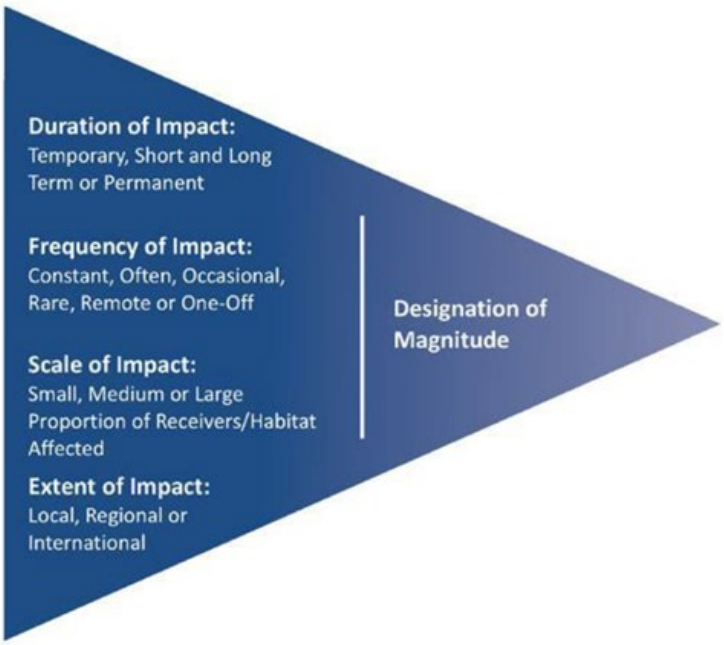


Figure 9-2: Definition of Magnitude in the Context of Impact Identification

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 while 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 development drilling activity.

Table 9-2: Magnitude Criteria

Definition	Environmental Impact
Positive effect **+1**	• Net positive effect arising from a proposed aspect of the Crux project
No effect **0**	• No environmental damage or effects
Slight effect **-1**	• Slight environmental damage contained within the project 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
Minor effect **-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
Moderate effect **-3**	• Moderate environmental damage that will persist or require cleaning up • Widespread change in habitats or species beyond natural variability

Definition	Environmental Impact
	• 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
Major effect **-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
Massive effect **-5** (to be used only for unplanned events)	• 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

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. 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, vessel 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
Low **(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.
Medium **(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 within 1–2 years following cessation of activities, or localised medium-term degradation with recovery in 2–5 years.
High **(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 and inform an assessment of acceptability.

Table 9-4: Impact Consequence Matrix

		Sensitivity		
		L	M	H
Magnitude	+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	

Unplanned Risks (Likelihood Criteria)

For unplanned/emergency events, the likelihood of such an event occurring also requires consideration. 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; however, the likelihood of such an event occurring is very low. 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 environmental risk.

As with planned activities, the potential impacts of unplanned events are identified, and the impact consequence ranking is determined, which inherently takes into account the 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 as summarised in Table 9-6. Controls are then identified to reduce the risk of such an event occurring in order to determine residual risk and inform assessment of acceptability.

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

For the purpose of the Crux development drilling activity 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
- Unplanned release of wastes
- Unplanned (spill) events.

9.2.3 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 to 9.14 represent a summary of the various individual environmental value/sensitivity rankings defined from a detailed environmental risk workshop attended by specialist environmental scientists together with key members of the Shell project team. The residual impact rankings provided represent the highest residual impact for that receptor group (i.e. physical environment, threatened species and ecological communities, ecosystems, communities and habitats, and socio-economic and cultural environment), and therefore may be a conservative assessment for some individual environmental values/sensitivities. These residual impacts and risks are then compared to the acceptability categories outlined in Section 8, 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.

9.2.4 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.

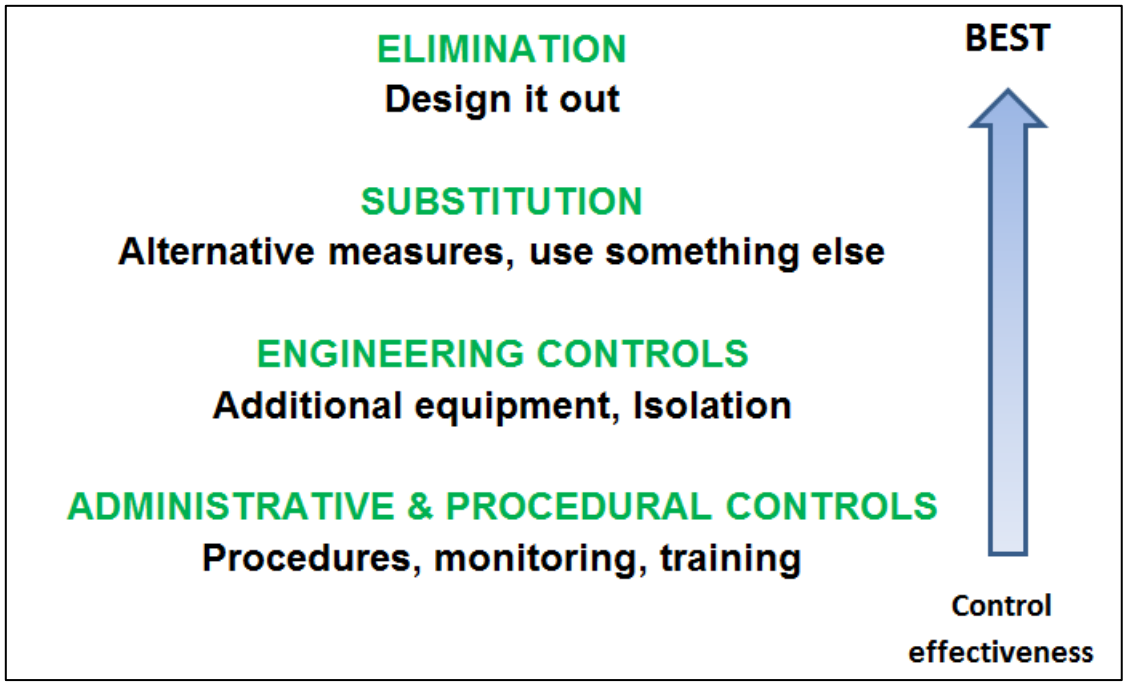


Figure 9-3: Hierarchy of Controls

9.2.5 Environmental Performance Outcomes

Environmental Performance Outcomes (EPOs) have been developed for all aspects of the Crux development drilling activity. The purpose of the EPOs is to provide specific, measurable levels of environmental performance that are:

- consistent with the principles of ESD; and
- demonstrate that the environmental impacts and risks of the Crux project are of an acceptable level.

Note that the consideration of acceptability for each aspect is provided in the relevant **Acceptability** sections in the evaluation of environmental impacts and risks. Consequently, these acceptability considerations are a component of the EPO.

EPOs associated with planned impacts will generally be demonstrated through successful implementation of controls, environmental performance standards and associated measurement criteria. Note that controls may include environmental monitoring programs, however these are not required where there is high confidence in the effectiveness of controls and the potential for environmental impact is low. Where an unplanned event (e.g. accidental discharge) results in the potential for environmental harm, the incident reporting and investigation process will identify if there is the potential for environmental impacts. This process will provide sufficient information to determine if the EPO has been achieved.

9.3 Physical Presence

9.3.1 Aspect Context

The presence of the MODU and vessels within the Operational Area has the potential to displace other marine users. This includes affecting activities and access to areas associated with fishing, tourism, defence, commercial shipping and other oil and gas activities in the region. Refer to Section 6 for a description of the Crux development drilling activity and infrastructure.

A PSZ of 500 m will be established around the drilling location, as per the OPGGS Act, from which unauthorised marine users are prohibited from entering. The PSZ is a key safety measure to reduce potential interactions with the Crux development drilling activity and associated subsea infrastructure.

The drilling template installation is the first activity that will be undertaken and will be carried out by an LCV. This activity is currently proposed to occur approximately 3 months ahead of MODU arrival. Following MODU arrival, drilling activities will commence for a planned duration of approximately 10 months, with an additional 10-month contingency drilling period. During drilling, the MODU will be supported by AHTS and general project vessels (Section 6.5.3). The docking pile installation will be installed after drilling has ceased utilising a similar class vessel as the template installation campaign.

At the completion of the drilling campaign the wells will be temporarily suspended. There are no planned infield activities associated with the wells during the suspension period covered under this EP.

The subsea wellheads and drilling template will remain for the duration of field life. They will take up a small area on the seabed and will rise several metres above the seabed. As described in Section 6.6.7 wells may need to be abandoned if a respud is required. This is considered a contingent activity and if a well is abandoned due to respud, a reasonable attempt to remove the wellhead(s) will be made.

9.3.2 Description and Evaluation of Impacts

Fishing effort of the Commonwealth North West Slope Trawl Fishery, WA Mackerel Fishery, and the WA Northern Demersal Scalefish in 2018-20 overlapped the Operational Area (Table 7-19). Potential impacts include minor interference (navigational hazard) and localised displacement/avoidance by commercial fishing vessels within the immediate vicinity of the MODU or project vessels. Impacts are expected to be Minor due to:

- low fishing effort in the region; and
- the limited extent of the PSZ in relation to the area available for fishing.

There was no relevant direct response from commercial fisheries during the stakeholder consultation period, and as such the potential impact is considered to be minor and temporary.

Traditional and recreational fishing, and aquaculture activities do not occur in the Operational Area (Section 7.4.4, therefore, they are not expected to be affected by the Crux development drilling activity.

There are no known tourism activities in the Operational Area (Section 7.4.5) 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 (Section 7.4.6). Therefore, no impacts to defence are expected.

The closest permanent petroleum infrastructure to the Operational Area is the Montara production FPSO facility, which is located approximately 36 km north of the Operational Area (Section 7.4.9). Impacts to other oil and gas activities in the region from the physical presence of vessels and the MODU in the Operational Area are therefore not expected.

Commercial shipping activity in the vicinity of the Operational Area is low. Vessel traffic data shows that the majority of vessel movements occurs to the south-west of the Operational Area, with the nearest major shipping channel over 500 km from the Operational Area. Given the small area of the PSZ and the Operational Area, and the low level of shipping activity within the Operational Area, the extent of any physical displacement of commercial ships will be Minor.

The residual impact ranking of physical displacement across all marine users is assessed as Minor (Magnitude – -2, Sensitivity – M).

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	-2	M	Minor

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 of the MODU and project vessels cannot be eliminated for the Crux development drilling activity.	N/A	N/A	N/A
Substitution	N/A	N/A	No additional or alternative control measures have been identified to reduce the impact from physical presence of the MODU and project vessels for the Crux development drilling activity.	N/A	N/A	N/A
Engineering	N/A	N/A	No additional or alternative control measures have been identified to reduce the impact from physical presence of the MODU and project vessels for the Crux development drilling activity.	N/A	N/A	N/A
Engineering	In the event of a respud, a reasonable attempt will be made to remove the unused wellhead.	No	The Crux wells are to be drilled in a cluster via the subsea template and are not open water individual wells. In the event of a respud, the presence of an inactive wellhead within the footprint of the template and adjacent to completed wells, does not cause any incremental increase in risk associated with the physical presence of that well. Additionally, the future Crux platform will be located directly above the drilling template and therefore there will be direct access to all wellheads to allow maintenance throughout the life of the wells (including unused well heads).	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			Subject to additional considerations of the requirements of the OPGGS (E) Regulations, unused well heads may also be used for future well activities. Future decommissioning of the wellheads is out of the scope of this EP, however, all subsea infrastructure is designed to allow removal at the end of field life, where required.			
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. Activities occurring within NOPSEMA's gazetted PSZs do not require promulgation of a 'Notice to Mariners'.	1.2	AHS is given notification in advance to enable a 'Notice to Mariners' to be issued prior to vessel based petroleum activities outside of the 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	Conduct stakeholder engagement	Yes	Consultation with relevant stakeholders has been undertaken during the preparation of the EP and is ongoing. 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 Crux development drilling activity.	1.3	Disruption to other marine users will be managed during ongoing stakeholder consultation.	Stakeholder engagement records
Administrative and	Adhere to administrative safety requirements	Yes	All project vessels operating within the Operational Area will adhere to the navigation safety requirements contained within the International Regulations for Preventing	1.4	Compliance with the navigation safety requirements contained within the International	Inspection records demonstrate compliance with

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Procedural Controls			Collisions at Sea 1972 (COLREGS), Chapter 5 of The International Convention for the Safety of Life at Sea 1974 (SOLAS Convention), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), the Navigation Act 2012 and any subsequent Marine Orders, which specify standards for crew training and competency, navigation, communication, and safety measures.		Regulations for Preventing Collisions at Sea 1972 (COLREGS), Chapter 5 of The International Convention for the Safety of Life at Sea 1974 (SOLAS Convention), International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention), the Navigation Act 2012 and any subsequent Marine Orders.	navigation safety requirements.

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	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 Operational Area (excluding petroleum safety zones) is acceptable. Permanent exclusion of commercial fishing activities from gazetted petroleum exclusion zones is acceptable.	Yes	Temporary exclusions of other marine users from the Operational Area is considered to be acceptable and necessary from a safety, security and oil spill prevention (collision) perspective. Permanent exclusion of marine users from gazetted petroleum exclusion zones is acceptable.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
	Traditional Indigenous fishing	No negative impacts to exploited fisheries resource stocks. Temporary displacement of traditional fishing activities within the Crux Operational Area (excluding petroleum safety zones) is acceptable. Permanent exclusion of traditional fishing activities from gazetted petroleum exclusion zones is acceptable.	Yes	
	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 Operational Area (excluding petroleum safety zones) is acceptable. Permanent exclusion of tourism activities from gazetted petroleum exclusion zones is acceptable.	Yes	
	Military/defence	Temporary displacement of defence activities within the Crux Operational Area (excluding petroleum safety zones) is acceptable. Permanent exclusion of defence activities from gazetted petroleum exclusion zones is acceptable.	Yes	
	Ports and commercial shipping	Temporary displacement of commercial shipping within the Crux Operational Area (excluding petroleum safety zones) is acceptable.	Yes	

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		Permanent exclusion of commercial shipping from gazetted petroleum exclusion zones is acceptable.		
	Offshore petroleum exploration and operations	Temporary displacement of petroleum exploration activities and operations within the Crux Operational Area (excluding petroleum safety zones) is acceptable. Permanent exclusion of petroleum exploration activities and operations from gazetted petroleum exclusion zones is acceptable.	Yes	

The assessment of impacts from physical presence determined the residual impact rating of Minor (Table 9-7). 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 northern 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:

- Part 6.6 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

Not applicable for this assessment.

Commonwealth Marine Environment

Not applicable for this assessment.

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 any 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 Environmental, Social and Health Impact Assessment (ESHIA) requirements. The EPO and the controls that will be implemented for the Crux development drilling activity are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from physical presence determined the residual impact rankings were Minor or lower (Table 9-7). As outlined above, the acceptability of the impacts has been considered in the context of:

- the established acceptability criteria for the physical presence aspect;
- principles of ESD;
- relevant requirements;
- MNES;
- external context (i.e. stakeholder claims); and
- internal context (i.e. Shell requirements).

Shell considers residual impacts of Minor 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 physical presence aspect.

Based on the points discussed above, Shell considers the impacts from physical presence associated with the Crux development drilling activity to be ALARP and acceptable.

9.3.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No adverse interactions between Shell's activities within the Operational Area and other marine users.	No supported claims reported which demonstrate direct loss of income or other

Environment Performance Outcome	Measurement Criteria
Displacement of other marine users within the Operational Area is restricted to: • Temporary displacement from project activities; and • Exclusion from gazetted Petroleum Safety Zones.	impacts to marine users as a result of undertaking the petroleum activities.

9.4 Lighting

9.4.1 Aspect Context

The MODU and project vessels will have external lighting to support safe navigation and safe operations at night, with project activities planned to be conducted 24 hours a day. All offshore facilities and vessels must meet maritime and operational safety lighting requirements, as specified by Safety Case assessments under the OPGGS Act and relevant legislation, such as the *Navigation Act 2012*. Artificial light from the Crux development drilling activity will result in light spill to the surrounding marine environment.

This lighting typically consists of bright white (i.e. metal halide, halogen, fluorescent) lights, and is not dissimilar to lighting used for other offshore activities, including fishing and shipping.

External lighting will be located over the entire MODU, with most external lighting directed towards working areas such as the main deck, pipe rack and drill floor. These areas are typically lower than 20 m above sea level when the MODU is on station. The highest point on the MODU is the top of the derrick, which is typically about 50 m above sea level.

To characterise the sources of light emissions from the Crux development drilling activity and assess the predicted impact of light in the context of the nearest sensitive receptors, Shell commissioned a study (Imbricata 2018) as part of the OPP process. The study involved:

1. Line of Sight (LOS) modelling, to determine how far light from the Operational Area will travel. This enables the identification of impacted receptors
2. Light intensity modelling, to determine the intensity of luminance.

This modelling was used to assess the light pollution from:

- the MODU mast and deck; and
- a supply vessel.

Line of Sight Assessment

The study determined that light from the MODU deck (assumed to be 25 m above sea level) may be visible on the horizon at a distance of up to 17.9 km, which would be visible from Goeree Shoal. Light from the mast (assumed to be 75 m above sea level) of the MODU may be visible at a distance of up to 30.9 km, encompassing Goeree Shoal and Eugene McDermott Shoals (Table 9-10). The lights of a supply vessel in the Operational Area may be visible on the horizon at a distance of up to 19.6 km.

Table 9-10: Modelled limit of light visibility the MODU and a Supply Vessel in the Crux Operational Area (Imbricata, 2018)

Equipment	Assumed height (m above sea level)	Limit of visibility (km)	Key habitats reached
MODU mast	75	30.9	• Goeree Shoal (~14 km NW of Operational Area) • Eugene McDermott Shoals (~20 km SE of Operational Area) • Vulcan Shoal (~24 km NW of Operational Area)
MODU deck	25	17.9	• Goeree Shoal (~13 km NW of Operational Area)
Supply vessel	Not applicable.	19.6	• Goeree Shoal (~13 km NW of Operational Area)

Light Intensity Assessment

While the line of sight may extend tens of kilometres from the source, the light density (measured in Lux – which represents the intensity of light that arrives at or leaves a surface, as perceived by the human eye) rapidly decreases as distance increases from the source of the light.

The results of the light intensity modelling are summarised in Table 9-11(Imbricata 2018). To contextualise these results, light intensity represents the intensity of light that arrives at or leaves a surface, as perceived by the human eye, and is typically measured in Lux. The total amount of light as it arrives at a surface is referred to as illuminance and is the parameter that has been modelled in this assessment. Light intensity decreases as distance increases from the source of light.

Comparison of the results can be made with typical ambient light conditions, as summarised below:

- > 1 Lux (day light)
- 0.1–1.0 Lux (full moon to twilight)
- 0.01–0.1 Lux (quarter moon to full moon)
- 0.001–0.01 Lux (moonless clear night to quarter moon).

The results of light intensity modelling show low levels of light influence. The functional lighting to ambient conditions is predicted to be 9 km from the MODU and supply vessel (Imbricata 2018). Therefore, light from a MODU reaching the nearest submergent receptors of Goeree Shoal (Exposure Value (Ev) = 0.0055 Lux) and Eugene McDermott Shoals (Ev = 0.0014 Lux) will be at ambient (equivalent to a moonless clear night to quarter moon).

Table 9-11: Extent of Horizontal and Vertical Light Propagation at Ambient Light Conditions (Luminance = 0.001 Lux) for the MODU and a Supply Vessel in the Crux Operational Area (Imbricata, 2018)

Location of Light Source	Modelling Analogues (max. luminance at 100 m) (Lux)	Horizontal Light Propagation (km)
MODU deck and mast	8.9	9
Project vessel stern	8.9	9

9.4.2 Description and Evaluation of Impacts

Artificial lighting can create light spill, which has the potential to affect marine fauna that use light as cues for navigation or behaviour. The impacts of artificial light on these animals may include:

- disorientation, misorientation, attraction or repulsion;
- disruption to natural behavioral patterns and cycles; and
- indirect impacts such as increased predation and reduced fitness.

Potential impacts of changes to ambient light are included in a number of recovery plans and conservation advice, including the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017a) and the Wildlife Conservation Plan for Migratory Shorebirds (Commonwealth of Australia, 2015c).

The introduction of light emissions from the Crux development drilling activity will result in a temporary change to ambient light. The Operational Area is at a significant distance from coastal sources of light emissions, and existing lighting in the region is limited to offshore facilities, associated supporting activities and shipping traffic. The contribution of light emissions from the Crux development drilling activity will be comparable with existing vessels and facilities in the region and will not result in a notable increase.

The National Light Pollution Guidelines for Wildlife (NLPG) addresses potential impacts to marine turtles, seabirds and migratory shorebirds from artificial light (Commonwealth of Australia, 2020). The guidelines recommend a specific artificial light impact assessment process is undertaken where there is important habitat for listed species that are known to be affected by artificial light within 20 km of a project. The 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15-18 km (Kamrowski, et al., 2014; Hodge et al., 2007) and fledgling seabirds grounded in response to artificial light 15 km away (Rodríguez et al., 2014). The Operational Area is located about 100 km from any emergent features and outside known BIAs for turtles and seabirds/migratory shorebirds, therefore a specific assessment of potential impacts of artificial lighting is not required under the NLPG. However, the assessment of impacts presented below is supported by the light modelling conducted for the OPP process as presented in Section 9.4.1.

9.4.2.1 Marine Turtles

Light can affect the behaviour of adults and hatchling turtles. Light pollution on nesting beaches can alter critical nocturnal behaviours in adult and hatchling turtles (Commonwealth of Australia 2020). In the water, 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 2020). However, as hatchlings swim offshore from their natal beach, they become less influenced by light cues and rely predominantly by wave motion, currents and the earth's magnetic field (Lohmann and Lohmann 1992).

While artificial lighting from the Crux development drilling activity may be visible up to tens of kilometres away from the MODU/vessels (as outlined in the modelling above), the light intensity will be low beyond several hundred metres from the light sources.

No marine turtle BIAs or habitat critical to the survival of marine turtle species overlap with the Operational Area, the closest being the green turtle internesting buffer (Cartier Island), approximately 85 km north-west of the Operational Area (Table 7-9). The closest nesting BIAs to the Operational Area are at Cartier Island and Ashmore Reef, located approximately 104 km and 163 km north-west of the Operational Area, respectively (Table 7-9). The maximum distance of light visibility predicted from the modelling is approximately 30 km, therefore light pollution from the Crux Operational Area will not interfere with marine turtle BIAs. Turtles may transit through the Operational Area, but in the absence of BIAs they are unlikely to be present in significant numbers. Furthermore, given the distance of the Operational Area from the nearest nesting habitat at Cartier Island, hatchlings will be widely dispersed and are not expected to be influenced by light from the Crux development drilling activity.

Given the large separation distance of the Crux development drilling activity from marine turtle BIAs and habitat critical to the survival of marine turtle species, the consequence of impacts on turtle hatchlings or adult turtles from light emissions during activities associated with the Crux development drilling activity is expected to be Minor (Magnitude – -2, Sensitivity – M).

9.4.2.2 Birds

High levels of marine lighting can attract and disorient seabird species resulting in species behavioural changes (e.g. circling light sources or disrupted foraging), injury or mortality near the light source (e.g. Longcore and Rich, 2004; Gaston et al., 2014; Rich and Longcore, 2006). As the Operational Area is offshore and away from islands or other emergent features, any presence of seabirds or shorebirds is considered likely to be of a transient nature only. The nearest BIA for birds is a breeding BIA for the red-footed booby and greater frigatebird, located approximately 56 km to the north-west of the Operational Area. Impacts to red-footed booby and greater frigatebird within the BIA from Crux drilling activity lighting are therefore not expected.

Behavioural disturbance to birds from light is expected to be localised to within the vicinity of the MODU and vessels within the Operational Area. The light source from the MODU and vessels will be temporary and only when operations are occurring. Interactions with seabirds are therefore expected to be unlikely. Any impacts are predicted to be at an individual level and not a population level. The temporary behavioural disturbance of birds will be localised around the light sources, and not result in a substantial adverse effect on a population of species or its lifecycle. Additionally, light emissions will not seriously disrupt the lifecycle of an ecologically significant proportion of any migratory birds. Based on the impact evaluation, the consequence of impacts to birds from light emissions during activities associated with the Crux development drilling activity is expected to be Minor (Magnitude – -2, Sensitivity – M).

9.4.2.3 Pelagic Communities

Pelagic fish and zooplankton may be directly attracted to lights, and this can alter the distribution and predatory interactions. Experiments using light traps 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 intensity of light associated with the Crux development drilling activity may temporarily increase the concentration of photopositive marine fauna in the surrounding area.

The concentration of photopositive organisms around artificial light sources can encourage marine predators to aggregate. Shaw et al. (2002), in a similar light trap study, noted that predatory juvenile tunas (Scombridae) and jacks (Carangidae) may have been preying upon concentrations of zooplankton attracted to the light field of oil and gas platforms. This suggests that artificial lighting can increase predation rates compared to unlit areas.

The range of attraction of fish and invertebrates to lighting from the Crux development drilling activity is expected to be localised with no discernible residual impact consequence (Magnitude – 0, Sensitivity - L), and lighting is not expected to attract individuals away from any shoals/banks, offshore reefs/islands or KEFs.

9.4.2.4 Shoals and Banks

Some coral species use moonlight cues to trigger reproductive spawning events; significant light pollution can prevent these corals from detecting moonlight, resulting in their failure to spawn. However, light modelling (presented in Section 9.4.1) demonstrates that visible lighting from a MODU or project vessel reaching the nearest submergent receptors of Goeree Shoal and Eugene McDermott Shoals will be at ambient (equivalent to a moonless clear night to quarter moon). No discernible residual impact consequence is therefore expected (Magnitude – 0, Sensitivity - H).

9.4.3 Impact Assessment Summary

Table 9-12 lists the highest impact consequence rating in the relevant environmental receptor groups.

Table 9-12: Light Emissions Evaluation of Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Biological Environment	-2	M	Minor

9.4.4 ALARP Assessment and Environmental Performance Standards

Table 9-13: 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 Crux development drilling activity, given the legal requirements for a well-lit work area.	N/A	N/A	N/A
Substitution	Use different wavelength lights	No	Given the low densities of marine turtles and migratory birds and seabirds that may pass through the Operational Area, and that the lighting impact assessment indicates that the impacts to birds and turtles will be minor, installation of different spectrum lighting is not demonstrably ALARP.	N/A	N/A	N/A
Engineering	Vessel and MODU lighting designed to minimise light spill via: • Shielding; • Use low spill/ directional lighting; • Use of low-reflective paints; • Directing luminaires inwards on the MODU and vessels and away from the ocean.	No	The use of low-spill/directional and shielded lighting is not warranted due to the distance between the Operational Area and the nearest turtle nesting BIA (~85 km) and bird BIA (~56 km) and the absence of other light-sensitive fauna around the Operational Area.	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural controls	N/A	N/A	No additional or alternative control measures have been identified for this impact for the Crux development drilling activity, given the safety driven requirement for a well-lit work area to support 24hr operations and the inherent minor residual consequence associated with impacts.	N/A	N/A	N/A

9.4.5 Acceptability of Impacts

Table 9-14: Acceptability of Impacts - Lighting

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Threatened Species and Ecological Communities	Marine reptiles Birds Fish	No mortality or injury of threatened MNES fauna from the Crux development drilling activity. Management of aspects of the Crux development drilling activity must be aligned to conservation advice, recovery plans and threat abatement plans published by DAWE. No significant impacts to threatened or migratory fauna.	Yes	Light from the MODU and vessels may result in temporary attraction of individual turtles that may pass through the Operational Area. Although this is considered unlikely given the distance from turtle BIAs. Any attraction will be of short duration and will not result in significant impacts. Lighting on the MODU may also attract threatened and migratory birds, which may roost on the MODU. This will not result in significant impacts or mortality.
Ecosystems, Communities and Habitats	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 development drilling activity.	Yes	Given the distance to the nearest shoal (~14 km to Goeree Shoal), fauna at the shoals and banks are unlikely to perceive light from the MODU. Hence, they are unlikely to be impacted.

The assessment of impacts from light emissions determined a Minor residual worst-case impact (Table 9-12). As outlined above, the acceptability of the impacts from light

[7] As defined in the Matters of National Environmental Significance - Significant impact guidelines 1.1 (Commonwealth of Australia 2013).

emissions associated with Crux development drilling activity 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 (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:

- National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds (Commonwealth of Australia 2020); and
- Management of impacts are consistent with policies, strategies, guidelines, conservation advice, and recovery plans for threatened species (Table 9-15).

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 the Crux development drilling activity.

Alignment of the Crux development drilling activity with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-15.

Commonwealth Marine Environment

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

Table 9-15: Summary of Alignment of the Impacts from Light Emissions Aspect of the Crux Development Drilling Activity 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 Crux development drilling activity 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 (Commonwealth of Australia 2015c)	Managing the light aspect of the Crux development drilling activity 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.
	National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2020).	Seabirds and migratory birds have been identified in the National Light Pollution Guidelines to be affected by artificial light sources. The management of light emissions for the Crux development drilling activity 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 the Crux development drilling activity 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 2017a)	Light pollution has been identified as a threat in the Recovery Plan for Marine Turtles (Commonwealth of Australia 2017a). Nesting females and hatchling turtles are at greatest risk of light impacts; however, the nearest potential nesting habitat too far to receive any light pollution from the Operational Area. Therefore, potential light-related impacts to turtles on nesting beaches is not credible.

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
		Actions in the Recovery Plan for Marine Turtles (Commonwealth of Australia 2017a) 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 Minor, the actions listed above are not applicable to the Crux development drilling activity.
	National Light Pollution Guidelines for Wildlife (Commonwealth of Australia 2020).	Marine turtles have been identified in the National Light Pollution Guidelines to be affected by artificial light sources. The management of light emissions for the Crux development drilling activity 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 the Crux development drilling activity 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 further assessment of impacts.

Internal Context

Shell has also considered the internal context, including Shell's environmental policy and ESHIA requirements. The EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from light emissions determined the residual impact ratings were Minor (Table 9-12) 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 Minor to be acceptable if they meet legislative and Shell requirements. To this effect, the acceptability of these impacts has 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); and
- internal context (i.e. Shell requirements).

Based on the discussion of these considerations presented above, Shell considers impacts from light emissions associated with the Crux development drilling activity 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 from the Crux petroleum activities.	Fauna observations and incident reports demonstrate no mortality of listed threatened or migratory MNES species as a result of artificial light emissions.

9.5 Noise

9.5.1 Aspect Context

Underwater noise emissions from Crux development drilling activity are generated from the following sources:

- Semi-submersible MODU
- Vessel operations, including LCV, AHTs and general offshore support vessels
- Pile driving for docking pile installation
- Acoustic positioning equipment
- Helicopter operations within 500 m of the MODU.

MODU Noise

Noise associated with a moored MODU will be restricted to drilling activities, such as drill pipe operations and on-board machinery. A range of broadband values (59 to 185 dB re 1 µPa at 1 m (rms)) have been quoted for various MODUs (Simmonds et al., 2004). As the MODU will be moored there will be no additional noise from using DP equipment.

McCauley (1998) recorded received noise levels of about 117 dB re 1 µPa at 1 m SPL (rms) at 125 m from a moored MODU while actively drilling (with support vessel on anchor). Extrapolation of the measured data suggests a source level for the drill rig while actively drilling of 164 dB re 1uPa at 1m (SVT 2018). A 3 dB safety factor (i.e. a doubling of the energy) was applied to this level in modelling of the MODU for the Crux OPP (described below) to account for uncertainties and potential differences between rigs. This yielded a source level for a moored MODU during active drilling of 167 dB re 1uPa at 1m.

Following MODU arrival, drilling activities will commence for a planned duration of between approximately 10 – 14 months.

Marine Vessel Operations

Prior to arrival of the MODU, the drilling template will be installed by a LCV. Upon arrival of the MODU, AHTS vessels will be used for mooring of the MODU and during drilling activity, along with associated support vessels.

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 160-180 dB re 1µPa at 1 m, 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).

Noise levels are highest when vessels are holding station, 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 1 m (Simmonds et al. 2004). McCauley (1998) measured underwater broadband noise equivalent to about 182 dB re 1 µPa SPL (rms) at 1 m from a support vessel holding station in the Timor Sea. Similar noise levels are expected to be generated by the LCV and support vessels used for the Crux development drilling activity.

Note that all support vessels are required to comply with EPBC Regulation 2000 – Part 8 Interacting with Cetaceans to reduce the likelihood of collisions with cetaceans (refer to Section 9.7. Implementing this control may incidentally reduce the noise generated by vessels in proximity to cetaceans as vessels will be travelling slower; slower vessel speeds may reduce underwater noise from machinery noise (main engines) and propeller cavitation.

Generation of Underwater Noise from Pile Driving Operations

The docking piles may be installed during the template installation campaign, or at a later date through a dedicated campaign, by lowering the docking piles into position. In the unlikely event seabed conditions are harder than expected, the docking piles may need to be piled into the seabed using a hammer pile to a target depth of up to approximately 28 m.

While the piling method has yet to be finalised, it is expected that installation will require the use of a hydraulic hammer to drive the piles into the seabed. A study to determine the optimal size of the piling hammer is ongoing, however, it is not expected to exceed an MHU-750. Continuous and easy pile driving is predicted with approximate blow-counts of <200 blows/m through upper soil units and <500 blows/m through deeper soil units. Hammering of individual piles is expected to require less than 24 hours of continuous hammering. Hammering of consecutive piles will not occur continuously; there will be a break between the hammering stage for the installation of each pile.

Piling noise is not continuous, with each strike of the hammer on the pile generating a short, discrete sound impulse. This type of noise contrasts with continuous sources of noise, such as continuous use of vessel thrusters.

Piling has the potential to generate high-intensity noise when the hammer strikes the pile. Each hammer strike induces the pile to vibrate briefly, converting some of the energy applied to the pile into a pressure wave in the water column. This pressure wave is perceived as noise and is radiated from the pile into the water column. The vibration of the pile may also result in a pressure wave propagating along the density interface between the sediment and water column. An indicative sound exposure level (SEL) for piling using a relatively large (2,027 kilojoules (kJ)) hammer is approximately 220 dB re 1 μPa^2.s. The frequency spectrum of piling is expected to be broad, with most energy concentrated between 10 hertz (Hz) and 2,000 Hz. This level was used in modelling of pile driving for the Crux OPP by SVT (2018), which is further outlined below.

Generation of Underwater Noise from Positioning Equipment

A seabed acoustic positioning array may be deployed to support the accurate positioning of the drilling template and docking piles. This will be installed on a temporary basis only and will indicatively consist of approximately 5 subsea beacons attached to clump weights or frames positioned over a 50 m^2 area.

Transponders typically emit pulses of medium frequency sound, generally within the range of 19 to 34 kHz. The estimated SPL would be 180 to 206 dB re 1 µPa at 1 m (Jiménez-Arranz et al., 2019).

Transmissions are not continuous, but consist of short ‘chirps’ with a duration that ranges from 3 to 40 milliseconds. When required to support general positioning, they will emit approximately one chirp every five seconds (estimated to be required for four hours at a time). When required to support precise positioning they will emit approximately one chirp every second (estimated to be required for two hours at a time). For the drilling activity, transponders will only be active at the commencement of the drilling when positioning is required. Transponders will not emit any sound when on standby.

Helicopter Operations

Helicopters will enter the operational area for short periods of time to undertake crew change or other personnel transfer activities. 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 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 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 1μPa^2.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.

Underwater Noise Transmission Modelling

Table 9-16 provides a summary of sound frequencies and sound levels used to model underwater noise transmission from noise sources produced by Crux development drilling for the OPP (SVT 2018). Table 9-17 provides a summary of sound frequencies and sound levels used to model impulsive noise sources.

Table 9-16: Modelled Broadband Source Levels of MODU and Support Operations (continuous sources)

Source	Source Level (dB re 1μPa at 1m)
Vessel using dynamic positioning (DP)	171
Anchored MODU (actively drilling)	167

Table 9-17: Modelled Broadband Source Levels of Pile driving (impulsive source)

Source	Source Level (dB re 1μPa^2.s at 1m)
Pile driving (2,027 kJ hammer)	220

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.

Impact thresholds for the fauna groups were derived from scientific literature and published guidelines, including:

- Sound exposure guidelines for fishes and sea turtles: a technical report prepared by American National Standards Institute (ANSI)-Accredited Standards Committee S3/SC1 and registered with ANSI (Popper et al. 2014)
- Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (National Oceanic and Atmospheric Administration (NOAA) 2018) and updated noise exposure criteria (Southall et al. 2019)
- Sound Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Finneran et al. 2017).

Marine Mammals (Cetaceans)

The vulnerability of marine mammals to underwater noise is linked to their ability to perceive sound. Cetaceans can be grouped based on similarities in their hearing range. Underwater noise exposure thresholds can then be weighted for each cetacean group to emphasise noise frequencies to which a group may be particularly vulnerable. This approach is described in Southall et al. (2007) and has been applied to a range of underwater noise guidelines and impact assessments on cetaceans. Southall et al. (2019) updated the nomenclature to describe the three cetacean hearing groups as "Low-frequency", "High-frequency" and "Very high-frequency" to better reflect their hearing sensitivities in marine bioacoustics terms. Only low frequency (e.g. baleen whales) and high frequency (e.g. dolphins) may be present in the Operational Area, therefore very high frequency cetaceans are not considered further. Most of the noise associated with Crux development drilling activities involves non-impulsive noise sources, such as MODU and vessel noise, however, pile driving and acoustic positioning equipment would involve impulsive noise as well for short durations. The impact thresholds for continuous (non-impulsive)[8] underwater noise are summarised in Table

[8] Underwater noise can generally be considered as two types:

- impulsive noise – typically discrete, short duration noises punctuated by periods of low/no noise, characterised by high peak sound pressure levels with relatively rapid rise and decay times, and
- non-impulsive – noises that do not have rapid rise and decay times, typically of longer duration.

9-18 and for impulsive noise in Table 9-19. These are derived primarily from technical guidelines and exposure criteria published by NOAA (2018) and Southall et al. (2019).

Table 9-18: Marine Mammal Sound Exposure Criteria (Continuous Noise)

Type of Animal	Generalised Hearing Range[1] [Hz]	PTS – Permanent Injury SEL (received levels)[2] (dB re 1 µPa^2.s $L_{E/p, 24h}$)	TTS – Impairment SEL (dB re 1 µPa^2.s $L_{E/p, 24h}$)	Behaviour SPL[3] (dB re 1 µPa)
Low-frequency cetaceans (baleen whales including humpback, blue, sei, fin, brydes, etc)	7 – 35,000	199 dB $L_{E/p, 24h}$	179 dB $L_{E/p}$	120 dB L_p
High-frequency cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 – 160,000	198 dB $L_{E/p, 24h}$	178 dB $L_{E/p}$	120 dB L_p

Notes:

Represents the generalised hearing range for the entire group as a composite (i.e. all species within the group), where individual species hearing ranges are typically not as broad.

LE/p, 24h is the weighted cumulative sound exposure level ($L_{E/p}$) and has a reference value of 1µPa^2.s. The recommended accumulated period is 24 hrs. The weighted cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle).

Lp – Continuous (non-impulsive) noises are quantified as Sound Pressure Level (SPL, or Lp) using units of dB re 1 µPa.

Table 9-19: Marine Mammal Sound Exposure Criteria (Impulsive Noise)

Type of Animal	PTS – Permanent Injury Peak SPL (unweighted) (dB re 1 µPa)	PTS – Permanent Injury SEL (weighted)[2] (dB re 1 µPa^2.s $L_{E/p, 24h}$)	TTS – Impairment Peak SPL (unweighted) (dB re 1 µPa)	TTS – Impairment SEL (weighted) (dB re 1 µPa^2.s $L_{E/p, 24h}$)	Behaviour SPL (dB re 1 µPa)
Low-frequency cetaceans (baleen whales including humpback, blue, sei, fin, brydes, etc)	219	183	213 dB	168	160 dB L_p
High-frequency cetaceans (dolphins, toothed whales, beaked	230	202 dB	224 dB	170	160 dB L_p

Type of Animal	PTS – Permanent Injury Peak SPL (unweighted) (dB re 1 µPa)	PTS – Permanent Injury SEL (weighted)[2] (dB re 1 $\mu Pa^2.s$ $L_{E/p, 24h}$)	TTS – Impairment Peak SPL (unweighted) (dB re 1 µPa)	TTS – Impairment SEL (weighted) (dB re 1 $\mu Pa^2.s$ $L_{E/p, 24h}$)	Behaviour SPL (dB re 1 µPa)
whales, bottlenose whales)					

Sea Turtles, Fish and Other Fauna

Table 9-20 provides a summary of sound exposure guidelines for fishes and sea turtles for shipping and continuous sounds, relevant for Crux MODU and support vessel operations, based on Popper et al. (2014) and Finneran et al. 2017 respectively. Table 9-21 provides similar guidelines for pile driving operations.

Table 9-20: Fish, Larvae and Sea Turtle Noise Criteria for Shipping and Continuous Sounds (Source: Popper et al. 2014; Finneran et al. 2017)

Type of animal	Mortality and Potential Mortal Injury	Impairment			Behaviour
		Recoverable Injury	TTS	Masking	
Fish	(N) Low (I) Low (F) Low	170 dB Lp for 48 h	158 dB Lp for 12 h	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low
Turtles	(N) Low (I) Low (F) Low	220 (Weighted SEL24h – LE.p,24h; dB re 1 $\mu Pa^2.s$)	200 (Weighted SEL24h – LE.p,24h; dB re 1 $\mu Pa^2.s$)	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Note: Where insufficient data existed to recommend objective guidelines, a subjective approach is adopted in which the relative risk (High, Moderate, Low) of an effect is placed in order of rank at three distances from the source – Near (N), Intermediate (I), and Far (F) (top to bottom within each cell of the table, respectively).

"Near" might be considered to be in the tens of metres from the source, "intermediate" in the hundreds of metres, and "far" in the thousands of meters.

Table 9-21: Fish, Larvae and Sea Turtle Noise Criteria for Pile Driving (Source: Popper et al. 2014; Finneran et al. 2017)

Type of animal	Mortality and Potential Mortal Injury	Impairment			Behaviour
		Recoverable Injury	TTS	Masking	
Fish (no swim bladder)	>219 dB LE,p or > 213 dB Lpk	>216 dB LE,p or > 213 dB Lpk	>186 dB LE,p	N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish (swim bladder involved in hearing)	207 dB LE,p or > 207 dB Lpk	203 dB LE,p or > 207 dB Lpk	186 dB LE,p	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate
Eggs and larvae	210 dB LE,p or > 207 dB Lpk	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low
Turtles	>210 dB LE,p or >207 dB Lpk	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	175 dB re 1 µPa (SPL)

Note: Where insufficient data existed to recommend objective guidelines, a subjective approach is adopted in which the relative risk (High, Moderate, Low) of an effect is placed in order of rank at three distances from the source – Near (N), Intermediate (I), and Far (F) (top to bottom within each cell of the table, respectively).

"Near" might be considered to be in the tens of metres from the source, "intermediate" in the hundreds of metres, and "far" in the thousands of meters.

Sharks and rays were grouped with fish (no swim bladder) (Table 9-20 and Table 9-21) for this assessment of impacts. No suitable published guidelines were identified for sea snakes.

While there are reputable published studies indicating the potential for underwater noise to impact upon invertebrates, there is currently insufficient evidence for the setting of interim quantitative impact assessment criteria. However, qualitative criteria based on relative risk, such as those adopted by Popper et al. (2014), may be used for impulsive noise (Table 9-22) (SVT 2018). No published studies or guidelines on the potential invertebrate response to non-impulsive/continuous noise sources (e.g. drilling) have been identified. Invertebrates have been considered in the assessment of risks and impacts from underwater noise based on these grounds.

Table 9-22: Suggested Invertebrate Sound Exposure Assessment Criteria for Impulsive Sources (Source: SVT 2018)

Type of animal	Mortality and Potential Mortal Injury	Impairment - Recoverable Injury	Behaviour
Invertebrates	(N) Moderate (I) Low (F) Low	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low

Note: Where insufficient data existed to recommend objective guidelines, a subjective approach is adopted in which the relative risk (High, Moderate, Low) of an effect is placed in order of rank at three distances from the source – Near (N), Intermediate (I), and Far (F) (top to bottom within each cell of the table, respectively).

"Near" might be considered to be in the tens of metres from the source, "intermediate" in the hundreds of metres, and "far" in the thousands of meters.

Modelling Results vs Threshold Levels

Underwater noise modelling conducted by SVT (2018) was included in Appendix I of the Crux Offshore Project Proposal (OPP) (Shell 2020) for expected noise levels from drilling and pile driving activities associated with the project.

Drilling Activities

Crux development drilling 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 ranges for different fauna, no marine fauna permanent injury, recoverable injury, TTS or behavioural disturbance criteria were exceeded for any drilling scenario modelled by SVT (2018) for the project.

Vessel noise

Modelling of vessel noise, based on a tender vessel operating on DP (at high propeller rates inducing significant cavitation), for a total of 1 hour showed:

1. No marine fauna criteria for permanent injury, PTS or TTS were exceeded under the modelled scenario
2. The criterion for behavioural disturbance to low-frequency cetaceans may be exceeded by a tender on DP within a 1.6 km range
3. Marine fauna impact criteria for fish, larvae, sea turtles and high-frequency cetaceans were not exceeded for the vessel scenario modelled.

Pile driving activities

Crux pile driving activities also have the potential to result in noise impacts on marine fauna. Based on modelling of an MHU-600 Hammer (660kJ energy, 95% efficiency), no marine fauna permanent injury, recoverable injury, TTS or behavioural disturbance instantaneous assessment criteria (i.e. peak SPL) were exceeded.

Behavioural disturbance criteria for a single hammer strike were also met for low-frequency and high-frequency cetaceans at a range extending to 2.7 km (SVT 2018).

Potential cumulative exposure was also modelled based on an estimated maximum of 6,530 strikes in a 24-hour period. However, it is noted that cumulative exposure assumes the receiving animal remains stationary in the area throughout the entire 24-hour period and also assumes that the pile is driven at maximum energy for the maximum number of strikes. These assumptions result in unrealistically large impact ranges and it is considered unlikely that an animal would remain within receiving ranges at which impact criteria may be exceeded for an extended period.

The following thresholds were met under the cumulative exposure scenario:

1. The criterion for permanent injury to fish (no swim bladder) for a likely daily exposure was not reached.
2. There is potential for permanent injury to fish (with swim bladder), larvae and sea turtles within a range of up to 390 m, based on the daily exposure criterion.
3. There is potential for onset of permanent threshold shift in high-frequency and low-frequency cetaceans within a range of up to 14 km and 17.3 km respectively based on the daily exposure criterion.
4. The potential for onset of TTS in low-frequency cetaceans using the daily exposure criterion extends to a range of 57.8 km.
5. The potential for onset of TTS in high-frequency cetaceans using the daily exposure criterion extends to a range of 56.9 km.

6. The range for onset of recoverable injury for fish (with swim bladder) is met at 1 km using the daily exposure criterion.
7. The range for recoverable injury for fish (no swim bladder) using the daily exposure criterion is not reached at any location.
8. There is potential for onset of TTS in fish within a range of 13.4 km using the daily exposure criterion.

9.5.2 Description and Evaluation of Impacts

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

Benthic Communities

The Operational Area is located in waters approximately 90-180 m deep. Benthic habitat surveys in the Operational Area indicated a very low abundance of macrobenthic fauna (Fugro 2017a, AECOM (2017). Given the modelled noise levels for drilling, operational and pile driving activities associated with the project, impacts to benthic communities because of underwater noise are not expected.

No known offshore reefs or islands are in close proximity to the Operational Area, with the closest shoals approximately 14-24 km to the north west. These shoals may potentially be exposed to short-term increases in underwater noise levels during pile driving operations. However, based on the noise attenuation away from noise sources within the Operational Area, as demonstrated by modelling (SVT 2018), and the short duration of piling activities there are no credible potential impacts to benthic communities at these shoals as a result of project operations.

Pelagic Communities

Pelagic communities in the Operational Area include planktonic communities and pelagic fish and invertebrates.

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 Commonwealth Scientific and Industrial Research Organisation (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).

An assessment of the underwater noise generated by drilling operations and vessel noise planned in the Crux Operational Area showed exposure criteria for larvae were not exceeded in the modelling for these activities. Impacts from these continuous noise sources to plankton are therefore not considered credible. Modelling of pile driving noise showed permanent or temporary injury threshold criteria were not met for larvae from a single hammer strike, but permanent injury could occur if larvae remain within 390 m of the pile throughout a 24-hour period. Potential impacts would therefore be highly localised and of short duration during the installation of the two docking piles. The residual impact consequence to planktonic communities is 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 (Note, potential impacts to whale sharks from underwater noise are addressed below in the assessment of impacts to threatened and migratory species). The noise modelling indicates that no exceedance of the permanent or temporary injury or behavioural disturbance thresholds for any category of fish would occur in the Operational area for drilling or operational activities, or for a single strike of the pile hammer. Modelling of cumulative exposure during piling indicates permanent injury of fish (with swim bladder) could occur if an individual were to remain within 390 m of the pile throughout a 24-hour period of continuous piling, while recoverable injury of fish (with swim bladder) could occur within 1 km. However, given the highly mobile nature of most fish, sharks and rays, exposure over a 24 hour period within these ranges is unlikely. TTS could also occur for 24-hour exposure of fish within 13.4 km.

Continuous noise sources from the Crux drilling program are assessed to have a Minor residual impact consequence (Magnitude - 2, Sensitivity – L) on resident and transient fish populations. Impulsive noise from transponders and pile driving is similarly expected to have a Minor consequence given the short duration of the activity and lack of habitat supporting diverse fish assemblages in the vicinity of the Operational Area.

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 Crux drilling activities, including pile driving and support operations.

Several low frequency cetaceans (blue, humpback, sei, fin and Bryde's whales) were identified as potentially occurring within the Operational Area (Section 7.3.5). 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. Humpback whales are considered unlikely to occur due to known distribution data. The closest marine mammal BIA to the Operational Area is the migration BIA for pygmy blue whales, which is 120 km to the west.

High 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). High frequency cetaceans include most toothed whales, dolphins and beaked whales and a number of species of high frequency cetaceans were identified as potentially occurring within the Operational Area and adjacent EMBA (Section 7.3.5). Noise monitoring in the Timor Sea indicates high-frequency cetaceans are present year-round (McPherson et al. 2016).

The noise modelling conducted for the Crux OPP (SVT 2018) indicated that during pile driving the instantaneous peak thresholds (i.e. the peak SPL from a single hammer strike) for PTS and TTS will not be exceeded at any range for low frequency and high frequency cetaceans. The instantaneous behavioural disturbance threshold for a single hammer strike is exceeded out to a radius of 2.7 km.

The cumulative (i.e. 24-hour) PTS and TTS thresholds for low frequency cetaceans were predicted by the modelling to be exceeded at 17.3 km and 57.8 km respectively. These thresholds are highly conservative as they are based on a worst-case hammer size and they also rely on the cetacean remaining within the threshold radius for the duration of the entire 24-hour period. This is considered very unlikely, as low frequency cetaceans

in the area are typically migrating and would be expected to move away from uncomfortable stimuli (i.e. high noise levels). Behavioural responses of cetaceans exposed to acoustic disturbance shows typical behavioural response is to move away from unpleasant stimuli. Several species of cetacean, including humpback and minke whales, have been shown to avoid high intensity low frequency sound (Dunlop et al. 2013, Kvadsheim et al. 2017, Sivle et al. 2015). The oceanic low frequency cetaceans that may occur within the Operational Area are expected to be able to move away from the piling noise rapidly. For example, speeds of sei whales and blue whales have been estimated at > 6 km/hr, and individual animals can easily exceed 100 km in a 24-hour period (Double et al. 2014, Prieto et al. 2014) and hence move away from the piling before the time-based PTS and TTS are exceeded. Considering the expected low utilisation of the Operational Area by low frequency cetaceans, avoidance behavioural responses and nature of the piling activity, no low frequency cetaceans are expected to be exposed to noise levels exceeding the 24-hr PTS or TTS thresholds. The nearest known aggregation of whales is the seasonal presence of blue whales in their migratory corridor, which lies approximately 120 km to the west of the Operational Area. Given this distance is well beyond the range at which cumulative PTS or TTS may occur, blue whales will not be significantly impacted by piling noise.

The cumulative (i.e. 24-hour) PTS and TTS thresholds for high frequency cetaceans were predicted by the modelling to be exceeded at 14 km and 56.9 km respectively. As with the low frequency cumulative thresholds, these PTS and TTS thresholds are highly conservative, as they rely on the cetacean remaining within the threshold radius for the duration of the entire 24-hour period. This is considered very unlikely, as mid frequency cetaceans in the area are highly mobile and would be expected to move away from uncomfortable stimuli (i.e. high noise levels). The instantaneous behavioural disturbance threshold for a single hammer strike is exceeded out to a radius of 2.7 km.

The modelling assessment did not indicate that drilling of vessel DP noise would exceed any of the low or mid frequency cetacean impact thresholds defined for continuous noise at any range. Vessel DP noise was predicted to exceed the low frequency cetacean behavioural impact threshold at a range of 1.6 km.

Based on the results of the noise assessment, the short duration of exposure to impulsive noise sources, the cetacean species that may occur within the Operational Area and the controls Shell will implement, potential impacts are expected to consist of behavioural disturbance only. This behavioural disturbance is likely to consist of avoidance of areas of high noise intensity, which may inhibit other behaviours such as feeding. Behavioural will be restricted in time to relatively short periods when high noise intensity activities are occurring. Following cessation of noise generation, animal behaviour is expected to return to normal. Following implementation of controls (e.g. piling “soft start-up”), potential impacts such as mortality, injury, PTS and TTS are considered very unlikely to occur.

The overall impact consequence for marine mammals is considered to be Minor (Magnitude – - 2, 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 7.3.5), although no critical habitat or BIAs overlap the Operational Area. The water depth and benthic habitat within the Operational Area is typically too deep for turtle foraging for several species (e.g. Hays et al. 2001; Polovina et al. 2003), although species that eat primarily pelagic prey (e.g. leatherback and

juvenile green turtles) may forage for pelagic prey. As such, turtles are expected to occur only at low densities within the Operational Area and are likely to be transiting the area rather than foraging, breeding or nesting.

The noise modelling conducted for the OPP (SVT 2018) indicated that none of the noise sources that may arise from the Crux project would not exceed the instantaneous threshold for permanent injury of fatality, nor the behavioural impact threshold, for marine turtles or sea snakes at any range. The 48-hour cumulative PTS threshold for turtles is exceed out to a range of 390 m for piling noise, however continuous piling activities will not occur for 48 consecutive hours. PTS for marine turtles is not considered credible.

Continuous noise from drilling and vessel activities may result in behavioural disturbance in a localised area around activities. However, the potential for impairment (including recoverable injury, TTS and masking) is low. Noise associated with drilling of the foundation wells is highly unlikely to impact turtles that may be foraging at any of the shoals within the Crux in-field development area, considering the nearest shoal is 14 km from the Operational Area and well beyond the predicted area of impact.

Based on the results of the noise assessment, potential impacts to marine reptiles will be restricted to short term behavioural disturbance to animals in close proximity to high intensity noise sources. Given the expected low density of turtles within the Operational Area this potential impact would only affect a relatively small portion of turtle populations in the region. Recovery from behavioural disturbance is expected to occur immediately once the noise emission is ceased. The overall impact consequence for marine reptiles is considered to be Minor (Magnitude – - 2, Sensitivity – M).

Whale Sharks

Whale sharks occur within the Operational Area (e.g. traversing the open waters within or surrounding the Operational Area during migration to/from aggregation off Ningaloo Reef) and a BIA for whale sharks overlaps with the Operational Area. However, it is expected that whale shark presence would not be in significant numbers as there is no main aggregation area within the vicinity of the Operational Area, and their presence would be transitory and of a 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 and Radford 2010). Given the contrast to the feeding behaviour off aggregation areas such as Ningaloo Reef, the BIA is unlikely to be a dedicated foraging area; rather, it is likely to be a broad area within which migratory movements can be expected. This is consistent with the Conservation Advice (TSSC 2015a) for this species which indicates this BIA up the north west coast is a migration corridor than significant foraging habitat. There are no constraints preventing whale sharks from moving away from the Operational Area (e.g. shallow water or shorelines).

Whale sharks forage on plankton (as well as small fish), and high intensity underwater noise has been shown to result in impacts to some taxa within zooplankton communities. Recent observations by McCauley et al. (2017) provides evidence of considerable mortality of crustacean zooplankton (e.g. copepods and nauplii larval stage of crustaceans) over short timeframes. However, longer term impacts may be much less discernible due to the high turnover of planktonic communities and the movement of water masses. 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). As a result, impacts to zooplankton, which are of short duration, will not negatively affect whale sharks moving through the area. Note that small crustacean zooplankton comprise only part of whale shark diets, with larger plankton and nekton (e.g. krill and baitfish) forming a part of the species' diet (Colman 1997).

Whale sharks are not considered to be particularly vulnerable to noise related impacts and were categorised as 'fish with no swim bladder' above in determining impact thresholds. The modelling assessment conducted for the OPP (SVT 2018) predicted that no exceedance of the permanent or recoverable injury threshold for fish with no swim bladder would occur under any of the noise scenarios considered. The cumulative TTS for piling noise may occur out to a range of 13.4 km, noting that the study results are conservative (i.e. likely to over-estimate received sound levels) and assume an individual would remain within the impact range for a 24 hour period.

Based on the results of the noise assessment, the potential impacts to whale sharks are expected to be a minor, short-term behavioural disturbance. The overall impact consequence for whale sharks is considered to be Minor (Magnitude – - 2, Sensitivity – M).

9.5.3 Impact Assessment Summary

Table 9-23 lists the highest residual impact consequence ranking of the relevant environmental receptor groups.

Table 9-23: Noise Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Biological Environment	-2	M	Minor

9.5.4 ALARP Assessment and Environmental Performance Standards

Table 9-24: 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	No additional or alternative control measures have been identified for the Crux development drilling activity in relation to underwater noise.	N/A	N/A	N/A
Substitution	N/A	N/A	No additional or alternative control measures have been identified for the Crux development drilling activity in relation to underwater noise.	N/A	N/A	N/A
Engineering	N/A	N/A	No additional or alternative control measures have been identified for the Crux development drilling activity in relation to underwater noise.	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 Dolphin Watching 2017 (Commonwealth of Australia 2017b). In particular: • Marine support vessels will not deliberately	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 (Commonwealth of Australia 2017b) 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 comply with EPBC Regulations 2000 Part 8, Division 8.1 Interacting with cetaceans and the Australian National Guidelines for Whale and Dolphin Watching (2017).	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
	approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300 m for a whale calf; and 150 m 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.					
Administrative and Procedural Controls	Procedures for pile driving activities conducted for installation of the docking piles have been adapted from the 'Standard Management Procedures' set out in EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines, specifically: • A suitable number of crew will be trained by an experienced Marine Fauna Observer (MFO) and be onboard the installation vessel before	Yes	Alignment with the 'Standard Management Procedures' set out in EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines, for pile driving activities (including adaptions based on piling equipment and operating restrictions), will minimise the risk of impairment or disturbance from underwater noise to whales. As the piling activities are intrinsically different to seismic activities the procedures outlined within the control measure have been adapted from EPBC Act Policy Statement 2.1, to operate within the limitations of the piling	3.2	Pile driving activities will be undertake in line with procedures, specifically: • A suitable number of crew will be trained by an experienced MFO and be onboard the installation vessel before any piling will occur, such that at least one trained MFO will be on watch during the piling activity. Pre-Start-up-Visual Observation: • During daylight hours, visual observations (using binoculars and the	MFO Logs

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	any piling will occur, such that at least one trained MFO will be on watch during the piling activity. Pre-Start-up-Visual Observation: • During daylight hours, visual observations (using binoculars and the naked eye from a high vantage point on the Vessel) for the presence of whales will be undertaken by a suitably trained crew member for at least 30 minutes before the commencement of piling activities. Soft Start Procedure (also known as ramp-up): • The hammer piling will be initiated at the lowest striking force (where equipment allows), with a gradual ramp-up over a 30-minute period until the full striking power is reached. Operations Procedure:		equipment and associated operating procedures. i.e. if a whale enters the 1000 m or 500 m zones while full strike piling is being undertaken and engineering limitations require piling to continue (until final position is achieved), it is deemed that the whale has entered the potential impact zone voluntarily and the requirement to implement mitigation actions is void. Even with these limitations in place, the control still provides reduction in potential noise impacts to whales.		naked eye from a high vantage point on the Vessel) for the presence of whales will be undertaken by a suitably trained crew member for at least 30 minutes before the commencement of piling activities. Soft Start Procedure (also known as ramp-up): • The hammer piling will be initiated at the lowest striking force (where equipment allows), with a gradual ramp-up over a 30-minute period until the full striking power is reached. Operations Procedure: • During daylight hours, trained crew should undertake visual observations continuously during the piling activity. • Any break in piling greater than a 30-minute	

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	• During daylight hours, trained crew should undertake visual observations continuously during the piling activity. • Any break in piling greater than a 30-minute period will reinitiate the soft start requirement. Stop Work Procedure: • If a whale is sighted within the 3km observation zone an additional trained crew member should also be brought to the bridge to continuously monitor the whale whilst in sight. • If a whale is sighted within or is about to enter the protection zone (1 km), the acoustic source should be powered down to the lowest possible setting (where equipment/operating procedure allows). If a whale is sighted or is about to enter the Shut-				period will reinitiate the soft start requirement. Stop Work Procedure: • If a whale is sighted within the 3km observation zone an additional trained crew member should also be brought to the bridge to continuously monitor the whale whilst in sight. • If a whale is sighted within or is about to enter the protection zone (1 km), the acoustic source should be powered down to the lowest possible setting (where equipment/operating procedure allows). If a whale is sighted or is about to enter the Shut-down zone (500 m), the acoustic source should be shut down completely. It is noted that for engineering purposes it may not be possible to shut-down or reduce	

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	down zone (500 m), the acoustic source should be shut down completely. It is noted that for engineering purposes it may not be possible to shut-down or reduce striking power until the pile is in its finial position. • Power-up of the acoustic source with soft-start procedures should only occur after the whale has been observed to move outside the protection zone, or when 30 minutes have lapsed since the last whale sighting. Night-time and Low Visibility Procedures: Operations may proceed provided that there have not been 3 or more whale instigated power-down or shut-down situations during the preceding 24-hour period.				striking power until the pile is in its finial position. • Power-up of the acoustic source with soft-start procedures should only occur after the whale has been observed to move outside the protection zone, or when 30 minutes have lapsed since the last whale sighting. • Night-time and Low Visibility Procedures: Operations may proceed provided that there have not been 3 or more whale instigated power-down or shut-down situations during the preceding 24-hour period.	

9.5.5 Acceptability of Impacts

Table 9-25: Acceptability of Impacts - Noise

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Ecosystems, Communities and Habitats	Benthic Communities	No significant impacts to benthic habitats and communities.	Yes	Highly localised noise-related impacts may occur during the short-duration of piling. Soft sediment benthic communities are broadly distributed in the wider region and are not considered to be unique or highly sensitive. Underwater noise will not result in significant impacts to benthic communities in the Operational Area.
Threatened Species and Ecological Communities	Marine mammals Fish Sharks and rays	No mortality or injury of threatened or migratory MNES fauna from the Crux development drilling activity. Management of aspects of the Crux project must be aligned to conservation advice, recovery plans and threat abatement plans published by DAWE. No significant impacts to threatened or	Yes	Potential noise-related impacts may occur during the Crux development drilling activity. The Operational Area is not important habitat for threatened or migratory MNES that may be impacted by underwater noise, such as cetaceans and marine turtles. Instantaneous PTS and TTS impact

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		migratory MNES fauna.		thresholds for these species will not be exceeded by any activity. Cumulative 24-hr PTS and TTS thresholds for cetaceans are predicted to be exceeded by modelling, however it is very unlikely that an animal would remain in the area long enough to result in PTS or TTS. Piling is a discrete, short duration activity; other sources of noise will not result in significant impacts to threatened and migratory MNES.

The assessment of impacts from underwater noise determined the worst-case residual ranking of Minor or lower (Table 9-23). As outlined above, the acceptability of the impacts from noise associated with the Crux development drilling activity have been considered in the context of:

Principles of ESD

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

- The underwater 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 the most recent scientific literature and international guidelines on noise impacts (Popper et al. 2014, NOAA 2018, Southall et al. 2019, Finneran et al. 2017) 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 underwater noise emissions is consistent with relevant legislative requirements, including:

- assessment of noise impacts is guided by the latest scientific research in defining impact thresholds and includes noise transmission modelling for the MODU, project vessels and pile driving;
- management of noise impacts is consistent with policies, strategies, guidelines and conservation advice (refer to Table 9-26);
- 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 (Commonwealth of Australia 2017b), 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.

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 underwater noise emissions during the Crux development drilling activity. Alignment with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-26.

Commonwealth Marine Environment

Impacts from the noise aspect of the Crux development drilling on the Commonwealth Marine Environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-26: Summary of Alignment of the Impacts from the Noise Aspect of the Crux drilling activity 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	Approved conservation advice *Balaenoptera borealis* (sei whale) (Threatened Species Scientific Committee 2015a)	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 (Commonwealth of Australia 2017b). A noise assessment consistent with the recommendations of technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NOAA 2018; Southall et al. 2019) was undertaken. Pile driving activities conducted for installation of the docking piles will comply with 'Standard Management Procedures' set out in EPBC Act Policy Statement 2.1 – Interaction between Offshore Seismic Exploration and Whales: Industry Guidelines
	Approved conservation advice for *Balaenoptera physalus* (fin whale) (Threatened Species Scientific Committee 2015b)	
	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 management plan for the southern right whale: a recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 2011-2021 DeepakC 2012b)	
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 underwater noise emissions on threatened or migratory marine reptiles are Minor and would not constitute a significant impact. As such, the Crux development drilling activity does 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 (Commonwealth of Australia 2017a)	Acute and chronic noise pollution has been identified as a threat in the Recovery Plan for Marine Turtles (Commonwealth of Australia 2017a), however there are no

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
		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 turtles (Popper et al. 2014; Finneran et al. 2017) was undertaken.
Other Species – Sharks and Rays	Conservation advice on whale shark (*Rhincodon typus*) (TSSC 2015a)	A noise assessment consistent with the recommendations of the sound exposure guidelines for fishes and sea turtles (Popper et al. 2014) 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 underwater noise emissions aspect of the Crux development drilling activity 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 underwater 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 EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from noise determined the residual impact rankings were Minor (Table 9-24). As outlined above, the acceptability of impacts from underwater 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); and
- internal context (i.e. Shell requirements).

Shell considers residual impacts of noise 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 underwater noise.

Based on the points discussed above, Shell considers the impacts from underwater noise associated with the Crux drilling activity to be acceptable.

9.5.6 Environment Performance Outcome

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

9.6 Disturbance to Seabed

9.6.1 Aspect Context

Disturbance to the seabed will occur from a number of the Crux development drilling activities, including:

- installation of subsea infrastructure such as the drilling template and docking piles;
- GPS positioning array clump weights;
- mooring of the MODU;
- presence of mooring chains;
- placement of equipment on seabed;
- Remote Operated Vehicle (ROV) operations; and
- the drilling of five development wells.

The approximate area of direct seabed disturbance from the installation of the drilling template is 322 m^2 (23 x 14 m) and two docking piles is 24 m^2 (Table 6-3).

The proposed development wells are planned to be drilled using a moored semi-submersible MODU. The mooring system will be 12-point anchor system with an anchor spread up to 1,500 m from MODU. Each anchor has the potential to disturb approximately 25 m^2 of seabed (up to 300 m^2 in total). Mooring chains and lines also cause temporary seabed disturbance. It has been estimated that this will cause up to 10 000 m^2 of direct seabed disturbance.

The planned anchoring activities will be within the parameters defined in the Anchoring of Vessels and Floating Facilities Environment Plan Reference Case (Department of Industry, Innovation and Science, undated), including:

- locations of water depth greater than 70 m; this boundary is set to exclude areas of sensitive marine primary producer habitats (e.g. corals, seagrass) that occur in shallower waters;
- installation of moorings, buoys, equipment or other infrastructure for a period of up to two years; and
- wet storage on seabed of anchor chains, etc. during activities up to two years.

Other equipment and operations will also result in localised seabed disturbance. The use of ROV's during activities as described may result in temporary seabed disturbance and localised suspension of sediment as a result of working close to, or occasionally on, the seabed. ROV use close to or on the seabed is limited to that required for effective and safe subsea activities. The footprint of a typical ROV is about 2.5 m × 1.7 m (4.25 m^2).

Drilling activities may result in intermittent or discontinuous disturbance to the seabed up to an approximate 150 m radial distance around each new well due to the installation of the BOP, conductor and discharge of cement adjacent to wells.

Contingent Drilling Activities

Respudding may be required if well problems result in it being impractical to continue to drill in the current well. Any seabed disturbance would be the same as those described above for drilling and MODU operations. In addition, in the event of a respud the base

case would be to remove the wellhead infrastructure. However, if reasonable attempts at wellhead removal are unsuccessful, a wellhead may remain in situ until the end of field life.

Dropped Objects

There is the potential for objects to be dropped overboard from the MODU and project vessels to the marine environment. Objects that have been dropped during previous offshore activities include small numbers of personal protective gear (e.g. glasses, gloves, hard hats), small tools (e.g. spanners) hardware fixtures (e.g. riser hose clamp) and drill equipment (e.g. drill pipe); however, there is also potential for larger equipment to be dropped during the activity, particularly during recovery of infrastructure from the seabed. The spatial extent in which dropped objects can occur is restricted to the Operational Area.

The generation and discharge of cuttings and drilling fluids are assessed in Section 9.10.

9.6.2 Description and Evaluation of Impacts

Physical Environment

The Crux development drilling activities will have a physical impact on the seafloor within a localised disturbance footprint. The seabed of the Operational Area is characterised by widespread soft sediment habitat. Impacts to sediment quality from seabed disturbance as a result of the activities listed above are considered to be slight. Significant changes to physical properties, such as particle size distribution and geological origin, are not expected to occur.

Disturbance to the seabed will also result in a localised increase in turbidity due to the resuspension of sediment and unconsolidated material. 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 only a slight effect.

Any seabed disturbance associated with dropped objects will be within the Operational Area and limited to a very localised footprint in the immediate vicinity of the contact with the seabed.

The overall residual impact consequence level to water and sediment quality is ranked as Slight (Magnitude – -1, Sensitivity – L).

Biological Environment

Benthic communities within the Operational Area, may be impacted from the permanent placement of infrastructure (i.e. drilling template and wellheads), or placement of temporary infrastructure (e.g. MODU anchors, ROV) on the seabed. Disturbance to the seabed can alter the physical seabed habitat conditions, resulting in epifauna and infauna (living on and in the sediment) community changes (Newell et al., 1998). The drilling template and subsea well installations are permanent for the duration of field life and will result in the displacement and/or permanent loss of epifauna and infauna within the physical footprint.

Habitat modification as a result of seabed disturbance could occur within a radius of up to ~100 m from each well (5 wells in total). In proximity to this area benthic communities may be altered or reduced, resulting in a highly localised impact to any epifauna and

infauna. Potential impacts include burial or smothering effects from localised sediment deposition, particularly for sessile epifauna. Sediment coating resulting from elevated turbidity/TSS can also potentially cause clogging or damage to the physiological functioning of biota such as sea pens and polychaetes that are reliant on external respiratory and feeding structures.

Soft sedimentary communities have, however, been shown to respond rapidly to temporary disturbance and impacts are thus expected to be slight and short-lived (Shell 2009).

The deep-water environment is not oxygen saturated and oxygen levels in the water column at depth are substantially reduced as compared to the upper surface layers. Deep water benthic biota are adapted to such conditions which also include zero light and reduced temperature. Changes in oxygen levels resulting from sediment disturbance during the seabed infrastructure installation will be of short duration and temporary (excluding the footprint of permanent structures).

The benthic habitat survey conducted in 2017 (Section 7.3.1) revealed a low abundance of macrobenthic fauna in the Operational Area. This is linked to the low proportion of hard substrate, which is required habitat for many benthic species. The habitats associated with these communities are broadly distributed in the wider region and are not considered to be unique or highly sensitive.

The scale and magnitude of potential impacts will be limited to the offshore seabed infrastructure physical footprint area, representing a small proportion of the total area of deep water habitat and associated benthic communities of the Operational Area, that are known to be present in the wider region.

Given the widespread extent of similar habitat, the low diversity and 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 Minor (Magnitude – -1, Sensitivity – L).

9.6.3 Impact Assessment Summary

Table 9-27: Benthic Disturbance Evaluation of Residual Impacts

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

9.6.4 ALARP Assessment and Environmental Performance Standards

Table 9-28: 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 of the MODU and subsea infrastructure cannot be eliminated for the Crux development drilling activity.	N/A	N/A	N/A
Substitution	Only use DP MODU (no anchoring required).	No	While use of a DP MODU would reduce the impact to the seabed from anchoring, it would introduce a source of underwater noise with potential impacts to listed threatened and migratory species. Use of a DP MODU would also significantly increase the GHG emission associated within the drilling campaign. Shell has a demonstrated capacity to manage the environmental risks and impacts from mooring to a level that is ALARP and acceptable.	N/A	N/A	N/A
Substitution	Do not use an ROV close to or on the seabed.	No	The ROV is the main tool used to guide equipment during drilling. However, it is noted that due to visibility and operational issues, ROV work on or close to the seabed is avoided unless necessary.	N/A	N/A	N/A
Engineering	Infrastructure will be positioned on the seabed within design footprint to reduce seabed disturbance.	Yes	Positioning of infrastructure on the seabed within the design footprint will ensure disturbance occurs within planned areas where impacts have been assessed.	4.1	Infrastructure (drilling template and docking piles) is installed on the seabed within the Operational Area.	As-laid surveys are performed following drilling activities to confirm the infrastructure has been

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
						installed within the Operational Area.
Engineering	Adopt a MODU anchoring plan	Yes	A MODU anchoring plan will identify suitable areas for anchors to be placed within the Operational Area	4.2	Seabed disturbance from MODU mooring limited to that required to ensure adequate MODU station holding capacity.	Records demonstrate MODU anchoring plan completed and implemented during anchor deployment.
Engineering	Conduct ROV visual clearance survey	Yes	Use of a ROV visual clearance survey prior to position infrastructure on the seabed and prior to the commencement of drilling activities will ensure set-down accuracy and reduce seabed disturbance.	4.3	ROV visual clearance survey prior to drilling template installation and commencement of drilling activities.	Records demonstrate ROV visual clearance surveys are completed.
Engineering	GPS positioning array clump weight recovery	Yes	Technology and support vessels capability are available to undertake the recovery off clump weights used for the deployment of the GPS positioning array. It is considered that the capital cost to recover the clump weights outweighs the negative long term impact that the option to abandon in place has on the seabed. It is also expected that the limited impact the clump weights have would on the seabed, will naturally recover following the removal of the clump weights.	4.4	All clump weights used to deploy GPS positioning array are recovered.	Records demonstrate recovery of clump weights.
Administrative and Procedural Controls	Anchoring in the Operational Area for project vessels is prohibited except in	No	The use of a DP MODU (no anchoring required) would eliminate seabed disturbance and associated impacts to benthic communities from anchor placement and movement.	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	emergency situations or under issuance of a specific permit by Shell		Shell requires an anchored MODU to meet technical and operational constraints.			

9.6.5 Acceptability of Impacts

Table 9-29: 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	Water and sediment quality	No significant impacts to water quality during the Crux development drilling activity.	Yes	Slight, temporary impacts to water quality as a result of seabed disturbance during the Crux development drilling activities will not impact biodiversity or ecological integrity within the Operational Area.
	Sediment quality	No significant impacts to sediment quality during the Crux development drilling activity.	Yes	Slight, temporary impacts to sediment quality as a result of seabed disturbance during the Crux development drilling activities will not impact biodiversity or ecological integrity within the Operational Area.
Ecosystems, Communities and Habitats	Benthic communities	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Crux Project Area.	Yes	No significant impacts are expected, given the low benthic diversity and lack of hard substrate in the Operational Area. 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

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
				relatively small in scale, infrequent and represent a small fraction of similar habitat in the region. Therefore any impacts are not expected to affect ecosystem function or connectivity of communities.

The assessment of impacts from seabed disturbance determined the residual impact consequence ranking to be Minor or lower (Table 9-27). 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. 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 Crux development drilling activity on the Commonwealth Marine Environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-30: Summary of Alignment of the Impacts from the Seabed Disturbance Aspect of the Crux Development Drilling Activity 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 EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from seabed disturbance determined the residual impact rankings were Minor or lower (Table 9-27). 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); and
- iInternal context (i.e. Shell requirements).

Shell considers residual impacts 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 seabed disturbance aspect.

Based on the points discussed above, Shell considers the impacts from seabed disturbance associated with the Crux development drilling activity to be ALARP and acceptable.

9.6.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Crux Project Area.	No records of incidents involving seabed disturbance from development drilling activities outside the Operational Area.

9.7 Vessel Movements

9.7.1 Aspect Context

Activities associated with the Crux development drilling will require a MODU and vessels for subsea installation, support operations and supply/transport. The type and number of vessels in the Operational Area at any one time, and the duration of presence, will differ depending on the activities being undertaken (Section 6.5.3). The drilling template installation will be carried out by an LCV and is currently proposed to occur approximately 3 months ahead of MODU arrival. Following MODU arrival, drilling activities will commence for a planned duration of approximately 10 months, with an additional 10-month contingency drilling period. Post drilling, the docking piles may be installed using a LCV in preparation for substructure arrival and set-down (covered in a separate EP).

The physical presence of the MODU and vessels within the Operational Area may present a hazard to threatened marine fauna including mammals, turtles and whale sharks (though the abundance of such fauna in and around the Operational Area has been observed to be low). Vessel movements may result in unplanned collisions with 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 2017c).

9.7.2 Description and Evaluation of Risks

Vessel movements can result in collisions between the vessel (hull and propellers) and marine fauna, potentially resulting in superficial injury, serious injury that may affect life functions (e.g. movement and reproduction), or mortality. Marine fauna are also at risk of mortality through being caught in thrusters during station keeping operations (dynamic positioning).

The likelihood of vessel/fauna collision being lethal is 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. Project vessels within the Operational Area are likely to be travelling <8 knots (and will often be stationary). At times, vessels will be transiting between wells where speed could be approximately 15 knots, however these would only be transitory through the area. Therefore, the chance of a vessel collision with protected species resulting in a lethal outcome is considered unlikely.

The risk of marine life getting caught in operating thrusters is unlikely, given the low presence of individuals, combined with the avoidance behaviour commonly displayed during dynamic positioning operations.

Marine Mammals

As described above, vessel speed influences the probability and severity of a vessel collision with marine mammals (Vanderlaan and Taggart, 2007). The behaviour of individuals may also influence the potential for a collision occurring. Large cetaceans may be expected to show localised avoidance in response to vessel noise, however studies have reported limited behavioural response to approaching ships (McKenna et al., 2015). Furthermore, individuals engaging in behaviours such as feeding, mating or

nursing may be less aware of their surroundings and more susceptible to collision (Laist et al., 2001).

Seven species of whales may be present (or habitat presence) within the Operational Area, however no BIAs or known key aggregation areas for marine mammals (resting, breeding or feeding) are located within or immediately adjacent to the Operational Area. Individuals may occasionally be present in the Operational Area, including pygmy blue whales during seasonal migrations (Section 7.3.5).

One species of dolphin may occur in the Operational Area (Section 7.3.5), however, most dolphins show preference for coastal habitats over deep offshore waters. This reduces the likelihood of dolphin species being encountered in the Operational Area and interacting with project vessels.

Vanderlaan and Taggart (2007) estimate that the risk of lethal injury to a large whale as a result of a vessel strike is less than 10% at a speed of 4 knots. Vessel-whale collisions at this speed are uncommon and, based on reported data contained in the NOAA database (Jensen and Silber, 2004) there are only two known instances of collisions when the vessel was travelling at less than 6 knots; both of these were from whale-watching vessels that were deliberately positioned amongst whales. Smaller cetaceans, such as dolphins, comprise a lower proportion of reported vessel collision records (Commonwealth of Australia 2017c). Although dolphins often engage in bow riding which may make them more vulnerable to entanglement with propellers or thrusters compared to larger cetaceans.

Based on this, the likelihood of a vessel collision with marine mammals is Unlikely (C).

Turtles

The Recovery Plan for Marine Turtles in Australia recognises turtles are at risk from vessel strikes, particularly in shallow coastal foraging habitats and internesting areas where there are high numbers of recreational and commercial vessels (Commonwealth of Australia, 2017a). Considering the offshore location of the Operational Area, the presence of marine turtles is expected to comprise only occasional individuals transiting the open, offshore waters for short periods of time. Individuals are likely to respond to vessel presence by avoiding the immediate vicinity of the vessels and, combined with low vessel speed, will reduce the likelihood of a vessel-turtle collision.

It is unlikely that vessel movements associated with the Crux development drilling activity will have a significant impact on marine turtle populations, given the low presence of transiting individuals and the low operating speed of the vessels (generally <8 knots or stationary, unless operating in an emergency).

Based on this, the likelihood of a vessel collision with marine turtles is Unlikely (C).

Whale Sharks

Whale sharks are at risk from vessel strikes when feeding at the surface. The Operational Area is located within the foraging BIA for whale sharks which extends offshore along the Pilbara and Kimberley coastlines (Table 7-11). This BIA is listed as foraging habitat, however the Conservation Advice (TSSC 2015a) indicates this BIA is used by whale sharks as a migration corridor rather than as significant foraging habitat.

While whale sharks may traverse the Operational Area, their presence is not expected in large 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).

Based on this, the likelihood of a vessel collision with whale sharks is Unlikely (C).

Summary

Given the migratory nature of whale sharks in the identified BIA, and the large distance between the Operational Area and BIAs and critical habitat for turtles and marine mammals, the abundance of threatened or migratory species in the Operational Area is expected to be low and their presence transient.

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 scale. Therefore, the potential risk of impact from a vessel collision is considered to have a Minor consequence, with a likelihood of Unlikely (C) and an overall residual risk ranking of Minor.

9.7.3 Risk Assessment Summary

Table 9-31: Vessel Collision with Marine Life Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Biological Environment – threatened species	Minor	C - Unlikely	Dark Blue

9.7.4 ALARP Assessment and Environmental Performance Standards

Table 9-32: 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 the Crux development drilling activity.	N/A	N/A	N/A
Substitution	Substitution	No	The number of vessels proposed is already considered the minimum to meet operational needs.	N/A	N/A	N/A
Engineering	Engineering	No	No appropriate control measures have been identified to reduce collision likelihood 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 Dolphin Watching 2017 (Commonwealth of	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 (Commonwealth of Australia 2017b) 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	3.1	Vessels comply with EPBC Regulations 2000 Part 8, Division 8.1 Interacting with cetaceans and the Australian National Guidelines for Whale and Dolphin Watching (2017).	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
	Australia 2017b). In particular: • Project vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300 m for a whale calf; and 150 m for a dolphin calf. • If the whale, dolphin, turtle or whale shark shows signs of being distressed, project vessels will immediately withdraw from the caution zone at a constant speed of less than 6 knots.		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 biologically important habitats within the Operational Area.	N/A	N/A	N/A

9.7.5 Acceptability of Risks

Table 9-33: Acceptability of Risks – Vessel Movements

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Threatened Species and Ecological Communities	Marine mammals Marine reptiles Sharks and rays	No mortality or injury of threatened or migratory MNES fauna from the Crux development drilling activity. Management of aspects of the Crux development drilling activity must be aligned to conservation advice, recovery plans and threat abatement plans published by DAWE. No significant impacts to threatened or migratory MNES fauna.	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, with the single exception of the BIA for the whale shark, which represents a broad migratory corridor and threatened and/ or migratory species are not expected in significant numbers in the region. In addition, with the low speeds of vessels within the Operational Area, significant impacts to Threatened and Migratory Species are not anticipated. Shell's environmental management of the physical presence and vessel movements aspect of the Crux project is aligned with conservation advice, recovery plans and threat abatement plans.

The assessment of risks from vessel movements determined the residual risk to have a ranking of Dark Blue (Table 9-31). 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. 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:

- Project 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 (Commonwealth of Australia 2017b), i.e.
    - Project vessels will not deliberately approach closer than 50 m to a dolphin, turtle or whale shark; 100 m for an adult whale; 300 m for a whale calf; and 150 m for a dolphin calf
    - If the whale, dolphin, turtle or whale shark shows signs of being distressed, project 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 9-34 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 but 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 9-34.

Commonwealth Marine Environment

The impacts and risks from the vessel movements aspect of Crux development drilling activity on the Commonwealth marine environment will not credibly exceed any of the significant impact criteria provided in Table 8-1.

Table 9-34: Summary of Alignment of the Risks from the Vessel Movements Aspect of the Crux Development Drilling Activity 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 Unlikely, 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 2017c)	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 project vessels adhering to Part 8 (Interacting with cetaceans and whale watching) of the EPBC Regulations. Note the other objectives of the Strategy relate to actions for Government agencies.
	Conservation advice on sei whale (*Balaenoptera borealis*) (TSSC 2015b)	The risk of vessel strikes will be managed by project 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*) (TSSC 2015c)	
	Conservation management plan for the blue whale: A recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 2015-2025	

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 2015a)	
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 Unlikely, 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 2017a)	Project 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 application to turtles 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 2008b)	
Threatened and Migratory species – whale sharks	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	The risk assessment indicates that the likelihood of vessel collisions whale sharks is Unlikely, 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*) (TSSC 2015a)	The Operational Area is recognised as a BIA for whale sharks. The conservation advice recommends minimising offshore developments close to marine features that may aggregate whale sharks, but only transitory whale sharks are likely to pass through the Operational Area and aggregations are not expected in the vicinity.
Commonwealth Marine Environment	Significant Impact Guidelines for the Commonwealth marine environment (Table 7-3)	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 EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

As outlined above, the acceptability of the associated risks has 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); and
- internal context (i.e. Shell requirements).

The residual risks have been assessed as Minor (Table 9-34). 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 Crux development drilling activity 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.	Records demonstrate no breaches with EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans.

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.

Two primary mechanisms can introduce IMS to new areas:

- Biofouling. Biofouling occurs when marine organisms attach and grow on the submerged parts of a vessel or marine equipment.
- Ballast water discharges. The mobile life stages of IMS can be taken up in ballast water in one location, and introduced into another location when the ballast is discharged.

During the Crux development drilling activity, vessels will be transiting to and from the Operational Area, potentially including traffic mobilising from beyond Australian waters. These project vessels may include the MODU, LCV, AHTS or general project vessels (Section 6.5.3).

All vessels are subject to some level of marine fouling whereby organisms attach to the vessel hull. This can particularly occur in areas where organisms can find a good attachment surface (e.g. seams, strainers and unpainted surfaces) or where turbulence is lowest (e.g. niches, sea chests, etc.). Biofouling may also be present on submerged equipment such as ROVs.

Organisms can also be drawn into ballast tanks during onboarding of ballast water as cargo is loaded or to balance vessels under load. The need for ballast water exchange for the project vessels within the Operational Area is expected to be limited. All vessels operating in the Operational Area are obliged to conduct ballast tank operations in line with International Maritime Organisation (IMO) guidelines and, where applicable, comply with the *Biosecurity Act 2015*.

The risk of introducing IMS through biofouling and ballast water exists only if the vessels or equipment have been submerged in water where an established population of IMS already exists. This includes international and Australian waters. Cross contamination between vessels can also occur (e.g. IMS translocated between project vessels) during times when vessels need to be alongside each other. These vessels may subsequently become vectors for translocation of potential IMS to new areas (NOPSEMA, 2020) or compound the impact of IMS already established in the wider region (Department of Fisheries, 2017). Shallow water, coastal marine environments are particularly 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). Once IMS establish, spread and become abundant in coastal waters some species could have major ecological, economic, and social/cultural consequences (Hewitt et al. 2011; Pimental et al. 2000).

9.8.2 Description and Evaluation of Risks

A range of environmental sensitivities within the following groups may be at risk from the introduction of potential IMS, including:

- biological environment; and
- socio-economic environment.

Potential risks associated with IMS establishment as a result of the drilling activities are discussed below.

Biological Environment

If IMS are introduced into a new area which can support their needs, the IMS can reproduce and establish a population in that area. IMS can outcompete or predate native species, and are recognised globally as a threat to marine biodiversity. In addition to affecting biodiversity in the immediate area, newly established populations of IMS can spread to nearby areas because many IMS produce larval stages that are easily transported by ocean currents.

Benthic Communities

The introduction IMS in the Operational Area has the potential to change the structure of benthic communities leading to a change in ecological function, if IMS were to become established. However, the offshore environment of the Operational Area is 90-180 m deep, and has little hard substrate available. In the unlikely event potential IMS are released into the Operational Area from biofouling or ballast water, the IMS are highly unlikely to encounter suitable habitat for settlement and establishment.

Benthic communities within the Operational Area are characterised by low density macrobenthic communities of deposit and filter feeders on bare sediments. The seabed within the Operational Area does not receive sufficient sunlight to support benthic primary producer habitat, such as macroalgae and zooxanthellate corals. Very few IMS could credibly survive in the water depths of the Operational Area.

While project vessels have the potential to introduce IMS into the Operational Area, the deep offshore open waters are not conducive to the settlement and establishment of IMS. Furthermore, the Operational Area is away from shorelines and/or critical habitat, the closest sensitive receptors are the Goeree Shoal, located approximately 14 km north-west of Operational Area.

The likelihood of IMS being introduced and establishing viable populations within the Operational Area or immediate surrounds 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 alongside the drilling operations). Further, project vessels will typically be sourced from Australian waters and will undertake the required assessments described in the Browse Basin Biosecurity Management Plan. Given the extremely remote likelihood and the moderate significance associated with the risk of IMS introduction to benthic habitats, the overall risk to benthic habitats is considered Minor.

There are no KEFs that overlap the Operational Area.

Shoals and Banks

The shoals and banks in the region are typically shallower than the Operational Area and may therefore be more vulnerable to introduction of IMS, although the shoals and banks are also below the preferred depth range of many potential IMS.

The nearest shoal to the Operational Area is Goeree Shoal, which lies approximately 14 km to the north-west. Given the extremely remote likelihood that an IMS is introduced and becomes established in the Operational Area, it is not expected that the IMS distribution would extend to include shoals and banks in the region.

Project vessels are very unlikely to spend any significant time in proximity to Goeree Shoal (or any other bank or shoal), and direct introduction of IMS to a shoal or bank is

considered very unlikely. With the controls in place to minimise potential IMS risk, direct introduction of IMS to a shoal, bank or island during these short-duration activities is also considered Extremely Remote. Given the major significance associated with the risk of IMS introduction to nearby shoals, reefs and islands, the overall risk to these receptors is considered Moderate.

Socio-economic Environment

The establishment of IMS has the potential to cause affect activities of other users through indirect impact such as changes to fisheries target species resulting in economic and social implications, or due to compromised reputation to the oil and gas industry.

Given the low likelihood of IMS introduction and establishment within the Operational Area, project activities are not expected to adversely affect other marine user activities in the region.

The consequence of potential impacts to other users is considered Major. However based on the extremely remote nature of IMS impacting socio-economic receptors, the residual risk is assessed as Moderate.

9.8.3 Risk Assessment Summary

Table 9-35: IMS Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Biological Environment	Major	A - Extremely remote	Dark Blue
Socio-Economic Environment	Major	A - Extremely remote	Dark Blue

9.8.4 ALARP Assessment and Environmental Performance Standards

Table 9-36: 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
Elimination	No discharge of ballast water during the Crux development drilling activity	No	Ballast water discharges are a safety critical requirement for maintaining vessel stability.	N/A	N/A	
Substitution	Only use local project 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 project 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.	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 and the Protection of the Sea	Valid International anti-fouling systems certificate or a Declaration on anti-fouling systems.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					(Harmful Antifouling systems) Act 2006.	
Administrative and Procedural controls	Vessel Specific Biofouling Management Plans	Yes	IMO Guidelines for the Control and Management of Ships' Biofouling is considered 'best practice' for mitigation of transfer of invasive aquatic species to ALARP. Control based on legislative requirements and will reduce the likelihood of introducing IMS. Vessel specific (as per IMO guidance) Biofouling Management Plan (BMP) and Biofouling Record Book (BRB) recording implementation of BMP.	6.2	Vessels will have a Biofouling Management Plan as per IMO guidance and will comply with requirements of the Commonwealth *Biosecurity Act 2015*, *WA Fish Resources Management Act 1994* and *Aquatic Resources Management Act 2016*, NT *Fisheries Act* and associated regulations.	Vessel-specific Biofouling Record Book recording implementation of Biofouling Management Plan. Vessel Ballast Water Management Plan. Vessel Ballast Water Certificate.
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 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	6.3	Vessels coming from overseas will have required DAWE clearance including the Ballast Water Certificate and Ballast Water Management Plan if the vessel is required to discharge ballast in Australian waters.	

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			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 m, 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; and			

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.			
Administrative and Procedural controls	Ballast water management within the Operational Area	Yes	Only low risk ballast water will be discharged within the Operational Area. Although the Operational Area location 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 > 50 m deep, no ballast water (originating from outside Australian waters) exchange will occur within the Operational Area of the MODU.	6.4	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
			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.			
Administrative and Procedural controls	Environmental Deoxyribonucleic acid (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	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 mitigate 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 Risks

Table 9-37: Acceptable Levels of Risks - IMS

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Ecosystems, Communities and Habitats	Benthic communities	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Crux Project Area.	Yes	The introduction of an IMS as a result of the Crux development drilling activity is unlikely to survive given the water depth of the Operational Area. Shell will take industry-standard measures to reduce the likelihood of an IMS being introduced as a result of the Crux development drilling activity. If an IMS were to be become established, it would be very difficult to eliminate, however it is unlikely to result in significant impacts to benthic habitats and communities.
Socio-economic and Cultural Environment	Marine Parks	No impacts to the values of marine parks.	Yes	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 the Crux development drilling activity.
	Commercial fisheries	No negative impacts to exploited fisheries resource stocks which result in a demonstrated direct loss of income.	Yes	
	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 9-35). 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 development drilling activity 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.
    - DAWE's mandatory biofouling management requirements for international vessels.
    - 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 9-38: Summary of Alignment of the Risks from the IMS Aspect of the Crux Development Drilling Activity 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.

External Context

There have been no objections or claims raised by Relevant Persons to date around the IMS 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 EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of risks from IMS determined the residual risk rankings were Dark Blue (Table 9-35). As outlined above, the acceptability of the impacts and risks from IMS associated with the Crux development drilling activity has been considered in the context of:

- the established acceptability criteria for the IMS aspect of the Crux development drilling activity;
- ESD;
- relevant requirements;

- MNES;
- external context (i.e. stakeholder claims); and
- internal context (i.e. Shell requirements).

Given the water depth (>90 m), potential IMS species which may be present on equipment and vessels used for the Crux development drilling activity would be unlikely to settle and establish on the available natural substrate within the Operational Area and the nearest shallow water sensitive receptor, Goeree Shoal, is located approximately 14 km north-west. Considering all of the controls which are in place, the residual risk of potential species of IMS being introduced to the Operational Area, spreading, attaching to project vessel hulls 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 extremely 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 activity. No introduction of IMS to the marine environment from ballast water exchange operations undertaken or biofouling by vessels carrying out petroleum activities.	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 Crux installed infrastructure.*

9.9 Discharge of Liquid Effluent

9.9.1 Aspect Context

A range of project activities associated with the Crux development drilling will result in the discharge of liquid waste from the MODU and project vessels to the marine environment. These include the following:

- Deck drainage and bilge water
- Putrescible waste, greywater and sewage
- Cooling Water
- Desalination brine
- Use and release of residual chemicals in ad-hoc discharges.

Note that unplanned spills, e.g. of chemicals or hydrocarbons, are considered separately in Section 9.14.

Deck Drainage and Bilge Water

Deck and surface drainage, including bilge water, from the MODU and project vessels will consist 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.

Putrescible Waste, Sewage and Greywater

The MODU and project vessels routinely generate/discharge treated sewage, putrescible wastes and greywater to the marine environment.

The volume of treated sewage discharged is influenced by the number of personnel onboard the MODU/vessel. A MODU with a crew capacity of up to 200 persons discharges in the order of 20 m^3 of domestic wastewater per day during drilling operations. An AHTS with approximately 60 persons on board and project vessels manned by up to 30 persons, will generate only small volumes of domestic wastes.

Cooling Water

Seawater is used as a heat exchange medium for the cooling of machinery engines and equipment. Seawater is drawn from the ocean and flows counter current through closed circuit heat exchangers, transferring heat from the machinery or production process to the seawater via an intermediate circulating freshwater system. Seawater is then discharged to the ocean at an average of approximately 5°C to 9°C above the ambient seawater temperature (depending on season and the depth it is drawn from). Cooling water is often treated with additives including scale inhibitors and biocide to avoid fouling of pipework.

It may be expected that small volumes of cooling water will be discharged from the MODU/vessels, with volumes expected to be in the order of approximately 5 –10 m^3 per day per vessel, depending on the type of vessel.

Desalination Brine

The production of freshwater from seawater via reverse osmosis (RO), distillation or desalination plants on the MODU and project vessels results in a discharge of seawater with a slightly elevated salinity (typically 20% - 50% higher than seawater) to the marine environment. Chlorine scavenging, scale inhibiting and/or small volumes of other treatment chemicals may be present in the waste stream at low concentrations.

Modelling of brine discharges from vessels developed by the United States Environmental Protection Agency (US EPA) found the brine discharged from the surface diluted 40–fold at 4 m from the source assuming no ocean current (Frick et al., 2001). The modelling indicated that salinity concentration drops below environmental impact thresholds within 4 m of discharge.

Use and Discharge of Chemicals

Chemical usage is required for various routine and non-routine process and non-process applications and as such, chemicals may be present in waste water streams which are discharged to the ocean.

Chemicals are utilised on the MODU and project vessels for a variety of purposes and can may include:

- process chemicals e.g. biocide, scale inhibitor etc;
- maintenance/non-process chemicals e.g. paints, degreasers, greases, fire-fighting foam, lubricants and domestic cleaning products; and
- Subsea discharges e.g. hydraulic fluids from ROVs or other underwater equipment.

9.9.2 Description and Evaluation of Impacts

Planned liquid discharges to the marine environment may result in a localised decline in water and sediment quality, which may cause sensitive biological receptors in those environments to be exposed to physical characteristics and contaminants at concentrations that may cause acute or chronic effects. The magnitude and sensitivity of any impacts on sensitive receptors will vary according to multiple factors, including discharge composition, plume dilution/dispersion, bioavailability, duration of exposure and marine species physiology and behaviour.

Physical Environment

Deck Drainage and Bilge Water

Deck drainage and bilge water 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. Discharges of oily water will be treated to <15 parts per million (ppm) (v) in accordance with MARPOL requirements. 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 open drains and bilge systems onboard the MODU and project vessels. This may result in the discharge of minor quantities of diluted toxicants into the ocean, potentially causing localised and temporary reductions in water quality. 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. Discharges are expected to disperse and dilute rapidly, with concentrations significantly dropping with distance from the discharge point.

As such, no significant impacts from the discharge of deck drainage and bilge water are anticipated, because of the minor quantities involved, the localised mixing zone and the high level of dilution within the open water environment of the Operational Area. Overall, the residual impact of the discharge of deck drainage and bilge water to water quality is considered of Minor impact consequence (Magnitude – - 2, Sensitivity – L).

Putrescible Waste, Sewage and Greywater

Discharge of putrescible waste, sewage and greywater into the marine environment may impact water quality, including eutrophication, increased turbidity, increased pathogens (bacteria, viral agents and/or parasites), and increased biological oxygen demand (BOD), with associated impacts on marine biota (discussed 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. 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.

Discharges of putrescible waste, sewage and grey water can cause 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 putrescible waste, sewage and greywater 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.

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. Similar rates of dilution are expected for the open waters of the Operational Area.

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 the offshore location of the Operational Area, the residual impact consequence to water quality is assessed as Slight (Magnitude – -1, Sensitivity – L).

Cooling Water and Desalination Brine

The key physicochemical stressors that are associated with reject brine and cooling water discharge include salinity, pH, temperature and chemical toxicity. Generally, desalination brine and cooling water containing chemical additives are inherently safe at the low dosages used. They are usually consumed in the inhibition process, so there is little or no residual chemical concentration remaining upon discharge. No detectable impacts to marine sediment quality are predicted based on the water depth, open ocean currents and low concentration/toxicity of chemical additives.

The potential impacts on water quality due to cooling water discharge include chlorine toxicity and increased water temperatures. The effect of chlorine and chlorine breakdown products in cooling water discharges have been the subject of many studies, generally

through toxicity testing. Chlorine is a strong oxidant and following discharge and dilution, the residual (free) chlorine quickly reacts with inorganic constituents such as sodium, iron (II), nitrite and sulphide to produce chlorides (such as NaCl). The potential impacts of chlorine on the biological environment are discussed further below. The elevated temperature of cooling water discharge is expected to decrease rapidly as it mixes with the receiving waters. As such, any potential impacts to water quality are expected to be highly localised.

As described above, desalination brine is typically 20 to 50% higher in salinity to the surrounding water. Being of greater density than seawater, this will sink and disperse rapidly in the deep water and open oceanic currents, decreasing in salinity rapidly as distance from source increases.

The residual impact consequence for water quality as a result of cooling water and desalination brine discharges is assessed as Slight (Magnitude – -1, Sensitivity – L).

Use and Discharge of Chemicals

The infrequent release of minor quantities of process and non-process chemicals during planned activities may result in a localised and temporary reduction in water quality around the discharge. Discharge of small volumes of these fluids are predicted to disperse and dilute rapidly with the spatial extent of any impacts likely to be limited to the water column, and very localised around the discharge point. Therefore, the residual impact consequence is assessed as Slight (Magnitude – - 1, Sensitivity – L).

Biological Environment

Deck Drainage and Bilge Water

As described above, discharges of oily water will be treated to <15 ppm (v) in accordance with MARPOL requirements. It is possible that marine fauna transiting the localised area may come into contact with these discharges (e.g. marine turtles, cetaceans, whale sharks) as they traverse the Operational Area. Most threatened fauna species potentially exposed to deck drainage and bilge water 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 expression is expected and therefore damage to eyes and lungs from exposure to oil on the sea surface is not anticipated. Given the localised extent of impacts from deck drainage and bilge water discharges and limited exposure, within the Operational Area, significant impacts to marine fauna are not expected.

Overall, the residual impact of the discharge of treated deck drainage and bilge water to the biological environment is considered to be of Slight impact consequence (Magnitude – - 1, Sensitivity – M).

Putrescible Waste, Sewage and Greywater

Nutrients in sewage greywater and putrescible 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. 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.

The overboard discharge of sewage and putrescible wastes will create 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. marine turtles, 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.

The residual impact associated with the discharge of putrescible waste, sewage and greywater is considered to be Slight (Magnitude – - 1, Sensitivity – M).

Cooling Water and Desalination Brine

The chemicals in cooling water and desalination brine typically have low inherent toxicity, low residual discharge concentrations and/or the active ingredients are consumed through the process for which they are utilised. As described above, environmental effects associated with cooling water and desalinisation brine are expected to be highly localised, therefore impacts to marine fauna in the vicinity of the discharge are not expected.

The residual impact as a result of the discharge of cooling water desalination brine to marine fauna are considered to be of Slight impact consequence (Magnitude – - 1, Sensitivity – M).

Use and Discharge of Chemicals

As described above, the infrequent release of minor quantities of process and non-process chemicals during planned activities may result in a localised and temporary reduction in water quality around the discharge. The potential for impacts to biota depend on the nature and degree of exposure received by a particular receptor. Given the short-term durations and low frequencies of any ad-hoc discharges associated with planned activities, any potential effects are likely limited in duration to a matter of minutes after the release, and confined to a small area in the water column. Therefore, only a low number of individuals that may intersect the discharge plumes prior to sufficient dilution would be affected. No adverse environmental effects are expected at a community or habitat level for any marine fauna species.

Chemicals present within these discharge streams are predicted to have slight residual impact consequence (Magnitude – - 1, Sensitivity – M) given the typically low toxicity of chemicals selected through the Shell Chemical Management Process (Section 10.1.4), distance to sensitive habitats, lack of sensitive receptors and high inherent rates of dilution and dispersion.

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 Operational Area. It is expected that any discharged pathogens will be susceptible to rapid mortality following exposure to natural levels of Ultra Violet (UV) radiation, oxygen, increased salinity and natural predation resulting in their reduction and ultimate destruction (Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (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 of the Operational Area 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 9-39 lists the highest residual impact consequence rankings of the relevant environmental receptor groups.

Table 9-39: Liquid Discharges Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Physical Environment	-2	L	Minor
Biological Environment	-1	M	Slight

9.9.4 ALARP Assessment and Environmental Performance Standards

Table 9-40: Deck Drainage and Bilge Water Discharges ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	Eliminate discharges from MODU and project vessels 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 MODU/ project vessels. 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 MODU and vessels are standard MARPOL-compliant systems for management of accidentally-oil contaminated drainage and bilge in offshore installations and vessels.	N/A	N/A	N/A
Engineering	Oily bilge water from machinery space drainage is treated to a maximum concentration of 15 ppm oil-in-water prior to discharge from the MODU and project vessels, as specified in MARPOL 73/78 (Annex I).	Yes	If the online monitor is not functional, manual samples will be taken to facilitate determination of oil in water concentration to allow batch discharges to occur where the batch concentration is confirmed below the limit. Discharges at this level are not expected to cause any significant impact to the marine environment given low flow rates and high dilutions close to the source.	7.1	Bilge 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	MODU and project vessel compliance with Marine Order 91 (International Oil	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.	7.2	Assurance will be undertaken for MODU and project vessels, including a check for valid and in date	Assurance records

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	Pollution Prevention [IOPP] certificates).		This control measure is in accordance with *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and the relevant AMSA Marine Orders.		International Oil Pollution Prevention (IOPP) certificates as required by vessel class requirements.	
Administrative and Procedural Controls	Spill kits onboard the MODU and project 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.	7.3	Spill kits are available on the MODU and project 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. Following the chemical management process as detailed within Section 10.1.4 will minimise the impact of those chemicals which are used and discharged to ALARP levels.	7.4	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.
				7.5	Chemicals that are planned for discharge to sea are substitution warning free and Gold, Silver, D, or E rated through the Offshore Chemical Notification Scheme (OCNS), or are considered to Pose Little or No Risk to the Environment (PLONOR) (listed by the Oil	Records demonstrating the chemical selection process outlined in the Chemical Management Process have been followed.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					Spill Prevention, Administration and Response (OSPAR) Commission), or have a complete ALARP assessment.	

Table 9-41: Putrescible Waste, Sewage and Grey Water Discharges ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	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, and is grossly disproportionate.	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	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			against the detrimental addition and increased cost of refined chemicals. Therefore, the available environmental impact reduction is negligible to non-existent.			
Substitution	Use of alternative treatment technologies	No	• Requires additional cost due to the space requirement onboard vessels and MODU to enable installation and is grossly disproportionate. • Increases operational costs for maintenance and staffing due to performance challenges associated with these technologies (e.g. clogging of membranes/screens). Also increases potential exposure of the workforce to pathogens associated with these waste streams.	N/A	N/A	N/A
Engineering	Food waste will be macerated to <25mm particle size prior to discharge to sea in accordance with Marine Order 95.	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.	7.6	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

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Engineering	MODU and project vessel compliance with Marine Order 96 (International Sewage Pollution Prevention [ISPP] certificates) as relevant to vessel class, size and type.	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.	7.7	Assurance will be undertaken for the MODU and project 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.	Assurance records
Administrative and Procedural Controls	The MODU and project vessels 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 (Prevention of Pollution from Ships) Act 1983* and AMSA Marine Order 95.	7.8	Project vessels (to which MARPOL Annex V / Marine Order 95 applies) have a current Garbage Management Plan (or equivalent).	Garbage Management Plan (or equivalent) is sighted onboard project vessels and are maintained up to date.

Table 9-42: Cooling Water and Desalination Brine 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	N/A	N/A	N/A	N/A	N/A	N/A
Substitution	Source all freshwater from onshore.	No	The use of the seawater desalination system and discharge of reject brine are common and accepted practice for vessels and offshore oil and gas facilities. Offshore activities cannot operate without fresh water.	N/A	N/A	N/A
Engineering	Storing waste desalination brine onboard and transporting for onshore treatment and/or disposal.	No	Storing on-board and then transferring it to shore results in increase personnel and environmental costs associated with more vessel movements, and is not possible given that the required storage space would not be available on the MODU and project vessels.	N/A	N/A	N/A
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. Following the chemical management process as detailed within Section 10.1.10 will minimise the impact of those chemicals which are used and discharged to ALARP levels.	7.4	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.
				7.5	Chemicals that are planned for discharge to sea are substitution warning free and Gold, Silver, D, or E rated through the OCNS, or are	Records demonstrating the chemical selection process

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					PLONOR (listed by the OSPAR Commission), or have a complete ALARP assessment.	outlined in the Chemical Management Process have been followed.

Table 9-43: Use and Discharge of Ad-Hoc Chemicals 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	N/A	N/A	The use of chemicals cannot be eliminated from the operation, preservation and maintenance of the MODU, project vessels, equipment and subsea infrastructure.	N/A	N/A	N/A
Engineering	Equipment to capture or collect subsea discharges	No	No practicable engineering controls are available that are proven to be able to capture or contain subsea discharges. Designing and installing a temporary capture system would result in significant financial costs, with technical uncertainty, grossly disproportionate to any slight increase in environmental benefit of preventing small and infrequent discharges.	N/A	N/A	N/A
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	7.4	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

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			chemicals than may pose environmental impact via planned discharges. Following the chemical management process as detailed within Section 10.1.10 will minimise the impact of those chemicals which are used and discharged to ALARP levels.			Chemical Management Process have been followed.
				7.5	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.

9.9.5 Acceptability of Impacts

Table 9-44: 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 or sediment quality during the Crux development drilling activity.	Yes	Liquid discharges have the potential to result in localised reduced water quality at the discharge location, however discharges will rapidly dilute in the open ocean environment. Shell will implement measures to reduce the potential for impacts to water quality from routine discharges. The potential magnitude of impacts to the marine environment is Slight. Given the offshore location and absence of particularly sensitive marine ecosystems at the Crux development drilling location and immediate surrounds.
Threatened Species and Ecological Communities	Marine mammals Marine reptiles Fish Sharks and rays	No mortality or injury of threatened or migratory MNES fauna from the Crux development drilling activity.	Yes	Most threatened and/or migratory fauna species within the area predicted to be influenced by planned liquid discharges are

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		Management of aspects of the Crux project must be aligned to conservation advice, recovery plans and threat abatement plans published by the DAWE. No significant impacts to threatened or migratory MNES fauna.		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 discharge concentrations that may adversely impact on individuals and therefore there will be no significant impacts.
	Ecosystems, Communities and habitats	No significant impacts to benthic habitats and communities.	Yes	The benthic communities within the Operational Area that may be impacted by liquid discharges are broadly represented in the region and are not of high environmental value.

The assessment of impacts from liquid discharges determined the residual impact consequence to be Minor or lower (Table 9-39). 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 are not expected to be significantly impacted
- The precautionary principle has been applied, and reviews undertaken where knowledge gaps were identified. This knowledge has been applied during the evaluation of environmental impacts.

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 9-45).
- Implementation of recognised industry standard practice, such as:
    - Treatment of collected drainage bilge water to < 15 mg/L residual oil.

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 Crux development drilling activity.

Alignment of the Crux development drilling activity with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-45.

Commonwealth Marine Area

The impacts and risks from the liquid discharges aspect of the Crux development drilling activity on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-45: Summary of Alignment of the impacts from the Liquid Discharges Aspect of the Crux Development Drilling Activity 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.
	Conservation advice on *Balaenoptera borealis* (sei whale) (TSSC 2015b)	
	Conservation advice fin whale (*Balaenoptera physalus*) (TSSC 2015c)	
	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017a)	
	Conservation advice on *Rhincodon typus* (whale shark) (TSSC 2015a)	
Commonwealth Marine Area	Significant impact guidelines for Commonwealth marine environment (Table 7-4)	Water quality impacts by planned liquid discharges are expected to be highly localised. Impacts 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

Matters of National Environmental Significance	MNES Acceptability Considerations (EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
		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 EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from liquid discharges determined the residual impacts rankings to be Minor (Table 9-39). 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); and
- 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 Crux development drilling activity to be acceptable.

9.9.6 Environment Performance Outcomes

Environment Performance Outcomes	Measurement Criteria
No measurable impacts to sediment quality or water quality in the region from liquid discharges.	Demonstrated implementation of EPSs for discharge of liquid effluents
No mortality or injury of threatened and migratory MNES species as a result of liquid discharges.	

9.10 Discharge of Drill Cuttings, Muds and Other Drilling-Related Discharges

9.10.1 Aspect Context

Five development wells are planned to be drilled during the Crux development drilling activity. Drilling activities generate drill cuttings, require cementing of the casing, and require the use of a range of fluids. Throughout the drilling activity several different fluids are to be run through the closed circulation system including, but not limited to, drilling fluids (water-based muds (WBM) and synthetic-based muds (SBM)), base oil, sea water, and kill-weight brine.

Routine drilling discharges associated with the Crux development drilling activity will include:

- drill cuttings;
- drilling fluids:
    - direct to seabed (WBMs only)
    - retained on cuttings
    - bulk discharge of mud pits (WBMs only);
- cementing fluids, cement and grout; and
- pit wash and (highly diluted) oily water.

Non-routine drilling discharges may include:

- additional drill cuttings and fluids generated due to respud or side tracking

Section 6.6.3 describes the drilling methodology in detail.

Drilling fluids, cuttings and chemicals

Drilling of the production wells will generate cuttings from each well. Drilling fluids (WBM and SBM) will be used to cool and lubricate the drill bit, maintain well bore stability, and remove cuttings from the well sections as they are drilled.

Top-hole sections (42” down to 17 ½”) will be drilled riserless using WBM. When using WBM, drilling fluids and cuttings will either be discharged at seabed or returned to the MODU using a Riserless Mud Recovery (RMR) system prior to discharge overboard. WBM and drill cuttings will be discharged to the seabed and will accumulate for short period of time on the 42” section. The drilling fluid and cuttings on sections down to the 17 ½” section will be returned to the MODU using an RMR system. These cuttings will be directed across shale shakers to recover WBM for re-use prior to cuttings being discharged to seabed.

The intermediate and production hole sections (12 ¼” and 8 ½”) will be drilled with a closed mud system following installation of a subsea BOP and riser, using SBM. Solids control equipment will be used to process the cuttings when using SBM to recover drilling mud, with cuttings then discharged to the sea. Drill cuttings will be processed via shale shakers and cuttings drying equipment to reduce discharge of SBM; however, some residual drilling fluids will adhere to the drill cuttings. The discharge of cuttings with residual SBM will comply with the Shell Australia HSSE & SP Control Framework, and the oil-on-cuttings concentration shall not exceed 6.9% wet weight averaged over the SBM well sections.

Quantities of drilling fluids and cuttings discharged will be minimised through the use of solids control equipment and recirculation of the mud where possible. Processed cuttings (WBM and SBM) will be discharged just below the water surface and will be dispersed over an extended area, governed by the ocean currents at the time.

The largest well diameters and types of fluids are provided in Table 9-46. In the event of severe losses and potential rapid depletion of whole fluid inventory when drilling with SBM in the drilling campaign, an alternative to synthetic based mud may be used to prevent further losses i.e. LAO base oil.

Table 9-46 provides a summary of an estimate of the drill cuttings and fluid discharges per well.

Table 9-46: Wells Section Diameters and Probable Discharges

Largest Well Section Diameter (inches)	Drilling Fluid Type and Typical Main Components[1]	Expected Drilling Fluids Discharged (m^3)	Expected Drill Cuttings Discharged (m^3)	Discharge Point
Planned Activities				
42	Pre-Hydrated Bentonite water-based mud (Pump and Dump).	1,235	231	Seabed
32”	Pre-Hydrated Bentonite & Polymer water-based mud.	3,201	752	Surface (Sub Waterline)
24	Water based mud – generally consists of freshwater base fluid with bentonite clay, dispersants, brine and viscosifiers	6,181	1,122	Surface (Sub Waterline)
17.5	Water based mud – generally consists of freshwater base fluid with bentonite clay, dispersants, brine and viscosifiers	9,319	778	Surface (Sub Waterline)
12.25	Synthetic based fluid - will include organophyllic clay, barite, fluid loss	487	846	Surface (Sub Waterline) (cuttings and residual

Largest Well Section Diameter (inches)	Drilling Fluid Type and Typical Main Components[1]	Expected Drilling Fluids Discharged (m^3)	Expected Drill Cuttings Discharged (m^3)	Discharge Point
	control agents, calcium chloride, lime, aqueous chloride, bridging agents and emulsifiers			synthetic base fluid only)
8.5		359	101	Surface (Sub Waterline) (cuttings and residual synthetic base fluid only)
WBCU & Suspension	Water-based mud – generally containing polymers, barite, solvent/surfactants and base oil.	All WBCU Pills captured. Only seawater discharged (<1% Oil)	0	Surface (Sub Waterline)
Contingent activities				
NA	LAO base oil	Unplanned Contingency	Unplanned Contingency	Surface (Sub Waterline) (cuttings and residual base fluid only)
NA	Additional fluids due to respudding up to 3 wells – Pre-Hydrated Bentonite & Polymer water-based mud.	As per well sections detailed above.	As per well sections detailed above.	Surface (Sub Waterline)

[1] *Formulation is still to be determined and will be detailed by vendor*

Wellbore Clean Up

At the end of the SBM drilling phase, the pits, surface equipment and lines will be cleaned using detergent to prepare for the Wellbore Clean Up (WBCU). The pits will be cleaned and circulated with aqueous fluids until oil percent discharged has been diluted down to <1% v/v, noting that the synthetic based mud present in the allocated pits is considered residual, not bulk synthetic based mud. Pit and topside cleaning events will occur throughout the drilling campaign. During pit and topside cleaning events, all fluids discharged overboard will be checked and logged by a contracted compliance engineer to ensure that fluids discharged have <1% v/v oil.

As part of the WBCU activity, the synthetic based mud will be initially displaced to sea water prior to displacing to base oil. The seawater used to clean the well and being

displaced out of the well by the base oil will be captured into a pit and discharged after ensuring the oil content is <1%.

Cement

Cementing fluids, including cementing mix water, may require discharge to the marine environment under various scenarios. Cementing fluids consist of, but are not limited to, cement and additives such as anti-foamers, extenders, accelerators, dispersants, silica, retarders, fluid loss agents and gas block agents.

While cementing fluids are not routinely discharged to the environment (unless cleaning residue from dead volume in tanks), cement will be released when the cementing mixture is circulated to seabed during cementing of the 36" and 26" conductors. Cement may remain liquid for several hours, during which time there may be some release of chemicals into ambient waters. After the cement has hardened, chemical components of the cement are locked in the inert cement matrix. Cement may be discharged at seabed at a short distance from the template (<150 m) to reduce the risk of cement discharge impacting future flowline installation and platform piling operations.

Excess or contaminated liquid cement cannot be used down hole and cannot be returned to shore for disposal, as it may solidify in storage tanks. Therefore, any remaining cement at the end of contract in the MODU cement tanks or on the project vessels will be pumped to the MODU to be mixed with sea water into a slurry and discharged overboard. There will be no discharge of dry cement to the environment from the vessels or the MODU. Unused cement additives will be returned for shore for reuse or disposal.

As discussed in Section 6.6.5, it is anticipated that a high temperature cement blend (or similar) will be used throughout the Crux Development Drilling Campaign, minimising the volume of residual bulk cement to be mixed and discharged (for disposal). Cement will be mixed and pumped as required from a small mixing tank on the cement unit. This limits the volume of excess or contaminated cement that could potentially require discharge into the ocean.

Respud

Respudding may be required if well problems result in it being impractical to continue to drill in the current well. In this situation the MODU would be moved to a spare well slot in the template and well construction operations repeated. Well problems requiring a respud typically occur during riserless operations, where remediation options are more limited. Respudding will result in an increased volume of cuttings and cement discharge from the 36" and 26" conductor cementation, and slightly increased area of impacted seabed and benthic habitat.

Geological sidetrack

The option of a sidetrack instead of a respud may be determined, if operational issues are encountered. Should a sidetrack be required, it will result in an increase in the volume of cuttings generated and a potential increase in the use of SBM. Additional drill cuttings volumes are estimated in Table 9-46.

9.10.2 Description and Evaluation of Impacts

Planned drilling discharges to the marine environment create a potential for a localised decline in water and sediment quality and for sensitive biological receptors in those environments to be exposed to physical characteristics and contaminants at concentrations that may cause acute or chronic effects.

9.9.2.1 Physical Environment

Drilling fluids, cuttings and chemicals

Water and Sediment Quality

The discharge of drill cuttings will impact the physical properties of the receiving marine environment. As described above, drill cuttings from the 42" section will be discharged to the seabed with cuttings from subsequent sections returned to the MODU via the RMR system or riser.

WBMs will be used in the riserless top hole sections; SBMs will be used in the 12-1/4" and 8-1/2" hole sections to meet technical and well objective requirements. WBMs will constitute most of drilling fluids discharged to the marine environment. Cuttings may contain potential contaminants derived from the geological formations from which they are generated; however, the potential for cuttings to be a source of contaminants is low compared to residual WBM and SBM drilling fluids. The residual WBMs may include potential contaminants such as metals (predominantly barium, a component of the commonly used weighting agent barium sulphate), as well as residual organic matter. Microbial degradation of residual organic matter can lead to depletion of oxygen in sediments within the cuttings pile, although this is unlikely to impact upon biota.

SBMs contain a range of synthetic hydrocarbons such as paraffins and olefins, which have low potential for toxicity and bioaccumulation, but may persist in the environment. Cuttings with residual SBMs are expected to have a higher concentration of residual organic matter compared to WBMs. The seabed affected by cuttings with residual SBM have greater potential for oxygen reduction via microbial degradation and associated changes to sediment chemistry (e.g. modified reduction/oxidation (redox) potential).Upon completion of the top hole sections, excess WBM will be discharged to the ocean from the drilling rig and pose little environmental risk or impact beyond a localised, temporary sediment plume. Excess SBMs will not be discharged to the ocean and may either be reused, returned or disposed onshore.

The offshore receiving environment typically has low turbidity (AECOM 2016), and the discharge of drill cuttings from the MODU will result in a temporary increase in turbidity and TSS. The nature of the change in turbidity is dependent on the characteristics of the cuttings, primarily size and density. The particle size distribution of cuttings will vary based on the geology of the formations being drilled, the characteristics of the drilling equipment, and the design of the well. Cuttings typically range from coarse gravel (> 32 mm) to silt (< 63 µm). Coarse particles will typically settle rapidly and have little potential to impact water quality (International Association of Oil and Gas Producers (IOGP) 2016). As cuttings particle size decreases, the settling velocity will typically decrease, and the ratio of residual drilling fluids to cutting size increases. This will result in a turbid plume that will decrease as the plume is diluted and the suspended particles are deposited (Continental Shelf Associates 2006).

Dissolved components of the plume, particularly the salts and water-soluble drilling fluid organic additives, dilute rapidly by mixing in the water column. Most of the organic additives in water-based and synthetic-based muds are strongly adsorbed to inorganic cuttings particles and are deposited to the sediments rather than being available in the water column.

Impacts to water quality from the discharge of drilling fluids and cuttings typically occur within close proximity of the discharge point. This is supported by results from the modelling of drill cuttings and fluids discharges for the Crux foundation wells conducted for the OPP, which indicated dilution is expected to occur rapidly due to the currents in

the open ocean environment (RPS 2018a). As outlined above, very fine cuttings form a very small portion of the total amount of cuttings and fluids discharges as they tend to clump together to form larger particles that sink relatively quickly. The combination of low toxicity and rapid dilution of unrecoverable SBM discharged in association with drill cuttings are of little risk of direct toxicity to water-column biota (Neff et al., 2000).

The majority of drill cuttings and residual fluids will be deposited in the area around the discharge location and will form a cuttings pile. The accumulation of cuttings will physically modify the sediments by modifying the particle size distribution. Stochastic modelling results indicate the cuttings pile may reach a thickness of up to 374 mm for a single well (RPS 2018a), which will be largely comprised of coarse cuttings directly under the discharge location. Impacts to sediment will decline with increasing distance from the wells. Modelling for the cumulative deposition of drilling fluids and cuttings indicated the maximum thickness would be up to 1,888 mm, with cumulative cuttings from five wells reaching 1 mm thickness at a maximum distance of 658 m from the Crux platform location.

Cuttings from an individual tieback well are expected to become progressively finer with increasing distance from the well location, with the thickness of deposited cuttings expected to be ≤ 1 mm within 318 m of the discharge location (single well) (RPS 2018a). Deposition ≥ 10 mm thickness for a single tieback well was predicted to extend up to approximately 62 m from the release location and cover an area of approximately 7,000 m^2 (or 0.7 ha). Cuttings > 0.25 mm in diameter are predicted to typically be deposited within 250 m of the discharge location for a single tieback well (RPS 2018a).

The coarser sediments deposited directly under the discharge location are unlikely to be resuspended by currents and will gradually be buried by naturally deposited sediments over time. Finer sediments deposited further away may be reworked by currents and transported via saltation or as suspended sediments.

Based on the assessment, potential impacts to the physical environment from the discharge of drill cuttings and fluids are considered to be Minor, with no long term effects anticipated.

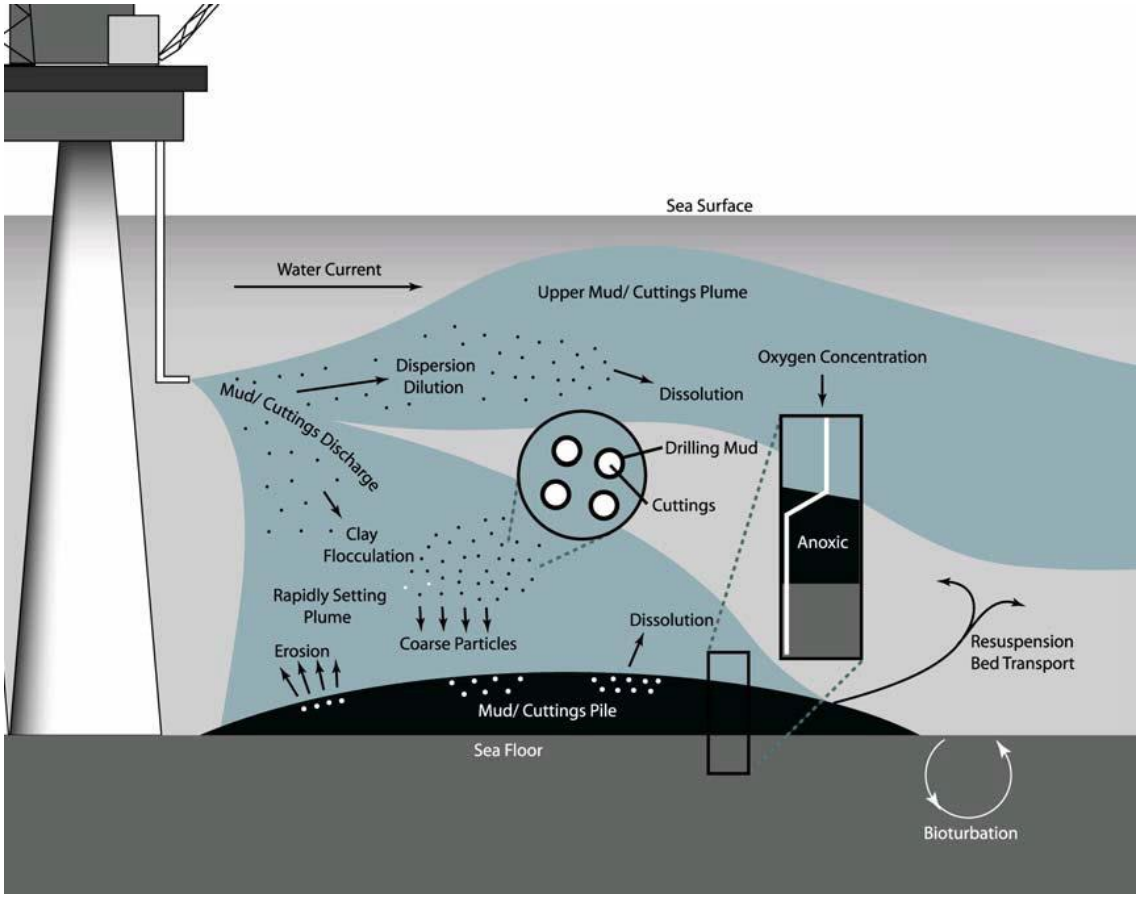


Figure 9-4: Generalised Schematic of the Fates of Drill Cuttings and Fluids Discharges

Cement

As described above, cement will be discharged during drilling when the cementing mixture is circulated to seabed, and may remain liquid for several hours, during which time there may be some release of chemicals into ambient waters. When the cement hardens it will form a hard substrate in a highly localised area around the wells, permanently altering the physical sediment properties.

Excess or contaminated liquid cement that could potentially require discharge into the ocean would result in increased local turbidity in the water column as the liquid cement plume dilutes and disperses though the water column. The cement will be dispersed by currents, potentially resulting in minor alteration of benthic habitat characteristics (sediment particle size, element composition). However, given the depth of water at the well locations (>90 m) and the local currents it is unlikely that detectable concentrations will accumulate on the seabed.

Given the low volumes of cement to be discharged and the open ocean waters of the Operational Area, impacts are expected to be Slight.

Biological Environment

Drilling fluids, cuttings and chemicals

Ecosystems, Communities and Habitats

Injury/mortality to planktonic species may occur due to a change in water quality following discharges of drill cuttings and fluids. Impacts to these organisms can be as a product of both physical and chemical alterations of water quality predominantly in the water column.

Studies by Smit et al. (2008) indicated that phytoplankton and filter-feeding zooplankton typically exhibit greater effects from suspended solids from drilling and suggested that these biota are less well-adapted to relatively high concentrations of suspended sediments than benthic biota. Smit et al. (2008) suggested that impacts to zooplankton were primarily the result of physical effects to filter-feeding and respiration organs, while impacts to phytoplankton were the result of reduced light levels. Concentrations at which impacts to phytoplankton are highly localised and unlikely to occur > 25 m from the discharge point (IOGP 2016; Smith et al. 2004). Studies indicated effects of drilling fluids and cuttings on zooplankton at concentrations > 100 mg/L are unlikely, based on 96-hr exposure duration experiments. Concentrations > 100 mg/L for more than 96 hours during Crux drilling activities would only occur in the immediate vicinity of the discharge location.

Minimal impact to plankton (phytoplankton, zooplankton and meroplankton (larvae of invertebrates and fish) is therefore expected from the discharge of drill cuttings. Neff (2010) explains that the lack of toxicity and low bioaccumulation potential of the drilling muds means that the effects of the discharges are highly localised and are not expected to spread through the food web (of which planktonic species are the basis).

Due to the low levels of planktonic productivity in the offshore area, plankton populations on a regional scale are not expected to be affected by drilling operations. In addition, due to the open nature of the marine environment of the Operational Area and associated environmental conditions (i.e. windy, strong currents, etc.), the content and dispersive nature of drilling muds within the marine environment and the high population replenishment of these organisms, it is expected that impacts to plankton species will be limited to within tens of metres of the discharge point and return to previous conditions within a relatively short period of time. On this basis, the impacts to plankton from drilling discharges is Slight.

The discharge of drill cuttings and residual fluids will impact upon benthic communities due to the potential physical and chemical changes to sediments. The deposition of cuttings has the potential to smother sessile benthic organisms, with effects predicted to occur at deposition thicknesses of greater than 6.5 mm (IOGP 2016). Sedimentation is an ongoing natural process, and benthic organisms exhibit adaptations to respond to increased sediment deposition. Natural sedimentation rates Northwest Australia were estimated by Glenn (2004) ranged from approximately 0.17 mm and 2.23 mm per year.

Stochastic modelling results for the five well foundation development drilling activity conducted for the OPP indicated deposition of drilling cuttings and fluids was expected to be > 10 mm and ≤ 1 mm within approximately 248 m and 658 m of the discharge location, respectively (RPS 2018a). For a single well the deposition thickness of > 10 mm and ≤ 1 mm and were predicted to be within approximately 68 m and 326 m, respectively. Benthic communities subject to deposition between 1 mm and 10 mm thickness are less likely to experience mortality but may experience sub-lethal impacts (IOGP 2016), such as impaired feeding due to clogging of filter feeding organs and

increased energy expenditure from removing sediment from burrows. Recognising that sediment deposition from drill cuttings and fluids is in addition to natural processes, benthic communities subject to deposition of drill cuttings and fluids of < 1 mm thickness are unlikely to experience impacts from physical deposition of cuttings, as this thickness is consistent with natural sedimentary deposition rates.

During the Greater Western Flank-2 drilling campaign. Jones et al. (2021) undertook pre- and post-drilling surveys close to the wells to determine impacts on epibenthic communities. The program involved measuring and profiling suspended solids (TSS) concentrations in discharges under the MODU by the ROV.

Effects to the sparse benthic filter feeder communities close to the wells were observed, but no effects were seen on the epibenthic or demersal fish assemblages across the nearby mesophotic reef (Jones et al. 2021). Overall, the surveys suggest a zone of high impact surrounding the drill centre up to 50–75 m in all directions caused by cuttings and fluid discharges from the MODU. An area of medium impact up to 200 m was observed where there were clear losses of epifauna, but sponges and soft corals were observed. In this area sponges and soft corals were sometimes observed with sediment attached. Sponges normally keep their surfaces free of sediment and have a number of cleaning mechanisms to remove sediments from their surfaces including mucus production, tissue sloughing, self-cleaning surfaces.

Changes in sediment chemistry may impact upon benthic communities, particularly changes in oxygen demand from biodegradation of organic compounds in residual drilling fluids. Trannum et al. (2010) examined the effects of cuttings with residual WBMs and found a significant reduction in abundance and diversity of benthic infauna with increasing cuttings thickness compared to natural sediment and suggested that changes in sediment chemistry were a significant factor. Increased oxygen demand resulting from aerobic degradation of organic compounds in the WBM were suggested as a cause, along with fluxes in silicon and phosphorous (Trannum et al. 2010). The effects at low sediment thickness (< 10 mm) were much less apparent than relatively high rates of burial; these results are consistent with findings from other investigations of potential impacts of WBMs (Smit et al. 2006). The increased oxygen demand will diminish over time as organic material is consumed and will approach natural conditions.

The recovery of the area subject to deposition ≥ 10 mm thickness will potentially take many years, depending on natural sedimentary processes. Recovery may be linked to the deposition of relatively fine natural sediments on the coarse sediments in the cuttings pile to create suitable habitat. Studies of the recovery of benthic communities on visible cuttings piles (consistent with the area subject to drill cuttings and fluids deposition ≥ 10 mm) indicated considerable recovery within three years (particularly where deposition was thinner), however the benthic communities had not yet recovered to be similar to pre-discharge conditions or the surrounding unaffected seabed.

The benthic communities within the Operational Area comprise sparse epibenthic burrowing macrofauna on soft sediment substrates (Fugro 2017a). These are widely represented in the region and are not of high environmental value. Modelling studies (RPS 2018a) indicate these existing communities at the base of the Crux platform will be affected by the discharge of drill cuttings and fluids out to a range of approximately 326 m from the discharge point (e.g. some reduction in species diversity and abundance). High levels (> 10 mm) of burial will occur out to a radius of approximately 68 m; sessile benthic fauna within this range are expected to be completely removed.

The Operational Area is not close to any sensitive environmental receptors, sensitive benthic habitats, such as the Goeree Shoal (14 km away) or the continental slope demersal fish communities KEF (approximately 73 km from the drill centre), therefore no impacts to these receptors are expected.

The absence of benthic primary producers in this environment and the relatively short duration of the discharge limits the potential for impacts upon receptors such as plankton or benthic communities. Given this, impacts are expected to be Minor, with no long term effects anticipated.

Key Fauna Species

The discharge of drill cuttings and fluids will impact upon seabed habitat below the cuttings pile, particularly where the thickness of the deposition is ≥ 10 mm. This is not expected to result in impacts to key fauna species, as many key fauna are associated with surface waters and the water column (e.g. marine mammals, birds and marine reptiles). Given the depth of the Operational Area and the lack of benthic foraging habitat, marine turtles are not expected to be affected by the impacts to benthic habitats from the discharge of drill cuttings and fluids.

The localised, temporary decrease in water quality from the discharge of drill cuttings and fluids may temporarily displace pelagic marine fauna from the plume; this short-term, behavioural impact is considered to be negligible.

Wellbore Clean Up

Discharges such as displacement and wellbore cleanout fluids are typically inert and of low-toxicity. These fluids are mostly brine, with a small proportion of chemical additives such as surfactants, biocide, corrosion inhibitor, oxygen scavenger, Mono-ethylene Glycol (MEG) and guar gum. Given the Chemical Hazard and Risk Management (CHARM)/OCNS rating gold or E of the products used (low toxicity and high degree of biodegradability) coupled with the settling time allowed in the storage tanks and the relatively small quantity of fluids produced as a result of the cleaning process, any change to water quality is expected to be localised and temporary and is not expected to pose any long term impacts to the receiving environment.

Given the low volumes of fluids that may be discharged, impacts are predicted to be Slight with no long term effects anticipated.

Cement

The discharge of cement to the marine environment around the 36” and 26” conductors is not expected to have a significant impact on the benthic environment, given the localised distribution of the cement being discharged and the fact that the receiving environment is comprised of soft sediments. The cement will cover the seabed around the wells, resulting in localised burial of benthic organisms and alteration of the benthic substrate. The cement will solidify, potentially providing a hard substrate for epifaunal organisms to occupy. However, it is likely that the cement will ultimately be covered by drill cuttings circulated to seabed from the well (during riserless drilling operations). It is very difficult to isolate any impact on the environment from cement from the broader impacts associated with drill cuttings.

Excess or contaminated cement that could potentially require discharge into the ocean would result in increased local turbidity in the water column as the liquid cement plume dilutes and disperses though the water column. The cement will be dispersed by currents, potentially resulting in minor alteration of benthic habitat characteristics (sediment particle size, element composition). However, given the depth of water in the

Operational Area (>90 m) and the local currents it is unlikely that detectable concentrations will accumulate on the seabed.

Given the low volumes of cement to be discharged, impacts are Slight, with no long term effects anticipated.

9.10.3 Impact Assessment Summary

Table 9-47 lists the highest residual impact consequence rankings of the relevant environmental receptor groups.

Table 9-47: Drilling Discharges Evaluation of Residual Impacts

Environmental Receptor	Magnitude	Sensitivity	Residual Impact Consequence
Evaluation – Planned Impacts			
Physical Environment	-2	L	Minor
Biological Environment	-2	L	Minor

9.10.4 ALARP Assessment and Environmental Performance Standards

Table 9-48: Drilling 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	No planned discharge of whole SBM (bulk or used) to the marine environment will occur during development drilling.	Yes	Despite SBMs inherently low toxicity, the impact of the release on the benthic environment and water quality is reduced by not discharging bulk SBM overboard.	8.1	No planned discharge of whole SBM during development drilling.	Records demonstrate that discharge criteria were met prior to discharge.
Elimination	No disposal of dry cement to the marine environment from the vessels or the MODU will occur during development drilling.	Yes	By restricting the disposal of dry cement to the marine environment, impacts on the benthic environment and water quality are reduced.	8.2	No disposal of dry cement to the environment from the vessels or the MODU.	Records demonstrate that discharge criteria were met.
Substitution	Return cuttings for disposal at another marine location or onshore for processing and land disposal (skip and ship).	No	Return of cuttings for disposal at another marine location or onshore would achieve a reduction in cuttings/mud discharged. However, given current impact assessment and controls adopted, this would not result in a significant reduction on consequence. The cost is considered grossly disproportionate to the environmental benefit.	N/A	N/A	N/A
Engineering	When using SBM, the solids control equipment will reduce the residual base fluid on cuttings content	Yes	Achieving average oil-on-cuttings discharge limit of 6.9% or less oil on wet cuttings will have a small reduction in consequence.	8.2	Drilling fluids which meet stock limitations for C16-C18 internal olefin: the end-of-well maximum weighted mass ratio averaged	Records confirm the average oil-on-cuttings concentration for SBM.

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	prior to discharge overboard. Residual SBM on cuttings will be less than 6.9% by weight (w/w), averaged over all well sections using SBM.				over all well sections drilled using SBMs shall not exceed 6.9 grams SBM per 100 grams of wet cuttings.	
Engineering	WBM drill cuttings that are returned to the MODU will be processed (using solids control equipment).	Yes	By limiting the discharge of WBMs through reuse, impacts on water quality are reduced.	8.3	WBM drill cuttings that are returned to the MODU are processed using solids control equipment allowing reuse of mud prior to discharge.	Records demonstrate that operational solids control equipment is in use.
Engineering	Bulk discharge of WBM below water line.	Yes	Discharge of bulk WBM below the water line will reduce carriage and dispersion WBM thereby reducing the consequence of WBM dispersion during the Crux development drilling activity.	8.4	Bulk WBM discharged below the water line.	Records confirm bulk WBM discharged below the water line.
Engineering	Drill cuttings returned to the MODU will be discharged below the water line.	Yes	Discharge of drill cuttings below the water line will reduce carriage and dispersion of cuttings thereby reducing the consequence of cuttings discharges during the Crux development drilling activity.	8.5	Discharge of cuttings via a caisson at >15 m water depth. Discharge of cuttings only in water depths >30 m. Gross measure (retort) is too crude for determining compliance.	Records confirm cuttings discharge chute/line below the water line.

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					Lab extraction/IR needed	
Engineering	Discharge of SBM pit wash/oily water less than 1% oil in water	Yes	The pits will be cleaned and circulated with aqueous fluids until oil percent discharged has been diluted down to <1% oil in water, noting that the synthetic based mud present in the allocated pits is considered residual, not bulk synthetic based mud. Pit and topside cleaning events will occur throughout the drilling campaign.	8.6	Achieve less than 1% by volume oil content before discharge of pit wash/oily water.	Records after pit clean out demonstrate mud pit wash residue was less than 1% by volume oil content before discharge.
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. Following the chemical management process as detailed within Section 10.1.4 will minimise the impact of those chemicals which are used and discharged to ALARP levels.	7.4	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.
				7.5	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	Records demonstrating the chemical selection process outlined in the Chemical Management Process have been followed.

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					complete ALARP assessment	
Administrative and Procedural Controls	Use of SBM will be based on a documented justification process and only used where technically required.	Yes	The documented justification process takes into account the technical need for SBM use along with factors such as the receiving environment, cost and additional controls that may be required. The process ensures potential impacts are well understood and control measures are in place to reduce the consequence of SBM use.	8.7	SBMs are only used where documented justification process has been followed.	Records show SBM justification process has been followed and SBM only used where technically required.
Administrative and Procedural Controls	Monitoring of drill cuttings discharges (heavy metals sampling)	No	Implementation of cuttings discharge monitoring during the activity would not result in an environmental benefit. Monitoring could be used to inform additional control measures in future drilling activities; however, there is a considerable body of existing scientific literature on potential impacts of drill cuttings and impacts are generally well understood.		N/A	N/A
Administrative and Procedural Controls	Sampling/analysis of stock barite to ensure acceptable levels of heavy metals (Cadmium and Mercury).	Yes	Implementation if sampling/analysis of stock barite ensures that heavy metals of concern (cadmium and mercury) are within limits prescribed by API standards: • Mercury (Hg): max 1 mg/kg (<1ppm) dry weight in stock barite • Cadmium (Cd): max 3 mg/kg (<3ppm) dry weight in stock barite	8.8	Concentrations of heavy metals within stock barite used during the activity shall not exceed: • Mercury (Hg): max 1 mg/kg (<1ppm) dry weight	Barite test results.

Hierarchy of Controls	Control Measure	Adopted?	Related ALARP Discussion and Alternate, Additional or Improved Control Measures Considered	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			Monitoring can be used to substitute barite that has unacceptable levels of mercury and cadmium.		• Cadmium (Cd): max 3 mg/kg (<3ppm) dry weight	

9.10.5 Acceptability of Impacts

Table 9-49: Acceptability of Impacts – Drilling Discharge

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 during the Crux development drilling activity.	Yes	The discharge of drilling fluids and cuttings have the potential to result in reduced water quality at the discharge location, however discharges will dilute in the open ocean environment. Modelling studies indicate impacts to water quality are highly localised around the discharge location (being open offshore waters), which is consistent with industry monitoring studies. Shell will implement measures to reduce the potential for impacts to water quality from routine discharges relating to the discharge of drilling discharges.
	Sediment Quality	No significant impacts to sediment quality during the Crux development drilling activity.	Yes	The discharge of drilling fluids and cuttings may result in a decrease in sediment quality at drilling locations. Modelling studies indicate impacts to sediment quality are highly localised around the discharge location (smooth, bare sandy seabed that is of low ecological value), which is consistent with industry monitoring studies.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
				Shell will implement measures to reduce the potential for impacts to sediment quality from routine discharges relating to the discharge of drilling discharges.
Ecosystems, Communities and Habitats	Benthic communities	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Crux Project Area.	Yes	The benthic communities (excluding shoals) within the Operational Area that may be impacted by drilling discharges are broadly represented in the region and are not of high environmental value.
Threatened Species and Ecological Communities	Fish	No mortality or injury of threatened or migratory MNES fauna from the Crux development drilling activity. Management of aspects of the Crux project must be aligned to conservation advice, recovery plans and threat abatement plans published by the DAWE.	Yes	Most threatened and/or migratory fauna species within the area predicted to be influenced by the planned drilling 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

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		No significant impacts to threatened or migratory MNES fauna.		therefore there will be no significant impacts.

The assessment of impacts from drilling discharges determined the residual impact consequence to be Minor (Table 9-47). As outlined above, the acceptability of the impacts from drilling discharges associated with the petroleum activity have been considered in the context of:

Principles of ESD

The impacts from drilling discharges are consistent with the principles of ESD based on the following points:

- The environmental receptors within the Operational Area are not expected to be significantly impacted
- 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.

Relevant Requirements

Management of the impacts from drilling 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
- 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)
- Management of impacts and risks are consistent with policies, strategies, guidelines, conservation advice, and recovery plans for threatened species (Table 9-50)

- Implementation of recognised industry standard practice, such as:
  - No discharge of whole SBMs
  - Use of solids control equipment on the drilling rig
  - Treatment of residual SBM on cuttings to be less than 10% by wet weight (w/w), averaged over all well sections using SBM
  - Discharge of pit wash/oily water less than 1% oil in water.

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of drilling discharges impacts indicates significant impacts to threatened and migratory species will not credibly result from drilling discharges aspect of the Crux development drilling activity.

Alignment of the Crux development drilling activity with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-50.

Commonwealth Marine Area

The impacts and risks from the drilling discharges aspect of the Crux development drilling activity on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-50: Summary of Alignment of the impacts from the Drilling Discharges Aspect of the Crux Development Drilling Activity 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 drilling discharges reduces the impact of toxic pollutants being introduced into and/or persisting in the marine environment.
	Conservation advice on *Balaenoptera borealis* (sei whale) (TSSC 2015b)	
	Conservation advice fin whale (*Balaenoptera physalus*) (TSSC 2015c)	
	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017a)	
	Conservation advice on *Rhincodon typus* (whale shark) (TSSC 2015a)	

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 Area	Significant impact guidelines for Commonwealth marine environment (Table 8-1)	Water quality impacts by planned drilling discharges are expected to be limited. Impacts 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 drilling 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 9.10.4.

External Context

There have been no objections or claims raised by Relevant Persons in preparation of this EP around the drilling 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 EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of impacts and risks from drilling discharges determined the residual impacts rankings were Minor (Table 9-47). As outlined above, the acceptability of the impacts has 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); and

- internal context (i.e. Shell requirements).

Shell considers residual impacts 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 drilling discharges aspect.

Based on the points discussed above, Shell considers the impacts from drilling discharges associated with the Crux development drilling activity to be acceptable.

9.10.6 Environment Performance Outcomes

Environment Performance Outcomes	Measurement Criteria
No measurable impacts to sediment quality or water quality in the region from drilling discharges during the Crux development drilling activity.	Demonstrated implementation of EPSs for drilling discharges
Direct impacts to benthic habitats will be limited to < 0.1% of the Crux Project Area.	
No mortality or injury of threatened and migratory MNES species as a result of drilling discharges during the Crux development drilling activity.	

9.11 Atmospheric Emissions

9.11.1 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, ethylbenzene, xylenes (BTEX), formaldehyde, etc.) and other harmful to human health gases (e.g. hydrogen sulphide) have the potential to impact local and regional air quality.

Atmospheric emissions will be generated by the MODU and project vessels from internal combustion engines (including all equipment and generators) and incineration activities (including onboard incinerators for standard operations, excluding drilling waste).

Atmospheric emissions generated during drilling activities will include Sulphur oxides (SOx), Nitrogen oxides (NOx), particulates and VOCs. SOx and particulate matter emissions are heavily influenced by the fuel used and its relative sulphur content, MGO usually having a lower sulphite content than marine diesel oil (MDO) or heavy fuel oil (HFO).

NO_2 emissions from routine MODU power generation for an offshore project was previously modelled by BP (BP, 2013). The model demonstrated that atmospheric emissions generated by MODU operations may increase ambient NO_2 concentrations by 1 µg/m³ (0.001 ppm) within 10 km of the source and 0.1 µg/m³ (0.0001 ppm) within 40 km of the source. This represents an increase of 2% over typical background concentrations within 40 km, with air quality remaining well below the WHO air quality guideline for NO2 of 40 µg/m³ annual mean. As NO_2 is the main emission that poses a threat to receptor health, it is considered conservative to use the above studies to justify potential impacts to receptors.

Greenhouse Gas Emissions (GHG) are covered in Section 9.12.

9.11.2 Description and Evaluation of Impacts

The predicted concentrations of combustion-related pollutants at identified receptors and attendant ambient air quality impacts associated with the Crux development drilling are expected to be of low magnitude.

Air emissions associated with the Crux development drilling activities will lead to increased NO_x, Sulphar dioxide (SO_2) and $PM_{2.5}$ within the local airshed. This may also result in deposition on the water surface and potential impacts on seawater and seabed sediments and other habitats for aquatic vegetation. However, due to the low levels of the contaminants, expected water column dilution and buffer capacity of sea water, it is unlikely that deposition emissions will cause a change in acidity/basicity (pH) to the extent that marine life is affected.

Atmospheric emissions may result in a decline in local air quality, within the immediate vicinity of the emissions source. As described above, produced emissions throughout the project will include SO_2, NOx, ozone depleting substances, CO_2, particulates and VOCs. Emissions from engines, generators and deck equipment may be toxic, odoriferous or aesthetically unpleasing, and will result in a reduction in air quality.

Given the offshore remote context, and the low volumes of atmospheric emission which will be generated, environmental sensitivities that may be impacted by emissions of

atmospheric pollutant include only the physical environment (air quality). No impacts on the biological, socio-economic and cultural environment are reasonably foreseeable.

Given the above assessment, no adverse environmental effects are anticipated and the associated impacts on local air quality are expected to be Slight.

Occupational health effects associated with emissions of air pollutants are excluded from the scope of the EP and will be covered in the Crux project occupational health management program and procedures. These have been extensively modelled in the design phases of the Project and mitigated through design and operating procedures.

9.11.3 Impact Assessment Summary

Table 9-51: Atmospheric Pollutant and Air Toxics Emissions Evaluation of Residual Impacts

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

9.11.4 ALARP Assessment and Environmental Performance Standards

Table 9-52: 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	None identified	N/A	N/A	N/A	N/A	N/A
Administrative and Procedural Controls	Use low sulphur fuel oil/ diesel (< 0.5% m/m S) for project vessels	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 field including offtake tankers. This requirement will also be adopted for Crux development drilling activities.	9.1	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
Administrative and Procedural Controls	MODU and project vessels (as appropriate to vessel class) will comply with MARPOL Annex VI (Prevention of air pollution from ships), the Navigation Act 2012, the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and subsequent Marine Orders, which requires vessels to have a valid International Air Pollution Prevention Certificate (for vessels > 400 tonnage).	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), 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.	9.2	Specified project 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 project vessels.

9.11.5 Acceptability of Impacts

Table 9-53: 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 during the Crux development drilling activity.	Yes	Impacts to air quality from atmospheric emissions during the Crux development drilling activity will be localised. Given the remoteness of the Operational Area, there is no potential for significant environmental impacts to occur.

The assessment of atmospheric pollutant emissions determined the impact magnitude to be Slight (Table 9-51). Given that air quality in the area is generally expected to be very high and the lack of sensitive human receptor populations, the residual impact consequence ranking is assessed as Slight (Magnitude -1, Sensitivity – L) and therefore acceptable (Table 9-53). 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 regionally are not expected to be significantly impacted
- The precautionary principle has been applied to the impact assessment.

Relevant Requirements

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

- Air quality in the Crux regional airshed complies with the current NEPM Ambient Air Quality Standards (National Environment Protection Council, 1998) as well as with the proposed draft NEPM Ambient Air Quality Standard (National Environment Protection Council, 2019).
    - Marine fuel oil used by the MODU and vessels supporting operations complies with 1 January 2020 MARPOL Annex VI (Prevention of air pollution from ships), the *Navigation Act 2012*, the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and subsequent Marine Orders which requires vessels to have a valid International Air Pollution Prevention Certificate (for vessels > 400 tonnage) and, when possible, use low sulphur fuel (0.5% m/m S content in marine fuel oil and diesel).

- Implementation of recognised industry standard practice, such as:
  - preventative maintenance system; and
  - equipment selection in design, to achieve emissions efficiencies.

Matters of National Environmental Significance

Threatened and Migratory Species

The evaluation of atmospheric pollutant emissions from the Crux development drilling activity indicates significant impacts and risks to threatened and migratory species will not credibly result from combustion of fuels conducted as part of the activity.

Alignment of the drilling activities with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-54.

Commonwealth Marine Environment

The impacts and risks from atmospheric pollutant emissions from the Crux development drilling activity on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-54: Summary of Alignment of the Impacts from the Atmospheric Pollutant Emissions Aspect of the Crux development drilling activity with MNES

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 Crux development drilling activity will operate have not been triggered by atmospheric pollutant emissions from the Crux field.

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 EPOs, 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 9-51). 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); and
- 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 Crux development drilling activity to be acceptable and ALARP.

9.11.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No significant decline in air quality at residential or sensitive populations as a result of atmospheric emissions from the Crux development drilling activity.	Atmospheric pollutant and air toxics emissions inventory (as part of NPI report).

9.12 Greenhouse Gas Emissions

9.12.1 Aspect Context

The Crux development drilling activity encompasses only a few discrete activities which will result in Greenhouse Gas (GHG) emissions. The combustion of marine diesel to fuel the MODU and project vessels will emit GHGs as part of a range of atmospheric emissions (discussed in Section 9.11). GHG emissions will contribute to the incremental build-up of GHGs in the atmosphere, which in turn drive global climate change.

GHG emissions associated with later stages of the Crux project are outside the scope of this Environmental Plan. Such emissions have been considered in the approved Crux OPP, and will be assessed in detail and submitted to NOPSEMA for approval in future Environmental Plans for the later, relevant stages of the Crux project.

GHG emissions are primarily classed as Scope 1 (direct emission from own facilities or businesses), Scope 2 (indirect emissions when purchasing steam or electricity for use) and Scope 3 (all other indirect emissions across the value chain). The Crux development drilling activity does not have any Scope 2 emissions.

Emissions from the drilling activities will be a minor portion (<0.5% of total scope 1 and 3 emissions) of overall Crux Project emissions and are therefore not described in detail.

9.12.2 Description and Evaluation of Impacts

This section describes how climate change, in general, may affect the Australian environment. As will be explained in the evaluation, while there is a relationship between GHG emissions and climate change, the exact contribution of emissions from the Crux development drilling is unknown.

The State of the Climate Report released by BOM and CSIRO (2020) reported that Australia has warmed by approximately 1.4°C since 1910 and may warm by 4°C or more this century. This will result in the country experiencing the following climate changes:

- Increases in sea and air temperatures, with more hot days and marine heatwaves, and fewer cool extremes
- Sea level rise and ocean acidification
- Decreases in rainfall across southern Australia with more time in drought, but an increase in intense heavy rainfall throughout Australia.

The broader impacts from GHG emissions are typically considered by the international community at an ecosphere level, most frequently in terms of an increase in global temperatures.

Climate projections depend upon emission/concentration/radiative forcing scenarios, which are based on assumptions concerning, for example, future socio-economic and technological developments that may or may not be realised and are therefore subject to substantial uncertainty (UNITAR 2015).

Climate projections are distinct from climate predictions. Climate predictions are estimates of future natural conditions, while climate projections are estimates of future climates under the assumptions of future human related activities such as socio-economic and technical developments. Making a prediction of GHG emission impacts at the ecosphere level is an inherently complex exercise because of the influence of variables such as surface pressure, wind, temperature, humidity and rainfall within multiple ecosystems. The listed items are all interdependent variables that contribute to a global temperature increase. For each variable, a series of generalising assumptions

would be required to be able to make a sensible calculation of the impacts. Considering the complex and dynamic natural processes within the ecosphere, there is substantial uncertainty in determining a specific increase in global temperatures due to the emissions associated with the Crux development drilling activity.

To be consistent with the precautionary principle, one of the guiding principles of ESD is that the lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation if there is also a threat of serious or irreversible environmental degradation from the action.

Scope 1 emissions from the Crux development drilling activity are a small portion of emission inventories. This suggests a similarly immeasurable contribution to global temperature increases even though there is no calculable direct relationship.

Whilst Scope 1 emissions from the Crux development drilling activity contribute a small amount to Australian and global GHG emissions, this fact alone does not make their impacts inherently acceptable. The relatively small percentage of global emissions should not be used to understate the seriousness of the threat of environmental degradation from climate change. Instead, it clarifies the source of the threat is from global emissions quantities rather than emissions from the Crux development drilling activity. The threat of serious environmental degradation from climate change comes from an increasing global population demanding more energy to maintain and improve global living standards.

Whether climate change is irreversible is even more scientifically uncertain than predicting impacts from Scope 1 GHG emissions from Crux development drilling activities for the same reasons that made these predictions speculative. The environmental influences of variables such as surface pressures, wind, temperature, humidity, and rainfall are added to the variables of human adaption measures to a lower carbon economy.

The key features of the Crux development drilling activities contributing to the improvement of GHG performance include:

- considering the fuel usage for both the MODU and project vessels is estimated to just over 60% of the emissions from the Crux drilling scope which are in large part driven by time on location. Shell has designed its wells and drilling activity to minimise time on location given the very significant daily cost of running such a program.

Increasing levels of GHG in the atmosphere is one contributing factor to the warming of the climate system. There is a lack of full scientific certainty about the effects of increased emissions, but they are understood to be non-linear. The evaluation considered that GHG emissions are among the causes of climate change, particularly if unmitigated.

Emissions from Crux drilling activities will be managed to an acceptable level because of its focus on well design optimisation and ensuring a stringent action plan is in place while assessing the tender submissions for drilling activities based on their understanding of GHG emission reduction during project execution. Shell will implement a GHG Energy Management Plan (GHGEMP), which is an internal Shell requirement to drive project teams to target lower emitting concepts and technologies. As a result, the Crux project will incorporate a range of inherent design and operational efficiencies during the detailed design engineering phase which reduce GHG intensity.

Uncertainty in the assessment of impacts will be managed through the GHGEMP and the legislative arrangements that apply to the Crux development drilling activity in

particular, the Safeguard Mechanism under the NGER Act. The impacts have been assessed and will be mitigated, abated, and (where legally required) offset.

Given Scope 1 emissions from the Crux development drilling activity are a small portion of emission inventories, impacts are considered to be slight, with no long term effects anticipated.

9.12.3 Impact Assessment Summary

Table 9-55: Greenhouse Gas Emissions Evaluation of Residual Impacts

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

9.12.4 ALARP Assessment and Environmental Performance Standards

Table 9-56: 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
Substitute	Use of renewable energy (e.g. solar, wind and wave) in lieu of fossil fuels for power generation and marine vessel propulsion	No	Use of solar, wind or wave energy does not have the required reliability and will also require additional space and capital investment which are not currently justified.	N/A	N/A	N/A
Substitute	Using a 20% biofuels blend.	No	Mechanical limitations of machinery, logistics (no appropriate supplier within the coastal hubs to support), and the cost of the product outweighing the small incremental gain in emissions reduction.	N/A	N/A	N/A
Engineering	Installation of mooring arrangement for use by support vessels when on standby.	No	The installation of mooring arrangements for use by support vessels reduces the need to vessels to burn fuel for station keeping while on standby. The drilling activity is not of a significant duration and therefore the cost of installation of the mooring buoys outweighs the benefit of reduction in carbon emissions.	N/A	N/A	N/A

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 project vessels	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 field including offtake tankers. This requirement will also be adopted for Crux development drilling activities.	10.1	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
Administrative and Procedural Controls	MODU and project vessels (as appropriate to vessel class) will comply with MARPOL Annex VI (Prevention of air pollution from ships), the Navigation Act 2012, the Protection of the Sea (Prevention of Pollution from Ships) Act 1983 and subsequent Marine Orders, which requires vessels to have a valid International Air Pollution Prevention Certificate (for vessels > 400 tonnage).	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), 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.	10.2	Specified project 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 project vessels.
Administrative and Procedural Controls	Reporting of GHG emissions where required by the NGER Act 2007 to the Clean Energy Regulator.	Yes	This is a regulatory requirement under the NGER Act 2007.	10.3	GHG emissions reported annually to the Clean Energy Regulator where required by the NGER Act 2007.	GHG emissions reports submitted where required (or contemporary requirements at the time of the activities).
Administrative and	Reporting of GHG emissions when required	Yes	This is a regulatory requirement under the NGER Act 2007.	N/A	N/A	GHG reporting records (or contemporary requirements

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Procedural Controls	by the NGER Act 2007 to the Clean Energy Regulator.		Because NGER reporting is a regulatory requirement, no EPS has been developed for this requirement.			at the time of the activities) maintained where required.
Administrative and Procedural Controls	Reporting records of GHG and National Pollutant Inventory (or contemporary requirements at the time of the activities) will be compiled during the project.	Yes	Tracking and reporting of emissions gives visibility to performance and enables improvement opportunities to be identified. Reporting increases transparency and accountability which can also drive performance improvements.	10.4	GHG and National Pollutant Inventory reporting records where required (or contemporary requirements at the time of the activities) will be compiled with during the project.	GHG and National Pollutant Inventory reporting records maintained.
Engineering, Administrative and Procedural Controls	Greenhouse Gas and Energy Management (GHGEM) System including Greenhouse Gas and Energy Management Plan (GHGEMP), Abatement Workshop and Assessment Process and Operating Plan (OP) Process.	Yes	Crux has a GHGEM System which receives and incorporates key inputs from the abatement assessment and OP processes. The annual abatement workshop and assessment process will ensure that further detailed assessment of additional emission reduction opportunities is undertaken and will ensure impacts from GHG emissions are reduced to ALARP on an ongoing basis. The GHGEMP is reviewed annually to incorporate the regular review and optimisation processes that occur, namely the abatement workshop and assessment process and subsequent OP process, which sets out	10.5	Abatement opportunities in and out of plan are identified and summarised within GHGEMP from 2021 revision onwards.	Greenhouse Gas and Energy Management Plan

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			integrated GHG targets for the Crux development drilling activity.			

9.12.5 Acceptability of Impacts

Table 9-57: Acceptability of Impacts – Greenhouse Gas Emissions

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
Physical Environment	Australian Environment	No significant impacts to the Australian environment attributable to the Crux development drilling activity.	Yes	Impacts to the Australian environment are concluded to be low although with a low level of certainty. GHG emissions attributable to the Crux development drilling activity are not likely to have a significant impact on MNES. In combination with Shell's own GHG abatement commitments the impacts are of an acceptable level.

The assessment of risks from GHG emissions associated with the Crux development drilling activity has been considered in the following context.

- Defined acceptable level of GHG emissions set for Crux
- Principles of ESD
- Relevant requirements
- Significant impacts to MNES
- Internal and external context.

Crux's Defined Acceptable Level of GHG Emissions

Gross scope 1 GHG emissions are an inherent feature of Crux development drilling activities. Acceptability is considered in light of:

- Shell recognises that scope 1 emissions must be reduced to ALARP on an ongoing basis in order to be acceptable. An ALARP assessment of GHG emissions is outlined in section 9.12.4 and abatement projects that improve GHG performance will be implemented on the Crux project. Shell will demonstrate emissions will be reduced to ALARP on an ongoing basis through implementation of key GHGEMP processes.
- The level of GHG emissions for the Crux development activity is consistent with design GHG emission predictions in the OPP.

Principles of ESD

The risks and impacts from GHG emissions from the Crux development drilling activity are consistent with the principles of ESD. Of particular note is 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 Crux development drilling activity demonstrates that it meets this principle through ensuring GHG emissions do not exceed the defined acceptable level. In addition, the risks and impacts from GHG emissions from Crux are consistent with the Paris Agreement and principles of ESD based on:

- meeting existing end-user demand for energy;
- facilitating the distribution of lower carbon energy to meet the UN Sustainable Development goals, in particular;
    - affordable and clean energy;
    - climate action;
    - no poverty; and
    - decent work and economic growth.
- the precautionary principle has been applied, and mitigation measures have been adopted in the absence of full scientific certainty;
- global policies and actions related to GHG emissions have been considered and Australian legislation supports these policies and will be complied with, as noted further below;
- the Crux OPP was subject to public comment and regulatory scrutiny which ensures the broadest community of people have been involved in management of issues that affect them. In addition, relevant persons have been consulted in the preparation of this EP. No objections or claims relevant to GHG emissions were raised by relevant persons during consultation; and
- the decision making process on production technology has effectively integrated both long-term and short-term economic, environmental, social and equitable considerations.

Significant Impacts to MNES

There is no clear and convincing evidence that GHG emissions from the Scope 1 GHG emissions from Crux development drilling activity will result in significant impacts to threatened or migratory species. The impacts and risks from the GHG emissions aspect of the Crux development drilling activity on the Commonwealth marine environment do not exceed any of the significant impact criteria for any MNES. However, given the lack of full scientific certainty, GHG emissions will be managed to ALARP and acceptable levels on an ongoing basis.

Relevant Requirements

During the drilling, Shell will ensure the MODU Contractor commits to continued compliance with the mechanisms implemented in Australia to achieve the goals of the Paris Agreement.

Australia has committed to a NDC under the Paris Agreement to reduce emissions in line with commitment in the NDC registry. The Commonwealth government's plans to achieve this commitment have included recognition of emissions associated with new LNG projects in Australia, including Crux.

Australia's commitments under the Paris Agreement are delivered through a range of policies and initiatives, with the primary legislation for emissions management being the NGER Act. The NGER Act provides a single, national framework for the reporting and distribution of information related to GHG emissions, GHG projects, energy production and energy consumption to meet the following objectives:

- Inform government policy
- Inform the Australian public
- Help meet Australia's international reporting obligations

- Assist Commonwealth, state and territory government programmes and activities
- Avoid duplication of similar reporting requirements in the states and territories.

Under the NGER Act facility operators are required to report on direct GHG emissions, energy production and energy consumption, enabling the capture of data on energy flows and transformations occurring throughout the economy. The NGER Act is aligned with the GHG Protocol in defining Scope 1 and 2 emissions.

The Safeguard Mechanism provides a framework for Australia's largest emitters to measure, report and manage their emissions. It was established to ensure that emissions reductions delivered through the Emissions Reduction Fund are not displaced significantly by GHG emissions over and above business-as-usual- levels elsewhere in the economy[10]. It does this by requiring large facilities, whose net emissions exceed the safeguard threshold of 100,000 tonnes of $CO_{2\text{-}e}$ per annum, to keep their net emissions at or below emissions baselines set by the Clean Energy Regulator. Key elements of the mechanism include:

- safeguard facilities must meet the reporting and record keeping requirements of the NGER Act, including the Clean Energy Regulator's requirements for audits prior to baseline setting or to check compliance management;
- if a safeguard facility is likely to exceed its baseline, the responsible emitter must act, including by purchasing and surrendering Australian Carbon Credit Units (ACCUs) to offset excess emissions; and
- penalties for non-compliance.

As mentioned previously, for the Crux development drilling activities, the MODU Contractor has overall operational control, therefore the emissions are the contractor's Scope 1 (or Scope 2) emissions and Shell's Scope 3 emissions. It is Shell's responsibility to ensure the MODU Contractor complies with the contemporary requirements as defined under the NGER Act and associated Safeguard Mechanism (including any future amendments or changes in law), such as:

- Complete and submit annual NGER reports for the Kyoto Protocol listed (or applicable post-Kyoto agreement at the time of operations) GHG emissions on a CO_2 equivalency basis (as defined in Section 9 of the NGER Act and NGER Regulations 2008) by fuel type, and the relevant requirements of the NGER (Safeguard Mechanism) Rule 2015
- If the Safeguard Mechanism baseline for Crux is exceeded, follow requirements outlined under the Safeguard Mechanism. This may require Shell to purchase and surrender ACCUs.

[10] *Explanatory Statement, NGER (Safeguard Mechanism) Rule 2015*

Internal and external context

Shell Australia, as part of the wider Shell Group, is playing a role in working towards larger, group-level ambitions to be a net zero emissions energy business[11] by 2050, and sooner if that is possible, in step with society and our customers.

The context for the Shell Group ambition was the recognition that for society to achieve a 1.5 degrees Celsius future in line with the Paris Agreement, the world is likely to need to stop adding to the stock of GHG in the atmosphere – a state known as net-zero emissions – by around 2060. But those who can move faster, must move faster – advanced parts of the world are likely to need to reach that point by 2050.

Shell Group currently proposes to work towards this ambition in three ways, in step with society:

- an ambition to be net zero on all the emissions from the manufacture of all its products (scope one and two) by 2050 at the latest;
- accelerating Shell Group's Net Carbon Footprint ambition to be in step with society's aim to limit the average temperature rise to 1.5 degrees Celsius in line with the goals of the Paris Agreement on Climate Change; and
- aiming to help its customers decarbonise. That means working with customers to address the emissions which are produced when they use the fuels they buy from Shell Group. That effort includes working with broad coalitions of businesses, governments and other parties, sector by sector, to identify and enable decarbonisation pathways for each sector.

Shell Group's aim is that, in the future, its operating plans will change to reflect this net zero ambition.

Examples of current Shell Group-level initiatives aimed at addressing uncertainty and contributing to society achieving the goals of the Paris Agreement targets are:

- Unconditional three-year target (to 2022) to reduce its Net Carbon Footprint12 against the 2016 baseline by 3-4%, linked to remuneration for more than 16,500 staff. It is intended that this target setting will be done annually, with each year's target covering a three-year period
- Continued growth of the New Energies business, having already invested in a range of low-carbon technologies, from biofuels, hydrogen and wind power, to electric vehicle charging and smart energy storage solutions
- Monitoring and reporting on Shell Group performance. Every five years, the Shell Group proposes to assess collective progress toward meeting the Paris Agreement's long-term goal informed by the agreement's five-yearly "global stocktake". Shell Group will review its ambition based on this assessment of

---

[11] *As of the date of this document Shell Group's operating plans and budgets do not reflect Shell Group's Net-Zero Emissions ambition. Shell Group's aim is that, in the future, its operating plans and budgets will change to reflect this movement towards its new Net-Zero Emissions ambition.*

[12] *Shell Group's "Net Carbon Footprint", includes Shell Group's carbon emissions from the production of its energy products, its suppliers' carbon emissions in supplying energy for that production and its customers' carbon emissions associated with their use of the energy products it sells. Shell Group only controls its own emissions. The use of the term "Net Carbon Footprint" is for convenience only and not intended to suggest these emissions are those of Shell Group or its subsidiaries.*

progress, revised scenarios, and nationally determined contributions. Inherent in this review will be an appraisal of developments in technology and policy. The first five-year review is currently anticipated to take place after 2021

- Developing scenarios. Shell Group has been developing possible visions of the future since the 1970s. Shell Scenarios[13] ask, "what if?" questions encouraging leaders to consider events that may only be remote possibilities and stretch their thinking. These scenarios also help governments, academia and business in understanding possibilities and uncertainties ahead. For example, Shell has built a scenario looking at what the European Union (EU) might do to decarbonise energy in the next 30 years. It explores a possible, but highly demanding pathway to help achieve a climate-neutral EU by 2050 – including deployment of clean technologies and shifting choices to support a green economy.

Shell Group's business plans will change over time in step with society's progress towards meeting the Paris Agreement. Further information and examples of how the Shell Group is playing a role in the energy transition is available on the website (www.shell.com).

Shell Australia, as Operator of Crux, is playing a role in working towards the larger group-level ambitions, for example by:

- setting performance outcomes which result in GHG reduction between 2022 and 2025 (see section 9.12.6);
- providing natural gas to customers to help them lower their own emissions by displacing other higher carbon intensity energy sources; and
- developing an energy business for commercial and retail customers to provide low carbon energy options to customers.

Shell's ongoing consultation program will consider statements and claims made by stakeholders when undertaking the assessment of impacts and risks. Shell has also considered the internal context, including Shell's environmental policy and corporate requirements (as further outlined in Section 10.1). The environmental performance outcomes, and the controls which will be implemented, are consistent with the outcomes from stakeholder consultation for the Crux development drilling activity and Shell's internal requirements.

Acceptability Summary

As outlined above, the acceptability of the impacts and risks from GHG emissions from the Crux development drilling activity have been considered and found to be acceptable in the context of:

- defined acceptable level of GHG emissions set for Crux development drilling activity
- the principles of ESD
- relevant requirements
- significant impacts to MNES; and
- internal and external context.

[13] *These scenarios are a part of an ongoing process used in Shell Group for over 40 years to challenge executives' perspectives on the future business environment. They are designed to stretch management to consider even events that may only be remotely possible. Scenarios, therefore, are not intended to be predictions of likely future events or outcomes.*

9.12.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
Atmospheric emissions associated with the project will be consistent with national and international mechanisms for the management of GHG emissions for the life of the project.	Implementation records of the GHGEMP.

9.13 Waste Management

9.13.1 Aspect Context

The Crux development drilling activity will result in the generation of a variety of hazardous and non-hazardous wastes. 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), chemical containers, paint solvents and containers, light tubes and batteries. Sand and sludges may also be generated during well clean-up operations.

All wastes generated (other than permitted waste discharge streams addressed elsewhere within this EP) are routinely 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 waste management strategy for the Crux project is designed to optimise segregation of waste in the offshore location and to minimise contamination of recovered waste destined for recycling or disposal. All non-hazardous and hazardous solid waste will be managed in accordance with the relevant Waste Management Procedure and the vessels' Waste Management Plan/Procedure. Waste segregation on vessels 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. The disposal of non-hazardous and hazardous wastes will be tracked to confirm they are disposed of at an appropriately licensed waste facility. The management and disposal of any quarantine risk material will be in accordance with relevant requirements of the *Biosecurity Act 2015*.

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 solid wastes to the marine environment are typically small scale and infrequent events. Minor accidental releases of liquid wastes may also occur.

The potential environmental impacts from the accidental loss of solid wastes to the marine environment depends on the nature and amount of the waste, and the sensitivity of the environmental receptors that may be impacted. Some non-hazardous wastes such as paper and cardboard will readily degrade in the marine environment and pose little environmental risk. Other non-hazardous wastes are more persistent in the environment, particularly plastics.

9.13.2 Description and Evaluation of Risks

Physical Environment

Improper management of hazardous or non-hazardous wastes and/or accidental release may cause localised contamination of the water through a release of toxins and chemicals, depending on the nature of the discharge, however volumes of the hazardous components are generally low (such as residual paint in cans).

Chemicals may result in acute, 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 temporary and highly localised. Modelling of small

volumes of hydrocarbons (e.g. Shell, 2010) indicate rapid dilution in the offshore marine environment, with impacts limited to the immediate vicinity of the contamination.

Based on this assessment, the consequence of a change in water quality is a slight effect and the likelihood is unlikely, with an overall risk ranking of Minor.

Biological Environment

The unplanned discharge of solid wastes can result in injury or mortality to fauna, either through contamination or physical injury depending on the nature of the waste. Marine fauna, including fish, birds, mammals and reptiles may be impacted through ingestion or entanglement of waste or through exposure to toxic chemicals. Ingestion or entanglement of marine fauna has the potential for physical injury which may limit feeding/foraging behaviours and therefore can result in mortality.

Plastic non-hazardous waste released into the marine environment can also concentrate toxic chemicals on their surface, including Persistent Organic Pollutants (POPs). POPs occur universally in seawater at very low concentrations; because they are attracted to the hydrophobic plastic surfaces, POPs can concentrate on the surface of plastic debris at concentrations several orders of magnitude higher than that in seawater. If ingested by marine animals, contaminated plastics present a credible route by which the POPs can enter the marine food web.

The Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (Commonwealth of Australia, 2018) identifies EPBC Act-listed species for which there are scientifically documented adverse impacts resulting from marine debris. Marine turtles and seabirds in particular may be at risk from plastics which may cause entanglement or be mistaken for food (e.g. Commonwealth of Australia, 2018; Commonwealth of Australia, 2017a) and ingested causing damage to internal tissues and potentially preventing feeding activities. In the worst instance this could have a lethal affect to an individual. Marine debris has been identified as threat in the Recovery Plan for Marine Turtles in Australia (2017–2027). While the threat abatement plan for impacts of marine debris on vertebrate marine life does not list explicit management actions for non-related industries (DEWHA, 2009b), management controls will reduce the risk of unplanned discharge of solid waste.

The release of hazardous waste to the marine environment has the potential to cause toxic effects to biota in the water and sediment. However, given the anticipated, rapid dilution of hazardous spills, algae and marine fauna are likely to encounter hazardous spills at toxic concentrations for only short durations, and within a highly localised area. Therefore, population-level effects are unlikely to occur from small spills of hazardous waste.

Impacts to marine species including fish, birds, mammals and reptiles from the unplanned discharge of waste is unlikely given the unlikely occurrence of unplanned discharges and the location of the activities at significant distance from sensitive habitats. Significant impacts are unlikely to occur at an individual level and will not occur at a population level, nor result in the decrease of the quality of the habitat such that the extent of these species is likely to decline.

Given the likelihood of a potential impact to marine fauna is considered unlikely and the consequence is slight, the residual risk of unplanned waste discharge is assessed to be Dark Blue.

9.13.3 Risk Assessment Summary

Table 9-58: Waste Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Physical Environment	Slight	C	Dark Blue
Biological Environment	Slight	C	Dark Blue

9.13.4 ALARP Assessment and Environmental Performance Standards

Table 9-59: ALARP Assessment and Environmental Performance Standards

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Elimination	Eliminate waste generation	N/A	Waste generation cannot be eliminated from the vessels and MODU.	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
Engineering	Designated Waste Storage Areas available on vessels and MODU.	Yes	Wastes to be properly stored, secured, adequately contained and transported to avoid the risks of accidental overboard discharge or release, especially during adverse weather.	11.1	Designated waste storage facilities on vessels and MODU are available to enable waste to be secured and stored.	Assurance against waste management facilities, equipment and practices demonstrates that appropriate waste storage facilities have been provided and maintained.
Administrative and Procedural Controls	All discharge of waste from vessels will comply with relevant MARPOL 73/78 and Protection of the Sea (Prevention of Pollution) Act 1983 and subsequent Marine Order requirements (as	Yes	The marine assurance system is administered by Shell's Marine team and, amongst other requirements, ensures compliance of contract vessels with MARPOL 73/78 and Protection of the Sea (Prevention of Pollution) Act 1983 and subsequent Marine Order	11.2	Assurance will be undertaken for MODU and project vessels, including a check for compliance with waste management requirements of MARPOL 73/78 and Protection of the Sea (Prevention of	Assurance records

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	appropriate for vessel classification).		requirements (as appropriate for vessel classification).		Pollution) Act 1983 and subsequent Marine Order requirements (as appropriate for vessel classification)..	
Administrative and Procedural Controls	Waste management procedures will be implemented for the Crux project that: • provide for waste segregation and storage • safe handling and transport of waste, and • appropriate waste classification and disposal, recycling and landfill.	Yes	Waste management procedures will reduce the likelihood of an unplanned release.	11.3	Hazardous and nonhazardous waste will be managed in accordance with the Waste Management Plan	Records demonstrate compliance against Crux Waste Management Plan.
Administrative and Procedural Controls	Project vessels will maintain a Garbage Management Plan (or equivalent) as relevant to vessel class, type and size.	Yes	Each 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 (Prevention of Pollution from Ships) Act 1983 and AMSA Marine Order 95.	11.4	Project vessels (to which MARPOL Annex V / Marine Order 95 applies) have a current Garbage Management Plan (or equivalent).	Garbage Management Plan (or equivalent) is sighted onboard project vessels and are maintained up to date.
				11.5	Vessels to comply with AMSA marine order 94 & 95 (marine pollution prevention – packaged harmful	Garbage record book maintained for project vessels as per Marine Order 95 demonstrates that there were no unpermitted discharges

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
					substances/garbage), specifically: No planned disposal of domestic waste, solid wastes or maintenance wastes overboard from vessels (other than planned discharges permitted by this EP).	of solid waste as part of the petroleum activities.
Administrative and Procedural Controls	The management and disposal of any quarantine risk material will be in accordance with relevant requirements of the *Biosecurity Act 2015*.	Yes	The management and disposal of any quarantine risk material in accordance with relevant requirements of the *Biosecurity Act 2015* will reduce the risk of impact from inappropriate disposal to the marine environment.	11.6	Any quarantine risk material is managed and disposed of in accordance with relevant requirements of the *Biosecurity Act 2015*.	Records demonstrate that any quarantine risk material is managed and disposed of in accordance with relevant requirements of the *Biosecurity Act 2015*.

9.13.5 Acceptability of Impacts

Table 9-60: 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	Water Quality	No significant impacts to water quality during the Crux development drilling activity.	Yes	Unplanned discharge of hazardous wastes have the potential to result in reduced water quality at the discharge location. However, small volume discharges will rapidly dilute in the open ocean environment with no significant effect.
Threatened Species and Ecological Communities	Marine mammals Marine reptiles Birds Fish Sharks and rays	No mortality or injury of threatened or migratory MNES fauna from the Crux development drilling activity. Management of aspects of the Crux development drilling activity must be aligned to conservation advice, recovery plans and threat abatement plans published by the DAWE. No significant impacts to threatened or migratory MNES fauna.	Yes	Shell implements MARPOL standards in relation to managing wastes, which reduce the likelihood of wastes being accidentally released to the marine environment. Given the remote location 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.

The assessment of risks from waste determined the residual risk rating to be Minor. As outlined above, the acceptability of the risks from waste associated with the Crux development drilling activity 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
- 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 9-61).

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 Crux development drilling activity given the limited number of animals that could potentially be impacted in the unlikely event of an unplanned release.

Alignment of the Crux development drilling activity with management plans, recovery plans and conservation advice for threatened and migratory fauna is provided in Table 9-61.

Commonwealth Marine Environment

The impacts and risks from the waste aspect of the Crux development drilling activity on the Commonwealth marine environment will not exceed any of the significant impact criteria provided in Table 8-1.

Table 9-61: Summary of Alignment of the Risks from the Waste Aspect of the Crux Development Drilling Activity 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*) (TSSC 2015b)	Pollution (persistent toxic pollutants)	Waste generated during the Crux development drilling activity 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*) (TSSC 2015c)	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 rigs, marine debris infrastructure and acute/chronic chemical discharge	
	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 2017a)	Marine debris	
	Conservation advice on leatherback turtle (*Dermochelys coriacea*) (DEWHA 2008b)	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
	Conservation advice on whale shark (Rhincodon typus) (TSSC 2015a)	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 2009b)	Marine debris	

External Context

There have been no objections or claims raised by Relevant Persons to date around the waste aspect of the Crux development drilling activity. 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 EPOs, and the controls which will be implemented, are consistent with Shell's internal requirements.

Acceptability Summary

The assessment of and risks from waste determined the residual risk rating to be Minor. 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); and
- internal context (i.e. Shell requirements).

Shell considers residual risks of Minor 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.

9.13.6 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No mortality or injury of threatened and migratory MNES species as a result of unplanned waste discharge to sea during the Crux Project petroleum activities.	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.

9.14 Emergency Events

9.14.1 Scenario Context

Two unplanned events (i.e. incidents or emergencies) resulting in the potential for large-scale releases of hydrocarbons were identified for the Crux development drilling activity. These events include:

- Loss of containment (LOC) of well fluids from an uncontrolled, 80 day subsea well blowout after loss of well control
- LOC of fuel during refuelling or as a result of a fuel tank rupture following a vessel collision within the Operational Area (intermediate fuel oil (IFO).

A worst-case scenario resulting from each of these events has been considered in this environmental risk assessment. Each of these scenarios is discussed further in this section. Each of these scenarios can result in smaller spills than the worst-case credible spills discussed below. The smaller spills have not been discussed specifically as their consequences will be lesser in both magnitude and impact.

LOC from a subsea well blowout after loss of well control

The subsea infrastructure associated with the Crux development drilling activity includes five production wells with subsea wellhead systems and blowout preventers, and one drilling template. Shell engineering standards require a range of features which manage the risk of a loss of well control to very low levels. However, there is a possibility that a loss of well control may occur during drilling. While the likelihood is very small, a complete loss of well control (a well blowout) has the potential to release significant volumes of condensate into the environment. Such a release could result in significant environmental damage.

Industry statistics from wells using similar controls that will be applied during drilling of the Crux development wells indicate the likelihood of a well blowout are $2.5 \times 10^{-4}\ Q^{-0.3}$ per well (where Q is the mass of spilled hydrocarbons in tonnes (Det Norske Veritas 2011).

These functions are shown in Figure 9-5, and are consistent with observed well blowout data observations in Australia and similar jurisdictions around the world. Most loss of well control incidents do not result in a worst-case well blowout scenario, and typically release relatively small masses of hydrocarbons. The likelihood of a well blowout from development drilling is considerably lower than a loss of containment from an exploration well, as are the release masses (Figure 9-5).

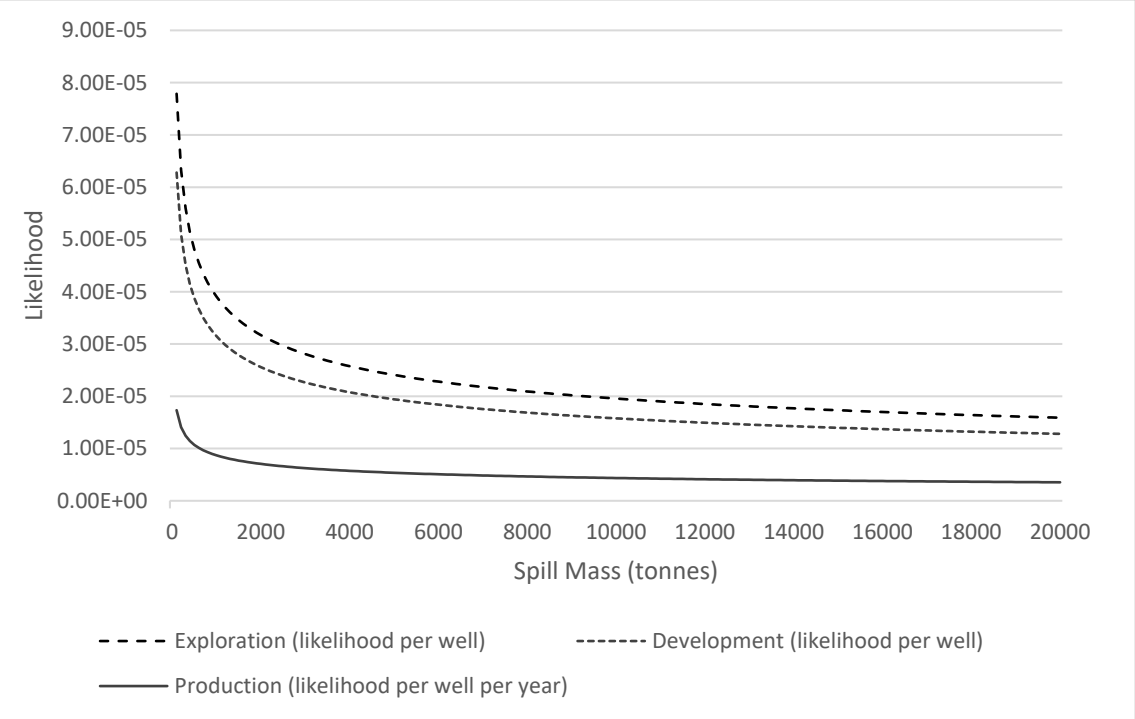


Figure 9-5: Estimated Likelihood and Mass of Well Blowouts for Exploration, Development and Production Wells (after Det Norske Veritas 2011)

Shell has extensive experience with safe and environmentally responsible drilling and reservoir engineering worldwide. Shell has developed a detailed understanding of the Crux field through historical seismic surveys and drilling. The offshore oil and gas industry has improved environmental performance since the Macondo and Montara catastrophes, and Australian regulations require that all environmental risks be managed to a level that is ALARP and acceptable, as demonstrated in this EP. All wells will be drilled and operated in accordance with an accepted WOMP in accordance with the OPGGS Act.

Shell has determined the worst-case credible spill scenario that could occur from drilling of the development wells within the scope of this EP. This scenario is a complete well blowout of a well during drilling. This scenario consists of an 80-day uncontrolled release of 220,000 m^3 of condensate (2,750 m^3 per day). The duration is based on the credible worst-case time required to control the well (either by capping or drilling of a relief well) and the volume is based on the maximum credible rate of release derived from the proposed well design and reservoir characteristics. The release location is at the seabed. While this scenario is very unlikely, using the worst-case credible spill as the basis for the risk assessment provides an environmentally conservative assessment of the potential impacts and risks posed by the Crux development drilling activity. Numerical modelling performed for the OPP has been used to inform the risk assessment in this EP. The modelled volume for the OPP was 206,240 m^3, therefore an additional 15% has been added to the EMBA derived from the modelling to capture any additional sensitive receptors that could be contacted in the event of a release of the worst-case 220,000 m^3 volume of condensate. Refer to Section 9.14.2 for further information on this worst-case credible spill scenario and associated modelling.

LOC from fuel tank rupture following a vessel collision

The Crux development drilling activity will require use of a range of project vessels, including an LCV, AHTS and general support vessels. The nature and scale of the environmental risks and impacts from a loss of fuel from a vessel varies significantly based on the vessel type and activities. The LCV may be fuelled with IFO, whereas the AHTS and general support vessels will be fuelled with marine diesel, which is less persistent in the environment.

Shell has determined the worst-case credible release from a loss of fuel from the LCV is a short-term (1 hour) release of 1,000 m^3 of IFO. This scenario was identified as credibly arising from a collision with a large vessel (e.g. bulk carrier). Based on the shipping activity in the region and standard maritime practices, this scenario is considered extremely unlikely. As outlined above in **Loss of Well Control**, this worst-case credible spill scenario is considered to provide an environmentally conservative assessment of potential impacts and risks from a loss of containment from a loss of fuel from a vessel. Shell commissioned numerical modelling to inform the risk assessment; refer to Section 9.14.2 for further information on this worst-case credible spill scenario and associated modelling.

Smaller volumes of marine diesel oil (MDO) could be spilled during refuelling activities or accidental vessel collision in the Operational Area. These scenarios have not been modelled as they would be within the footprint of the larger spill volumes described above.

9.14.2 Overview of Unplanned Spill Modelling

Numerical modelling studies were commissioned for the worst-case credible spill scenarios outlined above.

Table 9-62 details the locations of the two modelled LOC events, and the duration and volume of release. Modelling of the loss of well control and IFO fuel tank rupture following a vessel collision was conducted within the Operational Area and presented in the Crux OPP.

Table 9-62 Summary of Modelled Hydrocarbon Spill Modelling Scenarios

Modelled LOC Scenario	Latitude	Longitude	Depth (m)	Hydrocarbon Type	Release Duration	Total Volume (m^3)
Subsurface blowout after loss of well control	12° 57’ 52.46”	124° 26’ 33.21”	168.5	Condensate	80 days	206,240
Fuel tank rupture from vessel collision	12° 57’ 52.46”	124° 26’ 33.21”	Surface	IFO-180	1 hour	1000

The scenarios were modelled using the Oil Spill Model and Response System (OILMAP)-Deep model for nearfield modelling and the Spill Impact Mapping and Assessment Program (SIMAP) model for the far field effects. Simulations were run for 108 days in the loss of well control scenario and 42 days in the vessel collision scenarios.

Both of the spill scenarios were modelled using a stochastic modelling approach, where the release was repeatedly simulated using different metocean conditions. A total of 300 deterministic model runs were undertaken for the loss of well control and IFO release scenarios (100 during summer, 100 during winter and 100 during transitional season). The aggregated deterministic results (300 deterministic runs for each release scenario) constitute the stochastic data set, from which probabilities of contact above thresholds are determined. Shell considers all environmental receptors identified as potentially being contacted, regardless of the likelihood. This will identify more receptors than would be impacted by a given release, and hence it is environmentally conservative.

A single representative deterministic run was selected from the stochastic set based on the maximum oil volume accumulated across all shoreline receptors. This deterministic run for each of four scenarios has been presented as a time-series compilation of figures. This time-series compilation of figures provides an indication of how hydrocarbons released from a single worst-case spill event may behave in the environment. The time-series figure compilations include floating, entrained, dissolved and accumulated hydrocarbons.

Hydrocarbon Characteristics

Crux Condensate

Crux condensate is relatively volatile (> 90% volatile hydrocarbons by mass), non-viscous hydrocarbon mixture. Soluble aromatic hydrocarbons contribute approximately 12.3% by mass of the whole condensate, with a large proportion (9.8%) in the C4–C10 range of hydrocarbons. These compounds will evaporate rapidly, reducing the potential for dissolution of a proportion of them into the water. The physical properties and boiling points of Crux condensate are presented in Table 9-63 and Table 9-64 respectively.

Table 9-63: Physical Properties of the Hydrocarbons used in the Modelling

Physical Properties	Crux Condensate	IFO-180
Density (kg/m^3)	783.6 (at 15 °C)	967.0 (at 25 °C)
API	49.0	14.8
Dynamic viscosity (cP)	1.052 (at 20 °C)	2,324 (at 15 °C)
Pour point (°C)	9.0	-10.0
Hydrocarbon property category	Group I	Group IV
Hydrocarbon persistence classification	Non-persistent	Persistent (heavy)

Table 9-64: Boiling-point Breakdown of the Hydrocarbons used in the Modelling

Oil Type	Volatiles (%)	Semi-Volatiles (%)	Low Volatiles (%)	Residual (%)	Aromatics (%)
Boiling point (°C)	< 180 C4 to C10	180–265 C11 to C15	265–380 C16 to C20	> 380 > C20	Of whole oil < 380 BP
	Non-persistent			*Persistent*	-
Crux condensate	54.8	22.8	14.6	7.8	12.3
IFO-180	1.0	14.4	20.8	63.8	5.9

Intermediate Fuel Oil

IFO-180 has a high density (967 kg/m^3) and a high viscosity (2,324 cP), with a low portion of volatile component (Table 9-63 and Table 9-64). Once released to the environment, most of the oil will spread and form a surface slick, with the small portion of volatile components evaporating.

Given the low viscosity of IFO, it is unlikely to become entrained under most wind and wave conditions (RPS 2018b). IFO-180 can form stable water-in-oil emulsions (also referred to as “chocolate mousses”) in which seawater droplets become suspended into the oil matrix (Fingas and Fieldhouse 2004). The formation of emulsions requires physical mixing (i.e. wave action), with the stability of the emulsion influenced by the properties of the IFO (which will change as the oil weathers). Emulsions are expected to become less stable over time as the water content reduces. Emulsification will affect the spreading and weathering of the oil and increase the volume of oily material and may the affect natural degradation rate (Fingas and Fieldhouse 2004).

The IFO will continue to degrade in the environment through weathering processes and microbial action. Residual oil may remain as floating oil, form tarballs, and become deposited to the seabed if subject to high suspended sediment loads (such as those observed in nearshore environment) (International Tanker Owners Pollution Federation 2011a). High suspended sediment loads and therefore sedimentation of oil is not expected in the offshore marine environment.

Hydrocarbon Impact Thresholds

Spilled hydrocarbons can exist as a range of fates, or phases, in the marine environment. These are floating, entrained, dissolved and accumulated (i.e. stranded onshore) hydrocarbons. Each of these fates, or phases, can interact with the environment in diverse ways due to different pathways to receptors and impact mechanisms.

Impact thresholds 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. The thresholds applied align with the NOPSEMA Oil Spill Modelling Guidance Bulletin (NOPSEMA, 2019). Three thresholds were applied to each phase i.e. low exposure, moderate exposure and high exposure. These are described in Table 9-65 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.

The low thresholds have been used to delineate the Environment that May be Affected (EMBA) by the Crux development drilling activity as presented in Section 7.

The moderate and high thresholds define the Adverse Exposure Zone within which ecological impacts may be expected to occur.

Table 9-65: 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 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 2015b). Thresholds of 100 g/m^2 and 1,000
Adverse exposure zone High (> 1,000 g/m^2)	1,000 g/m^2	

Exposure Zone	Threshold	Justification
		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; Geraci and St Aubin 1990; Jenssen 1994; Tsvetnenko 1998). This exposure zone is not considered to be of

Exposure Zone	Threshold	Justification
		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.

9.14.3 Summary of Loss of Containment Modelling Results

Loss of Well Control

The loss of well control scenario will generate a plume of buoyant gas and condensate, which will rise rapidly through the water column (RPS 2018b). The resulting turbulent mixing of the gas and condensate with the water is predicted to entrain liquid hydrocarbons in the water column. Modelling results indicated these liquid hydrocarbon drops will be very small (< 30 µm) and will rise very slowly towards the sea surface (approximately 4.3 m per day). The droplets are expected to remain entrained in near-surface waters due to wind and wave action, although may form thin floating slicks under sufficiently calm conditions (RPS 2018b).

At the surface, evaporation rates of the condensate will be high because there is a large proportion of volatile (55%) and semi-volatile (23%) compounds within the condensate. The residual fraction of the condensate (8%) will persist in the environment until degradation processes occur over periods of weeks to months. Considering the spill volume and the relatively high likelihood of entrainment occurring, there is a high potential for dissolution of soluble aromatic compounds.

The results essentially suggest that the majority of the oil will be entrained into the upper mixed layer of the ocean, with some surfacing potential based on the proportion of larger droplets.

The metocean conditions significantly affected the distribution of entrained and dissolved hydrocarbons. The strong mesoscale flow to the south-west during winter months associated with the ITF moved the majority of dissolved and entrained hydrocarbons in this direction for released during this season. The weakening of the ITF during transitional and summer months lead to increased probabilities of entrained and dissolved hydrocarbons moving east from the release location.

Key results from the modelling for a worst-case loss of well control showed:

- **Floating hydrocarbons** were relatively localised to the release location due to the seabed release and the resulting entrainment of the condensate as very fine drops with low rising velocity. Modelling results indicated floating hydrocarbons would only occur above the low exposure threshold; no exceedance of the moderate or high floating hydrocarbon thresholds were predicted. The maximum distance to the outer extent of the low floating oil threshold is predicted to vary between seasons, extending to within 577 km, 387 km and 93 km during transitional, summer and winter conditions, respectively. Floating oil concentrations above the moderate threshold occurred only during the transitional season. The high floating oil threshold was not exceeded during any season.
- **Accumulation of Shoreline hydrocarbons** is unlikely to occur, with potential accumulation predicted to occur at isolated locations along the NT coastline during the summer season. The modelling predicts less than 1% probability of hydrocarbons accumulating at any shoreline at or above the moderate 100 g/m^2 threshold. The maximum local accumulated concentration on shorelines of 473 g/m^2 forecast at Melville Island. Given the worst-case release volume of condensate for the Crux development drilling activity (220,000 m^3) is slightly larger than the 206,240 m^3 modelled (~7% increase), additional shoreline locations may be contacted by hydrocarbons above the moderate threshold. However, this difference is not expected to be significant. This additional potential for shoreline contact has been taken into consideration in oil spill response planning presented in the Oil Pollution Emergency Plan (OPEP).
- **Entrained hydrocarbon** were predicted to extend in all directions. The maximum distance to the outer extent of the low entrained oil threshold is predicted to vary between seasons, extending up to 3,292 km, 2,589 km and 2,170 km during winter, transitional and summer conditions, respectively. The maximum extent is forecast to be slightly reduced for the moderate (100 ppb) and high (≥ 500 ppb) thresholds for all the seasons. Most of the spilled liquid hydrocarbons from a worst-case loss of well control will exist in the entrained phase. The extent of entrained oil based on the moderate threshold is presented in Figure 9-6.
- The modelled entrained phase was therefore used to define the EMBA. As described above, a 15% buffer has been added to the outer extent of the low entrained threshold to capture any additional sensitive receptors that could be contacted in the event of a release of the worst-case 220,000 m^3 volume of condensate, which is slightly larger than the 206,240 m^3 modelled (refer to Figure 9-6). This resulted in an additional extent of ~50 km in all directions. Any additional sensitivities contacted by the extended EMBA have been outlined in Section 7.
- **Dissolved aromatic hydrocarbons** were predicted to follow a similar distribution to entrained hydrocarbons and extend in all directions. The maximum distance to the outer extent of the dissolved aromatic hydrocarbon low threshold (6 ppb) is predicted to vary between seasons, extending up to 3,280 km, 2,364 km and 1,764 km during winter, transitional and summer conditions, respectively. The maximum extent is forecast to be slightly reduced for the moderate (50 ppb) and high (≥ 400 ppb) thresholds for all the seasons. The extent of dissolved aromatic hydrocarbons based on the moderate threshold is presented in Figure 9-6.

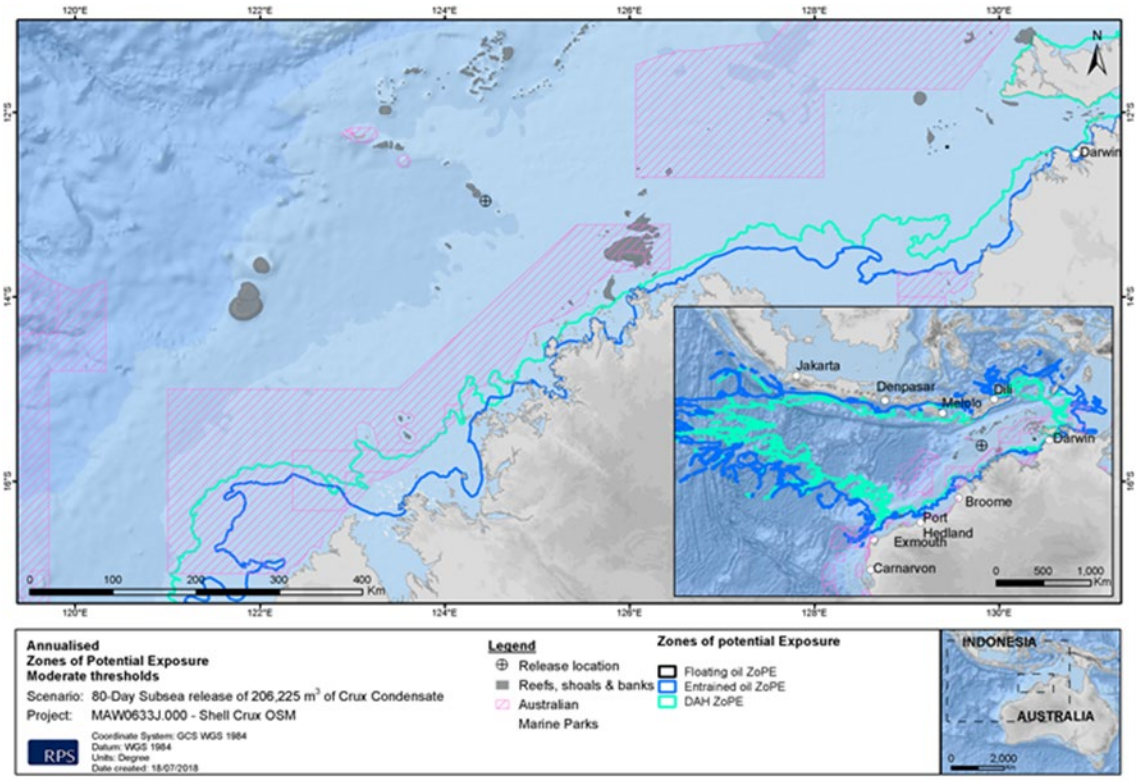


Figure 9-6: Predicted Annualised Moderate Exposure Threshold for Floating, Entrained and Dissolved Hydrocarbons from an 80-day Subsurface Release of Crux Condensate at a Development Well

The worst-case deterministic run was determined to be the deterministic model run from the stochastic set with the greatest volume of hydrocarbons accumulating on shorelines. This deterministic run resulted in approximately 9.3 m^3 of hydrocarbon accumulation on the shoreline within and around the Djukbinj National Park in the NT. This worst-case deterministic run indicated that hydrocarbons on the sea surface mainly drifted southwest of the release location. The potential floating oil exposure zones (low threshold) was limited to within 15 km of the release location, with the moderate and high thresholds not exceeded. The entrained oil and dissolved aromatic hydrocarbons were shown to move east and northeast of the release location. Low, moderate and high entrained hydrocarbons were observed up to 1,155 km, 1,048 km and 890 km, respectively, from the release location. Low, moderate and high dissolved aromatic hydrocarbons were observed up to 1,071 km, 597 km and 364 km, respectively, from the release location.

Loss of Fuel from Vessel – IFO

Key results from the stochastic modelling studies for a worst-case loss of IFO from the LCV showed:

- **Floating hydrocarbons** may disperse in all directions, depending on metocean conditions. The maximum distance to the outer extent of the low floating oil low threshold is predicted to vary between seasons, extending to within 1,853 km, 1,249 km and 985 km during winter, summer, and transitional conditions, respectively. The area potentially contacted above the moderate and high floating oil threshold was reduced, with floating oil not predicted to extend beyond 1,061 km, 727 km and 484 km, during winter, summer, and transitional conditions, respectively. The extent of floating hydrocarbons based on the moderate threshold is presented in Figure 9-7.

- **Accumulation of Shoreline hydrocarbons** were predicted to have a low likelihood (<5%). Maximum local accumulated concentration on shorelines of 7,777 g/m^2 were forecast at Bonaparte Archipelago, Kimberley PMZ and Kimberley Coast during a release starting in the summer period.
- **Entrained oil** concentrations are expected to be localised to the release location. The high viscosity of IFO means the potential for entrainment during typical metocean conditions is relatively low. The maximum distance to the outer extent of the low entrained oil threshold is predicted to vary between seasons, extending up to 170 km, 102 km and 24 km during summer, transitional and winter conditions, respectively. The maximum extent is forecast to be greatly reduced for the moderate and high thresholds for all the seasons. The extent of entrained hydrocarbons based on the moderate threshold is presented in Figure 9-7.
- **Dissolved hydrocarbons** will be localised to the release location. The maximum distance to the outer extent of the low dissolved aromatic hydrocarbon threshold is predicted only in the summer season, extending up to 20 km.

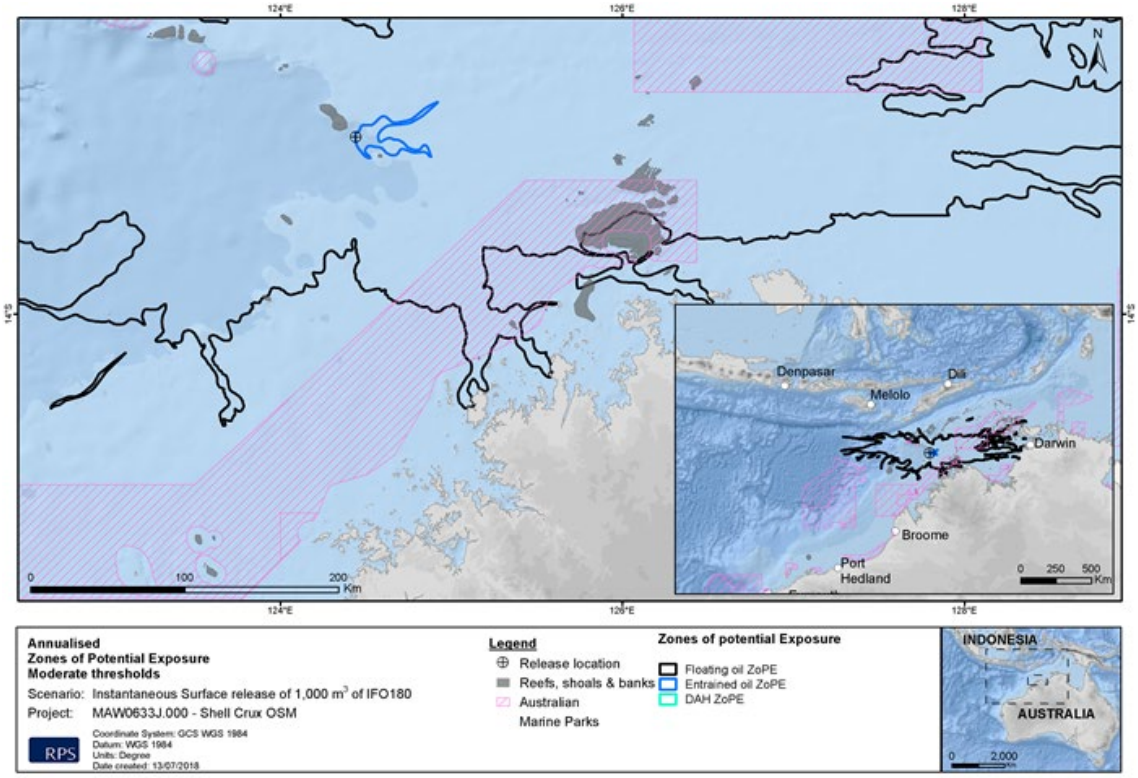


Figure 9-7: Predicted Annualised Moderate Exposure Threshold for Floating, Entrained and Dissolved Hydrocarbons from a 1-hour Surface Release of IFO-180 in the Operational Area

The worst-case deterministic run was determined to be the deterministic model run from the stochastic set with the greatest volume of hydrocarbons accumulating on shorelines. This deterministic run resulted in approximately 624 m^3 of hydrocarbon accumulation on the shorelines associated with the Bonaparte Archipelago/Bigge Island. Hydrocarbons on the sea surface mainly drifted south of the release location. The potential floating oil exposure zones were shown up to 198 km, 190 km and 159 km of the release location at the low, moderate and high thresholds, respectively. There was no entrained oil or dissolved aromatic hydrocarbon exposure predicted at any threshold.

9.14.4 Description and Evaluation of Impacts and Risks

This section lists the sensitive receptors that, based on the modelling, are predicted to contact oil at concentrations at or above the moderate threshold. These receptors are listed in Table 9-66 for the two modelled LOC scenarios. It is noted that an additional 15% buffer was added to the EMBA presented in Section 7 to account for the slightly larger spill volume that could result from a loss of well control (LOWC) compared to the modelled scenario, as described above. Receptors within this additional 15% buffer have been considered in the evaluation of impacts and risks below.

Table 9-66: Summary of Hydrocarbon Spill Modelling Results for Sensitive Receptors with a ≥50% Likelihood of Contact above Moderate or High Exposure Thresholds

Receptor Category	Scenario: Loss of Well Control				Scenario: Vessel Collision (IFO)			
	Hydrocarbon Phase Above Adverse Exposure Threshold				Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating	Accumulated	Entrained	Dissolved	Floating	Accumulated	Entrained	Dissolved
Shoals and Banks								
Barracouta Shoals			✓	✓				
Deep Shoal 1			✓					
Echuca Shoal			✓					
Eugene McDermott Shoal			✓	✓				
Gale Bank			✓					
Goeree Shoal			✓	✓				
Heywood Shoal			✓	✓				
Johnson Bank			✓					
Vulcan Shoals			✓	✓				
Woodbine Bank			✓	✓				
Reefs and Offshore Islands								
Browse Island			✓					
Seringapatam Reef			✓					
Scott Reef North			✓					
Scott Reef South			✓					
Sandy Islet			✓					
Mainland Coastlines								
No coastlines with likelihood of contact > 50%								
KEFs								
Ancient coastline at 125 m depth contour			✓	✓				

Receptor Category	Scenario: Loss of Well Control				Scenario: Vessel Collision (IFO)			
	Hydrocarbon Phase Above Adverse Exposure Threshold				Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating	Accumulated	Entrained	Dissolved	Floating	Accumulated	Entrained	Dissolved
Ashmore Reef and Cartier Island and surrounding Commonwealth waters			✓	✓				
Carbonate bank and terrace system of Sahul Shelf			✓	✓				
Continental slope demersal fish communities			✓	✓				
Seringapatam Reef and Commonwealth waters in the Scott Reef Complex			✓					
BIAs								
Flatback turtle			✓	✓				
Green turtle			✓	✓				
Hawksbill turtle			✓					
Loggerhead turtle			✓	✓				
Olive ridley turtle			✓	✓				
Habitat Critical to the Survival of a Species								
Green turtle			✓	✓				
Heritage								
Ashmore Reef National Nature Reserve			✓	✓				
Scott Reef and Surrounds – Commonwealth Area			✓					
Ramsar Wetlands								
Ashmore Reef National Nature Reserve			✓	✓				
Marine Parks								
Ashmore Reef AMP			✓					
Cartier Island AMP			✓	✓				
Kimberley AMP			✓					
Oceanic Shoals AMP			✓	✓				
Fisheries								
Northern Prawn Fishery			✓					
NWSTF			✓	✓				

Receptor Category	Scenario: Loss of Well Control				Scenario: Vessel Collision (IFO)			
	Hydrocarbon Phase Above Adverse Exposure Threshold				Hydrocarbon Phase Above Adverse Exposure Threshold			
	Floating	Accumulated	Entrained	Dissolved	Floating	Accumulated	Entrained	Dissolved
Southern Bluefin Tuna Fishery			✓	✓	✓			
Western Skipjack Fishery			✓	✓	✓			
Western Tuna and Billfish Fishery			✓	✓	✓			
Defence								
No defence areas with likelihood of contact > 50%								
Offshore Petroleum								
Montara Production Platform			✓	✓				
Prelude FLNG			✓	✓				
Indonesia and Timor-Leste Coastlines								
No Indonesian or Timorese coastlines with likelihood of contact > 50%								

Physical Environment

Water Quality

Large volume releases of Crux condensate or IFO have the potential to result in increased concentrations of dissolved hydrocarbons, which include BTEX and Polycylic Aromatic Hydrocarbons (PAHs). The proportions will vary depending on the type of hydrocarbon. These low molecular weight compounds are known to be toxic to marine biota (refer to **Ecosystems, Communities and Habitats** and **Threatened Species and Ecological Communities** below for a discussion of these effects). BTEX compounds do not persist in the environment due to their volatility and will diminish once released into the environment. The concentration of BTEX is expected to be highest near the release location and will decline as the spilled hydrocarbon weathers. PAHs are less volatile than BTEX and are expected to persist for longer in the environment.

The decrease in water quality from the worst-case hydrocarbon spills presented above are expected to consist of short-term acute toxic effects to phytoplankton and zooplankton. 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).

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. For short duration release scenarios (i.e. IFO from a vessel collision), these processes will begin to reduce the total amount of hydrocarbons in the water column shortly after the release. The worst-case loss of well containment will continue to release fresh hydrocarbons for the duration of the release, and the amount of hydrocarbons will increase until the release is stopped.

Sediment Quality (Subsurface)

Sediment quality is not expected to be significantly affected by any of the worst-case scenarios that release Crux condensate or IFO. Hydrocarbon contaminants (e.g. PAHs) from 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 subsea release (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 most likely to occur with the worst-case 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 IFO release from a loss of fuel from a vessel scenario will undergo rapid evaporation of volatiles following release. The remaining IFO 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 IFO relative to seawater and the naturally low sedimentation rates. Residual IFO near shorelines may be exposed to higher sediment loads and be more likely to sink. Stranding of residual IFO on shorelines can lead to long-term contamination of sediments, with a greater proportion of high-molecular weight hydrocarbons present in IFO. 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 and loss of pipeline containments scenarios will result in a gas cloud upon reaching the surface. This potentially large gas cloud is expected to disperse rapidly in the open, offshore environment.

The formation of a gas cloud poses a significant health and safety risk from the formation of explosive mixtures and asphyxiation. Given the highly localised extent and expected short duration of the gas cloud, this risk is considered to be very low.

Biological Environment

Benthic Communities

A seabed release of Crux condensate from a loss of well control scenario may result in impacts to water quality and sediments in the vicinity of the release location (refer to sections **Water Quality** and **Sediment Quality** above). The seabed in the vicinity of the potential release locations is characterised by unconsolidated sediments which host sparse assemblages of filter feeding and deposit feeding organisms. These fauna 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. Unconsolidated sediment habitat is very widely represented in the Timor Sea, and the associated fauna assemblages are not considered to be particularly sensitive of or high conservation value.

Many benthic fauna species have planktonic larval phases (e.g. corals, echinoderms, sponges etc.). 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-scale impacts.

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 and Driskell 2003). While typically less toxic than dissolved hydrocarbons, entrained oil may still cause toxic effects; entrained oil 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.

Results from modelling studies of the worst-case hydrocarbon spill scenarios indicated that several offshore reefs and islands, and bank and shoals, may be contacted by hydrocarbons above impact thresholds. Refer to **Offshore Reefs and Islands** and **Shoals and Banks** below for a discussion of potential impacts to these receptors.

Nearshore benthic communities are typically more diverse than those found in the deep-water habitat of the Operational Area, often due to the presence of primary producers, such as seagrasses, macroalgae, zooxanthellate corals and mangroves.

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 and NT coastlines. Seagrass in the subtidal and intertidal zones have different degrees of exposure to hydrocarbon spills. Subtidal seagrass is unlikely to be exposed to 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 toxicity 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 is 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). Given the potential for shoreline contact is very low in all the worst-case spill scenarios, impacts to macroalgae are considered to be highly unlikely.

Subtidal and intertidal zooxanthellate corals occur widely throughout the Timor Sea, including around offshore reefs and islands, bank and shoals, and the mainland coast. Shallow subtidal and intertidal corals may be coated by stranded floating hydrocarbons during low tides, which may subsequently be re-floated by subsequent incoming tides. Impacts from physical coating of corals appears to also depend on coral morphology. Coral species more likely to retain oil coatings (e.g. due to polyp morphology, or gross morphology with high surface area to volume ratios such as branching corals) have been shown to be more susceptible to impacts (Shigenaka 2001). Exposure to dissolved and entrained hydrocarbons may result in acute and chronic toxic effects, with longer exposure durations typically leading to greater potential for mortality (Shigenaka 2001). Corals may also ingest entrained oil particles, potentially leading to update of hydrocarbons into coral tissue (Loya and Rinkevich 1980).

Intertidal mangrove habitats occur throughout much of Kimberley and NT coastline, 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, such as weathered IFO, 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

Shoals and Banks

The Timor Sea region hosts numerus named shoals and banks, a number of which were identified by the stochastic modelling as being contacted by entrained and dissolved hydrocarbons from worst-case credible spill scenarios. Modelling results indicated shoals relatively close to the release locations are at greatest likelihood of being impacts. These include Goeree Shoal, Eugene McDermott Shoals, Vulcan Shoal, Barracouta Shoals, Heywood Shoals and Echuca Shoals. In the unlikely event of a significant hydrocarbon spill, these benthic features may be contacted by entrained and dissolved hydrocarbons above impact thresholds. The shortest modelled time to contact was ≤ 4 hour, providing relatively little time for hydrocarbons to weather.

Studies of the shoals and banks in the region show these areas host biological communities distinct from the surrounding relatively deep bare sediment habitat (e.g. Heyward et al. 2017, 2012, 1997) indicated the banks were broadly similar. Each bank hosted a range of light-dependent ecosystems characterised by benthic primary producers, such as coral and macroalgae. Surveys of shoals near the Crux project following the Montara oil spill indicated these communities did not exhibit obvious impacts as a result of the spill (Heyward et al. 2013, 2012, 2010). However, considerable natural variation both over time and between locations was observed (Heyward et al. 2013). Reviews of the ecological function of the shoals and banks in the Timor Sea east of the Operational Area concluded there is a relatively high degree of connectivity between shoals and banks, with the banks acting as a series of “stepping stones”

(Heyward et al. 2017, 2013). In the event of a disturbance to benthic communities as the result of a hydrocarbon spill, the upstream shoals and banks may act as a source of propagules or larvae, which may enhance recovery.

Contact with dissolved and entrained hydrocarbons above adverse exposure thresholds may result in mortality of benthic biota. The loss of habitat-forming biota such as corals, macroalgae or sponges could result in changes to habitats, with consequent changes to fauna assemblages. As described above in **Benthic Communities**, impacts to corals, seagrasses and macroalgae include acute and chronic toxicity which may result in non-lethal impacts (e.g. reduced feeding) and mortality.

The time required for recovery following disturbance will depend on the nature and scale of the impact. Shoals and banks in the region have been exposed to significant intermittent disturbance for long periods of time, such as damage from cyclones and changes in water temperature associated with the El Niño-Southern Oscillation. Differences in benthic communities over time within and between shoals and banks (such as those observed by Heyward et al. 2013) may represent different phases of ecological succession.

Offshore Reefs and Islands

Several offshore reefs and islands were identified by the modelling study results as potentially being contacted by hydrocarbons above adverse exposure thresholds. These include Cartier Island, Ashmore Reef, Browse Island, Hibernia Reef, Scott Reef and Seringapatam Reef. These offshore islands and reefs often host biological communities that are distinct from coastal islands and the mainland. Like the **Shoals and Banks** described above, offshore reefs and islands typically host light-dependent ecosystems characterised by benthic primary producers. Potential impacts to submerged receptors associated with offshore reefs and islands will be similar to those described in **Shoals and Banks** above. Unlike shoals and banks, offshore reefs and islands may be exposed to floating hydrocarbons (in addition to entrained and dissolved hydrocarbons). While floating hydrocarbons from the Crux condensate release scenarios were not predicted to contact or accumulate on any offshore reefs or islands, stochastic modelling of the loss of IFO scenario indicated a low probability of shoreline accumulation of IFO at several offshore islands and reefs, including the Bonaparte Archipelago, Bathurst Island and Browse Island.

The shorelines of offshore reefs and islands typically consist of intertidal reef flats and sandy beaches; shoreline types such as rocky shores, estuaries and mangroves typically do not occur. Given the modelling results estimated the minimum time to contact would be at least 144 hours for an emergent receptor (Hibernia Reef), any residual IFO reaching the shoreline of an offshore island or reef would be highly weathered. Stranding of floating oil on offshore islands and reefs may result in a band of weathered oil between the low- and high-water marks on shorelines and intertidal corals. This may result in impacts to fauna in these habitats, such as nesting turtles and wading birds. Refer to **Key Fauna Species** below for a discussion of potential impacts to these taxa.

WA and NT Mainland Coastline

The modelling studies identified potential shoreline contact along mainland Australian shores above the moderate shoreline exposure threshold for both the NT (Kakadu Coast, Cobourg Peninsula West Arnhem Land and Darwin Coast) and WA (Kimberley Coast). This was primarily from the loss of IFO from a vessel scenario, which is a fairly persistent hydrocarbon type. Minimum time to contact for these shoreline receptors ranged between 190 and 2,356 hours, indicating the IFO has considerable weathering time prior to reaching a shoreline.

As described above, the worst-case release volume of condensate for the Crux development drilling activity from a loss of well control (220,000 m^3) is slightly larger than the 206,240 m^3 modelled (~7% increase). Additional shoreline locations may be therefore be contacted by hydrocarbons above the moderate threshold. However, this difference is not expected to be significant. This additional potential for shoreline contact has been taken into consideration in oil spill response planning presented in the Crux Development Drilling Oil Pollution Emergency Plan (OPEP).

Key Ecological Features

Modelling study results indicated several KEFs may be exposed to hydrocarbons above adverse impact thresholds. KEFs with relatively high likelihoods of contact above impact thresholds include:

- ancient coastline at 125 m depth contour;
- carbonate bank and terrace system of the Sahul Shelf;
- continental slope demersal fish communities;
- Ashmore Reef and Cartier Islands and surrounding Commonwealth waters;
- Seringapatam Reef and Commonwealth waters in the Scott Reef complex, and
- pinnacles of the Bonaparte Basin.

All but two of these KEFs are entirely sub-tidal; discussion of potential impacts in this section is limited to sub-tidal features of the KEFs listed above. The exceptions of Ashmore Reef and Cartier Islands and surrounding Commonwealth waters and Seringapatam Reef and Commonwealth waters in the Scott Reef complex are considered above in **Offshore Reefs and Islands** and **Shoals and Banks**, respectively.

The sub-tidal KEFs may be exposed to entrained and dissolved above the adverse exposure thresholds. The environmental values of these sub-tidal KEFs are a function of their geomorphology and depth. A worst-case loss of well containment will not alter the geomorphology or depth characteristics of the sub-tidal KEFs. Given the nature of these KEFs (i.e. potentially more rugose and complex benthic habitats), there may be relatively diverse benthic communities associated with these habitats, such as filter feeding communities and demersal fish assemblages. These biological receptors may be impacted by dissolved and entrained hydrocarbon above adverse 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. The sub-tidal KEFs are large environmental features. Modelling results indicated that a single deterministic run would only affect a minor portion of any sub-tidal 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.

Pelagic Communities

Plankton

Potential impacts to phytoplankton and zooplankton from the worst-case hydrocarbon 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.

Fish

Fish respire through gills, which may make them more vulnerable to dissolved hydrocarbon fraction that fauna with less permeable skins, such as cetaceans, marine reptiles and birds. Despite this apparent vulnerability, fish mortalities are rarely observed to occur because of hydrocarbon spills (Fodrie and Heck 2011; International Tanker Owners Pollution Federation 2011b), although instances of fish mortality from spills in confined areas (e.g. bays) have been recorded. These observations are consistent with fish moving away from hydrocarbons in the water (Hjermann et al. 2007). Stochastic modelling results indicated that hydrocarbons are likely to be concentrated in surface waters. As a result, demersal fish are unlikely to be directly affected unless near a subsea release, as these are likely to be associated with seabed features (e.g. **Shoals and Banks** and **Ecological Features**). Pelagic fish are more likely to encounter dissolved and entrained hydrocarbons above adverse exposure thresholds but are may move away from affected areas.

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). Environmental monitoring of pelagic and demersal fishes immediately following the Montara oil spill indicated that fish were exposed to hydrocarbons, although no adverse effects were detected (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).

Most marine fish species produce very high numbers of eggs, which then undergo a planktonic larval development phase. 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. 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. 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).

Threatened and Migratory Species

Marine Mammals

A range of cetaceans potentially occurring within the adverse exposure zones for the worst-case credible spill scenarios outlined above. These are described in Section 7.3.5. Cetaceans exposed to hydrocarbons may exhibit avoidance behaviour. Geraci (1988) documented apparent avoidance of floating by bottlenose dolphins, suggesting that cetaceans can detect and avoid surface slicks. However, observations during spills have recorded whales and dolphins traveling through and feeding in oil slicks. During the Deepwater Horizon spill cetaceans were routinely seen swimming in surface slicks offshore (and nearshore) (Aichinger Dias et al. 2017). Cetaceans observed during the spill response for the Montara oil spill included oceanic species such as false killer whales, bottlenose dolphins, spotted dolphins and spinner dolphins (Watson et al. 2009).

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. Impacts from direct exposure are expected to be irritation of eyes and mucous membranes. Some protection is provided by thick skin and blubber. Entrained hydrocarbons may be ingested by cetaceans during feeding, particularly by baleen whales. Some species of baleen whale, such as blue whales, may be seasonally present during their migrations. However, significant feeding during migration is not expected (although opportunistic feeding may occur).

Dugongs are known to occur in coastal waters and around offshore islands within the adverse 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.

Marine Reptiles

Stochastic modelling results indicated adverse 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 salt water 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 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 Crux condensate, the loss of IFO scenario is 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.

Several shoals and banks occur in the vicinity of the Operational Area, which may be used as foraging areas by marine turtles (although none are recognised as BIAs).

Impacts to benthic habitats and biota at these shoals and banks may result in a reduction of prey for marine turtles. Refer to **Shoals and Banks** above for further information on potential impacts to shoals and banks.

Stochastic modelling identified a number of shoreline habitats (sandy beaches and inter-nesting habitat) that may be exposed to hydrocarbons above adverse exposure thresholds. Many 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). Significant breeding and nesting activity occurs at these locations throughout the region. Given the distance of these locations from the Operational Area, worst-case credible spills of Crux condensate reaching these areas will be highly weathered and unlikely to result in impacts. The relatively persistent IFO from a worst-case loss of vessel fuel may result in shoreline accumulation on nesting beaches. Shorelines with the greatest potential for hydrocarbon accumulation were the Bonaparte Archipelago, Bigge Island, Joseph Bonaparte Gulf, the Kimberley Coast and Bathurst Island, all as a result of the loss of fuel from a vessel scenario. A spill reaching coastal waters during peak periods to turtle nesting may have increased potential to cause impacts. Nesting female turtles and hatchling turtles moving from the nest to the sea may be exposed to weathered IFO, potentially resulting in oiling. Given the highly weathered state of the oil, this is not expected to result in significant impacts.

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 snort-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 adverse exposure limits.

Birds

A number of seabird and migratory shorebird species have been identified as potentially occurring within the adverse exposure zone for the worst-case hydrocarbon spill scenarios contains. Additionally, a number of BIAs for several seabird and migratory shorebird species occur throughout the adverse exposure zone, centred around offshore and coastal islands and mainland shorelines.

Spill of Crux condensate are unlikely to pose a significant risk due to the non-persistent nature of the condensate, however a worst-case IFO spill may result in a considerable mass of persistent floating oil. Seabirds and migratory birds are particularly vulnerable to contact with floating hydrocarbons, which may mat feathers. This may lead to hypothermia from loss of insulation and ingestion of hydrocarbons when preening to remove hydrocarbons; both impacts may result in mortality (Hassan and Javed 2011).

Seabirds may encounter floating oil when foraging for food. Seabird foraging is typically concentrated around roosting locations, such as offshore and coastal islands. Potential roosting locations lie considerable distances from the Operational Area; the nearest significant roosting location is Cartier Island, which lies approximately 106 km from the Operational Area. Ashmore Reef is a Ramsar-listed wetland and hosts significant seabird

colonies and is an important stopping area for migratory shorebirds. Ashmore Reef lies approximately 160 km from the Operational Area. Floating hydrocarbons reaching these locations would be significantly weathered. Seabirds typically nest above the high-water mark and as such, are not likely to encounter stranded hydrocarbons.

Migratory shorebirds are seasonally abundant during summer months, and a spill during this period would have greater potential to impact migratory shorebirds. Migratory shorebirds are not likely to encounter floating oil at sea, but may be affected by shoreline accumulation of oil, or oil and shallow foraging habitats such as intertidal mudflats. Unlike seabirds, shorebird mortality due to hypothermia from matted feathers is relatively uncommon (Henkel et al. 2012). Indirect impacts, such as reduced prey availability and bioaccumulations of PAHs, may occur (Henkel et al. 2012).

Shark and Rays

Transitory and resident sharks may occur within the adverse exposure zones identified by the stochastic spill modelling. Whale sharks may occur within the Operational Area (e.g. traversing the Operational Area during migration to and from aggregation off Ningaloo Reef) and a BIA for foraging whale sharks overlaps with the Operational Area. Tagging studies by Meekan and Radford (2010) have shown whale sharks traversing the Timor Sea following the seasonal aggregation off the Ningaloo Coast. Whale sharks may be exposed to entrained and dissolved hydrocarbons by contact with their gills and ingestion during feeding. The large volume filter feeding behaviour of whale sharks may result in a relatively high potential for exposure to entrained hydrocarbons compared to many other marine species (Campagna et al. 2011).

Tagging studies off Ningaloo Reef have shown that whale sharks disperse broadly (Meekan and Radford 2010; Wilson et al. 2006). Genetic studies of whale sharks have shown low genetic diversity, which suggests flow of genetic material through the movement of individual sharks over large spatial scales (Schmidt et al. 2009). On this basis, only a portion of the whale shark population in the Timor Sea would be within the area above the adverse exposure threshold at any one time and impacts such as toxic effects leading to mortality would be expected to affect a small number of individual animals.

Other oceanic (e.g. mako) and resident (e.g. reef) sharks will occur throughout the adverse exposure zone, although Heyward et al. (2017) noted that shark numbers were lower than expected, potentially due to fishing pressure. Potential impacts to other oceanic shark species are likely to be similar to fish (see **Fish** above). Any reduction of shark numbers may take longer to recover due to the relatively long lifespans and low reproductive output compared to finfish species.

Socio-economic and Cultural Environment

World Heritage

A small portion of the Kakadu World Heritage Area, approximately 800 km from the Operational Area, was overlapped by the floating, dissolved and entrained hydrocarbons above the moderate adverse exposure threshold from the loss of well containment and loss of vessel fuel scenarios. Modelling results indicate the likelihood of contact above adverse exposure thresholds was very low. No shoreline accumulation above adverse exposure thresholds was predicted to occur by the modelling. However, it is noted that given the slightly larger spill volume predicted for a loss of well control compared to the modelling (~7% as described above), it is possible that some shoreline accumulation could occur. On the basis of the nature and scale of the contact predicted, impacts to the world heritage values of the Kakadu World Heritage Area are not expected to occur.

National Heritage Places

The Kakadu National Heritage Place has the same extent at the Kakadu World Heritage Area discussed above in **World Heritage**; no impacts to the heritage values of the Kakadu National Heritage Place will occur as a results of a worst-case credible hydrocarbon spill.

Spill modelling results indicated that the shorelines of the West Kimberley National Heritage Place may be contacted by floating, accumulated, entrained and dissolved hydrocarbons above impact thresholds. The West Kimberley National Heritage Place contains a range of shoreline types, including rocky shores, sandy beaches and mangroves. Potential impacts to these are discussed above in **WA and NT Mainland Coastline**. Many of the heritage values of the West Kimberley National Heritage Place (refer to Section 7.4.1) lie inland and would not be impacted by a hydrocarbon spill. The modelling study results indicate probabilities of shoreline accumulation above the moderate adverse accumulation threshold within the West Kimberley and Kakadu National Heritage Places are very low, 1.8% and 0.6% respectively. The maximum modelled shoreline accumulation of spilled oil on both the West Kimberley and Kakadu National Heritage Place coastlines are < 45 g/m^2.

Commonwealth Heritage Places

Several offshore islands and reefs listed as Commonwealth Heritage Places were identified by the spill modelling results as potentially being contacted by hydrocarbons. These include:

- the Ashmore Reef National Nature Reserve Commonwealth Heritage Place;
- Scott Reef and Surrounds Commonwealth Heritage Place; and
- Mermaid Reef – Rowley Shoals Commonwealth Heritage Place.

The heritage values of these reefs are primarily their outstanding natural values. Refer to **Offshore Reefs and Islands** above for a discussion of potential impacts to these natural values.

Ramsar Wetlands

Several Ramsar sites were identified in the results of the spill modelling studies as potentially being impacted by spilled hydrocarbons. Most of these are in the far-field of the model and are highly unlikely to be contacted by hydrocarbons above the moderate adverse exposure thresholds. The exception is Ashmore Reef, which is the closest Ramsar site to the Operational Area. The migratory bird species associated with Ramsar sites are most vulnerable to floating oil, and oil accumulations along the shoreline. All credible worst-case scenarios were identified as potentially resulting in shoreline accumulation at Ashmore Reef, however the likelihoods for contact by floating hydrocarbons is very low (≤ 2.4%). Potential impacts of spilled hydrocarbons on migratory shorebirds are discussed above in **Threatened and Migratory Species**; refer to this section for further information.

Note the Protected Matters search tool report identified several Ramsar wetlands at Christmas Island, however given the distance to these receptors these Ramsar wetlands will not credibly be impacted.

Marine Parks

Modelling results of the worst-case credible spill scenarios indicated a range of Commonwealth (AMPs), state and territory marine parks may be contacted above adverse exposure thresholds (Table 9-66). 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 7.3.6 and discussed above in **Physical Environment**, **Biological Environment**, and **Threatened and Migratory Species**. Refer to these sections for discussion of potential impacts to these environmental values within marine parks.

Cultural Heritage

Aboriginal people have a long history of inhabitation across northern Australia, particularly coastal regions. As outlined above in **WA and NT Mainland Coastline**, potential shoreline contact above adverse exposure thresholds may occur. Hydrocarbon pollution and shoreline clean-up activities may result in disturbance to culturally significant sites. Given the nature of the worst-case credible spill scenarios, the potential for shoreline accumulation above which clean-up activities would be effective is very low.

Marine Archaeology

No impacts to marine archaeological features will occur because of a worst-case credible hydrocarbon spill. The nearest historic shipwreck, the Anne Millicent, lies approximately 108 km from the Operational Area.

Commercial Fisheries

A number of commercial fisheries operate within the adverse 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 2011b):

- 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; and
- 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 adverse 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 in the area potentially contacted above adverse exposure thresholds, a spill is unlikely to result in complete closure of a fisher. Rather, the closure of areas to fishing is more likely to result in the displacement of fishing effort. Displacement from productive fishing areas may result in impacts to fishers such as increased costs and reduced catch per unit effort.

Exposure of fish to hydrocarbons may result in tainting, which may render landings unsuitable for human consumption. Tainting may occur even a 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.

Traditional Indonesian Fishing

Traditional Indonesian fishing activity occurs within the MoU box, which is located approximately 40 km outside the Operational Area and lies within the adverse exposure zones identified by the spill modelling results. Traditional fishing is concentrated around banks, shoals, island and reefs; refer to **Shoals and Banks** and **Offshore Reefs and Islands** for discussion of potential impacts to these receptors. The worst-case credible spill scenarios may impact upon the biological resources exploited by traditional Indonesian fishers, such as fish and benthic invertebrates (e.g. sea cucumbers and trochus shells). Impacts to these biological resources may result in effects on traditional fishers, such as reduced catch rates and displacement of fishing effort. Given the distance between the release locations and the reefs exploited by traditional Indonesian fishers, impacts to traditional Indonesian fishing activities are considered to be unlikely and would be minor.

Tourism and Recreation

There are currently no known tourism activities in the Operational Area, or surrounds, due to the remoteness of the area. Some tourism activities may occur at the remote offshore islands and reefs within the adverse exposure zones. 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. Refer to **Offshore Reefs and Islands** for discussion on the potential impacts to these receptors.

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. Refer to **WA and NT Mainland Coastline** above for a discussion of potential impacts to the natural receptors along these coastlines.

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, and potentially minor loss of revenue for tourist operators (e.g. charter fishing cancellations due to fishery closures).

Military/Defence

Defence activities within the offshore 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.

Ports and Commercial Shipping

Potential impacts to ports and commercial shipping from the worst-case credible spill scenarios are expected to be very minor 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.

Offshore Petroleum Exploration and Operations

Petroleum activities in the region include the Shell-operated Prelude FLNG facility, the INPEX-operated Ichthys facility and the Montara development (previously operated by PTTEP Australia, now Jadestone Energy). 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 Reverse Osmosis (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).

Indonesian and Timor-Leste Coastlines

The spill modelling results indicated there is the potential for the worst-case credible spill scenarios to result in contact with the Indonesian and Timor-Leste coastlines above the moderate adverse exposure thresholds. The likelihood of contact was very low except for the entrained fraction from the worst-case loss of well control scenario. The probabilities of this fraction contacting the Indonesian and Timor-Leste coastlines above the moderate entrained adverse exposure threshold were 17.1% and 14.7% respectively. Minimum times to contact were 28.2 days and 30.8 days for Indonesia and Timor-Leste respectively. 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.

9.14.5 Risk Assessment Summary

The risk assessment summary in Table 9-67 is based on the worst case in terms of consequences spill event, i.e. the loss of well control LOC.

Table 9-67: Emergency Events Evaluation of Residual Risks

Environmental Receptor	Consequence	Likelihood	Residual Risk
Evaluation – Unplanned Risks			
Physical Environment	Massive	B - Remote	Yellow
Biological Environment	Massive	B - Remote	Yellow
Socio-economic Environment	Massive	B - Remote	Yellow

9.14.6 ALARP Assessment and Environmental Performance Standards

Table 9-68: 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
Engineering	Use of radars/ Automatic Identification System (AIS)/ Automatic Radar Plotting Aid (ARPA) and associated alarms on MODU and project vessels	Yes	Use of radars/ Automatic Identification System (AIS)/ ARPA and associated alarms on project vessels. This technology allows early identification and notification of approaching vessels and is crucial in minimising the risk of vessel-to-vessel collision. Specific collision prevention procedures and measures including: • Controlled speed for all marine vessels in the Operational Area • The Operational Area is patrolled by support vessels • MODU radar/ ARPA and associated alarms monitored for approaching vessels • Vessels follow pre-determined access routes to the MODU and assess environmental conditions (wind, current and sea state) • Contractual requirement for vessels to be manned by competent crew	12.1	MODU and support vessels are 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
			• All contracted vessels employed are subjected to a stringent assurance process.			

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Engineering	Inspection Maintenance Repair (IMR) during well suspension period	No	IMR is not planned during the subsea wells suspension period for the following reasons: • The wells be suspended with the production liner cemented and un-perforated. • There will be at least two pressure and inflow tested deep set suspension barriers in place during well suspension. In addition to the deep set barriers, an "environmental" plug will be installed high in the production casing to contain the suspension fluid in the well ahead of the blow out preventor being disconnected. While the "environmental" plug is not a stated well barrier, it will be specified to the same level as plugs used as well barriers, so is functionally an additional barrier. • There is only a short duration between the MODU departure and jacket installation when there are no other vessel over the Crux location. IMR access to the subsea wells would be limited / precluded by the presence of other infield vessels and later by the presence of the jacket and associated pilling operations. • Following jacket and top sides installation, the wells will be tied back to the platform which, even ahead of the installation of the	N/A	N/A	N/A

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			well completions, will allow monitoring from the platform.			
Engineering	Subsea BOP installed and function tested during drilling operations. The BOP shall meet the requirements below: • one annular preventer • two pipe rams (excluding the test rams) • a minimum of one set of blind shear rams which are capable of sealing • the capability of ROV intervention • back-up power systems or emergency	Yes	Testing of the BOP will reduce the likelihood of a blowout resulting in release of hydrocarbons to the marine environment. This standard is consistent with API Standard 53.	12.2	Subsea BOP specification, installation and function-testing compliant with internal Shell Standards (Shell Pressure Control Manual for Drilling, Completion and Well Intervention Operations)	Records demonstrate that BOP and BOP control system specifications and function testing were in accordance with minimum standards for the expected drilling conditions.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
	generator power requirements.					
Engineering	Project specific Mooring Design Analysis completed are guided by: • API RP 2SK – Design and Analysis for station keeping systems for floating structures. • APEEA Guideline for MODU Mooring in Australian Tropical Waters	Yes	A Project specific Mooring Design Analysis will ensure adequate MODU station holding capacity to prevent loss of station. This will reduce the likelihood of a blowout resulting in release of hydrocarbons to the marine environment.	12.3	Anchors installed as per Mooring Design Analysis to ensure adequate MODU station holding capacity.	Records demonstrate Mooring Design Analysis completed and implemented during anchor deployment.
Engineering	Use of subsurface well barriers during well suspension period	Yes	Each development well will have two independently verified subsurface barriers in place to manage the risk of a sub-surface blow out. The risk is further reduced as wells will be left unperforated.	12.4	Subsurface barriers are installed and tested in each well prior to suspension.	Drilling records demonstrate subsurface well barriers are installed and tested.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Substitution	Refuel during daylight hours.	Yes	Refuelling operations will commence during daylight under normal conditions and only at the well location. Contractor procedures followed for refuelling activity reduces likelihood of a spill occurring during refuelling.	12.5	Refuelling commences during daylight hours only.	Records demonstrate refuelling operations commenced during daylight hours only.
Administrative and Procedural Controls	Establish a PSZ	Yes	A PSZ of 500 m will be established and gazetted around the drilling location, in accordance 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 Crux development drilling activity and associated subsea infrastructure.	12.6	Compliance with PSZ as per Part 6.6 of the OPGGS Act.	Gazette notice of PSZ Incident report form used to record breaches of PSZ requirements.
Administrative and Procedural Controls	An approved SCREP is in place prior to commencement of drilling, including feasibility and any specific considerations for relief well kill.	Yes	A SCREP with prior assessment of the feasibility considerations for relief well kill may reduce the duration of a spill, resulting in a reduction in consequence and overall risk.	12.7	SCREP is in place prior to drilling that ensures feasibility of performing a well kill operation.	An approved SCREP.
Administrative and Procedural Controls	Lifting procedures and maintenance and inspection of lifting equipment.	Yes	MODU and vessel contractors lifting, maintenance and inspection procedures are implemented for all lifting operations. These procedures specify lifting requirements, standards and roles and responsibilities to be implemented to reduce the risk of dropped	12.8	All lifts are undertaken in line with contractor lifting procedures and associated PTW/risk	Records of PTW, lift plans, training records and lifting equipment register.

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
			objects impacting the seabed and subsea infrastructure.		assessments where applicable.	
Administrative and Procedural Controls	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 vessels 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.	12.9	Transfer hoses will have dry-break couplings, inspected and certified bunkering hoses, and this equipment will be maintained.	Assurance and maintenance records.
Administrative and Procedural Controls	Shipboard Oil Pollution Emergency Plan (SOPEP) for vessels[14]	Yes	SOPEP shall be in place for all project vessels and the MODU as required by class in accordance with as per AMSA Marine Order 91.	12.10	Vessels and MODU shall have a current SOPEP onboard to respond to small spills	A valid SOPEP for relevant vessels and MODU is in place
Administrative and Procedural Controls	Vessel anchoring and mooring plan	Yes	No support vessel anchoring in the Operational Area except in emergency situations or under issuance of a specific permit by Shell.	12.11	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.

[14] *Advice from the Recognised 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.*

Hierarchy of Controls	Control Measure	Adopted?	Justification	EPS #	Environmental Performance Standard (EPS)	Measurement Criteria
Administrative and Procedural Controls	NOPSEMA accepted WOMP	Yes	Maintenance of well integrity is a key requirement to avoid loss of well control. The wells will be covered by NOPSEMA accepted Well Operations Management Plan (WOMP) that details key controls in place for the duration of the well lifecycle.	12.14	Accepted WOMP in place for Crux development wells to manage risks associated with well drilling and suspension.	WOMP acceptance letter
Administrative and Procedural Controls	NOPSEMA accepted safety case	Yes	In accordance with the OPGGS (Safety) Regulations 2009, all drilling activities will be undertaken in accordance with the accepted Safety Case.	12.15	Accepted safety case in place for the Crux development drilling activity to manage risks associated with operations.	Safety case acceptance letter

9.14.7 Acceptability of Risks

Table 9-69: Acceptability of Risks – Emergency Events

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Acceptability Assessment
Physical Environment	Water quality	No significant impacts to water quality during the Crux development drilling activity.	Shell considers large-scale releases of hydrocarbons during the Crux development drilling activity to be unacceptable. Such spills have 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 during the Crux project 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. An Oil Pollution Emergency Plan (OPEP) has been developed to support the Crux development drilling activity that is commensurate to the nature and scale of the hydrocarbon pollution risks for the activity.
	Sediment quality	No significant impacts to sediment quality during the Crux development drilling activity.	
	Air quality	No significant impacts to air quality during the Crux project.	
Ecosystems, Communities and Habitats	Benthic communities	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Crux 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[15] impacts associated with the Crux development drilling activity.	
	Offshore reefs and islands	No impacts to offshore reefs and islands.	
	WA and NT mainland coastline	No impacts to WA and NT mainland coastline.	
	Key Ecological Features	No significant impacts to environmental values of KEFs.	
	KEFs	No significant impacts to environmental values of KEFs.	

[15] *As defined in the Matters of National Environmental Significance - Significant impact guidelines 1.1 (Commonwealth of Australia 2013).*

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Acceptability Assessment
Threatened Species and Ecological Communities	Marine mammals Marine reptiles Birds Fish Sharks and rays	No mortality or injury of threatened or migratory MNES fauna from the Crux development drilling activity. Management of aspects of the Crux development drilling activity must be aligned to conservation advice, recovery plans and threat abatement plans published by the DAWE. No significant impacts to threatened or migratory MNES fauna.	
Socio-economic and Cultural Environment	Commonwealth Marine Area	No significant impacts to the Commonwealth marine area beyond 1 km from the Crux drilling locations.	
	World Heritage Properties	No impacts to world heritage values.	
	National Heritage Places	No impacts to national heritage values.	
	Commonwealth Heritage Places	No impacts to Commonwealth heritage values	
	Declared Ramsar Wetlands	No impacts to ecological values of Ramsar wetlands	
	Marine Parks	No impacts to the values of marine parks	
	Commercial fisheries	No negative impacts to exploited fisheries resource stocks which result in a demonstrated direct loss of income.	
	Traditional Indigenous fishing	No negative impacts to exploited fisheries resource stocks.	
	Tourism and recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income.	
	Military / Defence	Temporary displacement of defence activities within the Crux Operational Area	

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Acceptability Assessment
		(excluding petroleum safety zones) is acceptable. Permanent exclusion of defence activities from gazetted petroleum exclusion zones is acceptable.	
	Ports and commercial shipping	Temporary displacement of commercial shipping within the Crux Operational Area (excluding petroleum safety zones) is acceptable. Permanent exclusion of commercial shipping from gazetted petroleum exclusion zones is acceptable.	
	Offshore petroleum exploration and operations	Temporary displacement of petroleum exploration activities and operations within the Crux Operational Area (excluding petroleum safety zones) is acceptable. Permanent exclusion of petroleum exploration activities and operations from gazetted petroleum exclusion zones is acceptable.	
	Indonesian and Timor Leste Coastlines	No impacts to Indonesian or Timor-Leste coastlines or nearshore environments are acceptable.	

A comprehensive assessment of the risks from the worst-case credible spill scenarios arising from Crux development drilling activity has been undertaken. Globally, Shell is experienced in similar activities 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
- 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 Crux development drilling 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; and
- 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 development drilling activity.
  - Implementation of recognised industry best practices, such as:
    - use of BOPs while drilling over-pressured formations with potential for flow, including regular function and pressure testing of the BOPs
    - 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 Crux development drilling activity.

Matters of National Environmental Significance

A worst-case hydrocarbon spill may result in significant impacts for several MNES. Shell will put in place a range of measures during the Crux development drilling activity to ensure that spills of hydrocarbons that may result in significant impacts to threatened and migratory species do not occur. Shell considers the residual risk to these MNES to be acceptable, after application of the key management controls proposed in this EP.

Threatened and Migratory Species

The evaluation of impacts and risks indicates that significant impacts to threatened and migratory species may occur in the event of a significant hydrocarbon spill. Pollution from hydrocarbon spills is recognised as a threat in management plans, recovery plans and conservation advice for a number of threatened and migratory species. Alignment of the Crux project with these documents is provided in Table 9-70.

Wetlands of International Importance

While considered very unlikely due to the distance from the Crux Operational Area, results from the stochastic spill modelling studies indicated hydrocarbons above impact thresholds may contact the Ramsar wetland at Ashmore Reef.

Commonwealth Marine Environment

The evaluation of impacts and risks indicates that significant impacts to the Commonwealth marine environment may occur in the event of a significant hydrocarbon spill. The potential for widespread impacts to water quality may result in a number of marine species being affected.

Table 9-70: Summary of Alignment of the Impacts and Risks from the Emergency Events associated with the Crux Development Drilling Activity to Relevant Requirements for MNES

Sensitivity	MNES Acceptability Considerations (Significant Impact Guidelines, EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Marine mammals	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	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 as release occur. Large-scale hydrocarbon releases pose a significant safety risk for Shell personnel, and considerable effort will be applied to the project design to reduce the inherent likelihood of large-scale hydrocarbon releases occurring.
	Conservation management plan for the blue whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2015a)	
	Conservation advice *Balaenoptera borealis* sei whale (TSSC 2015b)	
	Conservation advice *Balaenoptera physalus* fin whale (TSSC 2015c)	
	Conservation management plan for the southern right whale: A recovery plan under the *Environment Protection and Biodiversity Conservation Act 1999* (DSEWPaC 2012b)	
Marine reptiles	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	
	Recovery plan for marine turtles in Australia (Commonwealth of Australia 2017a)	
	Conservation advice on short-nosed sea snake (*Aipysurus apraefrontalis*) (DSEWPaC 2011a) Conservation advice on leaf-scaled sea snake (*Aipysurus foliosquama*) (DSEWPaC 2011b)	

Sensitivity	MNES Acceptability Considerations (Significant Impact Guidelines, EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Birds	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	
	Wildlife conservation plan for migratory shorebirds (Commonwealth of Australia 2015c)	
	Draft national recovery plan for threatened albatrosses and giant petrels (DSEWPaC 2021)	
	Conservation advice for *Sternula nereis* (fairy tern) (DSEWPaC 2011c)	
	Conservation advice *Numenius madagascariensis* eastern curlew (TSSC 2015f)	
	Conservation advice *Calidris ferruginea* curlew sandpiper (TSSC 2015e)	
	Conservation advice *Anous tenuirostris melanops* Australian lesser noddy (TSSC 2015d)	
	Conservation advice *Calidris canutus* red knot (TSSC 2016a)	
	Conservation advice *Calidris tenuirostris* great knot (TSSC 2016b)	
	Conservation advice *Charadrius leschenaultii* greater sand plover (TSSC 2016c)	
	Conservation Advice *Charadrius mongolus* lesser sand plover (TSSC 2016d)	
	Conservation advice *Limosa lapponica menzbieri* bar-tailed godwit (northern Siberian) (TSSC 2016e)	
	Conservation advice Limosa lapponica baurei bar-tailed godwit (western Alaskan) (TSSC 2016f)	

Sensitivity	MNES Acceptability Considerations (Significant Impact Guidelines, EPBC Management Plans/Recovery Plans/Conservation Advices)	Demonstration of Alignment as Relevant to the Project
Sharks and rays	Significant impact guidelines for Critically Endangered, Endangered, Vulnerable and Migratory species (Table 8-1)	
	Conservation advice *Rhincodon typus* whale shark (TSSC 2015a)	
	Recovery plan for the white shark (*Carcharodon carcharias*) (DSEWPaC 2013)	
	Sawfish and river shark multispecies recovery plan (Commonwealth of Australia 2015b)	
	Approved conservation advice for *Glyphis* (speartooth shark) (TSSC 2014c)	
	Approved conservation advice for *Pristis clavata* (dwarf sawfish) (DEWHA 2009a)	
	Approved conservation advice for *Pristis zijsron* (green sawfish) (DEWHA 2008c)	
Commonwealth marine environment	Significant impact guidelines for Commonwealth marine environment (Table 8-1)	

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 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 9-67). 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 Crux development drilling activity has been considered in the context of:

- ESD;
- relevant requirements;
- MNES;
- external context (i.e. stakeholder claims); and
- internal context (i.e. Shell requirements).

Based on the points discussed above, Shell considered the impacts and risks from worst case unplanned spill scenarios from the Crux development drilling activity to be acceptable following the application of the controls outlined in the ALARP Demonstration above.

9.14.8 Environment Performance Outcome

Environment Performance Outcome	Measurement Criteria
No emergency events[16] associated with the unplanned release of Crux condensate or vessel fuel to the marine environment during the Crux development drilling activity.	Incident reports associated with spills to water which initiated the Emergency Response Team (ERT) and/or Incident Management Team (IMT).

[16] *Emergency events are incidents which result in the mobilisation of the Shell emergency response team.*

9.15 Oil Spill Response Strategies

9.15.1 Spill Impact Mitigation Assessment

As described in the Spill Impact Mitigation Assessments (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.

In all spill scenarios (Section 9.14.1), 'source control' and 'monitor and evaluation' spill response strategies will be implemented. For condensate and marine 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 IFO spills they may be implemented as primary or secondary response strategies.

The available spill response strategies across multiple spill senarios that are applicable to the Browse Region are assessed in the Browse Regional OPEP (HSE_PRE_013075) (the OPEP). An ALARP assessment of the oil spill response strategies that are applicable to the Crux development drilling activity are described in Table 9-71.

Capability, readiness and implementation requirements for the specific spill response strategies are addressed in the OPEP, 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 9-71: 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: 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 suitable vessel will be acquired by Shell during the timeframe it takes for onloading of the SFRT equipment. 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.
Deployment of SFRT/Subsea Incident	Documents: Crux Source Control Contingency Plan	Access to the SFRT/SIRT to enable intervention in the event	Consideration was given to moving the	Based on its location in WA, the AMOSC SFRT (located in Perth) would be mobilised as

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
Response Toolkit (SIRT) and subsea dispersant injection (SSDI)	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. Oil Spill Response Limited (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.	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 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.	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 is little value to be gained by such.	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 be sourced in time and therefore the timeframe for mobilisation of the SFRT is not a limiting factor and improving this timeframe would not result in an environmental benefit.
Relief well drilling (primary containment method)	Documents: Crux Well Operations Management Plan (WOMP)	Improving the timeframes to drill a relief to 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	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

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	Crux Safety case Crux Source Control Contingency Plan Crux 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. Specialist personnel from Wild Well Control and Boots and Coots Various locations internationally +72 hours.		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 Crux wells can be killed with the pumping capacity of standard MODU, use of the RWIS would not result in a faster well kill and subsequent environmental benefit.	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.
Deployment of capping stack and OIE (if required)	Documents: Crux Well Operations Management Plan (WOMP) Crux Safety case	Improving the timeframes to install a capping stack will reduce the volume of hydrocarbons released to the marine environment.	N/A	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

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	Crux Source Control Contingency Plan Australia Subsea Capping Stack Deployment Procedure Source Control Equipment Mobilisation Plan <u>Equipment:</u> AMOSC/OSRL specialised equipment: Capping Stack Offset Installation Equipment (OIE) <u>Personnel:</u> Shell Capping stack and OIE Task Force 24/72 hours AMOSC/OSRL trained and experienced personnel.			standards meet or exceed current International and Australian standards. The APPEA MoU allows the signatories to share rigs, vessels, equipment, personnel and services to assist other operators in the event of a well blowout. This would potentially enable Shell to source a suitable capping stack installation vessel 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.
Monitor and Evaluate				
Modelling (oil spill trajectory, fate & weathering, met ocean data, satellite imagery)	Processes: AMOSC call-off procedure Equipment: ADIOS2 on IMT Computers	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	N/A	No alternative or additional controls have been identified that could improve this response.

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	In-house deterministic modelling Personnel: Shell Geomatics team	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.		
Surveillance - vessel	Processes: N/A Equipment: project vessels Personnel: Trained vessel crew	Several project vessels will be present in AC/L10. 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 project 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 geographical location close to the release point. Therefore, initial	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
			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 vessel crew for tracking buoy deployment	Tracker buoys are available for immediate deployment from a variety of locations including vessels. 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: Vessel 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.

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
Fixed Wing Aerial Dispersant (FWAD) application	Processes: Shell Surface Dispersant Application Guide. AMOSC/OSRL call-off procedure. Equipment: N/A Personnel: Air attack supervisors and pilots.	Pre-positioning of aircraft and personnel (air attack supervisor) in particular could enable a faster response time resulting in quicker application of dispersant with more oil treated and hence an overall environmental benefit.	Additional costs associated with pre-positioning aircraft and personnel are 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.	Shell has access to AMSA fixed wing aircraft wheels up in 4 hours and first implementation within 36 hours with supporting monitoring aircraft. 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: project 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 IFO 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 IFO spills.

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
Shoreline Protection and Deflection				
Shoreline and nearshore booming equipment	Processes: Browse Island Incident Management Guide Equipment: AMOSC/OSRL specialised equipment Personnel: AMOSC/OSRL trained and experienced personnel.	Undertaking an improved shoreline protection and deflection response may reduce shoreline accumulation of oil resulting in less environmental impacts to shoreline 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.	Access to additional booming equipment would cost in the order 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.	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). 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 Operational Monitoring Plan (OMP) Browse Island Incident Management Guide Helicopter call-off contract Equipment: Staging and accommodation facility	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	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

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	Personnel: AMOSC/OSRL trained and experienced personnel.	and safety risks. Earlier deployment may not result in an overall environmental gain.		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 473 g/m^2 of condensate at Melville Island 7,777 g/m^2 of IFO at Bonaparte Archipelago, Kimberley PMZ and Kimberley Coast. 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. Access by heavy machinery would also be restricted at offshore islands.	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 personnel safely rather than sourcing additional equipment.	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 in most of the shoreline locations predicted to be contacted.
Oiled Wildlife Response				
Oiled wildlife response implementation	Processes: WA Oiled Wildlife Response Plan (WAOWRP)/ NTOWRP Equipment: AMOSC Oiled Wildlife Response (OWR)	Given access to local OWR equipment and personnel (AMOSC) through existing arrangements the response capability cannot be improved to result in an environmental gain	Any OWR will be undertaken in consultation with the relevant agencies e.g. WA DBCA, WA DoT and NT DEPWS. Such	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

Oil Spill Response Strategy	Resources	Environmental gain from increasing or improving resources	Alternatives considered	ALARP assessment
	containers (2) and box kits. NatPlan OWR containers (4), OSRL OWR equipment. Personnel: AMOSC/OSRL trained and experienced national and international OWR personnel.	unless an OWR kit is maintained offshore.	consultation is more likely to be a time limiting factor than accessing additional OWR resources.	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.	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.	Based on the Browse Regional OPEP, the volume of waste generated by the worst case spill is up to 5500 m^3. 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 project 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.

9.15.2 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 spills as described in Section 9.14. Where impacts and risks are already adequately addressed in the preceding sections of this EP, as indicated in Table 9-72, 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 9.14 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 9-72 summarises the aspects generated by implementing the spill response activities and identifies any that are new or unique aspects for further assessment.

Table 9-72: 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	✓		✓		×	✓	✓		✓	✓	✓	✓

		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
	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 to 9.13.

× - 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.

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; and
- 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.

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.

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 offshore island groups present in the EMBA (Table 7-3), or along the WA and NT coastlines.

9.15.3 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 the inherent toxicity, biodegradability and bioaccumulation properties of dispersant chemical, which vary according to dispersant types. Additionally, dispersants combined with dispersed oil can increase the toxicity of spilled oil and this may affect sensitive receptors 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 to marine organisms (e.g. fish, plankton, benthic invertebrates). The effects of entrained hydrocarbons on sensitive environmental receptors are discussed in Section 9.14.4.

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 EMBA, with the closest being Goeree Shoal, Eugene McDermott Shoal and Vulcan Shoal (all located 13 - 22 km NW of the Operational Area). If applied appropriately, dispersants can provide a net environmental benefit by limiting exposure of an oil spill to receptors of high environmental value. 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 WA DoT, WA DBCA, NT Department of Environment, Parks and Water Security 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 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).

9.15.4 Impact Assessment Summary

Table 9-73 lists the highest residual impact consequence rankings of the relevant environmental receptor groups.

Table 9-73: 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.*

9.15.5 ALARP Assessment and Environmental Performance Standards

An ALARP assessment of oil spill response capability is presented in Table 9-71. A description of controls, EPSs and MC for each oil spill response strategy are presented in the OPEP.

9.15.6 Acceptability of Impacts

Table 9-74 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	No significant impacts to water quality during the Crux development drilling activity.	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 IFO 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	No significant impacts to benthic habitats and communities. Impacts to non-sensitive benthic communities limited to a maximum of 5% of the Operational Area.	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.

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
				The optimal suite of response strategies will be determined through the operational SIMA.
	Threatened and Migratory Species	No mortality or injury of threatened or migratory MNES fauna from the Crux development drilling activity. Management of aspects of the Crux development drilling activity must be aligned to conservation advice, recovery plans and threat abatement plans published by the DAWE. No significant impacts to threatened or migratory MNES fauna.	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, WA DoT and NT DEPWS.
	WA and NT 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 and NT 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 and NT DEPWS.
Socio-economic Environment	Commercial fisheries	No negative impacts to exploited fisheries resource stocks which result in a demonstrated	Yes	Shell will implement industry standard controls to manage impacts from the implementation of oil spill response strategies required due to unplanned hydrocarbon

Receptor Category	Receptor Sub-category	Acceptable Level of Impact	Are the Impacts of an Acceptable Level?	Acceptability Assessment
		direct loss of income.		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.
	Traditional Indigenous fishing	No negative impacts to exploited fisheries resource stocks.	Yes	
	Tourism & recreation	No negative impacts to nature-based tourism resources resulting in demonstrated loss of income.	Yes	

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 9-73). 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. 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 aspects. 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 EPOs and the controls which will be implemented are consistent with Shell's internal requirements.

Acceptability Summary

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

- the established acceptability criteria;
- ESD;
- relevant requirements;
- MNES;
- external context (i.e. stakeholder claims); and
- 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.

9.15.7 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 the following:

- 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 EPOs and standards are met
- Chain of Command
- Measures to ensure workers are aware of their responsibilities
- Monitoring and management
- Records and reporting
- OPEP provided as a separate document together with this EP submission
- Consultation (see Section 5 Stakeholder Consolation).

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 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 Emergency Response Plan (ERP), Records of Emergency Response (ER) drills, exercises and After Action Reviews (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 those activities associated with the Crux Development Drilling Program.

Shell's Wells Global Management System operates within the HSSE & SP Control Framework and provides for a consistent approach across Shell's well activities globally. It sets out the principles, policies, standards, and processes that must be adhered to for risk management, technical assurance and standards, competency as well as HSE management. The WOMP for the Crux drilling campaign describes the application of the Shell Global Well Management System specifically to the activities covered in this EP.

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. The contractor management processes implemented for Crux 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 consistent with International Association of Oil and Gas Producers (IOGP) modes of contacting
- 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.

Typically, the IOGP mode of contracting for activities occurring under this EP are Mode 2. Under this mode of contracting, 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.

Additionally, the MODU contractor operates under a safety case which identifies major accident events and the associated controls and mitigation measures for the MODU. The safety case also describes MODU operation; explains the risk identification and assessment processes; demonstrates how the contractor's HSE systems manage those risks to ALARP, and details recovery measures.

The MODU contractor also implements a Safety Case Revision Document that identifies any additional risks specifically associated with the Crux drilling campaign that are not already covered in the safety case. It demonstrates how Shell's Management Systems are planned to be bridged to the contractor's HSE Management Systems to maintain a consistent management approach between the two companies, including linkages to Shell's IMT(W) Emergency Response Plan (HSE_GEN_011209).

Vessel based activities occurring within the Operational Area predominantly operate under a Mode 2 contract and use their own vessel HSSE-MSs to manage work scopes onboard.

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 safely and effectively carry out the work. 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 Shell assets are based on the required contractor work scope and are developed in consultation between Shell and the contractor.

10.1.3 Management of Change (MOC)

The MOC process for the Crux project is described in the Crux Management of Change Procedure. The overall objectives of the Project MOC Process are:

- Fully assess significant impacts of proposed project-level changes before decisions are made
- Prevent changes that would threaten the achievement of project objectives
- Ensure all potentially affected disciplines/parties are considered in the change assessment
- Permit changes that add value to the project with full consideration of impacts and risks
- Fully assess the risks associated with implementing, or not, the change.

Potential changes covered by this procedure includes:

- HSSE Change: changes that may impact HSSE requirements, including commitments within regulatory documents, such as Environmental Plans
- Scope Change: changes to the technical scope of the project, including mandatory requirements, specifications and procedures
- Organisational Change: changes to critical roles in the project, including Critical HSSE Leadership roles.

The MoC procedure is supported by specific procedures, templates and checklists.

- Identify – identify the need for change, initiate a MoC request with a proposed solution and gain endorsement by project management
- Screen – the screening identifies and considers the HSSE and project risks to confirm whether the MoC requires further development. This includes considered alternatives, HSSE considerations if any, required resources, cost and schedule consequences as far as is reasonable possible with the available data
- Develop – the change is detailed to a sufficient level to be risk-assessed by impacted parties. HSSE hazard screening may take place to confirm the need for a subsequent risk assessment. Where possible, actions to mitigate the risks will be identified and requirements to verify the effectiveness and inclusion of the mitigating actions will be detailed
- Approve – the proposed change(s) and the associated risks is reviewed by an MOC Panel to determine whether the change should be accepted or rejected
- Implement – following acceptance from the MOC panel, the change is implemented by impacted parties
- Close-out – verify once the change has been implemented that all outstanding issues have been addressed, that all work is closed out and all open action items are completed.

The Develop step for changes includes an assessment of HSSE&SP aspects as per the Crux Management of Change Procedure.

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 5.0.

10.1.4 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.

Figure 10-1: Chemical Approval Lifecycle

All chemical applications are required to be screened in accordance with Shell Global Product Stewardship guidelines (Figure 10-1).

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.

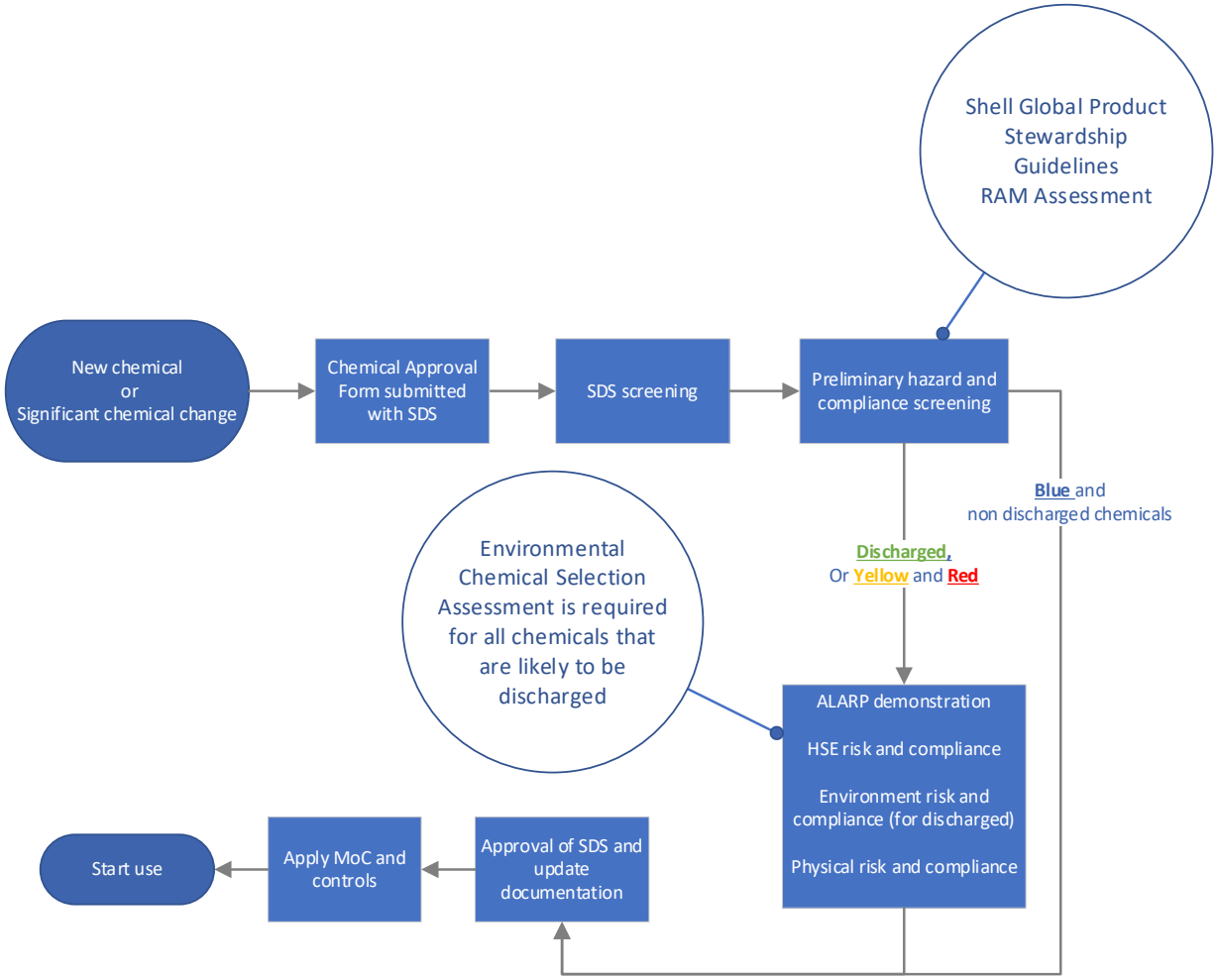


Figure 10-2: Chemical Approval Process

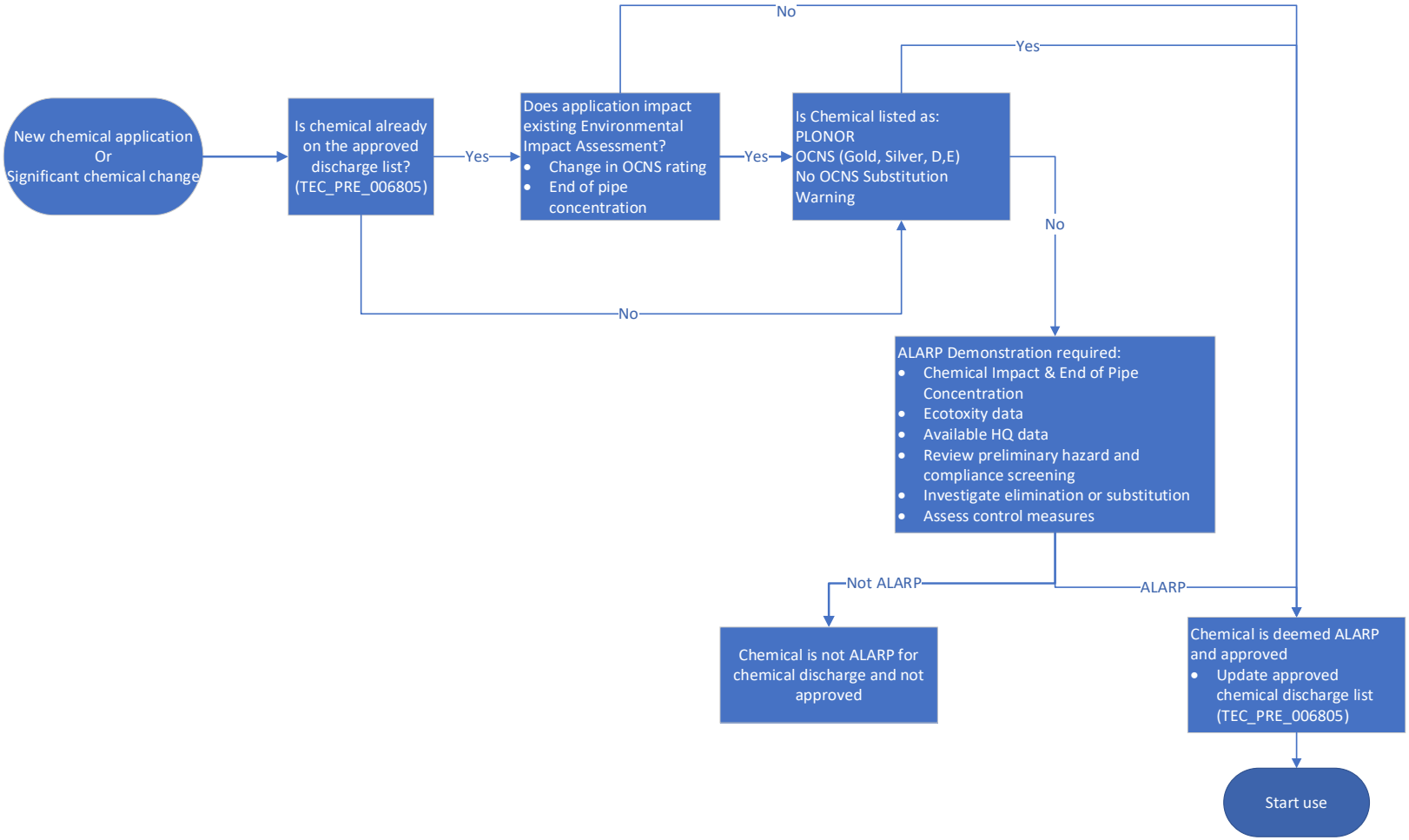


Figure 10-3: Environmental Chemical Impact Assessment

10.2 Roles and Responsibilities

Roles and responsibilities associated with this EP for key personnel are summarised in Table 10-2. Key roles and responsibilities related to the management and implementation of oil spill response arrangements in the event of an emergency event are outlined within the Shell Australia Regional OPEP.

Table 10-2: Key Responsibilities

Position	Responsibilities
Well Operations Team Lead	• Overall accountability for the activity. • Responsible for assigning resources and planning. • Responsible for the competence of the crews and contractors. • Responsible for auditing and verification. • Responsible for external reporting. • Accountable for Emergency and Oil Spill Response preparedness and readiness.[17] • Responsible for Environmental Performance and compliance with the EP.
SA Senior Well Engineer Operations (SWEO) [Rig Superintendent role]	• Reports to Well Operations Team Lead. • Responsible for the implementation of the EP. • Responsible for monitoring compliance (including contractor performance). • Responsible for the drilling unit compliance with Shell standards and any additional requirements laid out in this EP. • Responsible for the operational obligations outlined in this EP are communicated to the well site and is understood by the Senior Shell well site representative (SA Drilling Supervisor).
MODU Offshore Installation Manager (OIM)	• Responsible for carrying out all operations aboard the MODU in a manner consistent with EP. • Responsible for training and competency of all personnel so that they can carry out duties as required in this EP. • Responsible for notifying the Shell Australia Drilling Supervisor of any incidents arising from operations that may have an adverse impact on the performance objectives identified in this EP. • Manage deck spills per SOPEP.
AHT Master	• Responsible for acting immediately to rectify any environmental incident from the AHT • Ensure all crew members comply with the EP. • Manage deck spills per SOPEP. • Responsible for ensuring cetacean sighting recording is undertaken.
SA Drilling Supervisor(s) (DSV) (Company Site Representative)	• Infield implementation and monitoring including implementation of maintenance plan, waste management plan, operational procedures, maintaining logs.

[17] *Note, this does not include any responsibilities specifically around executing emergency or oil spill response activities. These are all outlined within the OPEP.*

Position	Responsibilities
	• Responsible for the operational obligations of this EP, communicating these obligations to the rig crew and enforcing compliance. • Prepare the well site operations plan and communicate this to the rig crew. • Daily reporting to the SWEO. • Responsible for ensuring Fountain Incident Management (FIM) reports and reporting incidents to Shell.
MODU Crew	• Responsible for immediate reporting of any environmental incident to the OIM. • Responsible for waste materials disposal such that no waste materials are disposed of to the sea (other than waste from the vessel's ablutions). • Follow any directive issues by the OIM with respect to environmental protection.
Wells and Logistics HSSE advisor	• Support and provide advice to the SWEO on HSE for the activity. • Compile monthly reporting and end of activity reports. • Manages HSSE incident investigations and closeout of actions and reporting.
MM Lead Wells	• Accountable for the provision of logistics resources including supply base, warehouse, road transport, airfreight and waste services and compliance with this EP.
Onshore Supply Chain Coordinator	• Responsible for execution of supply base, warehouse, road transport, airfreight and waste services and compliance with this EP.
Offshore Supply Chain Coordinator	• Responsible for execution of cargo management to and from the MODU in coordination with the Onshore Supply Chain Coordinator and compliance with this EP.
Aviation Service Coordinator	• Responsible for implementation of aviation logistics in compliance with this EP.
Rig Maintenance Supervisor	• Maintains a list of environmentally sensitive hoses as well as other critical maintenance items.

10.3 Competence and Inductions

10.3.1 Competency

All personnel required to work on the development drilling campaign shall be employed on the basis they are competent to do their job.

Within Shell, the Shell HSSE & SP Control Framework requires people in HSSE Critical Positions to have their HSSE-MS competence assured. These people must attain a set proficiency level in three competences: HSSE Lead; HSSE Prepare; and HSSE Apply. People in HSSE Critical Positions are responsible for the development and maintenance of effective barriers to prevent incidents.

SA maintains a HSSE Critical Positions Register and HSSE Critical Positions have been identified and positional competency requirements have been defined according to the Group HSSE Competence Framework Critical Leaders.

The minimum standard of competency in the Wells department staff is detailed in the Global Wells Management System Manual. HSSE professionals, including the Wells and

Logistics HSSE advisor, have competency requirements established in the Global HSSE and SP Management System Manual.

Shell Drilling Supervisors must have attended a W320 Advanced Well Control course in the past 4 years (an internally run Shell course) or have sat a Shell Trade Test (for contractors) and hold a valid International Well Control Forum (IWCF) / International Association of Drilling Contractors (IADC) certification.

In terms of the MODU and vessel operators, only prequalified companies with whom Shell has a service agreement are qualified to bid for the activity. A HSE pre-qualification questionnaire is included in the tender package, which is evaluated by the HSE department in parallel to the technical and commercial evaluations. The Shell Maritime assurance processes including an approval through the Group Maritime Assurance Process and including the use of the OCIMF Offshore Vessel Inspection Database (OVID) and OVMSA assurance processes apply to all contractor vessel activities associated with Shell. Shell stakeholders required to assure a positive vetting through the Subject Matter Expert - Maritime Safety (or delegate), Aviation Subject Matter Expert and country security manager, Global Maritime Marine Warranty Surveyor and the project workstreams responsible for the activity to be conducted. Contractors have their own Competence requirements in place.

10.3.2 EP Induction

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 personnel will be given an HSSE induction prior to the commencement of work on the development drilling activity so that they are aware of their obligations and commitments. The HSSE inductions shall cover:

- Shell Australia HSSE & SP Policy and Commitment;
- legislative requirements – including key MARPOL requirements;
- key environmental aspects, impacts and risks associated with the activity; and
- Shell's key EP commitments and environmental management requirements.

Additionally, 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 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 is 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 EPOs and EPSs in the EP are being met.

Parameters that are monitored and recorded during activities 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

Source	Parameter to be Monitored	Monitoring Frequency	Monitoring Equipment/ Methodology*	Records	EP Reference
Discharge from bilge system	Oil Content Volume As per IOPP Certificate	Per discharge	As per IOPP Certificate	Maintenance records of oily water separator Oil Record Book	Section 9.10
Discharge from the sewage and greywater	Quality Volume As per ISPP Certificate	As per ISPP Certificate	As per ISPP Certificate	Maintenance records of sewage treatment system	Section 9.10
Drill Cutting Fluids (including pit cleaning in the event of SBM being used)	Volume of Oil in Water	End of campaign	Oil on Cuttings test	Daily Mud Report	Section 9.10
Ballast Water	Volume Location	As required / per exchange	Ballast Water log	Ballast Water log	Section 9.8
Atmospheric Emissions	Diesel sulfur content	As required (every delivery)	Delivery certificates	Delivery certificates	Section 9.11
	Diesel volume used	As required (every delivery)	Delivery certificates	Delivery certificates	
Non-hazardous wastes generated and disposed	Volume of wastes	As required (every delivery)	Garbage Record Book	Garbage Record Book	Section 9.13
Hazardous wastes generated and disposed	Volume of wastes	As required (every delivery)	Garbage Record Book	Garbage Record Book	Section 9.13

Source	Parameter to be Monitored	Monitoring Frequency	Monitoring Equipment/ Methodology*	Records	EP Reference
Accidental releases of hydrocarbons or chemicals	Type, volume and concentrations of release Incidents reported in accordance with Shell and regulatory requirements.	Per incident	Monthly incident reports and analysis. Volumes will be estimated based on technical data and evaluations (e.g. duration of release and known inventory)	Incident reports Monthly Environmental Incident Reports	Section 9.14

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 Subject Matter Expert (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 ; and
- Emergency shut-down, alarm and lighting systems.

Oil Companies International Marine Forum (OCIMF) OVID is the basis for all support vessel vetting. Additionally, vessels are screened for class and port state control infractions.

Offtake tankers are positively vetted against the OCIMF inspection.

The following compliance are required for “Positive Vetting” for vessel operating in the Crux field, excluding equipment and material transportation vessels.

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.

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.

Shell Aircraft International (SAI) Approval

The Shell Aircraft International (SAI) approval ensures that all helidecks on any selected marine vessels utilised for personnel transport are approved. Furthermore, helicopters and helicopter refuelling equipment are approved by SAI.

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.

Biofouling Risk Assessments

In accordance with Shells Biosecurity Management Procedure (2000-010-G000-GE00-G00000-HX-5798-00003) and to ensure the ongoing 'Low Risk Status' of offshore infrastructure, the assessment of biofouling risk will be carried out for all vessels which will operate within the Operational Area.

The risk assessment will be carried out by the Vessel Owner/Operator.

10.4.3 Environmental Assurance

Shell and its contractors' 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.

A series of audits and inspections are undertaken prior to commencing the activities as part of the vessel and MODU pre-qualification and premobilisation assurance process, including:

- Shell's Global Rig Start-up Team inspect the MODU prior to acceptance for compliance with applicable Shell Standards and the drilling contract;
- Shell Aviation International shall conduct an audit of the MODU helideck and aircraft refueling facilities prior to rig acceptance; and
- Offshore Vessel Inspection Database (OVID) is conducted by the SA Marine department (results will not be published to the database) to confirm the marine integrity of the MODU and vessel.

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.

The SA Drilling Supervisor (DSV) is Shell's representatives aboard the MODU. They are responsible for ensuring the operational requirements of the EP are communicated to the MODU crew and implemented on a daily basis. The DSV may attend tool box talks, pre-phase meetings and after-action reviews as required.

The DSV also conduct's regular informal HSE checks of the MODU activities to ensure that the EP commitments are implemented, attend the daily MODU operations meetings

and prepare the daily report to the SA SWEO, which details any environmental incidents that have occurred in the previous 24 hours.

The MODU contractor also conduct's checks in line with contractor requirements.

These regular checks work to make sure that the specified controls are in place to manage environmental risks, and that they remain working, and contribute to continually reducing the risks to ALARP.

The SA Marine Department communicates the operational requirements of the EP to the vessel crew, conduct regular informal HSE checks of the vessel activities to ensure that the EP commitments are implemented.

Any hazards or areas of concern identified during formal or informal inspections, or during normal working operations, will be rectified immediately where possible. Any specific worksite environmental issues identified are discussed with site management and highlighted to supervisors to brief their teams during toolbox talks and shift handovers.

Critical Monitoring and measuring equipment to be identified and inspected to ensure calibration and operation is correct. It is the responsibility of the Well Operations Team Lead to ensure this occurs.

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 incident records are managed in an online electronic system called Fountain Incident Management (FIM). 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 FIM
- FIM 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.

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.

All employees or contracted staff are encouraged to submit incident reports to alert the organisation about the occurrence of an incident or non-conformance. The SA Drilling Supervisor is responsible for making sure these reports are raised in the Sphera system. Incidents will be reported to Shell by the SA DSV or SA Marine Superintendent for marine vessels.

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 Annual Environmental Performance Reporting

Regulation 14(2) and 26C requires that an Environmental Performance report will be submitted to NOPSEMA in intervals of not more than one year. Annual Environmental Performance Reports will contain a full year (1 July – 30 June the following year) and will be submitted to NOPSEMA by 31 December.

Shell is also required to report annual GHG emissions and energy usage and pollutants emissions under the NGER Scheme and NPI reporting, respectively. The reporting period for these also cover a full year (1 July – 30 June the following year).

10.5.2 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 magnitude levels +1 to -5 to define environmental consequences (positive effect, no effect, slight effect, minor effect, moderate effect, major effect and massive effect'). All environmental effects with a magnitude -3 or greater (i.e. moderate to massive) are considered Reportable Incidents. Based on the risk assessments documented in Section 9, three events are considered to be of moderate or higher consequence:

- Any confirmed introduced marine pest species in Australian waters attributable to the petroleum activities
- Hydrocarbon release resulting from a collision with another vessel
- Hydrocarbon release from a well control incident.

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 submitted 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; and
- 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	The Secretary, DAWE

Incident	Legislation	Timing of Notification with respect to the occurrence of the incident.	Contact Details
		consequences of the action.	

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 EPSs and MC.

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 & SP 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.

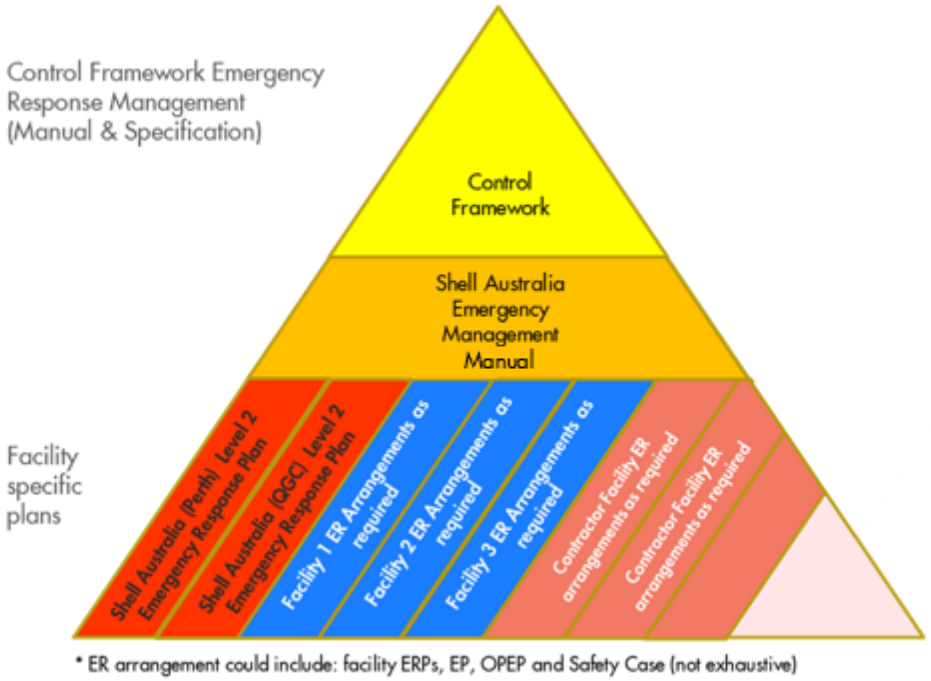


Figure 10-4: Shell Australia Emergency and Incident Management System Overview

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, Incident Command System (ICS) forms and briefing templates
- IMT (W) communications
- Guidance for responding to emergencies
- Supporting subject matter expert units

- De-escalation and recovery.

10.7.4 Oil Pollution Emergency Plan

The Shell Browse Regional OPEP (HSE_PRE_013075) outlines emergency management arrangements to respond to credible spill scenarios associated with all offshore activities, including Crux. 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) f (APPEA, 2020) and its associated OMP's and 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 browse Regional Operational and Scientific Monitoring Bridging Implementation Plan (HSE_PRE_16370).

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
- 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.

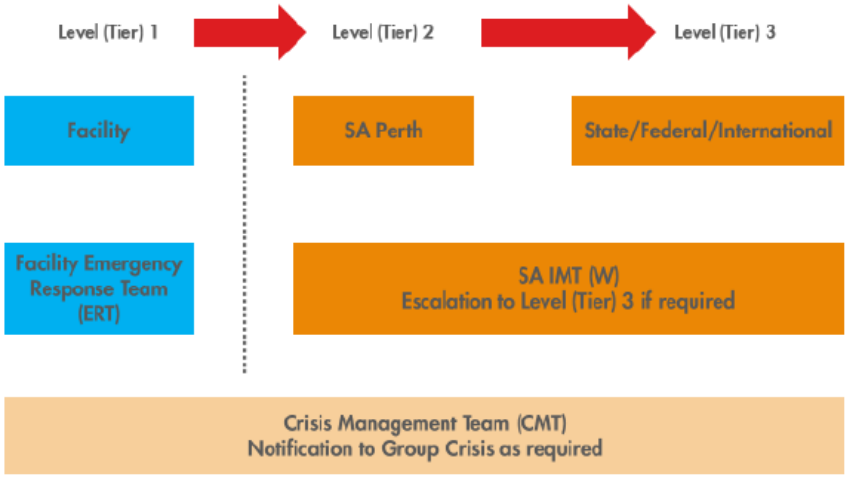
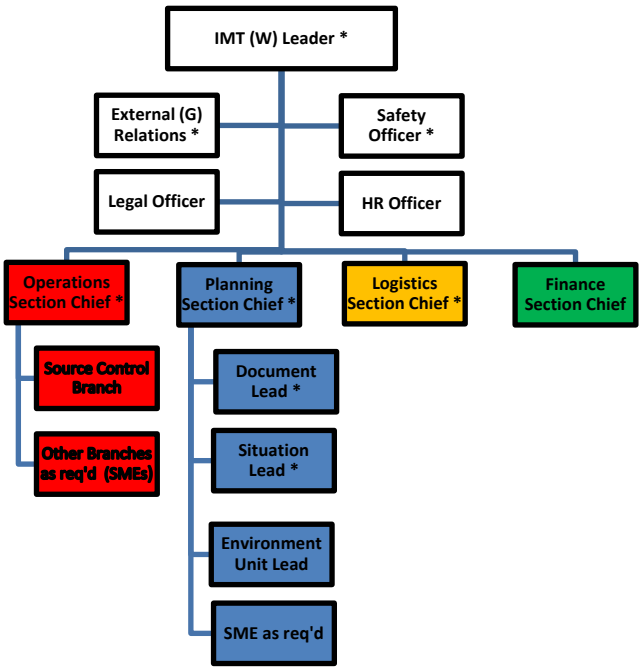


Figure 10-5: Emergency Management Escalation Process Adopted by IMT (W)

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.

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 the Browse Regional 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) provides 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
MODU Incident Commander (OIM) (Offshore)	Maintain the safety of all personnel and initiates actions to protect the environment and the MODU 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
MODU 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
SA Drilling Supervisor	Assist OIM in the implementation of first strike actions set out in the OPEP Assist OIM in the clarification of 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
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

Key Roles	Responsibilities
	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
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 Tactical response Plans (TRP) 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

Key Roles	Responsibilities
	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 (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 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
MODU ERT Personnel MODU OIM	As per contractor ERT requirements	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

Key Roles	Exercises	Training
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
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 D0BCA 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	Annually

Exercise Type	Objective	Frequency
	Target of 100% for participation of Shell Australia's Core Group personnel in GRSN regional exercises as required.	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

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. This system assigns a responsible person and due date against each action to ensure they are tracked to closure.

Assurance of Shell Group Response Arrangements

The major advantage of the GRSN/WCVERT is the ability to leverage the resources and support from the Shell Group for a local operations team, which may have a reasonably small footprint, in the event of an incident. However, it is recognised and must be made clear that during an incident the accountability for the response remains with the local organisation, in this case Shell Australia. It is therefore a requirement that the local organisation has the ability to test, evaluate and assure the capability of the Shell GRSN and WCVERT to meet their response needs on an ongoing basis.

The GRSN and WCVERT partake in frequent exercises around the world to ensure a state of readiness; these may be validated by local operating units as follows.

- Upon request the GRSN/ WCVERT will share an updated drill schedule for forthcoming global drills in which they will partake
- Where practicable and under instruction from Shell Australia General Manager Wells some of the Shell Australia Source Control team may attend such drills to enhance training and validate response capability
- Where practicable reports from previously conducted drills including learnings may be requested by Shell Australia to validate GRSN/ WCVERT response capabilities.

In order to monitor and track the availability of personnel, the WCVERT simulates regular call out drills. This involves sending a group communication to the WCVERT Source Control Branch members and recording the response, availability and response time.

- As required, a local operating unit may request from the Well Control Principle Technical Expert an overview of the recent call out drills to validate response capabilities.

11. References

a, R.M., Carranza, M.M., Hogle, S.L., Levin, R.A., Netburn, A.N., Seto, K.L., Snyder, S.M., and Franks, P.J. 2011. Deepwater Horizon oil spill: A review of the planktonic response. Oceanography 24: 294–301.

AECOM. 2016. Crux Field Baseline Water Quality Assessment. Report prepared for Shell Australia Pty Ltd, Perth, Western Australia.

AECOM. 2017. Crux Field Baseline Sediment and Water Quality Assessment. Report prepared for Shell Australia Pty Ltd, Perth, Western Australia

Almeda, R., Wambaugh, Z., Wang, Z., Hyatt, C., Liu, Z., and Buskey, E.J. 2013. Interactions between zooplankton and crude oil: toxic effects and bioaccumulation of polycyclic aromatic hydrocarbons. PloS one 8: e67212.

ANZECC & ARMCANZ. 1997. National Water Quality Management Strategy: Australian Guideline.

ANZECC & ARMCANZ. 2000. Australian and New Zealand guidelines for fresh and marine water quality. National Water Quality Management Strategy Paper No 4. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra, ACT.

APASA, 2013. Prelude: Quantitative Oil Spill Exposure Modelling, November 2013, prepared for Shell Development Australia.

APASA, 2014. Prelude FLNG Spill Modelling – Diesel Results

Asian Development Bank (ADB). 2014a. State of the Coral Triangle: Indonesia. Asian Development Bank, Mandaluyong City, Philippines.

Asian Development Bank (ADB). 2014b. State of the Coral Triangle: Timor-Leste. Asian Development Bank, Mandaluyong City, Philippines.

Australian Maritime Safety Authority (AMSA). 2015a. Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities. Australian Maritime Safety Authority, Canberra, Australian Capital Territory.

Australian Maritime Safety Authority (AMSA). 2015b. Response, assessment and termination of cleaning for oil contaminated foreshores (Guidance No. NP-GUI-025), National Plan. Australian Maritime Safety Authority, Canberra, Australian Capital Territory.

Australian Maritime Safety Authority (AMSA). 2017. Advisory Note for Offshore Petroleum Industry Consultation with Respect of Oil Spill Contingency Plans.

Australian Petroleum Production and Exploration Association (APPEA). 2008. Code of Environmental Practice. Australian Petroleum Production and Exploration Association, Canberra, Australian Capital Territory.

Australian Petroleum Production and Exploration Association (APPEA).2020. Joint industry operational and scientific monitoring plan framework. Australian Petroleum Production and Exploration Association, Canberra, Australian Capital Territory.

Bakke, T., Klungsoyr, J. and Sanni, S. 2013. Environmental Impacts of produced water and drilling water discharges from the Norwegian offshore petroleum industry. Marine Environmental Research. (92) 154-169.

Bolle, L.J., de Jong, C.A.F., Bierman, S.M., van Beek, P.J.G., van Keeken, O.A.,Wessels, P.W., van Damme, C.J.G., Winter, H.V., and de Haan, D., Dekeling, R.P.A. 2012. Common sole larvae survive high levels of pile-driving sound in controlled exposure experiments. PLoS ONE 7: e33052. doi:10.1371/journal.pone.0033052.

BP 2013. Shah Deniz 2 Project. Environmental & Socio-Economic Impact Assessment. BP Development Pty Ltd. https://www.bp.com/en_az/caspian/sustainability/environment/ESIA.html

Bureau of Meteorology (BOM) and Commonwealth Scientific and Industrial Research Organisation (CSIRO). 2020. State of the Climate Report. Commonwealth of Australia, 2020.

Clark, R. 1984. Impact of oil pollution on seabirds. Environmental Pollution Series A, Ecological and Biological 33: 1–22.

Colman, J., 1997. A review of the biology and ecology of the whale shark. Journal of Fish Biology 51: 1219–1234.

Commonwealth of Australia. 2013. Matters of National Environmental Significance (MNES) Significant Impact Guidelines 1.1. *Environment Protection and Biodiversity Conservation Act 1999.* Department of the Environment.

Commonwealth of Australia. 2014. Recovery plan for the grey nurse shark (*Carcharias taurus*). Department of the Environment, Canberra.

Commonwealth of Australia. 2015a. Conservation management plan for the blue whale: A recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 2015-2025. Department of the Environment, Canberra.

Commonwealth of Australia. 2015b. Sawfish and River Sharks Multispecies Recovery Plan. Canberra, Australian Capital Territory.

Commonwealth of Australia. 2015c. Wildlife Conservation Plan for Migratory Shorebirds. Threatened Species Scientific Committee, Department of the Environment and Energy, Canberra, Australian Capital Territory.

Commonwealth of Australia. 2017a. Recovery plan for marine turtles in Australia: 2017-2027. Department of the Environment and Energy.

Commonwealth of Australia. 2017b. Australian National Guidelines for Whale and Dolphin Watching. Department of the Environment and Energy

Commonwealth of Australia. 2017c. National Strategy for Reducing Vessel Strikes on Cetaceans and other Marine Megafauna.

Commonwealth of Australia. 2018. Threat abatement plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans. Department of the Environment and Energy

Commonwealth of Australia. 2020. Light Pollution Guidelines National Light Pollution Guidelines for Wildlife Including Marine Turtles, Seabirds and Migratory Shorebirds. Department of the Environment and Energy, Canberra.

Continental Shelf Associates. 2006. Effects of oil and gas exploration and development at selected continental slope sites in the Gulf of Mexico - Volume II: Technical Report (OCS Study No. MMS 2006-045). U.S. Department of the Interior/Minerals Management Coral Triangle Center. 2018. Timor-Leste: A Nation of the 21st Century. Available from:https://www.coraltrianglecenter.org/timor-leste/

Dafforn, K. A., Glasby, T. M., and Johnston, E. L. 2009a. Links between estuarine condition and spatial distributions of marine invaders. Diversity and Distributions 15(5): 807–821.

Dafforn, K. A., Johnston, E. L., and Glasby, T. M. 2009b. Shallow moving structures promote marine invader dominance. Biofouling 25:3, 277-287.

Davenport, J., Angel, M., Gray, J., Crisp, D., and Davies, J. 1982. Oil and planktonic ecosystems. Philosophical Transactions of the Royal Society B: Biological Sciences 297: 369–384.

Day, Ryan D., McCauley, R.D., Fitzgibbon, Q.P., and Semmens, J.M. 2016. Seismic air gun exposure during early-stage embryonic development does not negatively affect spiny lobster *Jasus edwardsii* larvae (*Decapoda:Palinuridae*). Scientific Reports 6: 22723.doi:10.1038/srep22723.

De Vogelaere, A.P., and Foster, M.S. 1994. Damage and recovery in intertidal Fucus gardneri assemblages following the “Exxon Valdez” oil spill. Marine Ecology Progress Series 106: 263–271.

Dean, T.A., Stekoll, M.S., Jewett, S.C., Smith, R.O., and Hose, J.E. 1998. Eelgrass (Zostera marina L.) in Prince William Sound, Alaska: effects of the Exxon Valdez oil spill. Marine Pollution Bulletin, vol. 36, pp. 201-210.

Deepwater Horizon Natural Resource Damage Assessment Trustees, 2016. Deepwater Horizon oil spill: final programmatic damage assessment and restoration plan and final programmatic environmental impact statement. National Oceanic and Atmospheric Administration, Silver Spring.

Department of Agriculture and Water Resources (2017) Australian ballast water management requirements (Report No. Version 7). Department of Agriculture and Water Resources, Canberra.

Department of Agriculture, Fisheries and Forestry. 2009. National biofouling management guidance for the petroleum production and exploration industry. (The National System for the Prevention and Management of Marine Pest Incursions).

Department of Agriculture, Fisheries and Forestry, Canberra.

Department of Agriculture, Water and the Environment (DAWE). 2019. Offshore Installations Biosecurity Guide 2019.

Department of Agriculture, Water and the Environment (DAWE). 2022. Australian Underwater Cultural Heritage Database.

Department of Conservation and Land Management (CALM), 2005. Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005–2015 (Management Plan No. 52). Department of Conservation and Land Management, Perth.

Department of Defence (Defence), 2019. Unexploded Ordnance (UXO) Mapping Application. Available at: http://www.defence.gov.au/UXO/Where/.

Department of Defence. 2015. Australia Significant ADF Facilities, ADF Training Areas, Selected Civil Ports and Offshore Resources. Department of Defence, Canberra, Australian Capital Territory.

Department of Fisheries. 2017. Biofouling Biosecurity Policy. Available from: http://www.fish.wa.gov.au/Documents/biosecurity/biofouling_biosecurity_policy.pdf

Department of Transport. 2020. Marine oil pollution: response and consultation arrangements (Offshore Petroleum Industry Guidance Note v5.0 July 2020). Department of Transport, Perth.

Department of Home Affairs (DHA). 2018a. Maritime. Available from: https://www.homeaffairs.gov.au/australian-border-force-abf/protecting/maritime

Department of Home Affairs (DHA). 2018b. Maritime Border Command. Department of Home Affairs, Canberra, Australian Capital Territory. Available from: https://www.homeaffairs.gov.au/australian-border-forceabf/protecting/maritime/command

Department of Mines and Petroleum (DMP). 2014. Western Australia's Petroleum and Geothermal Explorer's Guide. Department of Mines and Petroleum, Perth, Western Australia.

Department of Planning, Lands and Heritage (DPLH). 2022. Aboriginal Heritage Inquiry System. Government of Western Australia

Department of Primary Industries and Regional Development (DPIRD). 2021.Fishcube data

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2011a. Approved conservation advice for *Aipysurus apraefrontalis* (Short-nosed sea snake). Canberra, ACT.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2011b. Approved conservation advice for *Aipysurus foliosquama* (Leaf-scaled sea snake). Canberra, ACT.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2011c. Approved conservation advice for Sternula nereis nereis (Fairy tern). Canberra, ACT.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2012a. Marine bioregional plan for the North-west Marine Region. Prepared under the *Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2012b. Conservation management plan for the southern right whale. Commonwealth of Australia, 2012.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2013. Recovery plan for the white shark (*Carcharodon carcharias*). Commonwealth of Australia, 2013.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). 2021. Draft national recovery plan for albatrosses and petrels. Commonwealth of Australia, 2021.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008a. The North-west Marine Bioregional Plan: Bioregional Profile. Commonwealth of Australia, 2008.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008b. Approved conservation advice for *Dermochelys coriacea* (Leatherback Turtle). Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008c. Approved conservation advice for green sawfish. Canberra.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2008d. North Marine Bioregional Plan bioregional profile: a description of the ecosystems, conservation values and uses of the North Marine Region. Commonwealth of Australia, Canberra, ACT.

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2009a. Approved conservation advice for *Pristis clavata* (Dwarf Sawfish). Canberra, ACT

Department of the Environment, Water, Heritage and the Arts (DEWHA). 2009b. Threat abatement plan for the impacts of marine debris on vertebrate marine life. Department of the Environment, Water, Heritage and the Arts, Canberra, Australian Capital Territory.

Director of National Parks. 2018a. North Marine Parks Network Management Plan 2018, Director of National Parks, Canberra.

Director of National Parks. 2018b. North-west Marine Parks Network Management Plan 2018, Director of National Parks, Canberra.

Det Norske Veritas. 2011. Assessment of the risk of pollution from marine oil spills in Australian ports and waters (Report No. PP002916). Det Norske Veritas Ltd, London, United Kingdom.

Díez, I., Secilla, A., Santolaria, A., and Gorostiaga, J.M. 2009. Ecological monitoring of intertidal phytobenthic communities of the Basque Coast (N. Spain) following the Prestige oil spill. Environmental Monitoring and Assessment 159: 555–575. doi:10.1007/s10661-008-0651-5.

Double, M., Jenner, K., Jenner, M., Ball, I., Childerhouse, S., Loverick, S., and Gales, N. 2012. Satellite tracking of northbound humpback whales (Megaptera novaeangliae) off Western Australia. Australian Marine Mammal Centre, Hobart.

Double, M.C., Andrews-Goff, V., Jenner, K.C.S., Jenner, M.-N., Laverick, S.M., Branch, T.A., and Gales, N.J. 2014. Migratory movements of pygmy blue whales (Balaenoptera musculus brevicauda) between Australia and Indonesia as revealed by satellite telemetry. PloS one 9: e93578.

Duke, N.C., and Archibald, R.D. 2016. Understanding the environmental risks of unplanned discharges - the Australian context: mangroves and intertidal habitats (Document No. 1128_01_001/9_Rev1). Australian Petroleum Production and Exploration Association, Perth, Western Australia.

Dunlop, R.A., Noad, M.J., Cato, D.H., Kniest, E., Miller, P.J.O., Smith, J.N., and Stokes, M.D., 2013. Multivariate analysis of behavioural response experiments in

humpback whales (*Megaptera novaeangliae*). The Journal of Experimental Biology 216: 759.doi:10.1242/jeb.071498

Edgar, G., Kerrison, L., Shepherd, S., and Toral, V. 2002. Impacts of the Jessica oil spill on intertidal and shallow subtidal plants and animals, in: Lougheed, L., Edgar, GJ, Snell, H. (Eds.), Biological Impacts of the Jessica Oil Spill on the Galápagos Environment. Charles Darwin Foundation, Puerto Ayora, pp. 58–6

Elemental Consulting Services 2022. Crux Project - Execute Phase Greenhouse Gas Assessment Final Report . Report prepared for Shell Australia.

Engelhardt, F.R. 1983. Petroleum effects on marine mammals. Aquatic Toxicology 4: 199–217.

Environment Australia, 2002. Ningaloo marine park (Commonwealth waters) management plan. Environment Australia, Canberra.

Fingas, M., and Fieldhouse, B. 2004. Formation of water-in-oil emulsions and application to oil spill modelling. Journal of Hazardous Materials 107: 37–50.

Finneran, J., Henderson, E., Houser, D., Jenkins, K., Kotecki, S., and Mulsow, J. 2017. Criteria and thresholds for U.S. navy acoustic and explosive effects analysis (Phase III).

Fletcher, W., Friedman, K., Weir, V., McCrea, J., and Clark, R., 2006. Pearl oyster fishery (ESD Report Series No. 5). Department of Fisheries, Perth, Western Australia.

Fodrie, F.J., and Heck, K.L. 2011. Response of coastal fishes to the Gulf of Mexico oil disaster. PLoS ONE 6: e21609. doi:10.1371/journal.pone.0021609.

French, D., Reed, M., Jayko, K., Feng, S., Rines, H., and Pavignano, S. 1996. The CERCLA Type A Natural Resource Damage Assessment Model for Coastal and Marine Environments (NRDAM/CME) (Technical Documentation Volume No. I). Office of Environmental Policy and Compliance, Washington, D.C. Gagnon, 2009.

French, D.P. 2000. Estimation of oil toxicity using an additive toxicity model. Applied Science Associated, Narragansett. French, D.P., Schuttenberg, H.Z., Isaji, T. 1999. Probabilities of oil exceeding thresholds of concern: examples from an evaluation for Florida Power and Light. Presented at the Arctic and Marine Oilspill Program Technical Seminar, Ministry of Supply and Services, Ottawa, pp. 243–270.

French, D.P., Schuttenberg, H.Z., and Isaji, T. 1999. Probabilities of oil exceeding thresholds of concern: examples from an evaluation for Florida Power and Light. Presented at the Arctic and Marine Oilspill Program Technical Seminar, Ministry of Supply and Services, Ottawa, pp. 243–270.

French, M., Reich, D.,Rowe, J., Schroeder, M., and Graham, E., 2011. Oil spill modeling input to the offshore environmental cost model (OECM) for US-BOEMRE's spill risk and costs evaluations, in: Proceedings of the 34th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar. Presented at the 34th Arctic and Marine Oil Spill Program (AMOP) Technical Seminar, Environment Canada, Ottawa.

French-McCay, D. 2003. Development and application of damage assessment modelling: example assessment for the North Cape oil spill. Marine Pollution Bulletin 47: 341–359. doi:10.1016/S0025-326X(03)00208-X.

French-McCay, D. 2004. Estimation of potential impacts and natural resource damages of oil. Journal of Hazardous Materials 107: 11–25. doi:10.1016/j.jhazmat.2003.11.013.

French-McCay, D. 2009. State-of-the-art and research needs for oil spill impact assessment modelling, in: Proceedings of the 32nd AMOP Technical Seminar on Environmental Contamination and Response. Presented at the 32nd AMOP Technical Seminar on Environmental Contamination and Response, Environment Canada, Ottawa, pp. 601–653.

French-McCay, D. Reich, D., Michel, J., Etkin, D., Symons, L., Helton, D., and Wagner, J. 2012. Oil spill consequence analyses of potentially polluting shipwrecks, in: Proceedings of the 35th Arctic & Marine Oilspill Program Technical Seminar. Presented at the 35th Arctic & Marine Oilspill Program Technical Seminar, Environment Canada, Ottawa.

French-McCay, D.P. 2002. Development and application of an oil toxicity and exposure model, OilToxEx. Environmental Toxicology and Chemistry 21: 2080–2094.

Frick, W.E., Roberts, P.J.W., Davis, L.R., Keyes, J., Baumgartner, D.J., and George, K.P. 2001. Dilution Models for Effluent Discharges, 4th Edition (Visual Plumes) Draft. US Environmental Protection Agency, Georgia. July 2001.

Fugro. 2017a. Provision of Geomatic Services (Crux Development), Volume 1D – Environmental Habitat. Report prepared for Shell Australia Pty Ltd, Perth, Western Australia.

Gagnon, M., 2009. Report on biopsy collections from specimens collected from the surrounds of the West Atlas oil leak - sea snake specimen. Curtin University, Perth, Western Australia.

Gagnon, M., and Rawson, C., 2011. Montara well release monitoring study S4A - Assessment of effects on Timor Sea fish. Curtin University, Perth, Western Australia.

Gagnon, M., and Rawson, C., 2012. Montara well release, monitoring study S4A Phase IV - assessment of effects on Timor Sea fish. Curtin University, Perth, Western Australia.

Gagnon, M.M., Rawson, C., 2010. Montara well release: Report on necropsies from a Timor Sea green turtle. Curtin University, Perth, Western Australia.

Gaston, K. J., Gaston, S., Bennie, J., and Hopkins, J., 2014. Reducing the impacts of artificial light. British Wildlife, 25(5), 332-339.

Geraci, J., 1988. Physiologic and toxicologic effects of cetaceans, in: Geraci, J., St Aubin, D. (Eds.), Synthesis of Effects of Oil on Marine Mammals, OCS Study. Department of Interior, Ventura, pp. 168–202.

Geraci, J.R. and St Aubin, D.J. 1990. Sea mammals and oil: confronting the risks. Academic Press, San Diego, USA. 259pp.

Glasby, T. M., Connell, S. D., Holloway, M. G., and Hewitt, C. L. 2007. Nonindigenous biota on artificial structures: could habitat creation facilitate biological invasions. Marine Biology 151: 887–895.

Glenn, K. 2004. Sedimentary processes during the Late Quaternary across the Kimberley Shelf, Northwest Australia. The University of Adelaide, Adelaide, South Australia.

Hassan, A., and Javed, H. 2011. Effects of Tasman Spirit oil spill on coastal birds at Clifton, Karachi coast, Pakistan. Journal of Animal and Plant Sciences 21: 333–339.

Hart, A., Murphy, D., and Wright, L. 2021. Pearl Oyster Managed Fishery Resource Status Report 2021. In: Status reports of the fisheries and aquatic resources of Western Australia 2020/21. State of the fisheries. Department of Primary Industries and Regional Development (DPIRD).

Hart, A., Travaille, K.L., Jones, R., Brand-Gardner, S., Webster, F., Irving, A. and Harry, A.V. 2016. Western Australian Marine Stewardship Council Report Series No. 5: Western Australian Silver-lipped Pearl Oyster (Pinctada maxima) Industry. Department of Fisheries, Western Australia. 316 pp.

Hays, G., Åkesson, S., Broderick, A., Glen, F. Godley, B., Luschi, P., Martin, C., Metcalfe, J., and Papi, F., 2001. The diving behaviour of green turtles undertaking oceanic migration to and from Ascension Island: dive durations, dive profiles and depth distribution. Journal of Experimental Biology 204: 4093–4098.

Henkel, J.R., Sigel, B.J., and Taylor, C.M. 2012. Large-scale impacts of the Deepwater Horizon oil spill: can local disturbance affect distant ecosystems through migratory shorebirds? BioScience 62: 676–685. doi:10.1525/bio.2012.62.7.10.

Hewitt, C., Campbell, M., Coutts, A., Dahlstrom, A., Shields, D., and Valentine, J. 2011. Species Biofouling Risk Assessment, Department of Agriculture, Fisheries and Forestry. Canberra, ACT.

Heyward, A. J., Farrell, P., and Seamark, R. F. 1994. The effect of petroleum based pollutants on coral gametes and fertilisation success. In 6th Pacific Congress on Marine Science and Technology, Townsville Australia, p. 119.

Heyward, A., Moore, C., Radford, B., and Colquhoun, J. 2010. Environmental Study S5, Monitoring Program for the Montara Well Release Timor Sea: Final Report on the Nature of Barracouta and Vulcan Shoals. Report for PTTEP AA Australasia (Ashmore Cartier) Pty. Ltd. Australian Institute of Marine Science, Townsville, Queensland.

Heyward, A., Jones, R., Meeuwig, J., Burns, K., Radford, B., Colquhoun, J., Cappo, M., Case, M., O'Leary, R., Fisher, R., Meekan, M. and Stowar, M. 2012. Monitoring Study S5 Banks and Shoals, Montara 2011 Offshore Banks Assessment Survey. Report for PTTEP AA Australasia (Ashmore Cartier) Pty. Ltd. Australian Institute of Marine Science, Townsville, Queensland.

Heyward, A., Speed, C., Meekan, M., Cappo, M., Case, M., Colquhoun, J., Fisher, R., Meeuwig, J., and Radford, B. 2013. Montara: Barracouta East, Goeree and Vulcan Shoals survey 2013 (Report for PTTEP Australasia (Ashmore Cartier) Pty Ltd). Australian Institute of Marine Science, Perth, Western Australia.

Heyward, A., Wakeford, M., Cappo, M., Olsen, Y., Colquhoun, J., Radford, B., Case, M., and Stowar, M. 2017. Applied Research Program – ARP7: Subtidal Benthos: towards benthic baselines in the Browse Basin, Final Report – Submerged Shoals 2017. Report prepared for Shell Australia Pty Ltd and INPEX, Perth, Western Australia.

Hjermann, D.Ø., Melsom, A., Dingsør, G.E., Durant, J.M., Eikeset, A.M., Røed, L.P., Ottersen, G., Storvik, G., and Stenseth, N.C. 2007. Fish and oil in the Lofoten–

Barents Sea system: synoptic review of the effect of oil spills on fish populations. Marine Ecology Progress Series 339: 283–299.

Hodge, W., Limpus, C.J., and Smissen, P.J. 2007. Queensland turtle conservation project: Hummock Hill Island nesting turtle study December 2006.

How, J., and Baudains, G. 2021. Weste Coast Deep Sea Crustacean Resource Status Report 2021. In: Status reports of the fisheries and aquatic resources of Western Australia 2020/21. State of the fisheries. Department of Primary Industries and Regional Development (DPIRD).

International Finance Corporation (IFC). 2007. Environmental, Health, and Safety (EHS) Guidelines. Available from: https://www.ifc.org/wps/wcm/connect/554e8d80488658e4b76af76a6515bb18/Final%2B-%2BGeneral%2BEHS%2BGuidelines.pdf?MOD=AJPERES (accessed: 29/08/18).

International Finance Corporation (IFC). 2012. Performance Standards on Environmental and Social Sustainability. Available from: https://www.ifc.org/wps/wcm/connect/c8f524004a73daeca09afdf998895a12/IFC_Performance_Standards.pdf?MOD=AJPERES (accessed: 29/08/18).

International Finance Corporation (IFC) 2015. EHS Guidelines for Offshore Oil and Gas Development. Available from: FINAL_Jun+2015_Offshore+Oil+and+Gas_EHS+Guideline.pdf (ifc.org)

Imbricata Environmental Pty Ltd. 2018. Crux Project: Light Modelling Study. Report number IM180001-1.

International Association of Oil and Gas Producers (IOGP). 2016. Environmental fates and effects of ocean discharge of drill cuttings and associated drilling fluids from offshore oil and gas operations (Report No. 543). International Association of Oil and Gas Producers, London, United Kingdom.

International Petroleum Industry Environmental Conservation Association (IPIECA). 2017. Improving environmental and social performance. Available from: http://www.ipieca.org/resources/good-practice/improving-social-and-environmentalperformance/(accessed: 29/08/18).

International Tanker Owners Pollution Federation. 2011a. Fate of marine oil spills (Technical Information Paper No. 2). International Tanker Owners Pollution Federation Limited, London, United Kingdom.

International Tanker Owners Pollution Federation. 2011b. Effects of oil pollution on fisheries and mariculture (Technical Information Paper No. 11). International Tanker Owners Pollution Federation Limited, London, United Kingdom..

Jenner, K., Jenner, M., and McCabe, K. 2001. Geographical and temporal movements of humpback whales in Western Australian waters. APPEA Journal 41: 692–707.

Jensen, A., and Silber, G. 2004. Large whale ship strike database (NOAA Technical Memorandum No. NMFS-OPR). National Marine Fisheries Service, Silver Spring

Jenssen, B.M. 1994. Effects of oil pollution, chemically treated oil, and cleaning on thermal balance of birds. Environmental Pollution 86: 207–215.

Jiang, Z., Huang, Y., Chen, Q., Zeng, J., and Xu, X. 2010. Advance in the toxic effects of petroleum water accommodated fraction on marine plankton. Acta Ecologica Sinica 30: 8–15.

Jimenez-Arranz, G, Hedgeland D, S. Cook. 2019. Acoustic characterisation of a mobile offshore drilling unit. Proc. Mtgs. Acoust. 37, 070005 (2019); doi: 10.1121/2.0001193.

Johansen, J.L., Allan, B.J., Rummer, J.L., and Esbaugh, A.J. 2017. Oil exposure disrupts early life-history stages of coral reef fishes via behavioural impairments. Nature Ecology & Evolution 1: 1146–1152. doi:10.1038/s41559-017-0232-5.

Kamrowski, R.L., Limpus, C., Jones, R., Anderson, S., and Hamann, M. 2014. Temporal changes in artificial light exposure of marine turtle nesting areas. Global Change Biology, 20 (8): 2437 - 2449

Koops, W., Jak, R., and van der Veen, D., 2004. Use of dispersants in oil spill response to minimize environmental damage to birds and aquatic organisms. Interspill 2004.

Kvadsheim, P.H., DeRuiter, S., Sivle, L.D., Goldbogen, J., Roland-Hansen, R., Miller, P.J., Lam, F.-P.A., Calambokidis, J., Friedlaender, A., and Visser, F. 2017. Avoidance responses of minke whales to 1–4 kHz naval sonar. Marine Pollution Bulletin 121: 60–68.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., and Podesta, M. 2001. Collisions between ships and whales. Marine Mammal Science 17, 35–75.

Law, R.J., and Hellou, J., 1999. Contamination of fish and shellfish following oil spill incidents. Environmental Geosciences 6: 90–98.

Law, R.J., and Kelly, C., 2004. The impact of the “Sea Empress” oil spill. Aquatic Living Resources 17: 389–394.

Lewis, P., and Watt, M. 2021. Statewide Large Pelagic Finfish Resource Status Report 2021. In: Status reports of the fisheries and aquatic resources of Western Australia 2020/21. State of the fisheries. Department of Primary Industries and Regional Development (DPIRD).

Lindquist, D.C., Shaw, R.F. and Hernandez Jr, F.J. 2005. Distribution patterns of larval and juvenile fishes at off shore petroleum platforms in the north central Gulf of Mexico. Estuarine, Coastal and Shelf Science, 62: 655-665.

Lobón, C.M., Fernández, C., Arrontes, J., Rico, J.M., Acuña, J.L., Anadón, R., and Monteoliva, J.A. 2008. Effects of the ‘Prestige’ oil spill on macroalgal assemblages: Large-scale comparison. Marine Pollution Bulletin 56: 1192–1200. doi:10.1016/j.marpolbul.2008.02.009.

Lohmann, K.J., and Lohmann, C.M.F. 1992. Orientation to oceanic waves by green turtle hatchlings. J. Exp. Biol. Issue. 171, pp. 1–13.

Longcore, T., and Rich, C., 2004. Ecological light pollution. Frontiers in Ecology and the Environment, 2(4), 191-198

Loya, Y., and Rinkevich, B., 1980. Effects of oil pollution on coral reef communities. Marine Ecology Progress Series 3: 180.

Lutcavage, M., Lutz, P., Bossart, G., and Hudson, D., 1995. Physiologic and noclinicopathologic effects of crude oil on loggerhead sea turtles. Archives of Environmental Contamination and Toxicology 28: 417–422.

McCauley, R. 1998. Radiated underwater noise measured from the drilling rig Ocean General, rig tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture

and natural sources in the Timor Sea, Northern Australia. (Report No. C98-20). Centre for Marine Science and Technology, Curtin University of Technology, Perth, Western Australia.

McCauley, R.D., Day, R.D., Swadling, K.M., Fitzgibbon, Q.P., Watson, R.A. and Semmens, J.M. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1: 0195. doi:10.1038/s41559-017-0195.

McKenna, M. F., Calambokidis, J., Oleson, E. M., Laist, D. W., and Goldbogen, J. A. 2015. Simultaneous tracking of blue whales and large ships demonstrates limited behavioral responses for avoiding collision. Endanger. Species Res. 27, 219–232. doi: 10.3354/esr00666

McPherson, C., Kowarski, K., Delarue, J., Whitt, C., MacDonnell, J. and Martin, B. 2016. Passive acoustic monitoring of ambient noise and marine mammals - Barossa Field (JASCO Document No. 00997). JASCO Applied Sciences, Capalaba.

Meekan, M. G., Wilson , S. G., Halford , A. and Retzel, A. 2001. “A comparison of catches of fishes and invertebrates by two light trap designs, in tropical NW Australia”, Marine Biology. Iss. 139, pp. 373–381.

Meekan, M. and Radford, B. 2010. Migration patterns of whale sharks: A summary of 15 satellite tag tracks from 2005 to 2008. Australian Institute of Marine Science, Perth, Western Australia.

Milicich, M. J., Meekan, M. G. and Doherty, P. J. 1992. Larval supply: a good predictor of recruitment in three species of reef fish (Pomacentridae). Mar Ecol Prog Ser. Iss. 86, pp. 153-166.

National Environment Protection Council (NEPC). 1998. National Environment Protection Measure for Ambient Air Quality (the 'Air NEPM'), June 1998 (as amended).

National Environment Protection Council (NEPC). 2019. Draft Varied National Environment Protection (Ambient Air Quality Measure). Draft for Public Comment.

National Oceanic and Atmospheric Administration (NOAA). 2010. Oil and Sea Turtles. Biology, Planning and Response. US Department of Commerce. National Ocean Service. National Oceanic and Atmospheric Administration.

National Oceanic and Atmospheric Administration (NOAA). 2014. Oil Spills in Mangroves. Planning and Response Considerations. US Department of Commerce. National Ocean Service. National Oceanic and Atmospheric Administration.

National Oceanic and Atmospheric Administration (NOAA). 2018. 2018 revision to: Technical guidance for assessing the effects of anthropogenic sound on marine mammal hearing (NOAA Technical Memorandum No. NMFS-OPR-59). National Oceanic and Atmospheric Administration, Silver Spring.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2015. PROHIBITION OF ENTRY INTO A PETROLEUM SAFETY ZONE - Notice: A441884. Government Notices Gazette C2015G01490 15 September 2015.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2016. Operational and scientific monitoring programs (Information Paper No. N-04700- IP1349 Revision 2). National Offshore Petroleum Safety and Environmental Management Authority, Perth.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2018a. Petroleum activities and Australian marine parks (Guidance Note No. N-04750-GN 1785 Revision 0). National Offshore Petroleum Safety and Environmental Management Authority, Perth.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2018b. Oil pollution risk management (Guidance Note No. GN1488 Revision 2). National Offshore Petroleum Safety and Environmental Management Authority, Perth.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2018c. Acoustic impact evaluation and management (Information Paper No. N-04750-IP1765 Revision 2) National Offshore Petroleum Safety and Environmental Management Authority, Perth.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2020. Environmental plan content requirement (N-04750-GN1344 A339814).

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2019a. Bulletin #2. Oil Spill Modelling. Document No: A696998 November 2019. National Offshore Petroleum Safety and Environmental Management Authority, Perth.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2019b. Consultation with Commonwealth agencies with responsibilities in the marine area. Document number: N-06800-GL1887 A705589.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2020. Information Paper. Reducing Marine Pest Biosecurity Risks through Good Practice Biofouling Management. Document No: N-04750-IP1899 Revision 1 March 2020. National Offshore Petroleum Safety and Environmental Management Authority, Perth.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). 2021. Environmental Plan Decision making. Document number: N-04750-GL1721 A524696.

National Research Council (NRC). 2003. Ocean Noise and Marine Mammals. Summary Review for the National Academies National Research Council, The National Academies Press, Washington D.C, United States.

Neff, J. M. 2010. Fate and effects of water based drilling muds and cuttings in cold water environments. Houston (TX): Report to Shell Exploration and Production Company.

Neff, J., McKelvie, S., and Ayers Jr., R. 2000. Environmental impacts of synthetic based drilling fluids (OCS Study No. MMS 2000-064). United States Department of the Interior, New Orleans.

Newell, R. C., Seiderer, L. J., and Hitchcock, D. R. 1998. The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent

recovery of biological resources on the sea bed. Oceanography and Marine Biology: an annual review, 36(1), 127-178

Newman, S., Wakefield, C., Skepper, C., Boddington, D., and Steele, A. 2021. North Coast Demersal Resource Status Report. In: Status reports of the fisheries and aquatic resources of Western Australia 2020/21. State of the fisheries. Department of Primary Industries and Regional Development (DPIRD).

Northern Territory Government. 2015. Status of Key Northern Territory Fish Stocks Report 2013. Northern Territory Government. Department of Primary Industry and Fisheries. Fishery Report No. 114

Northern Territory Government. 2019. Status of Key Northern Territory Fish Stocks Report 2017. Northern Territory Government Department of Primary Industry and Resources. Fishery Report No. 121.

Northern Territory Government. 2021. Aquaculture species. Accessed online on 14 April 2022 at https://nt.gov.au/marine/aquaculture/commercial/aquaculture-species

Patterson, H., Bromhead, D., Galeano, D., Larcombe, J., Woodhams, J., and Curtotti, R. 2021. Fishery status reports 2021, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra.

Payne, J.R. and Driskell, W.B. 2003. The importance of distinguishing dissolvedversus oil-droplet phases in assessing the fate, transport, and toxic effects of marine oil pollution, in: International Oil Spill Conference Proceedings. Presented at the International Oil Spill Conference, American Petroleum Institute, pp. 771–778.

Payne, J.F., Coady, J. and White, D. 2009. Potential effects of seismic airgun discharges on monkfish eggs (*Lophius americans*) and larvae (Environmental Studies Research Funds Report No. 170). Environmental Studies Research Funds, St. John's.

Pimental, D.L., Leach, R., Zuniga, and Morrison, D. 2000. Environmental and economic costs of nonindigenous species in the United States. Bioscience 50:53-65.

Polovina, J.J., Howell, E., Parker, D.M. and Balazs, G.H. 2003. Dive-depth distribution of loggerhead (*Caretta caretta*) and olive ridley (*Lepidochelys olivacea*) sea turtles in the central North Pacific: might deep longline sets catch fewer turtles? Fishery Bulletin 101:189–193.

Popper, A. N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T., Coombs, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Lokkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G., and Tavolga, W.N. 2014. ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI.

Prieto, R., Silva, M.A., Waring, G.T., and Gonçalves, J.M. 2014. Sei whale movements and behaviour in the North Atlantic inferred from satellite telemetry. Endangered Species Research 26: 103–113.

Rawson, C., Gagnon, M. and Williams, H. 2011. Montara well release olfactory analysis of Timor Sea fish fillets. Curtin University, Perth.

Rich, C. and Longcore, T. 2006. Ecological consequences of artificial night lighting. Island Press.

Richardson, W. J., Greene, C. R., Malme, C. I. and Thomson, D. H. 1995. Marine Mammals and Noise. Academic Press, San Diego.

Rodríguez, A., Burgan, G., Dann, P., Jessop, R., Negro, J.J., and Chiaradia, A. 2014. Fatal attraction of short-tailed shearwaters to artificial lights. PLoS ONE 9(10).

Rogers, D., Hassell, C., Boyle, A., Gosbell, K., Minton, C., Rogers, K., and Clarke, R. 2011. Shorebirds of the Kimberley Coast-Populations, key sites, trends and threats. Journal of the Royal Society of Western Australia 94: 377.

Romero, I.C., Schwing, P.T., Brooks, G.R., Larson, R.A., Hastings, D.W., Ellis, G., Goddard, E.A., and Hollander, D.J. 2015. Hydrocarbons in deep-sea sediments following the 2010 Deepwater Horizon blowout in the northeast Gulf of Mexico. PLOS ONE 10: e0128371. doi:10.1371/journal.pone.0128371.

RPS. 2018a. Shell Crux Project – Sediment Dispersion Modelling of Drill Cuttings and Fluids. Report prepared for Shell Australia Pty Ltd, Perth, Western Australia.

RPS. 2018b. Shell Crux Project – Hydrocarbon Spill Modelling. Report prepared for Shell Australia Pty Ltd, Perth, Western Australia.

Runcie, J., Macinnis-Ng, C. and Ralph, P. 2010. The toxic effects of petrochemicals on seagrassess - literature review. Institute for Water and Environmental Resource Management, University of Technology Sydney, Sydney.

Schmidt, J.V., Schmidt, C.L., Ozer, F., Ernst, R.E., Feldheim, K.A., Ashley, M.V. and Levine, M. 2009. Low genetic differentiation across three major ocean populations of the whale shark, Rhincodon typus. PLoS ONE 4: e4988. doi:10.1371/journal.pone.0004988.

Scholten, Mct., Kaag, N., Dokkum, H. van, Jak, R., Schobben, H., Slob, W. 1996.

Toxische effecten van olie in het aquatische milieu (TNO Report No. TNO-MEPR96/

230). den Helder.

Scholten, Mct., Kaag, N., Dokkum, H. van, Jak, R., Schobben, H., and Slob, W. 1996. Toxische effecten van olie in het aquatische milieu (TNO Report No. TNOMEPR96/ 230). den Helder.

Shaw, R. F., Lindquist, D. C., Benfield, M. C., Farooqi, T., and Plunket, J. T. 2002. Offshore petroleum platforms: functional significance for larval fish across longitudinal and latitudinal gradients. Prepared by the Coastal Fisheries Institute, Louisiana State University. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2002-077, p. 107.

Shell Development Australia (Shell). 2009. Prelude Floating LNG Project Draft Environmental Impact Statement, EPBC 2008/4146, October 2009.

Shell Development Australia (Shell). 2010. Prelude Floating LNG Project, Environmental Impact Statement (EPBC No. 2008/4146) Shell Development (Australia) Pty Ltd.

Shell Australia Pty Ltd. 2020. Crux Offshore Project Proposal. Document number: HSE_CRU_014827.

Shigenaka, G. 2001. Toxicity of oil to reef building corals: a spill response perspective (NOAA Technical Memorandum No. NOS OR&R 8). National Oceanic and Atmospheric Administration, Seattle.

Simmonds, M. P., Dolman, S. and Weilgart, L. (eds). 2004. Oceans of Noise: A WDCS Science Report. Whale and Dolphin Conservation Society. Wiltshire, UK

Sivle, L.D., Kvadsheim, P.H., Curé, C., Isojunno, S., Wensveen, P.J., Lam, F.-P.A., Visser, F., Kleivanec, L., Tyack, P.L., and Harris, C.M., 2015. Severity of Expert-Identified Behavioural responses of humpback whale, minke whale, and northern bottlenose whale to naval sonar. Aquatic Mammals 41.

Sleeman, J. C., Meekan, M. G., Fitzpatrick, B. J., Steinberg, C. R., Ancel, R., and Bradshaw, C. J., 2010. Oceanographic and atmospheric phenomena influence the abundance of whale sharks at Ningaloo Reef, Western Australia. Journal of Experimental Marine Biology and Ecology, 382(2), 77-81.

Smit, M.G., Holthaus, K.I., Trannum, H.C., Neff, J.M., Kjeilen-Eilertsen, G., Jak, R.G., Singsaas, I., Huijbregts, M.A., and Hendriks, A.J. 2008. Species sensitivity distributions for suspended clays, sediment burial, and grain size change in the marine environment. Environmental Toxicology and Chemistry 27: 1006–1012.

Smith, J.P., Brandsma, M.G., and Nedwed, T.J. 2004. Field verification of the Offshore Operators Committee (OOC) mud and produced water discharge model. Environmental Modelling & Software 19: 739–749.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene, C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P.L. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic mammals 33: 411–414.

Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowles, A.E., Ellison, W.T., Nowacek, D.P., and Tyack, P. 2019. Marine mammal noise exposure criteria: updated scientific recommendations for residual hearing effects. Aquatic Mammals, 45(2), 125-232.

Strain, L., Brown, J., and Jones, R. 2020. West Coast Roe's Abalone Resource Status Report. In: Status Reports of the Fisheries and Aqutic Resources of Western Australia 2019/20: The State of the Fisheries eds. D.J. Gaughan and K. Santoro. Department of Primary Industries and Regional Development, Western Australia. Pp 37-42

SVT. 2018. Crux Development– Underwater Noise Assessment. Report prepared for Shell Australia Pty Ltd, Perth, Western Australia.

Taylor, H.A., Rasheed, M.A. 2011. Impacts of a fuel oil spill on seagrass meadows in a subtropical port, Gladstone, Australia – the value of long-term marine habitat monitoring in high risk areas. Marine Pollution Bulletin 63: 431–437. doi:10.1016/j.marpolbul.2011.04.039.

Threatened Species Scientific Committee (TSSC). 2013. Approved conservation advice for *Rostratula australis* (Australian painted snipe). Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2014a. Approved Conservation Advice for *Glyphis garricki* (Northern River Shark). Department of the Environment, Canberra.

Threatened Species Scientific Committee (TSSC). 2014b. Approved Conservation Advice for *Pristis pristis* (largetooth sawfish). Department of the Environment, Canberra

Threatened Species Scientific Committee (TSSC) 2014c. Approved Conservation Advice for *Glyphis glyphis* (speartooth shark). Department of the Environment, Canberra

Threatened Species Scientific Committee (TSSC). 2015a. Approved Conservation Advice *Rhincodon typus* (whale shark). Department of the Environment, Canberra, Australian Capital Territory.

Threatened Species Scientific Committee (TSSC). 2015b. Approved Conservation Advice *Balaenoptera borealis (*sei whale*)*. Department of the Environment, Canberra, Australian Capital Territory.

Threatened Species Scientific Committee (TSSC). 2015c. Approved Conservation Advice *Balaenoptera physalus* (fin whale). Department of the Environment, Canberra, Australian Capital Territory.

Threatened Species Scientific Committee (TSSC). 2015d. Conservation advice *Anous tenuirostris melanops* Australian lesser noddy. Department of the Environment, Canberra.

Threatened Species Scientific Committee (TSSC) 2015e. Conservation advice *Calidris ferruginea* curlew sandpiper. Department of the Environment, Canberra.

Threatened Species Scientific Committee (TSSC) 2015f. Conservation advice *Numenius madagascariensis* eastern curlew. Department of the Environment, Canberra.

Threatened Species Scientific Committee (TSSC). 2015g. Conservation advice *Papasula abbotti* Abbott's booby. Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2015h. Conservation advice *Pterodroma mollis* soft-plumage petrel. Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2016a. Conservation advice *Calidris canutus* red knot. Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2016b. Conservation advice *Calidris tenuirostris* great knot. Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2016c. Conservation advice *Charadrius leschenaultii* greater sand plover. Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2016d. Conservation Advice *Charadrius mongolus* lesser sand plover. Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2016e. Conservation advice *Limosa lapponica* menz bar-tailed godwit (western Alaskan). Threatened Species Scientific Committee, Canberra.

Threatened Species Scientific Committee (TSSC). 2016f. Conservation advice *Limosa lapponica* baueri bar-tailed godwit (western Alaskan). Threatened Species Scientific Committee, Canberra.

Trannum, H.C., Nilsson, H.C., Schaanning, M.T. and Øxnevad, S. 2010. Effects of sedimentation from water-based drill cuttings and natural sediment on benthic macrofaunal community structure and ecosystem processes. Journal of

Experimental Marine Biology and Ecology 383: 111–121. doi:10.1016/j.jembe.2009.12.004.

Tsvetnenko, Y. 1998. Derivation of Australian tropical marine water quality criteria for the protection of aquatic life from adverse effects of petroleum hydrocarbons. Environmental Toxicology and Water Quality: An International Journal 13: 273–284.

UNITAR 2015. Resource Guide for Advanced Learning on Predicting and Projecting Climate Change. The One UN Climate Change Learning Program. United Nations Institute for Training and Research. Available at: https://www.uncclearn.org/sites/default/files/guide_predicting_and_projecting.pdf

United Nations Environment Programme Industry and Environment Centre (UNEP IE) and Oil Industry International Exploration and Production Forum.1997. Environmental management in oil and gas exploration and production: An overview of issues and management approaches.

Vanderlaan, A.S.M., and Taggart, C.T. 2007. Vessel collisions with whales: the probability of lethal injury based on vessel speed. Marine Mammal Science 23, 144–156. Doi:10.1111/j.1748- 7692.2006.00098.x.

Varela, M., Bode, A., Lorenzo, J., Álvarez-Ossorio, M.T., Miranda, A., Patrocinio, T., Anadón, R., Viesca, L., Rodríguez, N., Valdés, L., Cabal, J., Urrutia, Á., García-Soto, C., Rodríguez, M., Álvarez-Salgado, X.A. and Groom, S. 2006. The effect of the “Prestige” oil spill on the plankton of the N–NW Spanish coast. Marine Pollution Bulletin 53: 272– 286. doi:10.1016/j.marpolbul.2005.10.005.

Westera, M., and Babcock, R. 2016. Understanding the environmental risks of unplanned discharges - the Australian context: fishes (Document No. 1128_01_001/5_Rev1). Australian Petroleum Production and Exploration Association, Perth.

Wilson, K. and Ralph, P. 2011. Effects of oil and dispersed oil on temperate seagrass: scaling of pollution impacts. Plant Functional Biology and Climate Change Cluster, Sydney.

Witherington B. and R. Martin. 1996. Understanding, assessing, and resolving light pollution problems on sea turtle nesting beaches, Florida Marine Research Institute Technical Report, TR-2.

Woodside Energy Limited (Woodside). 2008. Torosa South - 1 (TS-1) Pilot Appraisal well, Environmental Monitoring Program - Development of Methodologies Part 1 (p51). Report produced by Environmental Resources Management and SKM.

12. Abbreviations

Acronym	Description
°C	Degrees Celsius
>	Greater than
%	Percent
AAR	After Action Review
ABF	Australian Border Force
ACAP	The Agreement on the Conservation of Albatrosses and Petrels
ACCUs	Australian Carbon Credit Units
ACF	Australian Conservation Foundation
ADB	Asian Development Bank
ADF	Australian Defence Force
AFMA	Australian Fisheries Management Authority
AHD	Along Hole Depth
AHS	Australian Hydrographic Service
AHTS	Anchor Handling Tug Supply
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
AMSC	Australian Marine Conservation Society
ANSI	American National Standards Institute
ANZECC & ARMCANZ	Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand
APPEA	Australian Petroleum Production & Exploration Association
ARPA	Automatic Radar Plotting Acid
ASBTIA	Australian Southern Bluefin Tuna Industry Association
BOD	Biological Oxygen Demand
BOM	Bureau of Meteorology
BOP	Blowout Preventer
BIA	Biologically Important Area

Acronym	Description
BTEX	Benzene, toluene, ethylbenzene, xylenes
BWMP	Ballast Water Management Plan
CAMBA	China-Australia Migratory Bird Agreement
CAR	Construction All Risk
Cd	Cadmium
CER	Clean Energy Regulator
CFA	Commonwealth Fisheries Association
CHARM	Chemical Hazard and Risk Management
CMT	Crisis Management Team
CO_2	Carbon dioxide
COLREGS	International Regulations for Preventing Collisions at Sea 1972
CR	Corporate Relations
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cth	Commonwealth
DAWE	Department of Agriculture, Water and the Environment
DAC	Djarindjin Aboriginal Corporation
DBCA	Department of Biodiversity Conservation and Attractions
DEWHA	Department of Environment, Water, Heritage and Arts
DFAT	Department of Foreign Affairs
DFES	Department of Fire and Emergency Services
DHA	Department of Home Affairs
DMIRS	Department of Mines, Industry Regulation & Safety
DoT	Department of Transport
DP	Dynamic Positioning
DPIRD	WA Department of Primary Industries and Regional Development
DPLH	Department of Planning, Land and Heritage
DSV	Drilling Supervisor
DWER	Department of Water & Environmental Regulation
EAAFP	The East Asian – Australian Flyway Partnership 2006
eDNA	Environmental Deoxyribonucleic acid
EDOWA	Environmental Defender's Office of WA
EGR	External and Government Relations

Acronym	Description
EHS	Environment, Health, and Safety
EIAPP	Engine International Air Pollution Prevention
EMBA	Environment that May Be Affected
EMGS	Emergency Diesel Generators
EP	Environmental Plan
EPBC Act	Environmental Protection Biodiversity and Conservation Act 1999
EPO	Environmental Performance Outcome
EPS	Environmental Performance Standards
ER	Emergency Response
ERP	Emergency Response Plan
ERT	Emergency Response Team
ESD	Ecological Sustainable Development
ESHIA	Environmental, Social and Health Impact Assessment
EU	European Union
EUL	Environment Unit Lead
Ev	Exposure value
FESA	Department of Fire and Emergency Services
FIM	Fountain Incident Management
FLNG	Floating Liquefied Natural Gas
FOB	Forward Operations Base
FPSO	Floating Production Storage and Offloading
FSR	Facility Status Report
FWAD	Fixed Wing Aerial Dispersant
g/m^2	Grams per square meter
GHG	Greenhouse Gas
GHGEM	Greenhouse Gas Emergency Management
GHGEMP	Greenhouse Gas Emergency Management Plan
GMAS	Group Maritime Assurance System
GPS	Global Positioning System
GRSN	Global Response Support Network
H	High

Acronym	Description
HEMP	Hazards and Effects Management Process
HFO	Heavy Fuel Oil
Hg	Mercury
HSSE	Health, Security, Safety, and Environment
HWU	Hydraulic Workover Unit
Hz	Hertz
IACD	International Association of Drilling Contractors
IAP	Incident Action Plan
IAPP	International Air Pollution Prevention Certificate
ICS	Incident Command System
IEE	International Energy Efficiency
IFC	International Finance Corporation
IFO	Intermediate Fuel Oil
IMCRA	Integrated Marine and Coastal Regionalisation of Australia
IMO	International Maritime Organisation
IMR	Inspection Maintenance Repair
IMS	Invasive Marine Species
IMT	Incident Management Team
IOGP	International Association of Oil and Gas Producers
IOPP	International Oil Pollution Prevention
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
ISPP	International Sewage Pollution Prevention
IUCN	International Union for the Conservation of Nature
IWCF	International Well Control Forum
JAMBA	Japan-Australia Migratory Bird Agreement
JTSI	Department of Jobs, Tourism, Science and Innovation
KEF	Key Ecological Feature
Kj	Kilojoules
km	kilometre
L	Low

Acronym	Description
LAO	Linear Alpha Olefin
LCV	Light Construction Vessel
LNG	Liquefied Natural Gas
LOC	Loss of Containment
LOS	Line of Sight
London Convention	London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972
LOWC	loss of well control
LSC	Logistic Section Chief
Lux	Luminous flux per unit area
M	medium
m	Metre
m^2	Square metre
m^3	Cubic metre
MARPOL	International Convention for Prevention of Pollution from Ships
MARS	Maritime Arrivals Reporting System
MBC	Maritime Border Command
MDO	Marine Diesel Oil
MEG	Mono-ethylene Glycol
MFO	Marine Fauna Observers
mm	millimetres
MNES	Matters of National Environmental Significance
MOC	Management of Change
MODU	Mobile Offshore Drilling Unit
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MPR	Modular Platform Rig
MS	Management System
MSL	Mean Sea Level
MWS	Marine Warranty Surveyor
N/A	Not Applicable
NAXA	North Australian Exercise Area

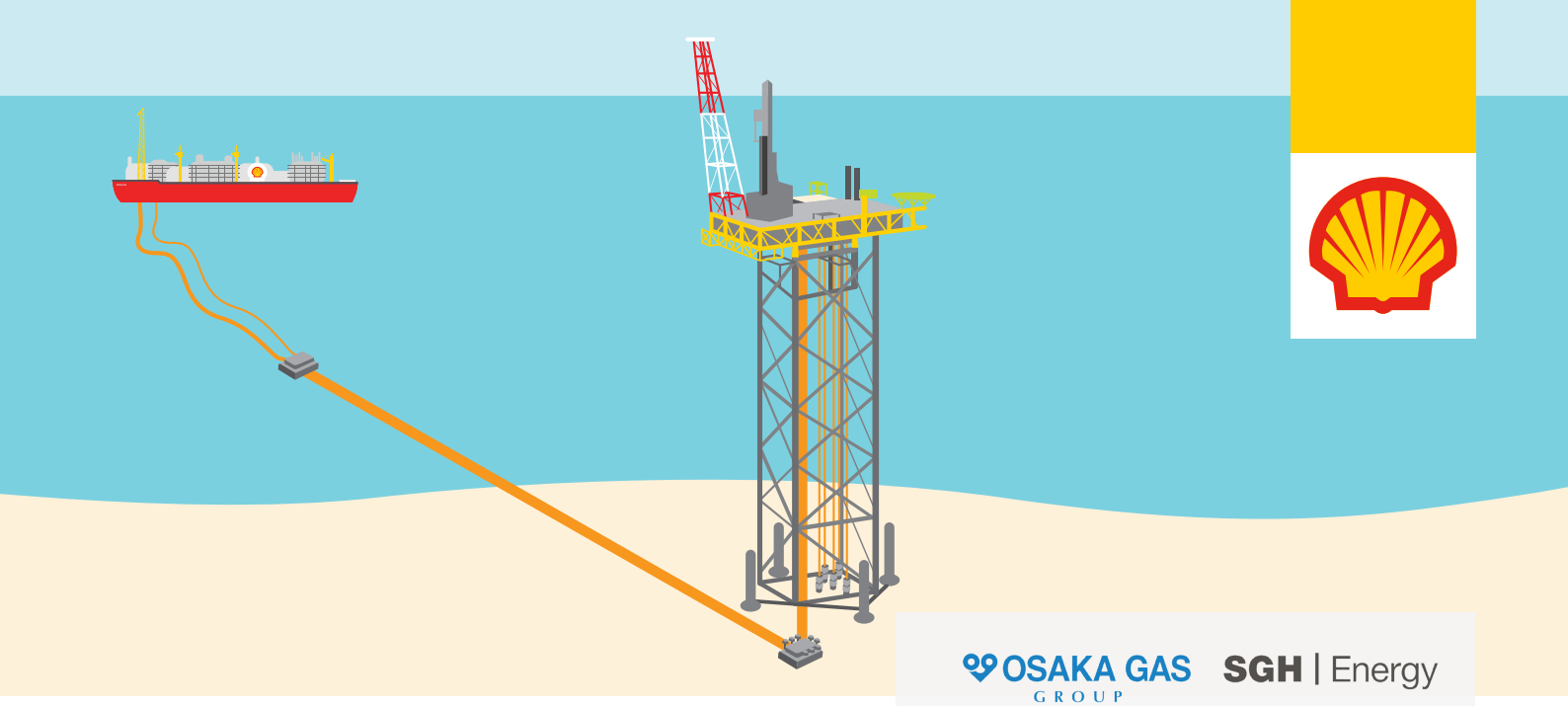
Acronym	Description
NDC	Nationally Determined Contributions
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measures
NGER Act	National Greenhouse and Energy Reporting Act 2007
NGO	Non-governmental Organisations
NLPG	National Light Pollution Guidelines for Wildlife
NOAA	National Oceanic and Atmospheric Administration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOx	Nitrogen oxides
NO_2	Nitrogen dioxide
NPI	National Pollutant Inventory
NT	Northern Territory
NWBM	Non water based muds
NWMR	North-West Marine Region
OCIMF	Oil Companies International Marine Forum
OCNS	Offshore Chemical Notification Scheme
ODS	Ozone Depleting Substances
OILMAP	Oil Spill Model and Response System
OIM	Offshore Installation Manager
OMP	Operational Monitoring Plan
OP	Operating Plan
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Commonwealth Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPP	Offshore Project Proposal
OSC	Operations Section Chief
OSM	Operational and Scientific Monitoring
OSMP	Operational and Scientific Monitoring Plan
OSPAR	Oil Spill Prevention, Administration and Response
OSRL	Oil Spill Response Limited
OSRO	Oil Spill Response Organisation

Acronym	Description
OVID	Offshore Vessel Inspection Database
OWR	Oiled Wildlife Response
PA	Parks Australia
PAH	Polycyclic aromatic hydrocarbon
pH	Power of Hydrogen
PIO	Public Information Officer
PLONOR	Pose Little or No Risk to the Environment
PM	Particulate Matter
PM_{10} / $PM_{2.5}$	Particulate Matter with aerodynamic diameter less than 10 microns or 2.5 microns respectively
PMR	Performance Monitoring and Reporting
PMST	Protected Matters Search Tool
POPs	Persistent Organic Pollutants
ppb	Parts per billion
ppm	Parts per million
PSC	Planning Section Chief
PSZ	Petroleum Safety Zone
PTS	Permanent threshold shift
PTW	Permit to Work
RAM	Risk Assessment Matrix
Ramsar	International Convention on Wetlands of International Importance 1975
RAN	Royal Australian Navy
RMR	Riserless Mud Recovery
RNTBC	Registered Native Title bodies Corporate
RO	Reverse Osmosis
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
ROV	Remote Operated Vehicle
RWIS	Relief Well Injection Spoon
SA	Shell Australia
SAI	Shell Aircraft International
SBM	Synthetic Based Mud

Acronym	Description
SCAT	Shoreline Clean-up Assessment Technique
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SFRT	Subsea First Response Toolkit
SGGS	Synthetic Greenhouse Gases
SIMA	Spill Impact Mitigation Assessment
SIMAP	Spill Impact Mapping and Assessment Program
SIRT	Subsea Incident Response Toolkit
SMART	Specific, Measurable, Achievable, Realistic and Timely
SME	Subject Matter Expert
SMEEC	State Maritime Environmental Emergency Coordinator
SMP	Scientific Monitoring Plan
SO_x	Sulphur oxides
SO_2	Sulphur dioxide
SOLAS	Safety of Life at Sea Convention 1974
SOPEP	Shipboard Oil Pollution Emergency Plan
SP	Social Performance
SSDI	Subsea Dispersant Injection
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
SWEO	Senior Well Engineer Operations
tCO_2e	Tonnes of carbon dioxide equivalent
TD	Total Depth
TEC	Threatened Ecological Community
The Bonn Convention	Convention on the Conservation of Migratory Species of Wild Animals 1979.
TRP	Tactical response Plans
TTS	Temporary Threshold Shift
US EPA	United States Environmental Protection Agency
UV	Ultra Violet
UXO	Unexploded Ordinance
VOC	Volatile Organic Compound

Acronym	Description
W	West
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WAOWRP	WA Oiled Wildlife Response Plan
WB	World Bank
WBCU	Wellbore Clean Up
WBM	Water Based Mud
WCVERT	Well Control Virtual Emergency Response Team
WOMP	Well Operations Management Plan
WWF	World Wildlife Fund

Appendix A Crux Development Drilling Fact Sheet



CRUX DRILLING ENVIRONMENT PLAN

ABOUT CRUX

The Crux project forms an important part of Shell Australia's gas portfolio and remains an important backfill opportunity for the existing Prelude FLNG facility. The project consists of a not normally manned platform with five production wells, in ocean waters approximately 165 m deep. The facility will be connected to Prelude via a 160km export pipeline and will be operated remotely from the Prelude FLNG facility.

The project is being progressed by operator Shell Australia in joint venture with Seven Group Holdings Energy and Osaka Gas Australia.

Representative Mobile Offshore Drilling Unit

Location:
Browse Basin, 190 km offshore north-west Australia and 620 km north-east of Broome

Offshore Petroleum Titles:
In Commonwealth Waters and the Territory of Ashmore and Cartier Islands, Retention Lease AC/RL9

Proposed Activity:
Installation of a drilling template, guideposts and five deviated production wells

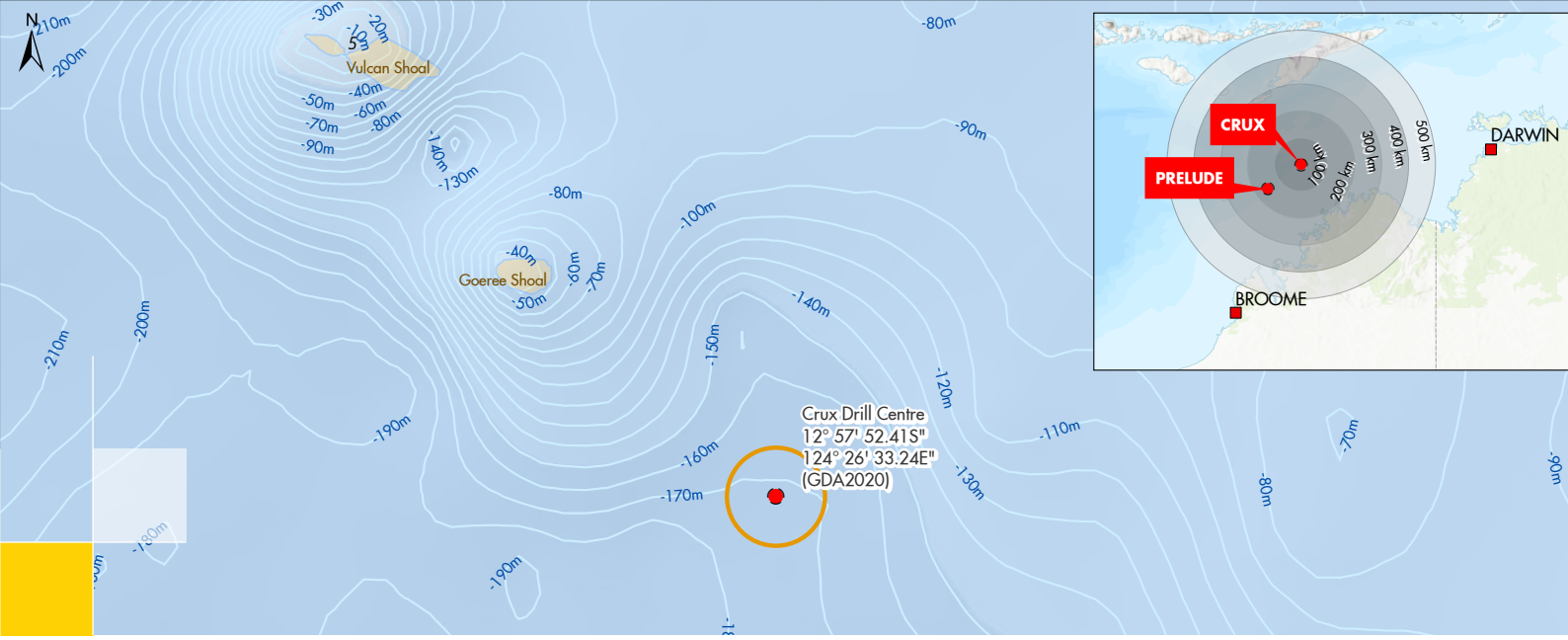
Drilling Methodology:
Mobile Offshore Drilling Unit; batch drilling; temporary suspension

Water depth at drilling location:
165 m

Timing*

- Expected Drilling Template Installation – Q1-Q3 2023 for 2-4 weeks
- Expected Mobile Offshore Drilling Unit Operations – Q3-Q4 2023 for approximately 2 years. Scope completed no later than the end of 2025
- Expected temporary well suspension period, approximately 2-3 years.

*Dates for the commencement of activities and durations are subject to schedule changes. Respective relevant persons will be kept informed of any significant changes to the proposed schedule.



ENVIRONMENTAL APPROVAL

Before Shell begins substantial work on major projects or existing facilities, regulatory, environmental and social impacts are assessed, alongside commercial and technical considerations.

The Crux Offshore Project Proposal was accepted in August 2020 by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and is publicly available on the NOPSEMA website.

The Crux drilling program is the first infield activity planned to occur to support the execution of the Crux development.

Future Environment Plans will cover:

- The installation and commissioning of the remaining Crux substructure, platform and other project infrastructure.
- The startup, commissioning and operations of Crux, including the completion and clean-up of the Crux production wells drilled by the Mobile Offshore Drilling Unit.

ACTIVITY DESCRIPTION

The Crux Drilling Environment Plan includes provision for the installation of a drilling template, guideposts and five deviated production wells via the preinstalled drilling template. The location of the drill center has been selected to optimise well length and reservoir penetration, and for avoidance of any potential subsurface hazards.

- **The drilling template:** provides a guide for the drill bit during drilling activities. It is a steel structure with 8 drill slots to allow for drilling of 5 production wells with spares for contingent drilling activities (i.e. respudding) It will be installed on the seabed at the drill center location by a Light Construction Vessel of Class DNV 1A1 (or similar). It will remain on location for the life of the asset.
- **The guideposts:** ensure that the Crux substructure and topsides are accurately positioned over the drilling template when installed during the subsequent installation campaigns. The guideposts will remain on location at the seabed for the life of the asset. The drilling template and guideposts have an approximate structural footprint of Length 28 m X Width 9 m X Height 10 m
- **The wells:** will be drilled and suspended from a Mobile Offshore Drilling Unit, prior to installation of the Crux Substructure and Topsides. They will be drilled from a single drill center, via the pre-installed drilling template. The wells will be suspended and left in-situ with well completions planned to occur following installation of the Crux platform.
- **Mobile Offshore Drilling Unit:** This will be a semi-submersible Mobile Offshore Drilling Unit – which will be held in position by anchor spread.

The development drilling program will be supported by a range of services including helicopter transfers from mainland Australia, a dedicated installation vessel, four anchor handling, tug and support vessels and remotely operated vehicles undertaking inspection, maintenance and repair activities.

ENVIRONMENTAL MANAGEMENT

The Crux drilling campaign has been designed to operate and manage environmental risks to as low as reasonably practicable (ALARP) and acceptable levels. The table below provides a summary of key environmental risks and mitigation measures.

Risk/Impact	Mitigation measures
Planned	
Physical presence, vessel movements and seabed disturbance	▪ Exclusion of non-project vessel from the 500 m Petroleum Safety Zone ▪ Implementation of national and international regulations and conventions for collision prevention, safety and navigation at sea. ▪ Maintenance of a minimum 1 km buffer from shoals and the Operational Area ▪ *Environmental Protection and Biodiversity Conservation Regulations (2000) (EPBC Regulations), Part 8.1 – Interacting with cetaceans* ▪ Mobile Offshore Drilling Unit anchoring plan ▪ Notice to Mariners highlighting Petroleum Safety Zone and operational activities
Lighting	▪ External lighting on offshore facilities minimised to that required for navigation, safety of deck operations and security considerations
Noise	▪ Maintenance of a minimum 1 km buffer from shoals and the Operational Area ▪ EPBC Regulations *Part 8.1 – Interacting with cetaceans* ▪ Marine fauna observations
Drilling mud/ cuttings/cement discharge	▪ Chemical Management Process for chemical assessment and selection ▪ No planned discharge of whole Synthetic Based Mud (SBM) will occur during development drilling ▪ When using SBM, the solids control equipment will reduce the residual base fluid on cuttings content to acceptable levels prior to discharge overboard
Discharge of Liquid Effluent	▪ Comply with relevant requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) and associated regulations ▪ Chemical Management Process for chemical assessment and selection
Atmospheric Emissions	▪ Comply with relevant requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) and associated regulations. ▪ Relevant vessels to have a valid International Air Pollution Prevention Certificate ▪ Use of low sulphur fuel when possible
Greenhouse Gas Emissions	▪ Comply with International Convention for the Prevention of Pollution from Ships (MARPOL) requirements and associated regulations ▪ Comply with the *National Greenhouse and Energy Reporting Act (2007)* and *National Greenhouse and Energy Reporting Regulations (2008)*
Waste Management	▪ Discharge of waste from vessels will comply with relevant International Convention for the Prevention of Pollution from Ships (MARPOL) requirements and associated regulations ▪ Waste management procedures ▪ Waste tracking process ▪ The management and disposal of any quarantine risk material will be in accordance with state and commonwealth regulations

Unplanned	
Emergency Events – Hydrocarbon Spill	▪ Align with relevant International Convention for the Prevention of Pollution from Ships requirements and subsequent regulations ▪ Valid Shipboard Oil Pollution Emergency Plan or Shipboard Marine Pollution Emergency Plan (as appropriate for vessel classification) ▪ Implementation of national and international regulations and conventions for collision prevention, safety and navigation at sea ▪ Offshore Vessel Inspection Database (OVID) process ▪ Australian Hydrographic Office notified of location of installed infrastructure to facilitate inclusion on nautical charts ▪ Australian Hydrographic Office advised of project activities to facilitate issuing Notice to Mariners ▪ NOPSEMA accepted Well Operations Management Plan (WOMP) in place for all wells ▪ NOPSEMA accepted Environment Plan and Oil Pollution Emergency Plan (OPEP) in place ▪ Stakeholder consultation process ▪ Maintenance management system ▪ Simultaneous operations management plans where required ▪ Accepted safety case in place prior to commencing drilling operations ▪ Scientific Monitoring Plan ▪ Shell Source Control Emergency Response Plan
Introduction of Invasive Marine Species from Vessels	▪ Ballast water exchange operations will comply with the international conventions and associated national regulations. ▪ Biofouling management for vessels in accordance with state, national and international biofouling management guidelines ▪ Biofouling management in compliance with state and commonwealth regulations ▪ Vessels (of appropriate class) will have a valid International Anti-Fouling System Certificate ▪ Maintenance of a minimum 1 km buffer from shoals and the Operational Area

NOTIFICATION TO MARINE USERS

The 500 m Petroleum Safety Zone will be established under the *Offshore Petroleum and Greenhouse Gas Storage Act (2006)* and administered by NOPSEMA. This zone will also be marked on all relevant marine navigation charts issued through the Australian Hydrographic Office. Because the suspended wells, drilling template and guideposts will be left in-situ following the completion of the drilling activities, the Petroleum Safety Zone will remain in place for subsequent installation campaigns and for the operating life of the Crux development. A notice to mariners will be issued via the Australian Hydrographic Office in advance of the drilling template and guidepost installation campaign, detailing the Petroleum Safety Zone and associated restrictions of entry.

FEEDBACK

Shell welcomes any feedback on the proposed Crux Drilling Environment Plan submission including requests to receive further information. Please contact us using the following details.

CONTACT US

Community Hotline: 1800 059 152

Email: SDA-crux-project@shell.com

www.shell.com.au/crux

/shell

@shell_australia

Appendix B PMST Search

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: 20-Apr-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:	2
National Heritage Places:	3
Wetlands of International Importance (Ramsar	7
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	13
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	115
Listed Migratory Species:	94

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:	231
Commonwealth Heritage Places:	45
Listed Marine Species:	166
Whales and Other Cetaceans:	32
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	3
Australian Marine Parks:	37
Habitat Critical to the Survival of Marine Turtles:	6

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	79
Regional Forest Agreements:	None
Nationally Important Wetlands:	24
EPBC Act Referrals:	527
Key Ecological Features (Marine):	16
Biologically Important Areas:	99
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Legal Status
Kakadu National Park	NT	Declared property
The Ningaloo Coast	WA	Declared property

National Heritage Places [Resource Information]

Name	State	Legal Status
Natural		
Kakadu National Park	NT	Listed place
The Ningaloo Coast	WA	Listed place
The West Kimberley	WA	Listed place

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Ashmore reef national nature reserve	Within Ramsar site
Cobourg peninsula	Within Ramsar site
Hosnies spring	Within Ramsar site
Kakadu national park	Within Ramsar site
Pulu keeling national park	Within Ramsar site
Roebuck bay	50 - 100km upstream from 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 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
EEZ and Territorial Sea
EEZ and Territorial Sea
EEZ and Territorial Sea

Feature Name
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf
Extended Continental Shelf

Extended Continental Shelf

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.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Monsoon vine thickets on the coastal sand dunes of Dampier Peninsula	Endangered	Community likely to occur within 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
BIRD		
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

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting 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	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Epthianura crocea tunneyi Alligator Rivers Yellow Chat, Yellow Chat (Alligator Rivers) [67089]	Endangered	Species or species habitat known to 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
Falco hypoleucos Grey Falcon [929]	Vulnerable	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 known 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

Scientific Name	Threatened Category	Presence Text
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	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within 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
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Malurus coronatus coronatus Purple-crowned Fairy-wren (western) [64442]	Endangered	Species or species habitat may occur within area
Malurus leucopterus edouardi White-winged Fairy-wren (Barrow Island), Barrow Island Black-and-white Fairy-wren [26194]	Vulnerable	Species or species habitat likely to 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 habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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	Species or species habitat known 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 [77037]	Endangered	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding known to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	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
Turdus poliocephalus erythropleurus Christmas Island Thrush [67122]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
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
FISH		
Milyeringa veritas		
Blind Gudgeon [66676]	Vulnerable	Species or species habitat known to occur within area
Ophisternon candidum		
Blind Cave Eel [66678]	Vulnerable	Species or species habitat known to occur within area
Thunnus maccoyii		
Southern Bluefin Tuna [69402]	Conservation Dependent	Breeding known to occur within area
FROG		
Uperoleia daviesae		
Howard River Toadlet, Davies's Toadlet [85375]	Vulnerable	Species or species habitat known to occur within area
MAMMAL		
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
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Bettongia lesueur Barrow and Boodie Islands subspecies		
Boodie, Burrowing Bettong (Barrow and Boodie Islands) [88021]	Vulnerable	Species or species habitat known 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 likely to occur within area
Hipposideros inornatus		
Arnhem Leaf-nosed Bat [86675]	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
Isoodon auratus barrowensis		
Golden Bandicoot (Barrow Island) [66666]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes conspicillatus conspicillatus		
Spectacled Hare-wallaby (Barrow Island) [66661]	Vulnerable	Species or species habitat known to occur within area
Lagorchestes hirsutus Central Australian subspecies		
Mala, Rufous Hare-Wallaby (Central Australia) [88019]	Endangered	Translocated population known to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat 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
Osphranter robustus isabellinus Barrow Island Wallaroo, Barrow Island Euro [89262]	Vulnerable	Species or species habitat likely to occur within area
Petrogale concinna canescens Nabarlek (Top End) [87606]	Endangered	Species or species habitat known to occur within area
Petrogale concinna monastria Nabarlek (Kimberley) [87607]	Endangered	Species or species habitat known to occur within area
Petrogale lateralis lateralis Black-flanked Rock-wallaby, Mororong, Black-footed Rock Wallaby [66647]	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
Pteropus natalis Christmas Island Flying-fox, Christmas Island Fruit-bat [87611]	Critically Endangered	Species or species habitat known to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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
Trichosurus vulpecula arnhemensis		
Northern Brushtail Possum [83091]	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
Zyzomys maini		
Arnhem Rock-rat, Arnhem Land Rock-rat, Kodjperr [25906]	Vulnerable	Species or species habitat may occur within area
PLANT		
Asplenium listeri		
Christmas Island Spleenwort [65865]	Critically Endangered	Species or species habitat known to occur within area
Atalaya brevialata		
[86125]	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
Elaeocarpus miegei		
[65147]	Endangered	Species or species habitat known to occur within area
Goodenia quadrifida		
[56035]	Vulnerable	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

Scientific Name	Threatened Category	Presence Text
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 known to occur within area
Tarennoidea wallichii [65173]	Endangered	Species or species habitat known 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
Typhonium taylori a herb [65904]	Endangered	Species or species habitat likely to occur within area
Xylopia monosperma a shrub [82030]	Endangered	Species or species habitat known to occur within area
REPTILE		
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

Scientific Name	Threatened Category	Presence Text
Aipysurus foliosquama Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur 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
Ctenotus zastictus Hamelin Ctenotus [25570]	Vulnerable	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
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
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Lucasium occultum		
Yellow-snouted Gecko, Yellow-snouted Ground Gecko [82993]	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
SHARK		
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
Sphyrna lewini		
Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
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 likely to 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

Scientific Name	Threatened Category	Presence Text
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 carteri Indian Yellow-nosed Albatross [64464]	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
Migratory Marine Species		
Anoxypristis cuspidata Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat known to 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

Scientific Name	Threatened Category	Presence Text
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
Carcharhinus longimanus Oceanic Whitetip Shark [84108]		Species or species habitat 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	Breeding 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
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Species or species habitat likely to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
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
Megaptera novaeangliae Humpback Whale [38]		Breeding known to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat known to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Breeding known to occur within area
Orcaella heinsohni Australian Snubfin Dolphin [81322]		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

Scientific Name	Threatened Category	Presence Text
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 sahulensis as Sousa chinensis		
Australian Humpback Dolphin [87942]		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		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting 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]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting known to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat 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]		Roosting 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]		Roosting known to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa incana Wandering Tattler [831]		Roosting 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]		Roosting 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]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [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.

Commonwealth Land Name	State
Attorney-General - Australian Customs Service	
Commonwealth Land - Australian Customs Service [70998]	NT
Attorney-General - Australian Government Solicitor	
Commonwealth Land - Australian Government Solicitor [70444]	NT
Commonwealth Land - Australian Government Solicitor [70208]	NT

Commonwealth Land Name	State
Commonwealth Land - Australian Government Solicitor [70450]	NT
Commonwealth Land - Australian Government Solicitor [70089]	NT
Commonwealth Land - Australian Government Solicitor [70996]	NT
Commonwealth Land - Australian Government Solicitor [71135]	NT
Commonwealth Land - Australian Government Solicitor [70332]	NT
Commonwealth Land - Australian Government Solicitor [70092]	NT
Commonwealth Land - Australian Government Solicitor [70093]	NT
Commonwealth Land - Deputy Crown Solicitor [70994]	NT
Commonwealth Land - Deputy Crown Solicitor [70333]	NT
Commonwealth Land - Deputy Crown Solicitor [70334]	NT
Defence	
Defence - AUSTRALIAN ARMY BAND - DARWIN [70042]	NT
Defence - BERRIMAH ONE [70053]	NT
Defence - DARWIN - AP10 RADAR SITE - LEE POINT [70021]	NT
Defence - DARWIN - AP3 RECEIVING STATION - LEE POINT [70044]	NT
Defence - DARWIN RELOCATIONS CENTRE [70045]	NT
Defence - DARWIN RIVER GRAVEL QUARRY [70025]	NT
Defence - DARWIN RIVER GRAVEL QUARRY [70026]	NT
Defence - DARWIN - TRANSMITTING STATION '11 MILE' [70027]	NT
Defence - DEFENCE FORCE CAREERS REFERENCE CENTRE [70046]	NT
Defence - ELIZABETH DOWNS STATION RADAR SITE [70084]	NT
Defence - ELIZABETH DOWNS STATION RADAR SITE [70085]	NT
Defence - Esanda Builidng [70048]	NT
Defence - EXMOUTH ADMIN & HF TRANSMITTING [50129]	WA
Defence - EXMOUTH ADMIN & HF TRANSMITTING [50126]	WA
Defence - EXMOUTH ADMIN & HF TRANSMITTING [50127]	WA
Defence - EXMOUTH ADMIN & HF TRANSMITTING [50128]	WA

Commonwealth Land Name	State
Defence - EXMOUTH ADMIN & HF TRANSMITTING [50124]	WA
Defence - EXMOUTH ADMIN & HF TRANSMITTING [50125]	WA
Defence - EXMOUTH VLF TRANSMITTER STATION [50122]	WA
Defence - EXMOUTH VLF TRANSMITTER STATION [50123]	WA
Defence - HMAS COONAWARRA (Berrimah) [70050]	NT
Defence - HMAS COONAWARRA (Berrimah) [70051]	NT
Defence - HMAS COONAWARRA (Berrimah) [70049]	NT
Defence - HUMPTY DOO TRANSMITTING STATION [70039]	NT
Defence - HUMPTY DOO TRANSMITTING STATION [70040]	NT
Defence - KANGAROO FLATS TRAINING AREA [70056]	NT
Defence - KANGAROO FLATS TRAINING AREA [70058]	NT
Defence - KANGAROO FLATS TRAINING AREA [70057]	NT
Defence - KANGAROO FLATS TRAINING AREA [70054]	NT
Defence - KANGAROO FLATS TRAINING AREA [70055]	NT
Defence - KOWANDI NORTH COMMUNICATION STATION [70060]	NT
Defence - KOWANDI NORTH COMMUNICATION STATION [70059]	NT
Defence - KOWANDI SOUTH REPEATING STATION [70079]	NT
Defence - KOWANDI SOUTH REPEATING STATION [70080]	NT
Defence - KOWANDI SOUTH REPEATING STATION [70081]	NT
Defence - KOWANDI SOUTH REPEATING STATION [70082]	NT
Defence - LARRAKEYAH BARRACKS [70061]	NT
Defence - LEANYER BOMBING RANGE [70024]	NT
Defence - LEANYER BOMBING RANGE [70023]	NT
Defence - LEANYER BOMBING RANGE [70022]	NT
Defence - LEARMONTH RADAR SITE - VLAMING HEAD EXMOUTH [50001]	WA
Defence - MT GOODWIN RADAR SITE [70063]	NT

Commonwealth Land Name	State
Defence - Patrol Boat Base (DARWIN NAVAL BASE) [70041]	NT
Defence - QUAIL ISLAND BOMBING RANGE [70003]	NT
Defence - RAAF BASE DARWIN [70072]	NT
Defence - RAAF BASE DARWIN [70073]	NT
Defence - ROBERTSON BARRACKS (Waler Barracks) [70030]	NT
Defence - SHOAL BAY RECEIVING STATION [70036]	NT
Defence - SHOAL BAY RECEIVING STATION [70038]	NT
Defence - SHOAL BAY RECEIVING STATION [70037]	NT
Defence - STOKES HILL OIL FUEL INSTALLATION [70035]	NT
Defence - WINNELLIE ONE [70076]	NT
Defence - WINNELLIE TWO [70077]	NT
Defence - YAMPI SOUND TRAINING AREA [50145]	WA
Defence - Defence Housing Authority	
Commonwealth Land - Director of Property Services Defence Estate [70715]	NT
Commonwealth Land - Director of Property Services Defence Estate [70714]	NT
Commonwealth Land - Director of Property Services Defence Estate [70856]	NT
Commonwealth Land - Director of Property Services Defence Estate [71000]	NT
Commonwealth Land - Director of Property Services Defence Estate [70858]	NT
Commonwealth Land - Director of Property Services Defence Estate [70855]	NT
Commonwealth Land - Director of Property Services Defence Estate [70722]	NT
Environment and Heritage	
Commonwealth Land - Christmas Island National Park [94103]	CI
Commonwealth Land - Christmas Island National Park [94102]	CI
Commonwealth Land - Christmas Island National Park [94105]	CI
Commonwealth Land - Christmas Island National Park [94101]	CI

Commonwealth Land Name	State
Commonwealth Land - Christmas Island National Park [94104]	CI
Commonwealth Land - Kakadu National Park [70835]	NT
Commonwealth Land - Kakadu National Park [70851]	NT
Commonwealth Land - Kakadu National Park [70850]	NT
Commonwealth Land - Kakadu National Park [70852]	NT
Commonwealth Land - Kakadu National Park [71139]	NT
Commonwealth Land - Kakadu National Park [71099]	NT
Commonwealth Land - Kakadu National Park [71129]	NT
Commonwealth Land - Pulu Keeling National Park [95001]	CKI
Commonwealth Land - Pulu Keeling National Park [95002]	CKI
Family and Community Services - Department of Community Services & Health	
Commonwealth Land - Department of Community Services & Health [70720]	NT
Finance and Administration	
Commonwealth Land - Department of Administrative Services [70210]	NT
Commonwealth Land - Department of Administrative Services [70590]	NT
Commonwealth Land - Department of Administrative Services [70091]	NT
Immigration and Multicultural and Indigenous Affairs - Department of Immigration Local Government and Ethnic Affairs	
Commonwealth Land - Department of Immigration Local Government & Ethnic Affairs [70336]	NT
Transport and Regional Services	
Commonwealth Land - Department of Transport & Regional Development [70207]	NT
Unknown	
Commonwealth Land - [94237]	CI
Commonwealth Land - [94203]	CI
Commonwealth Land - [94247]	CI
Commonwealth Land - [94240]	CI
Commonwealth Land - [94242]	CI

Commonwealth Land Name	State
Commonwealth Land - [94243]	CI
Commonwealth Land - [94246]	CI
Commonwealth Land - [94244]	CI
Commonwealth Land - [94245]	CI
Commonwealth Land - [94248]	CI
Commonwealth Land - [94249]	CI
Commonwealth Land - [70721]	NT
Commonwealth Land - [94276]	CI
Commonwealth Land - [96020]	CKI
Commonwealth Land - [94277]	CI
Commonwealth Land - [96003]	CKI
Commonwealth Land - [96004]	CKI
Commonwealth Land - [96005]	CKI
Commonwealth Land - [96006]	CKI
Commonwealth Land - [96008]	CKI
Commonwealth Land - [96009]	CKI
Commonwealth Land - [96001]	CKI
Commonwealth Land - [96002]	CKI
Commonwealth Land - [94254]	CI
Commonwealth Land - [94251]	CI
Commonwealth Land - [94256]	CI
Commonwealth Land - [94255]	CI
Commonwealth Land - [94250]	CI
Commonwealth Land - [94258]	CI
Commonwealth Land - [94257]	CI
Commonwealth Land - [94259]	CI
Commonwealth Land - [70447]	NT

Commonwealth Land Name	State
Commonwealth Land - [94239]	CI
Commonwealth Land - [70580]	NT
Commonwealth Land - [96014]	CKI
Commonwealth Land - [96012]	CKI
Commonwealth Land - [94218]	CI
Commonwealth Land - [94219]	CI
Commonwealth Land - [94214]	CI
Commonwealth Land - [94215]	CI
Commonwealth Land - [70734]	NT
Commonwealth Land - [94266]	CI
Commonwealth Land - [94278]	CI
Commonwealth Land - [94279]	CI
Commonwealth Land - [94270]	CI
Commonwealth Land - [94271]	CI
Commonwealth Land - [94272]	CI
Commonwealth Land - [94273]	CI
Commonwealth Land - [94274]	CI
Commonwealth Land - [94275]	CI
Commonwealth Land - [94269]	CI
Commonwealth Land - [70101]	NT
Commonwealth Land - [94262]	CI
Commonwealth Land - [94265]	CI
Commonwealth Land - [94264]	CI
Commonwealth Land - [94267]	CI
Commonwealth Land - [94268]	CI
Commonwealth Land - [94261]	CI
Commonwealth Land - [94260]	CI

Commonwealth Land Name	State
Commonwealth Land - [94263]	CI
Commonwealth Land - [96007]	CKI
Commonwealth Land - [96019]	CKI
Commonwealth Land - [94252]	CI
Commonwealth Land - [96018]	CKI
Commonwealth Land - [94213]	CI
Commonwealth Land - [94217]	CI
Commonwealth Land - [94210]	CI
Commonwealth Land - [94211]	CI
Commonwealth Land - [94212]	CI
Commonwealth Land - [70209]	NT
Commonwealth Land - [70595]	NT
Commonwealth Land - [70203]	NT
Commonwealth Land - [70206]	NT
Commonwealth Land - [70204]	NT
Commonwealth Land - [70205]	NT
Commonwealth Land - [94202]	CI
Commonwealth Land - [94204]	CI
Commonwealth Land - [94205]	CI
Commonwealth Land - [94206]	CI
Commonwealth Land - [52275]	WA
Commonwealth Land - [94201]	CI
Commonwealth Land - [52277]	ACI
Commonwealth Land - [52276]	ACI
Commonwealth Land - [70591]	NT
Commonwealth Land - [70593]	NT
Commonwealth Land - [52283]	WA

Commonwealth Land Name	State
Commonwealth Land - [52286]	WA
Commonwealth Land - [94241]	CI
Commonwealth Land - [94208]	CI
Commonwealth Land - [94209]	CI
Commonwealth Land - [94207]	CI
Commonwealth Land - [94280]	CI
Commonwealth Land - [52236]	WA
Commonwealth Land - [94216]	CI
Commonwealth Land - [70337]	NT
Commonwealth Land - [70335]	NT
Commonwealth Land - [70338]	NT
Commonwealth Land - [70999]	NT
Commonwealth Land - [70594]	NT
Commonwealth Land - [70995]	NT
Commonwealth Land - [70993]	NT
Commonwealth Land - [70859]	NT
Commonwealth Land - [94225]	CI
Commonwealth Land - [94224]	CI
Commonwealth Land - [94227]	CI
Commonwealth Land - [94226]	CI
Commonwealth Land - [94233]	CI
Commonwealth Land - [94236]	CI
Commonwealth Land - [94235]	CI
Commonwealth Land - [94238]	CI
Commonwealth Land - [94231]	CI
Commonwealth Land - [94234]	CI
Commonwealth Land - [94232]	CI

Commonwealth Land Name	State
Commonwealth Land - [94230]	CI
Commonwealth Land - [71140]	NT
Commonwealth Land - [52278]	ACI
Commonwealth Land - [52254]	WA
Commonwealth Land - [52255]	WA
Commonwealth Land - [52252]	WA
Commonwealth Land - [52253]	WA
Commonwealth Land - [52259]	WA
Commonwealth Land - [94253]	CI
Commonwealth Land - [70327]	NT
Commonwealth Land - [94220]	CI
Commonwealth Land - [94223]	CI
Commonwealth Land - [94221]	CI
Commonwealth Land - [70090]	NT
Commonwealth Land - [94222]	CI
Commonwealth Land - [94228]	CI
Commonwealth Land - [96013]	CKI
Commonwealth Land - [96017]	CKI
Commonwealth Land - [96016]	CKI
Commonwealth Land - [96011]	CKI
Commonwealth Land - [96010]	CKI
Commonwealth Land - [70608]	NT
Commonwealth Land - [94229]	CI
Commonwealth Land - [96015]	CKI

Commonwealth Heritage Places		[Resource Information]
Name	State	Status
Historic		
Administration Building Forecourt	EXT	Listed place

Name	State	Status
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
Larrakeyah Barracks Headquarters Building	NT	Listed place
Larrakeyah Barracks Precinct	NT	Listed place
Larrakeyah Barracks Sergeants Mess	NT	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 Base Commanding Officers Residence	NT	Listed place
RAAF Base Precinct	NT	Listed place
RAAF Base Tropical Housing Type 2	NT	Listed place
RAAF Base Tropical Housing Type 3	NT	Listed place
RAAF Memorial	EXT	Listed place
Settlement Christmas Island	EXT	Listed place

Name	State	Status
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
Indigenous		
Oombalai Area	WA	Within listed place
Natural		
Ashmore Reef National Nature Reserve	EXT	Listed place
Christmas Island Natural Areas	EXT	Listed place
Learmonth Air Weapons Range Facility	WA	Listed place
Mermaid Reef - Rowley Shoals	WA	Listed place
Ningaloo Marine Area - Commonwealth Waters	WA	Listed place
North Keeling Island	EXT	Listed place
Scott Reef and Surrounds - Commonwealth Area	EXT	Listed place
Yampi Defence Area	WA	Listed place

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Acrocephalus orientalis		
Oriental Reed-Warbler [59570]		Species or species habitat known to occur within area overfly marine area
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
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 overfly marine area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat likely to occur within area
Ardenna pacifica as Puffinus pacificus Wedge-tailed Shearwater [84292]		Breeding known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Breeding likely to occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area overfly marine area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat known to occur within area
Cecropis daurica as Hirundo daurica Red-rumped Swallow [80610]		Species or species habitat known to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Roosting known to occur within area overfly marine area
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding 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]		Roosting known to occur within area overfly marine area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area
Glareola maldivarum Oriental Pratincole [840]		Roosting known to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area
Hirundo rustica Barn Swallow [662]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Hydroprogne caspia as Sterna caspia Caspian Tern [808]		Breeding known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area overfly marine area
Limnodromus semipalmatus Asian Dowitcher [843]		Species or species habitat known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area overfly marine area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area overfly marine 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 overfly marine area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat known to occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine 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]		Roosting known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Onychoprion anaethetus as Sterna anaethetus Bridled Tern [82845]		Breeding known to occur within area
Onychoprion fuscatus as Sterna fuscata Sooty Tern [90682]		Breeding 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	Species or species habitat known to occur within area
Phaethon rubricauda Red-tailed Tropicbird [994]		Breeding known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area overfly marine area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area
Sterna dougallii Roseate Tern [817]		Breeding known to occur within area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Breeding known to occur within area
Sternula nereis as Sterna nereis Fairy Tern [82949]		Breeding known to occur within area
Stiltia isabella Australian Pratincole [818]		Roosting known to occur within area overfly marine 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 carteri Indian Yellow-nosed Albatross [64464]	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
Thalasseus bengalensis as Sterna bengalensis Lesser Crested Tern [66546]		Breeding known to occur within area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area overfly marine area
Tringa incana as Heteroscelus incanus Wandering Tattler [831]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area
Tringa totanus Common Redshank, Redshank [835]		Species or species habitat known to occur within area overfly marine area
Xenus cinereus Terek Sandpiper [59300]		Roosting known to occur within area overfly marine 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

Scientific Name	Threatened Category	Presence Text
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

Scientific Name	Threatened Category	Presence Text
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

Scientific Name	Threatened Category	Presence Text
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
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

Scientific Name	Threatened Category	Presence Text
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

Scientific Name	Threatened Category	Presence Text
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
Mammal		
Dugong dugon Dugong [28]		Breeding known to occur within area
Reptile		
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

Scientific Name	Threatened Category	Presence Text
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	Breeding known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Breeding known to occur within area
Chitulia inornata as Hydrophis inornatus Plain Seasnake [87379]		Species or species habitat may occur within area
Chitulia ornata as Hydrophis ornatus Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may occur within area
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnstone's 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

Scientific Name	Threatened Category	Presence Text
Emydocephalus annulatus Turtle-headed Seasnake [1125]		Species or species habitat may occur within area
Enhydrina schistosa Beaked Seasnake [1126]		Species or species 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 elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Hydrophis macdowelli as Hydrophis mcdowelli Small-headed Seasnake [75601]		Species or species habitat may occur within area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area
Leioselasma coggeri as Hydrophis coggeri Black-headed Sea Snake, Slender-necked Seasnake [87373]		Species or species habitat may occur within area
Leioselasma czeblukovi as Hydrophis czeblukovi Fine-spined Seasnake, Geometrical Seasnake [87374]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Leioselasma pacifica as Hydrophis pacificus		
Large-headed Seasnake, Pacific Seasnake [87378]		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]
Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera acutorostrata		
Minke Whale [33]		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

Current Scientific Name	Status	Type of Presence
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat likely to 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 sima as Kogia simus Dwarf Sperm Whale [85043]		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]		Breeding known to occur within area

Current Scientific Name	Status	Type of Presence
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 heinsohni as Orcaella brevirostris Australian Snubfin Dolphin [81322]		Species or species habitat known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
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 sahulensis as Sousa chinensis Australian Humpback Dolphin [87942]		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

Current Scientific Name	Status	Type of Presence
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

Commonwealth Reserves Terrestrial [Resource Information]

Name	State	Type
Christmas Island	EXT	National Park (Commonwealth)
Kakadu	NT	National Park (Commonwealth)
Pulu Keeling	EXT	National Park (Commonwealth)

Australian Marine Parks [Resource Information]

Park Name	Zone & IUCN Categories
Carnarvon Canyon	Habitat Protection Zone (IUCN IV)
Christmas Island	Habitat Protection Zone (IUCN IV)
Cocos (Keeling) Islands	Habitat Protection Zone (IUCN IV)
Gascoyne	Habitat Protection Zone (IUCN IV)
Kimberley	Habitat Protection Zone (IUCN IV)
Kimberley	Habitat Protection Zone (IUCN IV)

Park Name	Zone & IUCN Categories
Oceanic Shoals	Habitat Protection Zone (IUCN IV)
Arafura	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	Multiple Use Zone (IUCN VI)
Eighty Mile Beach	Multiple Use Zone (IUCN VI)
Gascoyne	Multiple Use Zone (IUCN VI)
Joseph Bonaparte Gulf	Multiple Use Zone (IUCN VI)
Kimberley	Multiple Use Zone (IUCN VI)
Montebello	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Oceanic Shoals	Multiple Use Zone (IUCN VI)
Argo-Rowley Terrace	National Park Zone (IUCN II)
Christmas Island	National Park Zone (IUCN II)
Cocos (Keeling) Islands	National Park Zone (IUCN II)
Cocos (Keeling) Islands	National Park Zone (IUCN II)
Cocos (Keeling) Islands	National Park Zone (IUCN II)
Gascoyne	National Park Zone (IUCN II)
Kimberley	National Park Zone (IUCN II)
Mermaid Reef	National Park Zone (IUCN II)
Ningaloo	National Park Zone (IUCN II)
Oceanic Shoals	National Park Zone (IUCN II)
Ashmore Reef	Recreational Use Zone (IUCN IV)
Ningaloo	Recreational Use Zone (IUCN IV)
Ashmore Reef	Sanctuary Zone (IUCN Ia)
Cartier Island	Sanctuary Zone (IUCN Ia)

Park Name	Zone & IUCN Categories
Arafura	Special Purpose Zone (IUCN VI)
Arnhem	Special Purpose Zone (IUCN VI)
Joseph Bonaparte Gulf	Special Purpose Zone (IUCN VI)
Arafura	Special Purpose Zone (Trawl) (IUCN VI)
Argo-Rowley Terrace	Special Purpose Zone (Trawl) (IUCN VI)
Oceanic Shoals	Special Purpose Zone (Trawl) (IUCN VI)

Habitat Critical to the Survival of Marine Turtles		
Scientific Name	Behaviour	Presence
Aug - Sep		
Natator depressus Flatback Turtle [59257]	Nesting	Known to occur
Dec - Jan		
Chelonia mydas Green Turtle [1765]	Nesting	Known to occur
Dermochelys coriacea Leatherback Turtle [1768]	Nesting	Known to occur
May - Jul		
Lepidochelys olivacea Olive Ridley Turtle [1767]	Nesting	Known to occur
Nov-Feb		
Caretta caretta Loggerhead Turtle [1763]	Nesting	Known to occur
Nov - May		
Eretmochelys imbricata Hawksbill Turtle [1766]	Nesting	Known to occur

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Adele Island	Nature Reserve	WA
Airlie Island	Nature Reserve	WA
Balanggarra	Indigenous Protected Area	WA
Bardi Jawi	Indigenous Protected Area	WA
Barrow Island	Nature Reserve	WA
Barrow Island	Marine Park	WA
Barrow Island	Marine Management Area	WA
Bedout Island	Nature Reserve	WA
Bessieres Island	Nature Reserve	WA
Black Jungle / Lambells Lagoon Conservation Reserve	Other Conservation Area	NT
Blackmore River	Conservation Reserve	NT
Boodie, Double Middle Islands	Nature Reserve	WA
Browse Island	Nature Reserve	WA
Bundegi Coastal Park	5(1)(h) Reserve	WA
Camp Creek	Conservation Park	WA
Cape Range	National Park	WA
Casuarina	Coastal Reserve	NT
Charles Darwin	National Park	NT
Coulomb Point	Nature Reserve	WA
Dambimangari	Indigenous Protected Area	WA
Djelk	Indigenous Protected Area	NT
Djukbinj	National Park	NT
Fogg Dam	Conservation Reserve	NT

Protected Area Name	Reserve Type	State
Garig Gunak Barlu	National Park	NT
Garig Gunak Barlu	Marine Park	NT
Harrison Dam	Other Conservation Area	NT
Holmes Jungle	Nature Park	NT
Howard Springs	Nature Park	NT
Howard Springs	Hunting Reserve	NT
Jurabi Coastal Park	5(1)(h) Reserve	WA
Knuckey Lagoons	Conservation Reserve	NT
Lacepede Islands	Nature Reserve	WA
Lalang-garram / Camden Sound	Marine Park	WA
Lalang-garram / Horizontal Falls	Marine Park	WA
Laterite	Conservation Park	WA
Lawley River	National Park	WA
Lesueur Island	Nature Reserve	WA
Litchfield	National Park	NT
Lowendal Islands	Nature Reserve	WA
Low Rocks	Nature Reserve	WA
Manton Dam Recreation Area	Other Conservation Area	NT
Marri-Jabin (Thamurrurr - Stage 1)	Indigenous Protected Area	NT
Marthakal	Indigenous Protected Area	NT
Mary River	National Park	NT
Melacca Swamp	Conservation Area	NT
Mitchell River	National Park	WA
Montebello Islands	Conservation Park	WA
Montebello Islands	Conservation Park	WA

Protected Area Name	Reserve Type	State
Montebello Islands	Marine Park	WA
Muiron Islands	Nature Reserve	WA
Muiron Islands	Marine Management Area	WA
Niiwalarra Islands	National Park	WA
Ningaloo	Marine Park	WA
North Kimberley	Marine Park	WA
North Lalang-garram	Marine Park	WA
North Turtle Island	Nature Reserve	WA
Prince Regent	National Park	WA
Round Island	Nature Reserve	WA
Rowley Shoals	Marine Park	WA
Scott Reef	Nature Reserve	WA
Serrurier Island	Nature Reserve	WA
Swan Island	Nature Reserve	WA
Tanner Island	Nature Reserve	WA
Territory Wildlife Park / Berry Springs	Other Conservation Area or Nature Park	NT
Territory Wildlife Park / Berry Springs	Other Conservation Area	NT
Thevenard Island	Nature Reserve	WA
Unnamed WA28968	5(1)(h) Reserve	WA
Unnamed WA37168	5(1)(h) Reserve	WA
Unnamed WA40322	5(1)(h) Reserve	WA
Unnamed WA40828	5(1)(h) Reserve	WA
Unnamed WA41080	5(1)(h) Reserve	WA
Unnamed WA41775	5(1)(h) Reserve	WA
Unnamed WA44665	5(1)(h) Reserve	WA

Protected Area Name	Reserve Type	State
Unnamed WA44669	5(1)(h) Reserve	WA
Unnamed WA44672	5(1)(h) Reserve	WA
Unnamed WA44673	5(1)(h) Reserve	WA
Unnamed WA44677	5(1)(h) Reserve	WA
Uunguu	Indigenous Protected Area	WA
Wilinggin	Indigenous Protected Area	WA

Nationally Important Wetlands

[Resource Information]

Wetland Name	State
"The Dales", Christmas Island	EXT
Adelaide River Floodplain System	NT
Ashmore Reef	EXT
Blyth-Cadell Floodplain & Boucaut Bay System	NT
Bunda-Bunda Mound Springs	WA
Cape Range Subterranean Waterways	WA
Cobourg Peninsula System	NT
Daly-Reynolds Floodplain-Estuary System	NT
De Grey River	WA
Finniss Floodplain and Fog Bay Systems	NT
Hosine's Spring, Christmas Island	EXT
Kakadu National Park	NT
Leslie (Port Hedland) Saltfields System	WA
Mary Floodplain System	NT
Mermaid Reef	EXT
Mitchell River System	WA
Moyle Floodplain and Hyland Bay System	NT
Murgenella-Cooper Floodplain System	NT

Wetland Name	State
Port Darwin	NT
Prince Regent River System	WA
Pulu Keeling National Park	EXT
Shoal Bay - Micket Creek	NT
Willie Creek Wetlands	WA
Yampi Sound Training Area	WA

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Action clearly unacceptable			
Highlands 3D Marine Seismic Survey	2012/6680	Action Clearly Unacceptable	Completed
Controlled action			
'Van Gogh' Petroleum Field Development	2007/3213	Controlled Action	Post-Approval
275 km gas pipeline from Wadeye to existing Darwin gas pipeline	2006/2930	Controlled Action	Post-Approval
2-D seismic survey Scott Reef	2000/125	Controlled Action	Post-Approval
Andranangoo Creek & Lethbridge Bay mineral sand mining	2005/2155	Controlled Action	Completed
Ashburton Infrastructure Project	2021/9064	Controlled Action	Guidelines Issued
Audacious Oil Field Standalone Development	2001/407	Controlled Action	Completed
Augmentation of the East Point Effluent Rising Main and Extension of East Point Outfall	2009/5113	Controlled Action	Post-Approval
Australia-ASEAN Power Link	2020/8818	Controlled Action	Proposed Decision
Barramundi Nursery Farm	2005/2378	Controlled Action	Completed
Bayview, The Boulevarde, Darwin, NT	2015/7466	Controlled Action	Assessment Approach
Blacktip Project - Wharf Construction	2007/3293	Controlled Action	Completed
Bonaparte Liquified Natural Gas Project	2011/6141	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Breeding, husbandry, slaughter and sale of goats	2004/1895	Controlled Action	Completed
Browse FLNG Development, Commonwealth Waters	2013/7079	Controlled Action	Post-Approval
Browse to North West Shelf Development, Indian Ocean, WA	2018/8319	Controlled Action	Final PER or EIS
Cape Leveque Road upgrade, Stage 3, Shire of Broome, WA	2013/6984	Controlled Action	Post-Approval
Christmas Island Airport Expansion	2001/434	Controlled Action	Post-Approval
Christmas Island Port Facility	2001/435	Controlled Action	Post-Approval
Clarence Strait Offshore Tidal Energy Project	2008/4660	Controlled Action	Assessment Approach
Cockatoo Island Multi-User Supply Base, WA	2017/7986	Controlled Action	Referral Decision
Compass Resources NL/Mining/Rum Jungle/NT/Copper, cobalt and nickel mine - Browns Oxide Project	2005/2011	Controlled Action	Post-Approval
Condensate Processing Facility, East Arm	2006/2734	Controlled Action	Proposed Decision
Conduct an exploration drilling campaign	2010/5718	Controlled Action	Completed
Construct and operate LNG & domestic gas plant including onshore and offshore facilities - Wheatstone	2008/4469	Controlled Action	Post-Approval
Construction of mobile phone tower	2002/694	Controlled Action	Completed
Cultural Appearance Upgrade of the Chinese Literary Association Building	2007/3568	Controlled Action	Completed
Darwin Ship Lift Project	2021/9068	Controlled Action	Further Information Request
Darwin to Moomba Gas Pipeline	2001/213	Controlled Action	Completed
Decommissioning of Challis Oilfield	2003/942	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Develop Ichthys gas-condensate field permit area W	2006/2767	Controlled Action	Completed
Develop Jansz-Io deepwater gas field in Permit Areas WA-18-R, WA-25-R and WA-26-	2005/2184	Controlled Action	Post-Approval
Development of Angel gas and condensate field, North West Shelf	2004/1805	Controlled Action	Post-Approval
Development of Blacktip Gas Field	2003/1180	Controlled Action	Post-Approval
Development of Browse Basin Gas Fields (Upstream)	2008/4111	Controlled Action	Completed
Development of Coniston/Novara fields within the Exmouth Sub-basin	2011/5995	Controlled Action	Post-Approval
Development of Stybarrow petroleum field incl drilling and facility installation	2004/1469	Controlled Action	Post-Approval
East Arm Marine Industry Park, Darwin, NT	2014/7318	Controlled Action	Completed
East Arm Wharf Expansion Works	2010/5304	Controlled Action	Post-Approval
East Christmas Island Phosphate Mines (9 sites)	2001/487	Controlled Action	Completed
Echo-Yodel Production Wells	2000/11	Controlled Action	Post-Approval
Eco quad tours for West Island visitors and tourists	2010/5749	Controlled Action	Completed
Enfield full field development	2001/257	Controlled Action	Post-Approval
Equus Gas Fields Development Project, Carnarvon Basin	2012/6301	Controlled Action	Completed
Establishment and operation of a refinery at Darwin, NT	2015/7604	Controlled Action	Proposed Decision
Exploration for Mineable Phosphate, Christmas Island	2000/43	Controlled Action	Completed
Glyde Point and Middle Arm Peninsula Infrastructure Support	2001/334	Controlled Action	Completed
Glyde Point Industrial Estate	2001/336	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Glyde Point Industrial Estate and Associated Infrastructure	2004/1506	Controlled Action	Completed
Gorgon Gas Development	2003/1294	Controlled Action	Post-Approval
Gorgon Gas Development 4th Train Proposal	2011/5942	Controlled Action	Post-Approval
Gorgon Gas Revised Development	2008/4178	Controlled Action	Post-Approval
Greater Enfield (Vincent) Development	2005/2110	Controlled Action	Post-Approval
Greater Gorgon Development - Optical Fibre Cable, Mainland to Barrow Island	2005/2141	Controlled Action	Completed
Hardwood Plantation	2001/229	Controlled Action	Post-Approval
Home Island slipway & access channel from Home Island Port Facility to Directio	2009/4969	Controlled Action	Completed
Howard Springs Sand Extraction Expansion, NT	2016/7699	Controlled Action	Completed
Ichthys Gas Field, Offshore and onshore processing facilities and subsea pipeline	2008/4208	Controlled Action	Post-Approval
Iron ore mine	2006/2522	Controlled Action	Post-Approval
Kilimiraka Mineral Sands and Associated Infrastructure (Bathurst Island), NT	2012/6587	Controlled Action	Assessment Approach
Lee Point Master-planned urban development, Darwin, NT	2015/7591	Controlled Action	Post-Approval
Light Crude Oil Production	2001/365	Controlled Action	Post-Approval
Lily Beach Recreational Facilities	2001/395	Controlled Action	Post-Approval
Lily Beach Rock Pool Development	2001/400	Controlled Action	Completed
Methanol Plant	2001/195	Controlled Action	Completed
Middle Arm Peninsula Industrial Area Development	2001/339	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Montara 4, 5, and 6 Oil Production Wells, and Montara 3 Gas Re-Injection Well	2002/755	Controlled Action	Post-Approval
Mt Peake iron, vanadium and titanium mining project & assoc infrastructure, 280kms NNW Alice Springs, NT	2013/7027	Controlled Action	Post-Approval
Muirhead Subdivision	2010/5525	Controlled Action	Post-Approval
Nava-1 Cable System	2001/510	Controlled Action	Completed
Ningaloo Lighthouse Development, 17km north west Exmouth, Western Australia	2020/8693	Controlled Action	Assessment Approach
Noonamah Ridge Residential Estate, Lloyd Creek, NT	2014/7269	Controlled Action	Further Information Request
Operation of 17 Tiger Helicopters at Robertson Barracks	2004/1459	Controlled Action	Post-Approval
Phosphate Mining in South Point Christmas Island	2012/6653	Controlled Action	Post-Approval
Pluto Gas Project	2005/2258	Controlled Action	Completed
Pluto Gas Project Including Site B	2006/2968	Controlled Action	Post-Approval
Pluton Irvine Island Iron Ore Project	2011/6064	Controlled Action	Proposed Decision
Port Hedland Outer Harbour Development and associated marine and terrestrial in	2008/4159	Controlled Action	Post-Approval
Port Patterson Barramundi Sea Cage Farm	2005/2149	Controlled Action	Completed
Prelude Floating Liquefied Natural Gas Facility and Gas Field Development	2008/4146	Controlled Action	Post-Approval
Proposed City of Weddell	2011/6090	Controlled Action	Assessment Approach
Proposed exploration drilling programme for Christmas Island	2016/7779	Controlled Action	Completed
PTTEP AA Floating LNG Facility	2011/6025	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Public Ferry Hovercraft Operation	2003/1239	Controlled Action	Post-Approval
Pyrenees Oil Fields Development	2005/2034	Controlled Action	Post-Approval
Red-footed booby bird harvest	2002/844	Controlled Action	Referral Decision
Rehabilitation of former Rum Jungle mine site, near Batchelor, NT	2016/7730	Controlled Action	Assessment Approach
Replacement of the East Point Outfall	2011/6099	Controlled Action	Assessment Approach
Residential subdivision of Lot 9793 (formerly Lots 9774 and 9779) Lee Point Road	2005/2108	Controlled Action	Post-Approval
Road Upgrade/Construction between Lily Beach Road and Port Faci	2001/436	Controlled Action	Post-Approval
Salvage, transport and processing of phosphate resource with extended airport si	2003/1217	Controlled Action	Post-Approval
Shipping Channel Enhancement	2010/5431	Controlled Action	Completed
Simpson Development	2000/59	Controlled Action	Completed
Simpson Oil Field Development	2001/227	Controlled Action	Post-Approval
Snake Bay Barramundi Sea Cage Farm	2005/2150	Controlled Action	Completed
Talisman Saber 2005 Military Exercise	2004/1819	Controlled Action	Post-Approval
Tassie Shoal Gas Reforming and Methanol Production Plants - NT/P48	2000/108	Controlled Action	Post-Approval
Tassie Shoal LNG Project	2003/1067	Controlled Action	Post-Approval
The Scarborough Project - FLNG & assoc subsea infrastructure, Carnarvon Basin	2013/6811	Controlled Action	Post-Approval
Torosa South Initial Appraisal Drilling	2007/3500	Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Trans-territory Gas Pipeline	2003/1186	Controlled Action	Completed
Tropical Tidal Testing Centre, Clarence Strait, 50km NE Darwin	2014/7299	Controlled Action	Guidelines Issued
Vincent Appraisal Well	2000/22	Controlled Action	Post-Approval
Wuudagu Bauxite Project	2019/8606	Controlled Action	Assessment Approach
Yardie Creek Road Realignment Project	2021/8967	Controlled Action	Assessment Approach
Yellow Crazy Ant Biological Control	2013/6836	Controlled Action	Post-Approval
Not controlled action			
'Goodwyn A' Low Pressure Train Project	2003/914	Not Controlled Action	Completed
'Van Gogh' Oil Appraisal Drilling Program, Exploration Permit Area WA-155-P(1)	2006/3148	Not Controlled Action	Completed
2D seismic survey, exploration permit NT/P67	2004/1587	Not Controlled Action	Completed
2D Seismic Survey in Permit Areas WA-318-P & WA-319-P, near Cape Londonderry	2004/1687	Not Controlled Action	Completed
3D marine seismic survey in WA 314P and WA 315P	2004/1927	Not Controlled Action	Completed
96-108 Gaze Road - Residential upgrade	2006/2632	Not Controlled Action	Completed
Adele Trend TQ3D Seismic Survey	2001/252	Not Controlled Action	Completed
AEC International Hydrocarbon Well Puffin 6	2000/36	Not Controlled Action	Completed
Aerial Baiting, Yellow Crazy Ant Supercolonies, Christmas Island, WA	2019/8492	Not Controlled Action	Completed
Airlie Island soil and groundwater investigations, Exmouth Gulf, offshore Pilbara coast	2014/7250	Not Controlled Action	Completed
Andranangoo Mine Site Aircraft Landing Area	2007/3743	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
APX-West Fibre-optic telecommunications cable system, WA to Singapore	2013/7102	Not Controlled Action	Completed
Aquaculture - Barramundi grow out, Yampi Sound	2005/2476	Not Controlled Action	Completed
Aquaculture farm	2002/737	Not Controlled Action	Completed
Audacious-3 oil drilling well	2003/1042	Not Controlled Action	Completed
Backpacker-1 Offshore Hydrocarbon Exploration Well	2001/300	Not Controlled Action	Completed
Barossa-1 (NT/P69), Caldita-2 (NT/P61) exploration wells	2006/2793	Not Controlled Action	Completed
Barrow Island 2D Seismic survey	2006/2667	Not Controlled Action	Completed
Boat Ramp Construction	2001/237	Not Controlled Action	Completed
Bollinger 2D Seismic Survey 200km North of North West Cape WA	2004/1868	Not Controlled Action	Completed
Buffett Close Residential Development	2004/1887	Not Controlled Action	Completed
Building of a carport adjacent to residential house	2004/1538	Not Controlled Action	Completed
Bulgarene Borefield	2006/2507	Not Controlled Action	Completed
Bultaco-2, Laverda-2, Laverda-3 and Montesa-2 Appraisal Wells	2000/103	Not Controlled Action	Completed
Caldita-1 Hydrocarbon Exploration Well, NT/P61	2004/1854	Not Controlled Action	Completed
Carnarvon 3D Marine Seismic Survey	2004/1890	Not Controlled Action	Completed
Cazadores 2D seismic survey	2004/1720	Not Controlled Action	Completed
Channel Island Bridge Pipeline Replacement Project	2020/8672	Not Controlled Action	Completed
Christmas Island/Construction of a double storey shed/carport at MQ387 Gaze Road	2004/1561	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Christmas Island Fuel Consolidation Project, Christmas Island	2012/6454	Not Controlled Action	Completed
Cocos (Keeling) Islands Maintenance Dredging Home Island Slipway Redevelopment, Cocos (Keeling) Islands	2014/7140	Not Controlled Action	Completed
Community Recreation Centre	2003/1279	Not Controlled Action	Completed
Construction and operation of an unmanned sea platform and connecting pipeline to Varanus Island for the extraction of natural gas	2004/1703	Not Controlled Action	Completed
Construction and operation of Radar Infrastructure	2004/1406	Not Controlled Action	Completed
Controlled Source Electromagnetic Survey	2007/3262	Not Controlled Action	Completed
Coot-1 hydrocarbon exploration well, Permit Area AC/L2 or AC/L3	2001/296	Not Controlled Action	Completed
Core Breeding and Broodstock Maturation Centre development, Point Ceylon, NT	2016/7713	Not Controlled Action	Completed
courtyard shower & handbasin facilities	2006/2803	Not Controlled Action	Completed
Cox Peninsular Remediation Project, NT	2015/7587	Not Controlled Action	Completed
Crowley Government Services Inc Bulk Fuel Storage Facility	2021/9015	Not Controlled Action	Completed
Crux-A and Crux-B appraisal wells, Petroleum Permit Area AC/P23	2006/2748	Not Controlled Action	Completed
Crux gas-liquids development in permit AC/P23	2006/3154	Not Controlled Action	Completed
Darwin Port Maintenance Dredging, Darwin Harbour, NT	2017/8122	Not Controlled Action	Completed
Darwin ship lift facility and marine industries project, Darwin Harbour NT	2018/8195	Not Controlled Action	Completed
Development of Halyard Field off the west coast of WA	2010/5611	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Development of Mutineer and Exeter petroleum fields for oil production, Permit	2003/1033	Not Controlled Action	Completed
Differential Global Positioning System (DGPS)	2001/445	Not Controlled Action	Completed
Drilling of 12 Hydrocarbon Exploration Wells, Permit Area WA-371-P	2006/3005	Not Controlled Action	Completed
Drilling of an exploration well Gats-1 in Permit Area WA-261-P	2004/1701	Not Controlled Action	Completed
Drilling of exploration well Audacious-1 in AC/P17	2000/5	Not Controlled Action	Completed
Drilling of exploration wells, Permit areas WA-301-P to WA-305-P	2002/769	Not Controlled Action	Completed
Drilling of Marina-1 Exploration Well	2007/3586	Not Controlled Action	Completed
Dwelling demolition, maintenance and carpark/carport/storage shed works	2004/1837	Not Controlled Action	Completed
Eagle-1 Exploration Drilling, North West Shelf, WA	2019/8578	Not Controlled Action	Completed
Echo A Development WA-23-L, WA-24-L	2005/2042	Not Controlled Action	Completed
Echuca Shoals-2 Exploration of Appraisal Well	2006/3020	Not Controlled Action	Completed
Establish a 4m wide trace line along the road allignment for James Price Point	2010/5682	Not Controlled Action	Completed
Exploration Drilling in AC/P17, AC/P18 and AC/P24	2001/359	Not Controlled Action	Completed
Exploration drilling well WA-155-P(1)	2003/971	Not Controlled Action	Completed
Exploration of appraisal wells	2006/3065	Not Controlled Action	Completed
Exploration Well (Taunton-2)	2002/731	Not Controlled Action	Completed
Exploration Well AC/P23	2001/234	Not Controlled Action	Completed
Exploration Well in Permit Area WA-155-P(1)	2002/759	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Exploratory drilling in permit area WA-225-P	2001/490	Not Controlled Action	Completed
Extension of a Masonary Brick Wall adjacent to the Poon Saan Club by 500 mm	2004/1564	Not Controlled Action	Completed
Extension of Simpson Oil Platforms & Wells	2002/685	Not Controlled Action	Completed
External Upgrade of House	2010/5387	Not Controlled Action	Completed
Field trials for cultivation of microalga (Botryococcus braunii) to produce hydr	2007/3277	Not Controlled Action	Completed
Flying Fish Cove Christmas Island Boat Ramp Maintenance	2021/8924	Not Controlled Action	Completed
Flying Fish Cove Landslide Mitigation Project	2020/8616	Not Controlled Action	Completed
Garage and Office Facilities	2004/1919	Not Controlled Action	Completed
Geo-scientific survey	2005/2004	Not Controlled Action	Completed
HCA05X Macedon Experimental Survey	2004/1926	Not Controlled Action	Completed
Hess Exploration Drilling Programme	2007/3566	Not Controlled Action	Completed
Housing and Garden Maintenance Works	2004/1487	Not Controlled Action	Completed
Huascaran-1 exploration well (WA-292-P)	2001/539	Not Controlled Action	Completed
Hydroponics Research Program	2007/3338	Not Controlled Action	Completed
Identification of unmarked grave, exhumation/identification of remains which may belong to a sailor of HMAS Sydney	2006/2992	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO West Submarine Telecommunications Cable, WA	2017/8126	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
industrial park and a Defence support hub	2006/3177	Not Controlled Action	Completed
Infill Production Well (Griffin-9)	2001/417	Not Controlled Action	Completed
Infrasound Monitoring Station	2007/3390	Not Controlled Action	Completed
Installation of a desalination plant and associated infrastructure	2013/6833	Not Controlled Action	Completed
Internal and external modifications Lot 1014 Gaze Road	2004/1807	Not Controlled Action	Completed
Jansz-2 and 3 Appraisal Wells	2002/754	Not Controlled Action	Completed
Kaleidoscope exploration well	2001/182	Not Controlled Action	Completed
Kimberley Multi-commodity Exploration Programme, WA	2013/6839	Not Controlled Action	Completed
Klammer 2D Seismic Survey	2002/868	Not Controlled Action	Completed
Koolan Island Mine - Reconstruction of seawall and capital dewatering of mine pit,130km northwest of Derby, WA	2016/7848	Not Controlled Action	Completed
Light Industrial Subdivision Development	2004/1799	Not Controlled Action	Completed
Lot 1056 Extensions and Alterations	2004/1801	Not Controlled Action	Completed
Maia-Gaea Exploration wells	2000/17	Not Controlled Action	Completed
Maintenance of Tai Jin House, Smith Point	2009/4933	Not Controlled Action	Completed
Manaslu - 1 and Huascaran - 1 Offshore Exploration Wells	2001/235	Not Controlled Action	Completed
Marine Seismic Survey in WA-239-P	2000/24	Not Controlled Action	Completed
Marine Survey for the Australia-ASEAN Power Link AAPL	2020/8714	Not Controlled Action	Completed
Mobile Radio Communications System Upgrade	2002/718	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Montara-3 Offshore Hydrocarbon Exploration Well Permit Area AC/RL3	2001/489	Not Controlled Action	Completed
Montesa-1 and Bultaco-1 Exploration Wells	2000/102	Not Controlled Action	Completed
Nexus Drilling Program NT-P66	2007/3745	Not Controlled Action	Completed
North Rankin B gas compression facility	2005/2500	Not Controlled Action	Completed
NT/P68 2007 Two Well Drilling Program	2007/3569	Not Controlled Action	Completed
Oman Australia Cable Installation, WA	2021/8922	Not Controlled Action	Completed
Oman Australia Cable - Marine Route Survey	2020/8731	Not Controlled Action	Completed
P30 Hydrocarbon Exploration Well	2001/293	Not Controlled Action	Completed
Pilot Power Station to Utilise Fuel Gas from Mimosa Pigra	2002/841	Not Controlled Action	Completed
Pipeline System Modifications Project	2000/3	Not Controlled Action	Completed
Placement of bitumen/ concrete on rail sections of heritage listed incline, Christmas Island	2013/7009	Not Controlled Action	Completed
Port Hedland Channel Risk and Optimisation Project, WA	2017/7915	Not Controlled Action	Completed
Power Station Diesel Generator Replacement	2009/4685	Not Controlled Action	Completed
Project Highclere Geophysical Survey	2021/9023	Not Controlled Action	Completed
Project Sea Dragon Stage 1 Hatchery - Gunn Point, NT	2017/8092	Not Controlled Action	Completed
Proposed Community Centre	2010/5306	Not Controlled Action	Completed
Proposed sale or lease of Crown land, 11 lots, Christmas Island	2018/8220	Not Controlled Action	Completed
Puffin Oil wells 7, 8 & 9 development	2005/2336	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Realignment of Gaze Road Service Road and Gaze Road Junction	2004/1735	Not Controlled Action	Completed
Refurbishment and Extension of Seaview Lodge	2012/6353	Not Controlled Action	Completed
renovate free-standing servant's quarters	2006/2811	Not Controlled Action	Completed
Replacement of deteriorating flat roof at rear of Mosque and extending side verandahs, Christmas Island	2013/6851	Not Controlled Action	Completed
Residential Complex - Lots 6575 and 6576	2001/163	Not Controlled Action	Completed
Residential Secondary College	2007/3276	Not Controlled Action	Completed
Residential upgrade, 2 Coconut Grove	2007/3295	Not Controlled Action	Completed
Saucepan 1 Exploration Well ACP23	2000/2	Not Controlled Action	Completed
Searipple gas and condensate field development	2000/89	Not Controlled Action	Completed
Skua and Swift Oilfields	2006/3195	Not Controlled Action	Completed
Spool Base Facility	2001/263	Not Controlled Action	Completed
Stormwater Remediation Project, Christmas Island	2019/8467	Not Controlled Action	Completed
Strumbo-1 Gas Exploration Well Permit Area WA-288-P	2002/884	Not Controlled Action	Completed
Subdivision of Lot 571 on DP 26701	2008/4230	Not Controlled Action	Completed
Subdivision of Part 7 of Lot 1014	2009/4851	Not Controlled Action	Completed
Subdivision of Two Sites (1712 and 1713) into four Portions	2006/2755	Not Controlled Action	Completed
Subsea Gas Pipeline From Stybarrow Field to Griffin Venture Gas Export Pipeline	2005/2033	Not Controlled Action	Completed
sub-sea tieback of Perseus field wells	2004/1326	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Supermarket Extensions	2006/2515	Not Controlled Action	Completed
Telstra North Rankin Spur Fibre Optic Cable	2016/7836	Not Controlled Action	Completed
Thevenard Island Retirement Project	2015/7423	Not Controlled Action	Completed
To construct and operate an offshore submarine fibre optic cable, WA	2014/7373	Not Controlled Action	Completed
upgrade of House 11, William Keeling Crescent	2005/2447	Not Controlled Action	Completed
Upgrade of House 16 on William Keeling Crescent, a Cwlth owned house in Type T H	2006/2903	Not Controlled Action	Completed
Upgrade of Residence, Coconut Grove	2006/2728	Not Controlled Action	Completed
Verandah Extension to Existing Breezeway Unit, Gaze Road	2005/1970	Not Controlled Action	Completed
WA-295-P Kerr-McGee Exploration Wells	2001/152	Not Controlled Action	Completed
Wanda Offshore Research Project, 80 km north-east of Exmouth, WA	2018/8293	Not Controlled Action	Completed
Waterfront Redevelopment	2003/1256	Not Controlled Action	Completed
Western Flank Gas Development	2005/2464	Not Controlled Action	Completed
Wheatstone 3D seismic survey, 70km north of Barrow Island	2004/1761	Not Controlled Action	Completed
Wickham Point Interconnect Gas Pipeline	2008/4309	Not Controlled Action	Completed
Not controlled action (particular manner)			
'Kate' 3D marine seismic survey, exploration permits WA-320-P and WA-345-P, 60km	2005/2037	Not Controlled Action (Particular Manner)	Post-Approval
'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
"Leanne" offshore 3D seismic exploration, WA-356-P	2005/1938	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
2 (3D) Marine Seismic Surveys	2009/4994	Not Controlled Action (Particular Manner)	Completed
2D and 3D Seismic Survey	2011/6197	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D seismic surveys	2005/2151	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2008/4133	Not Controlled Action (Particular Manner)	Post-Approval
2D and 3D Seismic Survey WA-405-P	2009/5104	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey	2012/6296	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey of Braveheart,Kurrajong,Sunshine and Crocodile	2006/2917	Not Controlled Action (Particular Manner)	Post-Approval
2D marine seismic survey within permit area WA-318-P	2007/3879	Not Controlled Action (Particular Manner)	Post-Approval
2D or 3D Marine Seismic Survey in Petroleum Permit Area AC/P35	2009/4864	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Marine Survey	2001/363	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D seismic survey	2008/4493	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2005/2146	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey in permit areas WA-274P and WA-281P	2004/1521	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey in WA Permit Area TP/22 and Commonwealth Permit Area WA-280-P	2005/2100	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey Permit Area WA-352-P	2008/4628	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey - Petroleum Exploration Area NT/P68, Eastern Bonaparte Basin	2006/2922	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey within permit WA-291	2007/3265	Not Controlled Action (Particular Manner)	Post-Approval
2 geotechnical surveys - preliminary and final	2006/2886	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey	2008/4281	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey	2009/4681	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey	2008/4437	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
3D Marine Seismic Survey, Permit AC/P 23	2005/2364	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey (WA-482-P, WA-363-P), WA	2013/6761	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey in Permit Areas WA-15-R, WA-18-R, WA-205-P, WA-253-P, WA-267-P and WA-268-P	2003/1271	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey in WA 457-P & WA 458-P, North West Shelf, offshore WA	2013/6862	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic Survey - Maxima 3D MSS	2006/2945	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey over petroleum title WA-268-P	2007/3458	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Surveys - Contos CT-13 & Supertubes CT-13, offshore WA	2013/6901	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic survey	2006/2715	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey	2006/2729	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, Browse Basin, WA	2009/5048	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, near Scott Reef, Browse Basin	2005/2126	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
3D Seismic Survey, petroleum exploration permit AC/P33	2006/2918	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey, WA	2008/4428	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2008/4121	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey (NT/P68)	2006/2980	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey in the Carnarvon Bsin on the North West Shelf	2002/778	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic survey of AC/P4, AC/P17 and AC/P24	2006/2857	Not Controlled Action (Particular Manner)	Post-Approval
3D Seismic Survey WA-406-P Bonaparte Basin	2007/3904	Not Controlled Action (Particular Manner)	Post-Approval
3D sesmic survey	2006/2781	Not Controlled Action (Particular Manner)	Post-Approval
AC/P37 3D Seismic Survey Ashmore Cartier	2007/3774	Not Controlled Action (Particular Manner)	Post-Approval
Acacia East Pit Cutback Mining Project,northern Kimberley, WA	2013/6752	Not Controlled Action (Particular Manner)	Post-Approval
Acheron Non-Exclusive 2D Seismic Survey	2009/4968	Not Controlled Action (Particular Manner)	Post-Approval
Acheron Non-Exclusive 2D Seismic Survey	2008/4565	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Addition of Verandah to Block of Four Units	2005/2315	Not Controlled Action (Particular Manner)	Post-Approval
Aerial Baiting of Yellow Crazy Ants	2012/6438	Not Controlled Action (Particular Manner)	Post-Approval
Apache Northwest Shelf Van Gogh Field Appraisal Drilling Program	2007/3495	Not Controlled Action (Particular Manner)	Post-Approval
Aperio 3D Marine Seismic Survey, WA	2012/6648	Not Controlled Action (Particular Manner)	Post-Approval
Artemis-1 Drilling Program (WA-360-P)	2010/5432	Not Controlled Action (Particular Manner)	Post-Approval
Asbestos Removal from Commonwealth Owned Assests including Commonwealth Heritage	2009/4873	Not Controlled Action (Particular Manner)	Post-Approval
Asbestos Removal from Various Buildings and Sites	2009/4887	Not Controlled Action (Particular Manner)	Post-Approval
Auralandia 3D marine seismic survey	2011/5961	Not Controlled Action (Particular Manner)	Post-Approval
Aurora MC3D Marine Seismic Survey	2010/5510	Not Controlled Action (Particular Manner)	Post-Approval
Australia to Singapore Fibre Optic Submarine Cable System	2011/6127	Not Controlled Action (Particular Manner)	Post-Approval
Babylon 3D Marine Seismic Survey, Commonwealth Waters, nr Exmouth WA	2013/7081	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Baiting Efficacy Trial of Feral Cat Bait and PAPP Toxicant	2008/4383	Not Controlled Action (Particular Manner)	Post-Approval
Balnaves Condensate Field Development	2011/6188	Not Controlled Action (Particular Manner)	Post-Approval
Bassett 3D Marine Seismic Survey	2010/5538	Not Controlled Action (Particular Manner)	Post-Approval
Blacktip Gas Project Yelcherr Beach Wharf Construction	2007/3537	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 2D & 3D marine seismic survey	2011/5962	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte 3D & 2D Seismic Survey, in NT/P82, Timor Sea	2012/6398	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Barossa Appraisal Drilling Campaign, NT	2012/6481	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Basin Seabed Mapping Survey	2009/4951	Not Controlled Action (Particular Manner)	Post-Approval
Bonaparte Seismic and Bathymetric Survey	2012/6295	Not Controlled Action (Particular Manner)	Post-Approval
Bonaventure 3D seismic survey	2006/2514	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Infill Marine Seismic Survey 100km offshore	2008/4442	Not Controlled Action (Particular Manner)	Post-Approval
Braveheart 2D Marine Seismic Survey	2005/2322	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Cable Seismic Exploration Permit areas WA-323-P and WA-330-P	2008/4227	Not Controlled Action (Particular Manner)	Post-Approval
Caldita 3D Marine Seismic Survey - NT/P61, NT/P69, and acreage release area NT06-5	2006/3142	Not Controlled Action (Particular Manner)	Post-Approval
Canis 3D Marine Seismic Survey	2008/4492	Not Controlled Action (Particular Manner)	Post-Approval
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Caswell MC3D Marine Seismic Survey	2012/6594	Not Controlled Action (Particular Manner)	Post-Approval
CGGVERITAS 2010 2D Seismic Survey	2010/5714	Not Controlled Action (Particular Manner)	Post-Approval
Charon 3D Marine Seismic Survey	2007/3477	Not Controlled Action (Particular Manner)	Post-Approval
Commonwealth Marine/Flying Fish Cove Jetty Extension	2012/6675	Not Controlled Action (Particular Manner)	Post-Approval
Conduct an exploration drilling campaign	2011/5964	Not Controlled Action (Particular Manner)	Post-Approval
Construction of a 43km long sealed access road to the Browse LNG precinct	2011/5852	Not Controlled Action (Particular Manner)	Post-Approval
Construction of a Power Station	2003/1177	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Consturction & operation of the Varanus Island kitchen & mess cyclone refuge building, compression plant & accomidation camp, Varanus Island	2013/6952	Not Controlled Action (Particular Manner)	Post-Approval
Coverack Marine Seismic Survey	2001/399	Not Controlled Action (Particular Manner)	Post-Approval
Crazy Ant Aerial Baiting Control Program	2002/722	Not Controlled Action (Particular Manner)	Post-Approval
Cue Seismic Survey within WA-359-P, WA-361-P and WA-360-P	2007/3647	Not Controlled Action (Particular Manner)	Post-Approval
CVG 3D Marine Seismic Survey	2012/6654	Not Controlled Action (Particular Manner)	Post-Approval
DAVROS MC 3D marine seismic survey northwaet of Dampier, WA	2013/7092	Not Controlled Action (Particular Manner)	Post-Approval
Decommissioning of the Legendre facilities	2010/5681	Not Controlled Action (Particular Manner)	Post-Approval
Deep Water Drilling Program	2010/5532	Not Controlled Action (Particular Manner)	Post-Approval
Deep Water Northwest Shelf 2D Seismic Survey	2007/3260	Not Controlled Action (Particular Manner)	Post-Approval
Demeter 3D Seismic Survey, off Dampier, WA	2002/900	Not Controlled Action (Particular Manner)	Post-Approval
Development of a small 25 bed, tented Eco Resort	2012/6284	Not Controlled Action (Particular Manner)	Post-Approval
Draeck 3D Marine Seismic Survey, WA-205-P	2006/3067	Not Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		(Particular Manner)	
Dredging of marine sediment to enable construction of eight berths and a turnin	2010/5678	Not Controlled Action (Particular Manner)	Post-Approval
Dredging the outer shipping channels of Darwin Harbour	2013/6988	Not Controlled Action (Particular Manner)	Post-Approval
Drilling 35-40 offshore exploration wells in deep water	2008/4461	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of Audacious-5 appraisal well	2008/4327	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of Exploration & Appraisal Wells Braveheart-1 & Cornea-3	2009/5160	Not Controlled Action (Particular Manner)	Post-Approval
Drilling of two appraisal wells	2011/5840	Not Controlled Action (Particular Manner)	Post-Approval
Earthworks for kitchen/mess, cyclone refuge building & Compression Plant, Varanus Island	2013/6900	Not Controlled Action (Particular Manner)	Post-Approval
Eendracht Multi-Client 3D Marine Seismic Survey	2009/4749	Not Controlled Action (Particular Manner)	Post-Approval
Effect of marine seismic sounds to demersal fish and pearl oysters, north-west WA	2018/8169	Not Controlled Action (Particular Manner)	Post-Approval
Endurance 3D Marine Seismic Data Acquisition Survey	2007/3667	Not Controlled Action (Particular Manner)	Post-Approval
Enfield M3 & Vincent 4D Marine Seismic Surveys	2008/3981	Not Controlled Action (Particular Manner)	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Enfield M3 4D, Vincent 4D & 4D Line Test Marine Seismic Surveys	2008/4122	Not Controlled Action (Particular Manner)	Post-Approval
Enfield M4 4D Marine Seismic Survey	2008/4558	Not Controlled Action (Particular Manner)	Post-Approval
Enfield oilfield 3D Seismic Survey	2006/3132	Not Controlled Action (Particular Manner)	Post-Approval
Eni Bathurst 3D Seismic Survey	2011/6118	Not Controlled Action (Particular Manner)	Post-Approval
Exmouth West 2D Marine Seismic Survey	2008/4132	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign	2011/6047	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Campaign, Browse Basin, WA-341-P, AC-P36 and WA-343-P	2013/6898	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling in Permit Areas WA-402-P & WA-403-P	2010/5297	Not Controlled Action (Particular Manner)	Post-Approval
Exploration drilling of Zeus-1 well	2008/4351	Not Controlled Action (Particular Manner)	Post-Approval
Exploration Drilling Program - Permit areas - WA-314-P, WA-315-P, WA-398-P.	2008/4064	Not Controlled Action (Particular Manner)	Post-Approval
Fishburn2D Marine Seismic Survey	2012/6659	Not Controlled Action (Particular Manner)	Post-Approval
Fletcher-Finucane Development, WA26-L and WA191-P	2011/6123	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Floyd 3D and Chisel 3D Seismic Surveys	2011/6220	Not Controlled Action (Particular Manner)	Post-Approval
Foxhound 3D Non-Exclusive Marine Seismic Survey	2009/4703	Not Controlled Action (Particular Manner)	Post-Approval
Gazelle 3D Marine Seismic Survey in WA-399-P and WA-42-L	2010/5570	Not Controlled Action (Particular Manner)	Post-Approval
Geco Eagle 3D Marine Seismic Survey	2008/3958	Not Controlled Action (Particular Manner)	Post-Approval
Geoscience Australia - Marine survey in Browse Basin to acquire data to assist assessment of CO2 storage potential	2013/6747	Not Controlled Action (Particular Manner)	Post-Approval
Gicea 3D Marine Seismic Survey	2008/4389	Not Controlled Action (Particular Manner)	Post-Approval
Gigas 2D Pilot Ocean Bottom Cable Marine Seismic Survey	2007/3839	Not Controlled Action (Particular Manner)	Post-Approval
Glencoe 3D Marine Seismic Survey WA-390-P	2007/3684	Not Controlled Action (Particular Manner)	Post-Approval
Gold 2D Marine Seismic Survey Permit Areas WA375P and WA376P	2009/4698	Not Controlled Action (Particular Manner)	Post-Approval
Greater Western Flank Phase 1 gas Development	2011/5980	Not Controlled Action (Particular Manner)	Post-Approval
Grimalkin 3D Seismic Survey	2008/4523	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Guacamole 2D Marine Seismic Survey	2008/4381	Not Controlled Action (Particular Manner)	Post-Approval
Harmony 3D Marine Seismic Survey	2012/6699	Not Controlled Action (Particular Manner)	Post-Approval
Harpy 1 exploration well	2001/183	Not Controlled Action (Particular Manner)	Post-Approval
Helicopter baiting of exotic yellow crazy ant supercolonies, Christmas Island, Indian Ocean	2009/5016	Not Controlled Action (Particular Manner)	Post-Approval
Home Island Slipway Redevelopment	2010/5511	Not Controlled Action (Particular Manner)	Post-Approval
Honeycombs MC3D Marine Seismic Survey	2012/6368	Not Controlled Action (Particular Manner)	Post-Approval
Huzzas MC3D Marine Seismic Survey (HZ-13) Carnarvon Basin, offshore WA	2013/7003	Not Controlled Action (Particular Manner)	Post-Approval
Huzzas phase 2 marine seismic survey, Exmouth Plateau, Northern Carnarvon Basin, WA	2013/7093	Not Controlled Action (Particular Manner)	Post-Approval
Ichthys 3D Marine Seismic Survey	2010/5550	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
John Ross & Rosella Off Bottom Cable Seismic Exploration Program	2008/3966	Not Controlled Action (Particular Manner)	Post-Approval
Joseph Bonaparte Gulf Seabed mapping survey	2010/5517	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Judo Marine 3D Seismic Survey within and adjacent to WA-412-P	2008/4630	Not Controlled Action (Particular Manner)	Post-Approval
Judo Marine 3D Seismic Survey within and adjacent to WA-412-P	2009/4801	Not Controlled Action (Particular Manner)	Post-Approval
Julimar Brunello Gas Development Project	2011/5936	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Klimt 2D Marine Seismic Survey	2007/3856	Not Controlled Action (Particular Manner)	Post-Approval
Koolama 2D Seismic Survey Dampier Basin	2010/5420	Not Controlled Action (Particular Manner)	Post-Approval
Kraken, Lusca & Asperus 3D Marine Seismic Survey	2013/6730	Not Controlled Action (Particular Manner)	Post-Approval
Laverda 3D Marine Seismic Survey and Vincent M1 4D Marine Seismic Survey	2010/5415	Not Controlled Action (Particular Manner)	Post-Approval
Laying a submarine optical fibre telecommunications cable, Perth to Singapore and Jakarta	2014/7332	Not Controlled Action (Particular Manner)	Post-Approval
Leopard 2D marine seismic survey	2005/2290	Not Controlled Action (Particular Manner)	Post-Approval
Lion 2D Marine Seismic Survey	2007/3777	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Macedon Gas Field Development	2008/4605	Not Controlled Action (Particular Manner)	Post-Approval
Malita West 3D Seismic Survey WA-402-P and WA-403-P	2007/3936	Not Controlled Action (Particular Manner)	Post-Approval
Marine Environmental Survey 2012	2012/6310	Not Controlled Action (Particular Manner)	Post-Approval
Marine Geotechnical Drilling Program	2008/4012	Not Controlled Action (Particular Manner)	Post-Approval
Marine reconnaissance survey	2008/4466	Not Controlled Action (Particular Manner)	Post-Approval
Mariner Non-Exclusive 2D Seismic Survey	2011/6172	Not Controlled Action (Particular Manner)	Post-Approval
Moosehead 2D seismic survey within permit WA-192-P	2005/2167	Not Controlled Action (Particular Manner)	Post-Approval
Munmorah 2D seismic survey within permits WA-308/9-P	2003/970	Not Controlled Action (Particular Manner)	Post-Approval
Nelson Point Dredging	2009/4920	Not Controlled Action (Particular Manner)	Post-Approval
New Housing Program	2011/6056	Not Controlled Action (Particular Manner)	Post-Approval
Nova 3D Seismic Survey	2013/6825	Not Controlled Action (Particular Manner)	Post-Approval
NT/P74 & NT/P75 - 2D marine seismic survey	2008/4316	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
NT/P77 3D Marine Seismic Survey	2009/4683	Not Controlled Action (Particular Manner)	Post-Approval
NT/P80 2010 2D Marine Seismic Survey	2010/5487	Not Controlled Action (Particular Manner)	Post-Approval
Ocean Bottom Cable Seismic Program, WA-264-P	2007/3844	Not Controlled Action (Particular Manner)	Post-Approval
Ocean Bottom Cable Seismic Survey	2005/2017	Not Controlled Action (Particular Manner)	Post-Approval
Octantis 3D Marine Seismic Survey, Permit Area AC/P41 off northern Western Australia	2007/3369	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Canning Multi Client 2D Marine Seismic Survey	2010/5393	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Drilling Campaign	2011/5830	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Exploration Drilling Campaign	2011/6222	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Fibre Optic Cable Network Construction & Operation, Port Hedland WA to Darwin NT	2014/7223	Not Controlled Action (Particular Manner)	Post-Approval
Offshore Gas Exploration Drilling Campaign	2012/6384	Not Controlled Action (Particular Manner)	Post-Approval
Orcus 3D Marine Seismic Survey in WA-450-P	2010/5723	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Osprey and Dionysus Marine Seismic Survey	2011/6215	Not Controlled Action (Particular Manner)	Post-Approval
Outer Canning exploration drilling program off NW coast of WA	2012/6618	Not Controlled Action (Particular Manner)	Post-Approval
Palta-1 exploration well in Petroleum Permit Area WA-384-P	2011/5871	Not Controlled Action (Particular Manner)	Post-Approval
Panda NT/P76 3D Seismic Acquisition Survey Program	2009/4992	Not Controlled Action (Particular Manner)	Post-Approval
Petrel MC2D Marine Seismic Survey	2010/5368	Not Controlled Action (Particular Manner)	Post-Approval
Phoenix 3D Seismic Survey, Bedout Sub-Basin	2010/5360	Not Controlled Action (Particular Manner)	Post-Approval
Pilot Appraisal Well - Torosa South 1	2008/3991	Not Controlled Action (Particular Manner)	Post-Approval
Pomodoro 3D Marine Seismic Survey in WA-426-P and WA-427-P	2010/5472	Not Controlled Action (Particular Manner)	Post-Approval
Port Headland Outer Harbour Pre-construction Pilling program	2012/6341	Not Controlled Action (Particular Manner)	Post-Approval
Port Melville marine supply base, Melville Island	2015/7510	Not Controlled Action (Particular Manner)	Post-Approval
Port of Port Hedland channel marker replacement project, WA	2017/8010	Not Controlled Action (Particular Manner)	Post-Approval
Pyrenees 4D Marine Seismic Monitor Survey, HCA12A	2012/6579	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Pyrenees-Macedon 3D marine seismic survey	2005/2325	Not Controlled Action (Particular Manner)	Post-Approval
Quiberon 2D Seismic Survey, permit area WA-385P, offshore of Carnarvon	2009/5077	Not Controlled Action (Particular Manner)	Post-Approval
Reindeer gas reservior development, Devil Creek, Carnarvon Basin - WA	2007/3917	Not Controlled Action (Particular Manner)	Post-Approval
Removal of Potential Unexploded Ordnance within NAXA	2012/6503	Not Controlled Action (Particular Manner)	Post-Approval
Repsol 3d & 2D Marine Seismic Survey	2012/6658	Not Controlled Action (Particular Manner)	Post-Approval
Residential Development, Lot 101 Cocos (Keeling) Island	2011/5856	Not Controlled Action (Particular Manner)	Post-Approval
Rose 3D Seismic Program	2008/4239	Not Controlled Action (Particular Manner)	Post-Approval
Rosebud 3D Marine Seismic Survey in WA-30-R and TR/5	2012/6493	Not Controlled Action (Particular Manner)	Post-Approval
Rydal-1 Petroleum Exploration Well, WA	2012/6522	Not Controlled Action (Particular Manner)	Post-Approval
Salsa 3D Marine Seismic Survey	2010/5629	Not Controlled Action (Particular Manner)	Post-Approval
Sandalford 3D Seismic Survey	2012/6261	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Santos Petrel-7 Offshore Appraisal Drilling Programme (Bonaparte Basin)	2011/5934	Not Controlled Action (Particular Manner)	Post-Approval
Santos Winchester three dimensional seismic survey - WA-323-P & WA-330-P	2011/6107	Not Controlled Action (Particular Manner)	Post-Approval
Schild MC3D Marine Seismic Survey	2012/6373	Not Controlled Action (Particular Manner)	Post-Approval
Schild Phase 11 MC3D Marine Seismic Survey, Browse Basin	2013/6894	Not Controlled Action (Particular Manner)	Post-Approval
Scott Reef Seismic Research	2006/2647	Not Controlled Action (Particular Manner)	Post-Approval
Searcher bathymetry & geochemical seismic survey, Brawse Basin,Timor Sea,WA	2013/6980	Not Controlled Action (Particular Manner)	Post-Approval
Skorpion Marine Seismic Survey WA	2001/416	Not Controlled Action (Particular Manner)	Post-Approval
Sonar and Acoustic Trials	2001/345	Not Controlled Action (Particular Manner)	Post-Approval
Songa Venus Drilling and Testing Operations	2009/5122	Not Controlled Action (Particular Manner)	Post-Approval
Sovereign 3D Marine Seismic Survey	2011/5861	Not Controlled Action (Particular Manner)	Post-Approval
Stag 4D & Reindeer MAZ Marine Seismic Surveys, WA	2013/7080	Not Controlled Action (Particular Manner)	Post-Approval
Stag Off-bottom Cable Seismic Survey	2007/3696	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Stybarrow 4D Marine Seismic Survey	2011/5810	Not Controlled Action (Particular Manner)	Post-Approval
Stybarrow Baseline 4D marine seismic survey	2008/4530	Not Controlled Action (Particular Manner)	Post-Approval
Sunshine Infill 2D and Mimosa 2D Marine Seismic Surveys	2009/4699	Not Controlled Action (Particular Manner)	Post-Approval
Swimming Pool modification	2007/3312	Not Controlled Action (Particular Manner)	Post-Approval
Tantabiddi Boat Ramp Sand Bypassing	2015/7411	Not Controlled Action (Particular Manner)	Post-Approval
Thoar 3D Marine Seismic Survey	2010/5668	Not Controlled Action (Particular Manner)	Post-Approval
Tidepole Maz 3D Seismic Survey Campaign	2007/3706	Not Controlled Action (Particular Manner)	Post-Approval
Tiffany 3D Seismic Survey	2010/5339	Not Controlled Action (Particular Manner)	Post-Approval
Torosa-5 Apraisal Well, WA-30-R	2008/4430	Not Controlled Action (Particular Manner)	Post-Approval
Tortilla 2D Seismic Survey, WA	2011/6110	Not Controlled Action (Particular Manner)	Post-Approval
Tow West Atlas wreck from present location to boundary of EEZ	2010/5652	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Translocation of T.gigas for breeding and release	2005/1958	Not Controlled Action (Particular Manner)	Post-Approval
Trials of a bait delivery system for the control of Yellow Crazy Ants	2009/4763	Not Controlled Action (Particular Manner)	Post-Approval
Tridacna 3D Ocean Bottom Cable Marine Seismic Survey	2011/5959	Not Controlled Action (Particular Manner)	Post-Approval
Triton 3D Marine Seismic Survey, WA-2-R and WA-3-R	2006/2609	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a 3D marine seismic survey	2010/5695	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5679	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5715	Not Controlled Action (Particular Manner)	Post-Approval
upgrade of 3 community recreation sites	2005/2349	Not Controlled Action (Particular Manner)	Post-Approval
Ursa 3D Marine Seismic Survey	2008/4634	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Veritas Voyager 2D Marine Seismic Survey	2009/5151	Not Controlled Action (Particular Manner)	Post-Approval
Vincent M1 and Enfield M5 4D Marine Seismic Survey	2010/5720	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Warramunga Non-Inclusive 3D Seismic Survey	2008/4553	Not Controlled Action (Particular Manner)	Post-Approval
Water supply upgrade	2005/2269	Not Controlled Action (Particular Manner)	Post-Approval
West Anchor 3D Marine Seismic Survey	2008/4507	Not Controlled Action (Particular Manner)	Post-Approval
West Panaeus 3D seismic survey	2006/3141	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Wheatstone 3D MAZ Marine Seismic Survey	2011/6058	Not Controlled Action (Particular Manner)	Post-Approval
Wheatstone Iago Appraisal Well Drilling	2008/4134	Not Controlled Action (Particular Manner)	Post-Approval
Wheatstone Iago Appraisal Well Drilling	2007/3941	Not Controlled Action (Particular Manner)	Post-Approval
Woodside Southern Browse 3D Seismic Survey, WA	2007/3534	Not Controlled Action (Particular Manner)	Post-Approval
Zeemeermin MC3D seismic survey, Browse Basin, Offshore WA	2009/5023	Not Controlled Action (Particular Manner)	Post-Approval
Zeppelin 3D Seismic Survey	2011/6148	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			

Title of referral	Reference	Referral Outcome	Assessment Status
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed
3D Marine Seismic Survey in the offshore northwest Carnarvon Basin	2011/6175	Referral Decision	Completed
3D Seismic Survey	2008/4219	Referral Decision	Completed
3D Seismic Survey (NT/P68)	2006/2949	Referral Decision	Completed
Alterations and Improvements to existing residence at Lot 3015 Gaze Rd, Christmas Island	2009/5039	Referral Decision	Completed
Aurora extension MC3D Marine Seismic Survey	2011/5887	Referral Decision	Completed
Bianchi 3D Marine Seismic Survey, Carnavon Basin, WA	2013/7078	Referral Decision	Completed
BRSN08 3D Marine Seismic Survey	2008/4582	Referral Decision	Completed
Cocos West Island Seawater Desalination Plant	2022/9153	Referral Decision	Referral Publication
CVG 3D Marine Seismic Survey	2012/6270	Referral Decision	Completed
Darwin Pipeline Duplication DPD Project	2022/9166	Referral Decision	Referral Publication
Enfield 4D Marine Seismic Surveys, Production Permit WA-28-L	2005/2370	Referral Decision	Completed
Experimental Study of Behavioural and Physiological Impact on Fish of Seismic Ex	2006/2625	Referral Decision	Completed
Field efficacy trial of the Hisstory bait for feral cats, at Yampi Sound Defence Training Area, Kimberley	2017/7977	Referral Decision	Completed
Howard East Borefield Second Stage	2002/828	Referral Decision	Completed
Installation of Telecommunication Facilities	2001/254	Referral Decision	Completed
Kimberley Multi-commodity Exploration Program	2013/6780	Referral Decision	Completed
Nova 3D Seismic Survey, WA 442-NT/P81, Joseph Bonaparte Gulf	2013/6820	Referral Decision	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Referral decision			
Outer Harbour Development and associated marine and terrestial infrastructure	2008/4148	Referral Decision	Completed
Phillips Petroleum Wickham Point LNG facility	2001/391	Referral Decision	Completed
Pilot Appraisal Well - Torosa South-1	2008/3985	Referral Decision	Completed
Puffin South-West Development of Oil Reserves	2007/3834	Referral Decision	Completed
Rocky Point Dwelling Redevelopment	2005/2203	Referral Decision	Referral Decision
Rose 3D Seismic acquisition survey	2008/4220	Referral Decision	Completed
Seismic Data Acquisition, Browse Basin	2010/5475	Referral Decision	Completed
Stybarrow Baseline 4D Marine Seismic Survey (Permit Areas WA-255-P, WA-32-L, WA-	2008/4165	Referral Decision	Completed
Tidal Power Generation Turbine	2009/5235	Referral Decision	Completed
Two Dimensional Transition Zone Seismic Survey - TP/7 (R1)	2010/5507	Referral Decision	Completed
Varanus Island Compression Project	2012/6698	Referral Decision	Completed

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
Ancient coastline at 125 m depth contour	North-west
Ashmore Reef and Cartier Island and surrounding Commonwealth waters	North-west
Canyons linking the Argo Abyssal Plain with the Scott Plateau	North-west
Canyons linking the Cuvier Abyssal Plain and the Cape Range Peninsula	North-west
Carbonate bank and terrace system of the Sahul Shelf	North-west

Name	Region
Carbonate bank and terrace system of the Van Diemen Rise	North
Commonwealth waters adjacent to Ningaloo Reef	North-west
Continental Slope Demersal Fish Communities	North-west
Exmouth Plateau	North-west
Glomar Shoals	North-west
Mermaid Reef and Commonwealth waters surrounding Rowley Shoals	North-west
Pinnacles of the Bonaparte Basin	North
Pinnacles of the Bonaparte Basin	North-west
Seringapatam Reef and Commonwealth waters in the Scott Reef Complex	North-west
Shelf break and slope of the Arafura Shelf	North
Tributary Canyons of the Arafura Depression	North

Biologically Important Areas		
Scientific Name	Behaviour	Presence
Dolphins		
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Breeding	Known to occur
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Breeding likely	Known to occur
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Calving	Known to occur
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Foraging	Known to occur
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Foraging (high density prey)	Known to occur
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Foraging likely	Known to occur

Scientific Name	Behaviour	Presence
Orcaella heinsohni Australian Snubfin Dolphin [81322]	Resting	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Breeding	Likely to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Breeding	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Breeding likely	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Calving	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Calving	Likely to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Foraging	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Foraging	Likely to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Foraging (high density prey)	Likely to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Foraging (high density prey)	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Significant habitat	Known to occur
Sousa chinensis Indo-Pacific Humpback Dolphin [50]	Significant habitat - unknown behaviour	Likely to occur
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Breeding	Known to occur
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Calving	Known to occur

Scientific Name	Behaviour	Presence
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Foraging	Known to occur
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Foraging likely	Known to occur
Tursiops aduncus Indo-Pacific/Spotted Bottlenose Dolphin [68418]	Migration likely	Known to occur
Dugong		
Dugong dugon Dugong [28]	Breeding	Known to occur
Dugong dugon Dugong [28]	Calving	Known to occur
Dugong dugon Dugong [28]	Foraging	Likely to occur
Dugong dugon Dugong [28]	Foraging	Known to occur
Dugong dugon Dugong [28]	Foraging (high density seagrass beds)	Known to occur
Dugong dugon Dugong [28]	Nursing	Known to occur
Marine Turtles		
Caretta caretta Loggerhead Turtle [1763]	Foraging	Known to occur
Caretta caretta Loggerhead Turtle [1763]	Internesting buffer	Known to occur
Caretta caretta Loggerhead Turtle [1763]	Nesting	Known to occur
Chelonia mydas Green Turtle [1765]	Aggregation	Known to occur

Scientific Name	Behaviour	Presence
Chelonia mydas Green Turtle [1765]	Basking	Known to occur
Chelonia mydas Green Turtle [1765]	Foraging	Known to occur
Chelonia mydas Green Turtle [1765]	Foraging	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting	Known to occur
Chelonia mydas Green Turtle [1765]	Internesting	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting buffer	Likely to occur
Chelonia mydas Green Turtle [1765]	Internesting buffer	Known to occur
Chelonia mydas Green Turtle [1765]	Mating	Known to occur
Chelonia mydas Green Turtle [1765]	Mating	Likely to occur
Chelonia mydas Green Turtle [1765]	Nesting	Known to occur
Chelonia mydas Green Turtle [1765]	Nesting	Likely to occur
Dermochelys coriacea Leatherback Turtle [1768]	Internesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Foraging	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Foraging	Known to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting	Known to occur

Scientific Name	Behaviour	Presence
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting buffer	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Internesting buffer	Known to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Mating	Known to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Nesting	Likely to occur
Eretmochelys imbricata Hawksbill Turtle [1766]	Nesting	Known to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Likely to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Foraging	Known to occur
Lepidochelys olivacea Olive Ridley Turtle [1767]	Internesting	Likely to occur
Natator depressus Flatback Turtle [59257]	Aggregation	Known to occur
Natator depressus Flatback Turtle [59257]	Foraging	Known to occur
Natator depressus Flatback Turtle [59257]	Internesting	Known to occur
Natator depressus Flatback Turtle [59257]	Internesting	Likely to occur
Natator depressus Flatback Turtle [59257]	Internesting buffer	Known to occur
Natator depressus Flatback Turtle [59257]	Mating	Known to occur

Scientific Name	Behaviour	Presence
Natator depressus Flatback Turtle [59257]	Nesting	Known to occur
River shark		
Pristis clavata Dwarf Sawfish [68447]	Foraging	Known to occur
Pristis clavata Dwarf Sawfish [68447]	Juvenile	Known to occur
Pristis clavata Dwarf Sawfish [68447]	Nursing	Known to occur
Pristis clavata Dwarf Sawfish [68447]	Pupping	Known to occur
Pristis pristis Freshwater Sawfish [60756]	Foraging	Known to occur
Pristis pristis Freshwater Sawfish [60756]	Nursing	Likely to occur
Pristis pristis Freshwater Sawfish [60756]	Nursing	Known to occur
Pristis zijsron Green Sawfish [68442]	Foraging	Known to occur
Pristis zijsron Green Sawfish [68442]	Pupping	Known to occur
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Fregata ariel Lesser Frigatebird [1012]	Breeding	Known to occur
Fregata minor Greater Frigatebird [1013]	Breeding	Known to occur
Onychoprion anaethetus Bridled Tern [82845]	Breeding	Known to occur

Scientific Name	Behaviour	Presence
Phaethon lepturus White-tailed Tropicbird [1014]	Breeding	Known to occur
Sterna dougallii Roseate Tern [817]	Breeding	Known to occur
Sterna dougallii Roseate Tern [817]	Breeding (high numbers)	Known to occur
Sterna dougallii Roseate Tern [817]	Resting	Known to occur
Sternula albifrons sinensis Little Tern [82850]	Breeding	Known to occur
Sternula albifrons sinensis Little Tern [82850]	Resting	Known to occur
Sternula nereis Fairy Tern [82949]	Breeding	Known to occur
Sula leucogaster Brown Booby [1022]	Breeding	Known to occur
Sula sula Red-footed Booby [1023]	Breeding	Known to occur
Thalasseus bengalensis Lesser Crested Tern [66546]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding	Known to occur
Thalasseus bergii Crested Tern [83000]	Breeding (high numbers)	Known to occur
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Rhincodon typus Whale Shark [66680]	Foraging (high density prey)	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Migration	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Calving	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Migration	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Migration (north and south)	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Nursing	Known to occur
Megaptera novaeangliae Humpback Whale [38]	Resting	Known to occur

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111

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: 22-Apr-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:	22
Listed Migratory Species:	35

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:	63
Whales and Other Cetaceans:	23
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	15
Key Ecological Features (Marine):	None
Biologically Important Areas:	1
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
EEZ and Territorial Sea

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
BIRD		
Anous tenuirostris melanops		
Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti		
Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
FISH		
Thunnus maccoyii		
Southern Bluefin Tuna [69402]	Conservation Dependent	Breeding known to occur within area
MAMMAL		

Scientific Name	Threatened Category	Presence Text
[Balaenoptera borealis](#) Sei Whale [34]	Vulnerable	Species or species habitat likely to occur within area
[Balaenoptera musculus](#) Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
[Balaenoptera physalus](#) Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
[Aipysurus foliosquama](#) Leaf-scaled Seasnake [1118]	Critically Endangered	Species or species habitat may occur within area
[Caretta caretta](#) Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Dermochelys coriacea](#) Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Eretmochelys imbricata](#) Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
[Lepidochelys olivacea](#) Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
[Natator depressus](#) Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
SHARK		

Scientific Name	Threatened Category	Presence Text
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Glyphis garricki Northern River Shark, New Guinea River Shark [82454]	Endangered	Species or species habitat may occur within area
Pristis pristis Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sphyrna lewini Scalloped Hammerhead [85267]	Conservation Dependent	Species or species habitat likely to occur within area

Listed Migratory Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Phaethon lepturus		
White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Migratory Marine Species		
Anoxypristis cuspidata		
Narrow Sawfish, Knifetooth Sawfish [68448]		Species or species habitat may occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Species or species habitat 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	Species or species habitat likely to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Carcharhinus longimanus		
Oceanic Whitetip Shark [84108]		Species or species habitat may occur within area
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour likely 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
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mobula alfredi as Manta alfredi Reef Manta Ray, Coastal Manta Ray [90033]		Species or species habitat likely to occur within area
Mobula birostris as Manta birostris Giant Manta Ray [90034]		Species or species habitat likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	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

Scientific Name	Threatened Category	Presence Text
Pristis pristis		
Freshwater Sawfish, Largetooth Sawfish, River Sawfish, Leichhardt's Sawfish, Northern Sawfish [60756]	Vulnerable	Species or species habitat may occur within area
Pristis zijsron		
Green Sawfish, Dindagubba, Narrowsnout Sawfish [68442]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus		
Whale Shark [66680]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Tursiops aduncus (Arafura/Timor Sea populations)		
Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anous stolidus Common Noddy [825]		Species or species habitat may occur within area
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Calonectris leucomelas Streaked Shearwater [1077]		Species or species habitat likely to occur within area
Fregata ariel Lesser Frigatebird, Least Frigatebird [1012]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Fregata minor Great Frigatebird, Greater Frigatebird [1013]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Papasula abbotti Abbott's Booby [59297]	Endangered	Species or species habitat may occur within area
Phaethon lepturus White-tailed Tropicbird [1014]		Species or species habitat likely to occur within area
Fish		
Bhanotia fasciolata Corrugated Pipefish, Barbed Pipefish [66188]		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 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 intestinalis Australian Messmate Pipefish, Banded Pipefish [66202]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
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
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
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 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

Scientific Name	Threatened Category	Presence Text
Hippichthys penicillus Beady Pipefish, Steep-nosed Pipefish [66231]		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
Micrognathus micronotopterus Tidepool Pipefish [66255]		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

Scientific Name	Threatened Category	Presence Text
[Trachyrhamphus longirostris](#) Straightstick Pipefish, Long-nosed Pipefish, Straight Stick Pipefish [66281]		Species or species habitat may occur within area
Reptile		
[Acalyptophis peronii](#) Horned Seasnake [1114]		Species or species habitat may 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 may occur within area
[Aipysurus laevis](#) Olive Seasnake [1120]		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 likely to occur within area
[Chelonia mydas](#) Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
[Chitulia ornata as Hydrophis ornatus](#) Spotted Seasnake, Ornate Reef Seasnake [87377]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour likely 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
Enhydrina schistosa Beaked Seasnake [1126]		Species or species habitat may occur within area
Eretmochelys imbricata Hawksbill Turtle [1766]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Hydrophis elegans Elegant Seasnake [1104]		Species or species habitat may occur within area
Lapemis curtus as Lapemis hardwickii Spine-bellied Seasnake [83554]		Species or species habitat may occur within area
Leioselasma coggeri as Hydrophis coggeri Black-headed Sea Snake, Slender-necked Seasnake [87373]		Species or species habitat may occur within area
Lepidochelys olivacea Olive Ridley Turtle, Pacific Ridley Turtle [1767]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Species or species habitat known to occur within area
Pelamis platurus Yellow-bellied Seasnake [1091]		Species or species habitat may occur within area

Whales and Other Cetaceans		[Resource Information]
Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Species or species habitat 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	Species or species habitat likely to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Species or species habitat likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		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
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area

Current Scientific Name	Status	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
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
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 may occur within area
Tursiops aduncus (Arafura/Timor Sea populations) Spotted Bottlenose Dolphin (Arafura/Timor Sea populations) [78900]		Species or species habitat may occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

EPBC Act Referrals			[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Crux-A and Crux-B appraisal wells, Petroleum Permit Area AC/P23	2006/2748	Not Controlled Action	Completed
Crux gas-liquids development in permit AC/P23	2006/3154	Not Controlled Action	Completed
Exploration Well AC/P23	2001/234	Not Controlled Action	Completed
Project Highclere Geophysical Survey	2021/9023	Not Controlled Action	Completed
Not controlled action (particular manner)			
2D Marine Seismic Survey	2009/4728	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Marine Survey	2001/363	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic survey	2009/5076	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey, Permit AC/P 23	2005/2364	Not Controlled Action (Particular Manner)	Post-Approval
Canis 3D Marine Seismic Survey	2008/4492	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Cartier East and Cartier West 3D Marine Seismic Surveys	2009/5230	Not Controlled Action (Particular Manner)	Post-Approval
Kingtree & Ironstone-1 Exploration Wells	2011/5935	Not Controlled Action (Particular Manner)	Post-Approval
Octantis 3D Marine Seismic Survey, Permit Area AC/P41 off northern Western Australia	2007/3369	Not Controlled Action (Particular Manner)	Post-Approval
Vampire 2D Non Exclusive Seismic Survey, WA	2010/5543	Not Controlled Action (Particular Manner)	Post-Approval
Westralia SPAN Marine Seismic Survey, WA & NT	2012/6463	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D Marine Seismic Survey	2008/4623	Referral Decision	Completed

Biologically Important Areas		
Scientific Name	Behaviour	Presence
Sharks		
Rhincodon typus Whale Shark [66680]	Foraging	Known to occur

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.

Department of Agriculture Water and the Environment
GPO Box 858
Canberra City ACT 2601 Australia
+61 2 6274 1111